RECLAMATION
*Managing Water in the West*

**Draft Central Valley Project**
**Final Cost Allocation Study**

# Hydrological Modeling Appendix

Bureau of Reclamation
Mid-Pacific Region

January 2019

# Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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# Introduction

This appendix documents the hydrological modeling tools used and analysis performed to support the Central Valley Project (CVP) Cost Allocation Study (CAS). The CAS uses the Separable Cost Remaining Benefits (SCRB) method for determining the appropriate distribution of CVP facilities' costs among the purposes for which the CVP was authorized. The parameters used by the SCRB methodology include single purpose alternative (SPA) costs, separable costs, and economic benefits. Hydrological modeling and analyses were used to determine SPA and omitted-purposes sizes for multi-purpose facilities, which are key components of the SPA and separable cost estimates (see *Cost Estimate Summary Tables Appendix*), and to develop inputs for economic benefit analyses (see *Economic Benefit Analysis Appendix*).

Hydrological model applications used in the CAS analysis include CalSim 2, Flow Tracker, and the Single Purpose Facility Sizing Model (Sizing Model). CalSim 2 is a reservoir-river simulation model developed by the California Department of Water Resources (DWR) and U.S. Bureau of Reclamation (Reclamation) that is commonly used for long-term water supply reliability planning. See Attachment 1 (*CalSim 2 Model Description*) and Attachment 2 (*CalSim 2 Inputs, Assumptions, and Results)* to this *Hydrological Modeling Appendix* for general information about CalSim 2 and specific assumptions and data used for the CVP CAS. Sensitivity analysis related to hydrological conditions under climate change was also conducted (see Attachment 3 *Hydrology Sensitivity Analysis*).

The Flow Tracker model was developed to identify State Water Project (SWP) storage releases made specifically for Delta outflow as input to the Sizing Model. The Flow Tracker and Sizing Model are described below. Additional analysis included post-processing of CalSim 2 results and evaluation of Central Valley Project Improvement Act (CVPIA) records. A spreadsheet post-processor for CalSim 2 results refined the model's representation of drought year allocation decisions to ensure that delivery results reflect recent operations. An evaluation was made of CVPIA 3406(b)(2) accounting records to determine the use of storage to accomplish the goals of this program.

The CAS analysis used CalSim 2 to estimate project deliveries and flows under a range of regulatory environments, and these results were used as the basis for water supply, water quality, flood control, and hydropower economic benefit and multi-purpose facility SPA sizing analyses. Flood control benefit and hydropower SPA facility sizing analyses did not directly use CalSim 2 output. Details on model assumptions, algorithms, and other analyses are provided for the water supply, water quality, hydropower, and flood control purposes below. In addition, sizing facilities to meet CVPIA and omitted-purpose analysis are described, as well as additional details on the hydrological model tools used, including the Sizing Model and Flow Tracker.

# Water Supply Purpose

The Central Valley Project has agreements and contractual obligations to deliver water to agricultural, municipal and industrial, and refuge water users throughout the Sacramento River and San Joaquin River watersheds. Water deliveries constitute the water supply purpose of the CVP. The capacity of the system to deliver water is affected by regulations that govern operations to meet water quality and flow standards at multiple locations. Deliveries are affected by water supply allocation, which is determined by contract terms, delivery category, and operator decisions on managing water supply to meet competing priorities.

For the water supply purpose, analysis served two needs. One was to quantify the deliveries that define the water supply purpose, and the other was to determine the water supply single purpose alternative storage sizes of the major CVP reservoirs. Figure 1 shows the flow of data, analysis, and modeling tools used to address the water supply purpose for the CVP CAS.

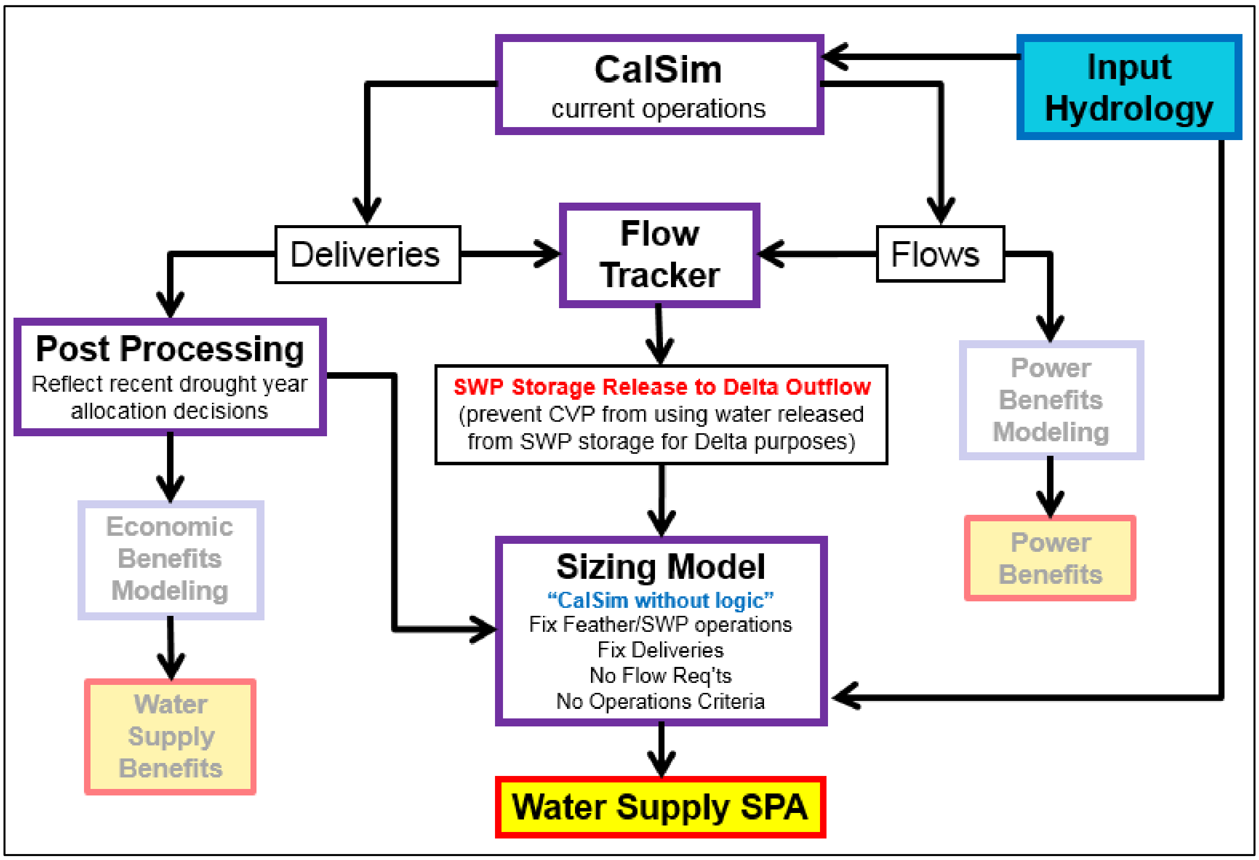


**Figure 1. Hydrology Modeling and Analysis for the CVP Water Supply Purpose**

**Quantifying the water supply purpose.** The historical record of CVP water deliveries cannot be used to characterize the water supply purpose of the project because demand has increased over time due to the progressive buildout of project facilities and because basin-wide regulations have evolved over time, mostly decreasing delivery capacity. The CalSim 2 planning model was used to simulate delivery that is possible 1) over a range of hydrologic conditions, 2) given a consistent level of demand (land use and population), and 3) under the current regulatory environment. The delivery results of this “current operations” scenario characterize the water supply reliability of the CVP.

CalSim 2 is a planning model typically used to compare an operational alternative to a base study to discern the impact of a particular facility or regulation. Its general operations logic does not include the ability to make unique decisions under extreme drought conditions. Results were therefore post-processed to better reflect allocation decisions such as those made in 2014 and 2015, when allocations were reduced to preserve north-of-Delta storage. If modeled end-of-September storage in Lake Shasta was below 1.1 MAF, the post-processing analysis calculated the storage shortfall and made commensurate reductions to delivery results. First, Central Valley Project Agricultural deliveries were cut, then San Joaquin Exchange Contractor deliveries were cut below the Shasta Critical allocation of 77 percent. Friant Kern Project deliveries were appropriated to make up for San Joaquin Exchange Contractor deliveries lower than the CVP contract obligation, taking into consideration San Joaquin River losses incurred to facilitate conveyance to Mendota Pool. After additional delivery cuts were established, lower Jones exports, Sacramento River flows, and Shasta releases were re-calculated accordingly. No modifications were made based on assumptions for meeting Delta water quality standards or other flow standards. These assumptions result in conservative estimates of water supply delivery capability.

In Figure 1, the modeling analysis that captures the water supply purpose is represented by the CalSim 2 and Post Processing boxes. CalSim 2 results for deliveries are inputs to the Post-Processor. Results from the Post-Processor are the best possible estimate of CVP capacity to deliver water under the current regulatory environment over a range of hydrologic conditions. These deliveries are used to calculate inputs to the economics models which calculate water supply benefits for irrigation and municipal and industrial (M&I) contractor types. Table 1 displays estimated irrigation, M&I, and Level 2 refuge deliveries by water year type. Note these deliveries are summarized from the post-processed CalSim 2 delivery results and not the economic models inputs (see *Economic Benefit Analysis Appendix* for more details).

**Table 1. Estimated Annual Water Supply Deliveries by Water Year Types (TAF)**

| Type | Wet | Above Normal | Below Normal | Dry | Critical |
|---|---|---|---|---|---|
| Irrigation | 6118 | 5603 | 4946 | 4353 | 3121 |
| M&I | 606 | 606 | 506 | 447 | 357 |
| Level 2 Refuge | 369 | 369 | 369 | 362 | 291 |

**Calculating water supply purpose SPAs.** Five multi-purpose CVP reservoirs serve the water supply purpose – Friant, New Melones, Trinity, Shasta, and Folsom. Friant serves direct diversions into the Madera Canal and Friant Kern Canal. New Melones must satisfy CVP contracts with Stockton East Water District and Central San Joaquin Water District along with settlement obligations to Oakdale Irrigation District and South San Joaquin Irrigation District. Trinity, Shasta, and Folsom collectively meet the needs of CVP water users in the Sacramento and American river basins and exports at Jones Pumping Plant. The Sizing Model was used to determine the size that each multi-purpose facility must be in order to satisfy the modeled deliveries determined by the CalSim 2 run and post-processing logic.

Figure 1 shows the pathway of model applications and data that calculates the SPA sizes for water supply. CalSim 2 determines deliveries and flows under current operating conditions. CalSim 2 output for delivery and flow are inputs to the Flow Tracker (see the separate section on the Flow Tracker for detailed information) which determines SWP storage releases made to meet Delta obligations. Inputs to the Sizing Model are: 1) post-processed CalSim 2 delivery results, 2) Flow Tracker results for SWP storage release to Delta outflow, and 3) input hydrology.

The Sizing Model is described in further detail in a separate section. All SWP operations, CVP deliveries, and non-project deliveries were fixed. Stream-groundwater interaction, weir flows, and Delta Cross Channel gate operations were dynamic. The only flow requirement in place was to convey the SWP storage release for Delta outflow to its intended destination. With no other flow requirements and no operational constraints, the sizing model does not release water from CVP storage except when this is necessary in order to meet the fixed deliveries. Iterations of the sizing model tested successively smaller CVP reservoir storage capacities until the reduced conservation storage was *fully utilized* to supply all deliveries in at least one year in the period of record. Table 2 displays the water supply SPA storage facility sizes. Note that water supply SPA sizes calculated by the Sizing Model do not include volumes associated with CVPIA B2 management actions. Volumes associated with CVPIA B2 management actions were estimated separately, as discussed below, and included in the CVP reservoir sizes used in cost estimates.

**Table 2. Water Supply SPA Storage Facility Sizes**

| CVP Reservoirs | Full Size | Water Supply SPA (without CVPIA B2)[1] | CVPIA B2 | Water Supply SPA Size |
|---|---|---|---|---|
| **Trinity** | 2447 | 709 | 24 | 733 |
| **Shasta** | 4552 | 1391 | 44 | 1435 |
| **Folsom** | 967 | 181 | 10 | 191 |
| **New Melones** | 2420 | 640 | 2 | 642 |
| **Friant** | 524 | 476 | 0 | 476 |

For a system which operates in a highly integrated manner, it was not realistic to determine SPA sizes based on a “Shasta only” scenario or other similar perspective. SPA sizes were determined assuming the integrated use of Trinity, Shasta, and Folsom. The ratios of active storage capacities between north-of-Delta reservoir facilities were kept proportionally the same in developing the sizing results. Dead pool is included in the SPA sizes.

Figure 2 shows the time series of total north-of-Delta storage for the final Sizing Model iteration. In almost every year of the simulation, the system draws on stored water to satisfy delivery and then storage refills to capacity. The red circle indicates the one point in the period of record when the storage condition reached collective dead pool. This is the year with the largest drawdown, so it defines the single purpose alternative storage. The grey circles identify multiple other years with similar storage needs.

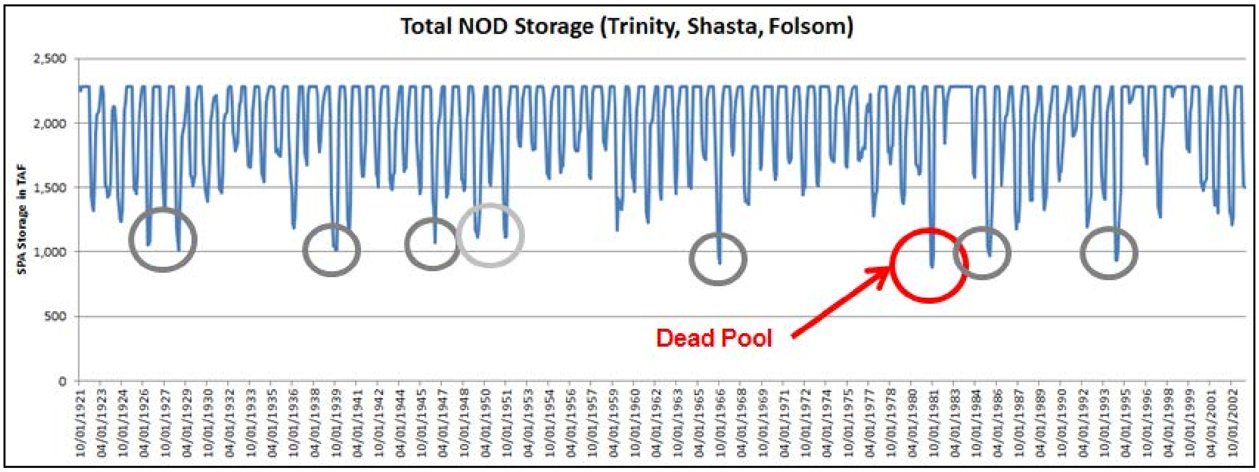


**Figure 2. Sequence of Single Purpose Storage Operations for Water Supply**

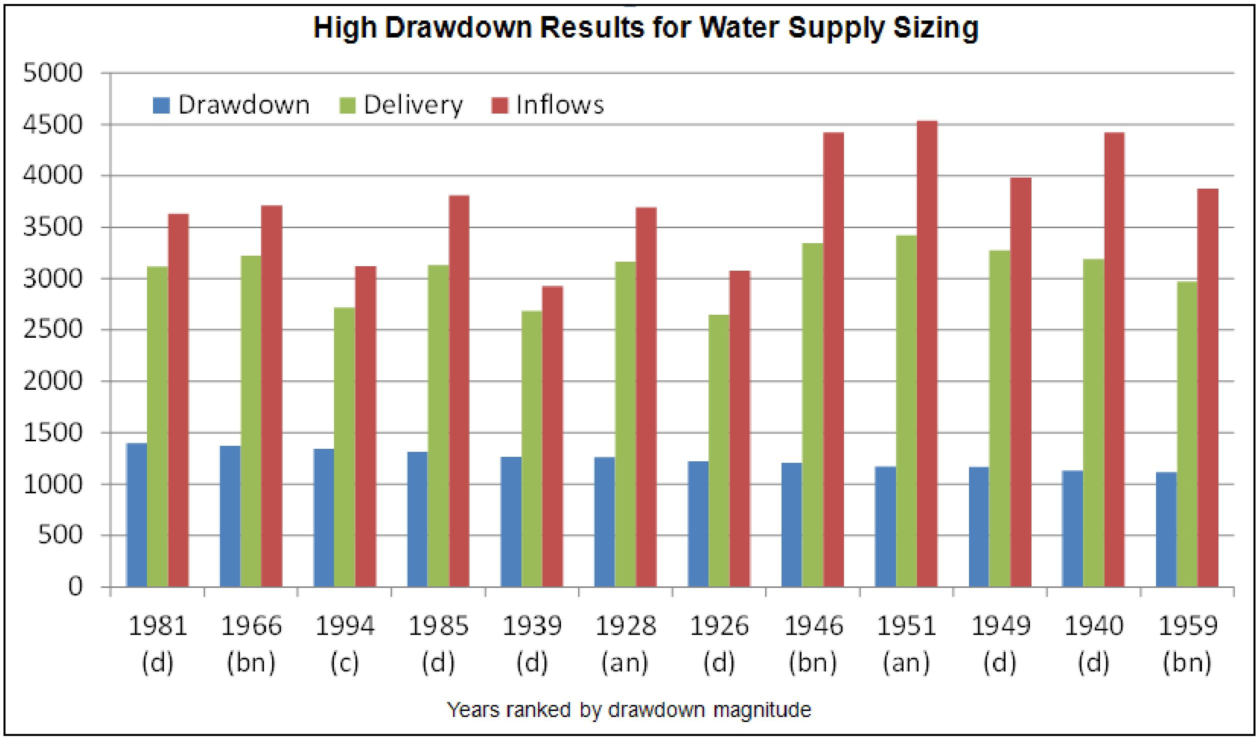


**Figure 3. Multiple Years Have Drawdown Needs Similar to the Year Which Defines NOD SPA Sizes**

Figure 3 shows the relationship between drawdown, delivery, and inflow for these high-drawdown years. Note that these years are neither extremely dry nor extremely wet. CVP agricultural allocations in these years vary around the 50 percent mark. It is in these somewhat drier years where the system needs to fully utilize its storage resources to satisfy project water supply needs.

This analysis is purely theoretical, performed for the unique purpose of providing specialized information for economics analysis for the CAS. The Sizing Model does not depict actual operations. It simply allows the calculation of the storage volume needed to ensure that the delivery time series is able to happen.

# Water Quality Purpose

CVP operations to meet water quality standards under State Water Resources Control Board (SWRCB) D-1485 are joint costs in the SCRB analysis, while incremental operations to meet the stricter standards of D-1641 are non-reimbursable. Quantifying the differences between CVP operations to meet D-1485 and D-1641, and determining the storage necessary to accomplish this, were the goals of the hydrology analysis for the Central Valley Project's Water Quality Purpose.

Water quality responsibilities of the CVP are expressed both by salinity standards, which are met by flow, and by flow requirements that can be surrogates for temperature or dissolved oxygen. Under the complex combined operations of the CVP and SWP, water that is provided to meet a water quality standard at one location can also be used to satisfy a delivery or water quality standard at another location. It can thus be difficult to discern a specific operation for incremental water quality.

Separate CalSim 2 studies were developed to represent system operations under both D-1485 and D-1641. A comparison of results between these scenarios shows differences in river flows, Delta outflow, deliveries, exports, and storage conditions, particularly in the Sacramento River basin.

The Delta outflow that is required to meet water quality standards in the Delta depends on export level. In order to correctly identify the *increment* of SPA storage required to satisfy the D-1641 water quality standards as compared to those in D-1485, the increment had to be defined given the same level of export and delivery. Two new CalSim 2 studies were constructed that fixed CVP and SWP project allocations to the time series of results from the Current Operations scenario but which used D-1485 and D-1641 regulatory environments respectively to guide other system operations. This provided a consistent delivery basis upon which to discern the difference in storage resources required to meet the different water quality standards. These studies were designated as "Hybrid" CalSim 2 runs (H-1485 and H-1641), since they combined current operation delivery levels with prior regulatory criteria.

**Quantifying the Water Quality Purpose.** In Figure 4, the modeling analysis that captures the differences between the D-1485 and D-1641environments is represented by the box labeled "CalSim D1485 D1641." The differences in deliveries between these studies reflect the water deliveries that are foregone in order to meet the higher water quality standards of D-1641. These foregone deliveries were used as inputs to economic benefits models to calculate the representation of economic benefit for the water quality purpose. Table 3 displays estimated annual Delta outflows and foregone irrigation and M&I water deliveries by water year type.

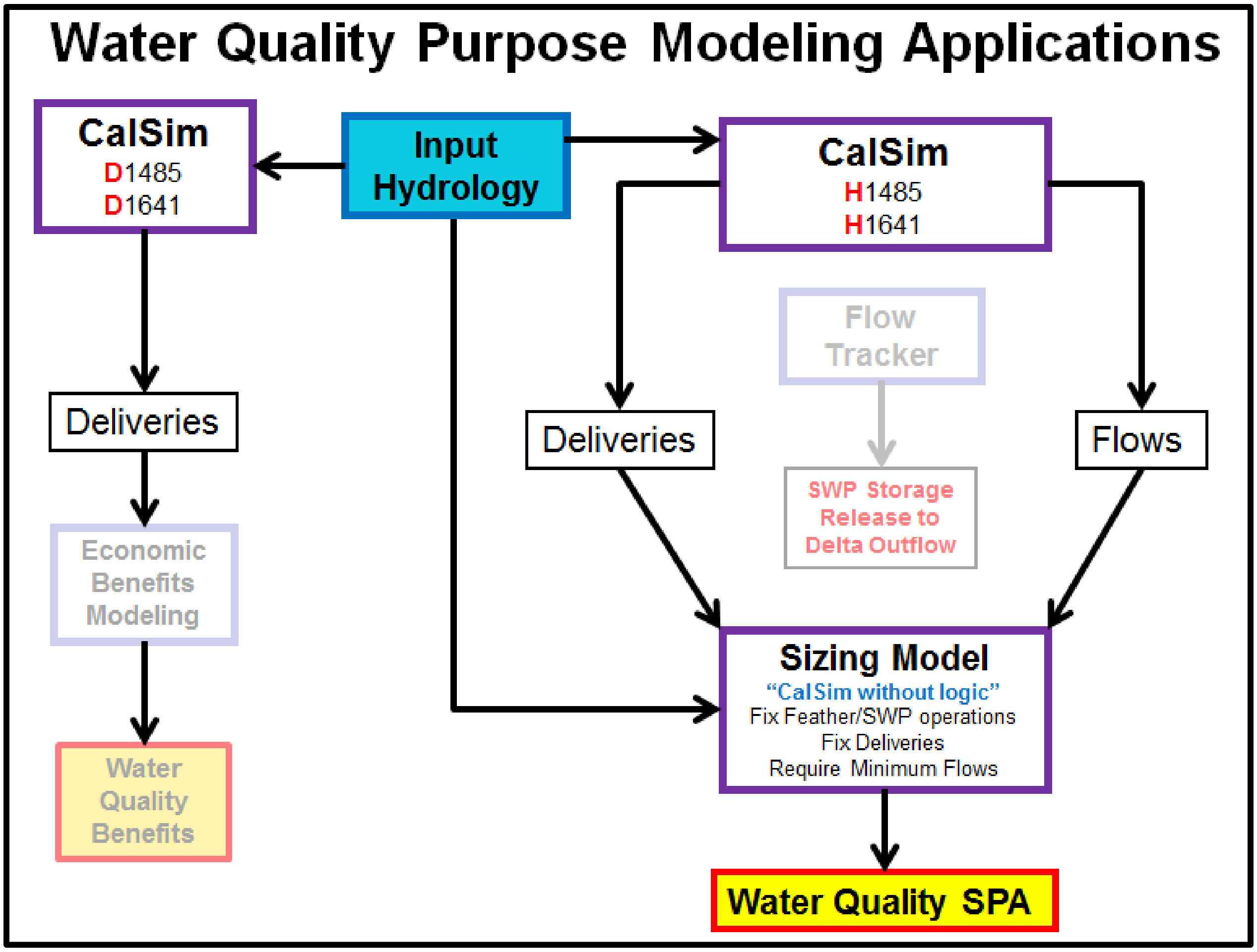


**Figure 4. Hydrology Modeling and Analysis for the CVP Water Quality Purpose**

**Table 3. D-1641 Estimated Annual Water Requirements by Source and Water Year Type (TAF)**

| D-1641 Water Requirements | Wet | Above Normal | Below Normal | Dry | Critical |
|---|---|---|---|---|---|
| Delta Outflows[1,2] | 0 | 0 | 206 | 338 | 449 |
| Foregone Irrigation Deliveries | 34 | 114 | 167 | 118 | 171 |
| Foregone M&I Deliveries | 2 | 5 | 7 | 4 | 10 |
| **Total** | **36** | **119** | **380** | **460** | **630** |

1. Represents CVP portion of Delta outflow requirement
2. CalSim 2 modeling shows that estimated Delta outflow requirements in wet and above normal years are negative; these values have been adjusted to zero.

**Calculating the Water Quality SPA Sizes.** Figure 4 shows that the analysis pathway for determining the SPA sizes for water quality starts with the Hybrid CalSim 2 studies. This is represented by the box labeled "CalSim H1485 H1641." The H1485 and H1641 scenarios resulted in identical delivery and export levels but different flows and Delta outflow. The SPA sizes for satisfying flows *and* delivery were used as inputs to the sizing model. Separate runs of the Sizing Model were done for each hybrid scenario, and the differences between the SPA sizes were calculated.

The Sizing Model runs for the water quality purpose did not size for flow only – deliveries were input as well. Because the input hydrology in CalSim is intrinsically tied to land use, and thus demand, it would be problematic to develop a scenario that met only flow and not any delivery. The sizing model runs for water quality are still devoid of any operations logic, just as in the sizing model for water supply. The difference is that in addition to meeting delivery, storage reserves are also needed to meet minimum flows at key locations and Delta outflow requirements. Note that the role of the Flow Tracker in this figure is grayed out. Feather River operations, which are still fixed, include releases for SWP responsibilities in the Delta, but Delta outflow is now a requirement in these Sizing Model runs and the SWP release helps to serve that outflow requirement. Table 2 shows the Sizing Model results for the Hybrid studies and the differences which describe the SPAs for water quality.

New Melones does not appear in Table 4 because the difference in SPA is negligible. New Melones does meet water quality standards at Vernalis and dissolved oxygen standards at Ripon, but overall differences in the combinations of criteria between D-1485 and D-1641 resulted in the reservoir needing to be the same size under both regulatory environments. Friant does not serve a water quality purpose.

**Table 4. SPA Storage Size Results for the Water Quality Purpose (TAF)**

| | Full Size | H-1485 (D-1485 with Current Deliveries) | H-1641 (D-1641 with Current Deliveries) | Difference = SPA storage size for water quality | Minimum Storage (Deadpool) | Water Quality SPA Size |
|---|---|---|---|---|---|---|
| Trinity | 2447 | 1793 | 1905 | 112 | 240 | 353 |
| Shasta | 4552 | 3361 | 3567 | 206 | 550 | 756 |
| Folsom | 967 | 718 | 757 | 39 | 90 | 129 |

1. Includes storage requirements for CVPIA B2 water quality objectives

Figure 5 shows the time series of total north-of- Delta storage operations performed to meet delivery and flow requirements in the sizing model. Similar to the water supply analysis, the SPA is defined by the largest drawdowns necessary to meet the combined flows and deliveries. The red circle indicates the point at which both the H1485 and H1641 sizing model storage results reached dead pool. This drawdown happened over the time span of three years leading into one of the driest years on record.

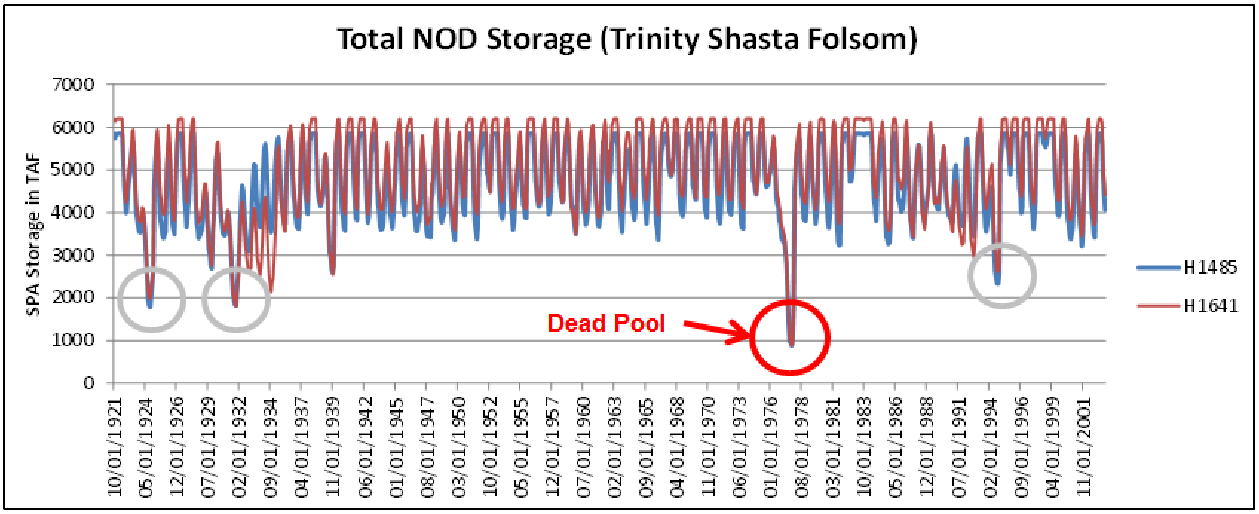


**Figure 5. Sequence of Single Purpose Storage Operations for Water Quality**

Figure 6 focuses on the *difference* between the two sizing runs, since for the water quality purpose it is not the size of the largest drawdown in either H1485 or H1641 that matters, but rather the difference in the size of the largest drawdown in each run. Note the SPAs are much larger than for the water supply purpose, due to the fact that the water quality sizing runs have to meet both delivery and flow. For both the H1485 and H1641 runs, the SPA is determined by the three-year period from 1975 to 1977. Figure 6 highlights the increment of storage capacity that is necessary to meet D-1641 criteria over D-1485 criteria over the period of the drawdown. Both scenarios start with full SPA reservoirs in 1975, and both end at dead pool by the end of water year 1977. The difference in the required storage capacities is the SPA for water quality.

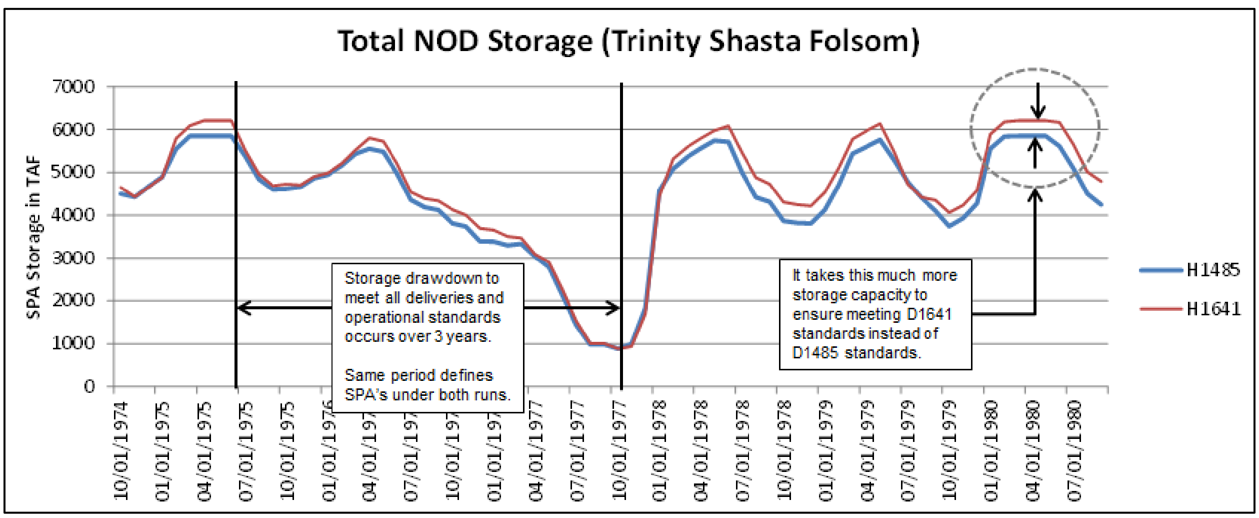


**Figure 6. Expanded View of the Time Period Which Defines the SPA for Water Quality**

# Hydropower Purpose

The hydropower purpose in the CVP reflects hydropower generation at project facilities that are used for both commercial and project use purposes. Project use energy (PUE) is the power required to operate CVP facilities, such as pumping plants. Any power generated that is not used by the project is considered commercial power, which is marketed by the Western Area Power Administration (WAPA).

CalSim 2 output was used as input to the long-term generation (LTGEN) model (developed by Reclamation and WAPA) to estimate power generation and consumption in the CVP system. CalSim 2 outputs include reservoir releases, conveyance flow rates, and end-of-month reservoir storages. The LTGEN is a monthly model that simulates both power generation and consumption in the CVP system resulting from a CalSim 2 simulation. Powerplants included in the LTGEN model are Trinity, Lewiston, Carr, Spring Creek, Shasta, Keswick, Folsom, Nimbus, and New Melones powerplants; and O'Neill and the CVP portion of Gianelli pumping-generating plants. Included pumping plants are C. W. "Bill" Jones, the CVP portion of Harvey O. Banks, Contra Costa, Pacheco, Dos Amigos, Folsom, Corning, and Red Bluff pumping plants; San Luis, Delta-Mendota Canal, and Tehama-Colusa relift pumping plants; and O'Neill and the CVP portion of Gianelli pumping-generating plants.

The Microsoft Excel-based LTGEN model reads reservoir storage and releases, as well as powerhouse and pump station monthly flows from CalSim 2 outputs. The total monthly energy generation, or usage, is computed for each powerhouse and pump station in the system. The total energy is then divided into on- and off-peak periods, with the goal to maximize on-peak generation and off-peak pumping. The functions and parameters assumed in LTGEN were developed by WAPA and Reclamation. Table 5 displays the CVP system estimated annual energy generation and consumption by water year type. Estimated energy generation is the basis of the hydropower economic benefit analysis and Thermal Plant SPA sizing for the hydropower purpose.

**Table 5. Estimated Annual Power Generation and Consumption by Water Year Type (GWh)**

| Power Component | Wet | Above Normal | Below Normal | Dry | Critical |
|---|---|---|---|---|---|
| Energy Generation | 6464 | 5333 | 4270 | 3901 | 2859 |
| Energy Use | 1426 | 1281 | 1162 | 985 | 669 |
| Net Generation | 5038 | 4051 | 3108 | 2917 | 2191 |

# Flood Control Purpose

The CVP storage facilities which operate for flood control are Trinity, Shasta, Folsom, New Melones, and Friant (Millerton). All of these facilities except for Trinity include flood control in their authorizing legislation. Trinity provides protection to downstream assets under guidelines set by the Trinity River Mainstem Fishery Restoration Record of Decision (ROD).

Flood control rules limit the volume of water that may occupy space in a reservoir, mandating that a certain amount of empty space be maintained in order to accommodate anticipated seasonal runoff. Figure 7 provides a conceptual diagram. Flood control rule curves are the time-varying values for flood control rules through the water year. Space requirements are typically highest in the late fall and may be determined annually depending on runoff forecasts for the reservoir catchment area. A high space requirement translates to a lower rule curve. Rule curve values over the course of any water year also depend on operating strategies and safety considerations for individual storage facilities. Limits are set by the Army Corps of Engineers or local flood protection authorities. Figure 8 shows a portion of the historical flood control rule curve for Folsom Lake, as used by the CalSim 2 planning model.

The flood control rule method for determining the single purpose size of a reservoir is simply to select the largest value for required flood space in a reservoir from the historical flood control diagrams and add this to the dead pool space. The largest flood space is found by taking the lowest value for the cumulative storage at which the bottom of the flood space begins from the time series of flood control rules used in the CalSim 2 planning model. This value is subtracted from the storage capacity of the reservoir to define the maximum required flood space. This is then added to the minimum operating storage level in the reservoir, representing the dead pool, to calculate the single purpose alternative size for the reservoir. Table 3 provides a summary of sizing results produced by this method, and Figure 11 shows the rule curves used by CalSim 2.

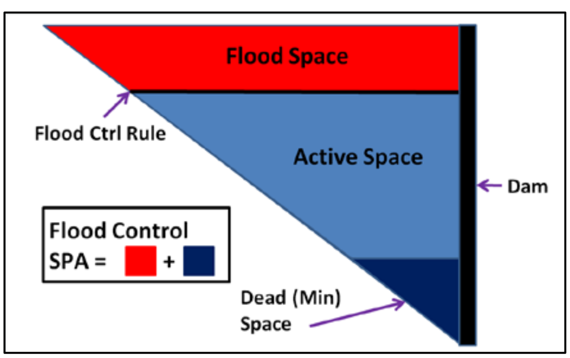


**Figure 7. Flood Control Rule Concept**

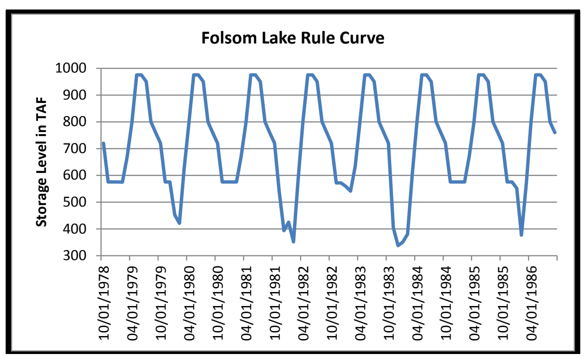


**Figure 8. Flood Control Rule Curve Example**

**Table 6. SPA Storage Size Results for the Flood Control Purpose (TAF)**

| | Minimum Flood Control Rule | Storage Capacity | Flood Space Required | Minimum Storage (Dead Pool) | Flood Control SPA Size |
|---|---|---|---|---|---|
| Shasta | 3250 | 4552 | 1302 | 550 | 1852 |
| Folsom | 367 | 967 | 670 | 90 | 690 |
| New Melones | 1970 | 2420 | 450 | 80 | 530 |
| Millerton | 351 | 524 | 174 | 135 | 309 |

All values in TAF

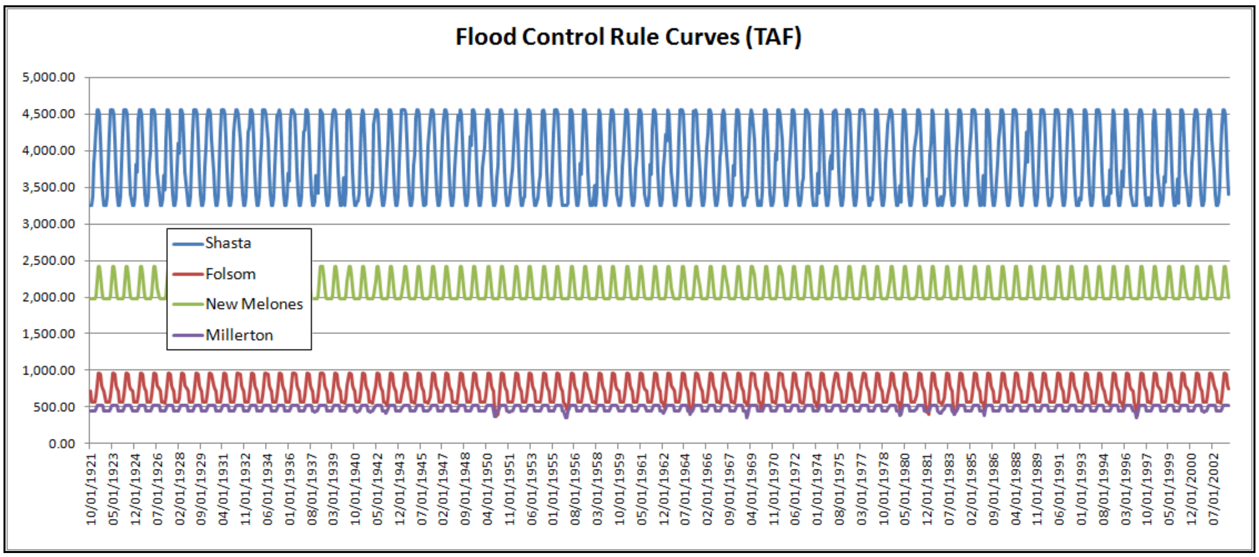


**Figure 9. Flood Control Rule Curves Used for CalSim 2 Planning Studies**

The flood control rule analysis approach does not necessarily provide a pure single-purpose or single-facility perspective, as the historical trace of required space in a reservoir may consider normal operations such as releases for water supply deliveries, flow standards, and other criteria, as well as the integration of that facility's operation with other facilities in the system. However, this approach is also not affected by outlier hydrology events that might exceed the scope of the project intent. The rule curve method was used for the four CVP facilities that have an authorized flood control purpose.

Trinity has a unique flood control mandate relative to the other four facilities; flood control is not an explicitly authorized purpose but the dam operates to protect downstream assets under the Trinity River Mainstem Fishery Restoration ROD. Due to the unique nature of the flood control mandate for Trinity, a daily hydrology model analysis was used to determine the flood control SPA for Trinity of 578 TAF.

## Trinity Lake Model

Historical daily data for computed inflows to Trinity Lake were available from November 1962 through the present day. Monthly input data from the CalSim 2 planning model was disaggregated to a daily average and used to represent the small local accretion between Trinity Dam and Lewiston Dam. No export of water through Clear Creek Tunnel was assumed. Trinity Dam is operated to avoid damages that would occur to downstream assets at flows above 11,000 cfs, so this was used as the flow threshold for initiating the flood control operation.

The daily model run for Trinity Dam starts on November 1, 1962, assuming a minimum regulated storage rule of 240 TAF. Release capacity as a function of reservoir storage is shown in Figure 10. Reservoir releases are limited to prevent flows above 11,000 downstream of Lewiston Dam. Daily storage is determined as:

*Previous Day Storage + Inflow – Evaporation*

*– min(Discharge Capacity, 11000-Trinity_Lewiston_Accretion, (Inflow-Evap+CarryoverStorage)).*

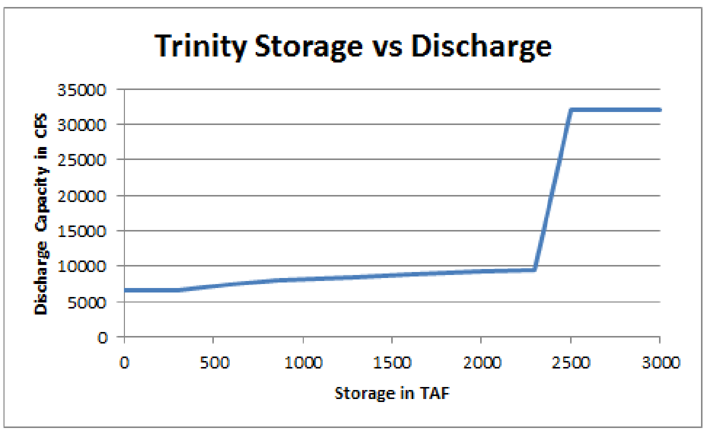


**Figure 10. Trinity Storage vs. Discharge Capacity**

The maximum storage attained in Trinity Lake in the daily hydrology model investigation is 577.9 TAF, occurring in January of 1997. Other extreme inflow events in 1964, 1974, 1983, and 2006 result in needs for storage capacities of 564 TAF, 533 TAF, 539 TAF, and 524 TAF respectively. A time series plot of Trinity inflow, release, and storage is shown in Figure 11, and an exceedance plot of the same data is shown in Figure 12. Instances of higher reservoir storage requirements to contain extreme inflow events are evident in the sharp spikes in the green lines in the time series plot. The overall frequency of storage requirement for flood control is about 11 percent. The 11,000 CFS flow threshold for preventing damages in the Trinity River never actually controls, as discharge capacity is always below that level for the storage levels attained in the operation.

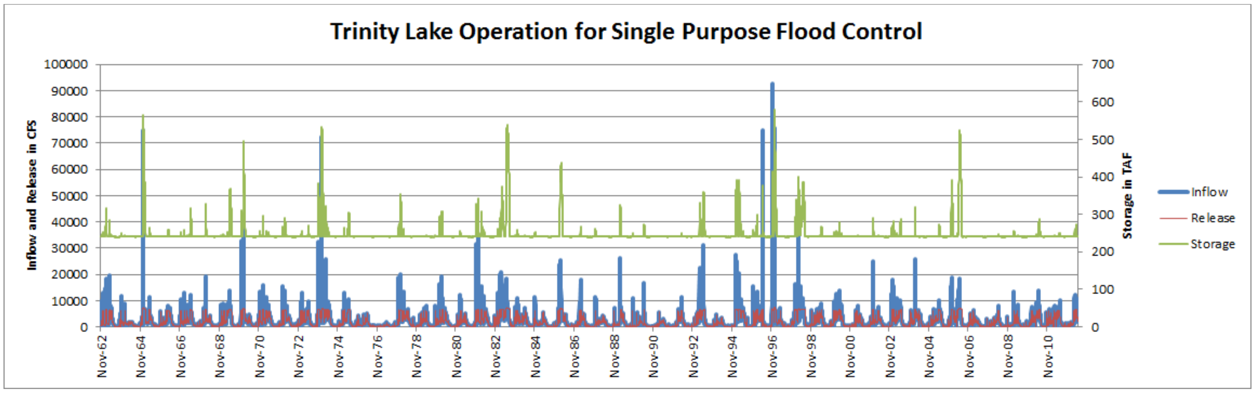


**Figure 11. Time Series of Trinity Lake Operation for Flood Control**

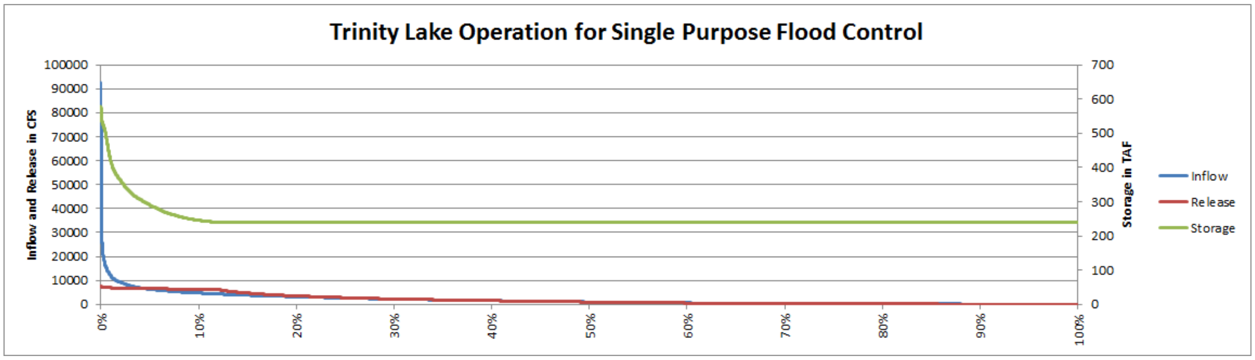


**Figure 12. Exceedance of Trinity Lake Operation for Flood Control**

# Sizing Storage Facilities to Meet the Central Valley Improvement Act

The CAS considers the storage cost of producing CVPIA instream flow actions and of exports that are foregone due to CVPIA Delta actions. The continuous and evolving nature of CVPIA accounting methodologies makes it impossible to include a consistent long-term plan for CVPIA 3406(b)(2) – abbreviated as B2 – actions in the CalSim 2 model. Consequently, daily accounting records detailing historical storage releases and export reductions used for actions from 2008 to 2014 were analyzed.

The designated reservoir releases to meet instream flow actions were classified as:

- releases under balanced conditions able to be recaptured for other water supply purposes and not considered B2 use of storage
- releases under excess conditions that could not be recaptured were designated as
    - action to meet D-1641 standard that was counted as a B2 action
    - action to meet a Reasonable and Prudent Alternative (RPA) standard that was counted as a B2 action
    - action that was performed solely to meet the CVPIA purpose

The designated export reductions were classified as:

- reductions under excess conditions, indicating that storage was not affected by the reduction and therefore would not have been considered B2 use of storage
- reductions under balanced conditions, indicating that additional use of stored water would have been necessary to meet the foregone export, were designated as
    - export reduction to meet a D-1641 standard that was counted as a B2 action
    - export reduction to meet an RPA standard that was counted as a B2 action
    - export reduction performed solely to meet the CVPIA purpose

These elements for historical B2 actions are shown in Figure 13:

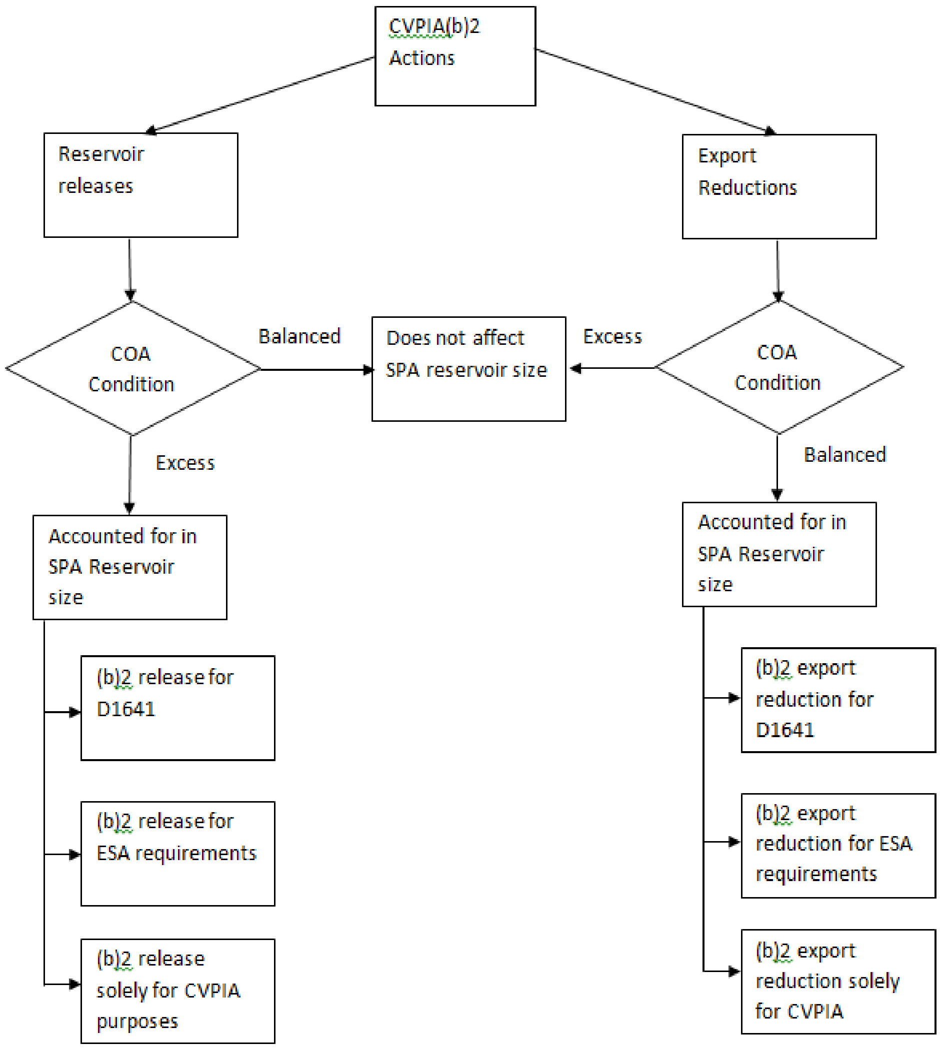


**Figure 13. Diagram Describing the Classification of B2 Actions for CVPIA Cost Allocation**

Reclamation records of annual B2 accounting specify how much B2 water is ultimately used by purpose, although water that is ultimately exported is not included in the accounting. Existing analysis identified the water storage requirements specifically for B2 to be 208 TAF, excluding B2 water that is ultimately exported as irrigation or M&I water. This figure can be broken into three pieces: B2 actions attributed to the water supply purpose (79 TAF), B2 for RPA mitigation (69 TAF), and B2 for water quality (60 TAF).

The required storage for B2 water supply actions was calculated as the 2008-2014 average annual total of the volume of releases designated to have been made for B2 actions during excess conditions and the average annual volume of exports reduced for B2 actions during balanced conditions. This average annual volume can be distributed among the storage facilities based on proportional B2 releases from each reservoir (instream release element) and distribution of north-of-Delta CVP reservoir sizes (export reduction element). Figure 14 depicts the impact on CVP storage of meeting CVPIA actions. It is recognized that the suite of actions over the years 2008-2014 reflect different water year hydrology conditions, different environmental needs, and evolving perspectives on B2 action management by Reclamation and the Fish and Wildlife Service. Table 7 displays the estimated storage reserves used to meet B2 action management for Trinity, Shasta, Folsom, and New Melones storage facilities.

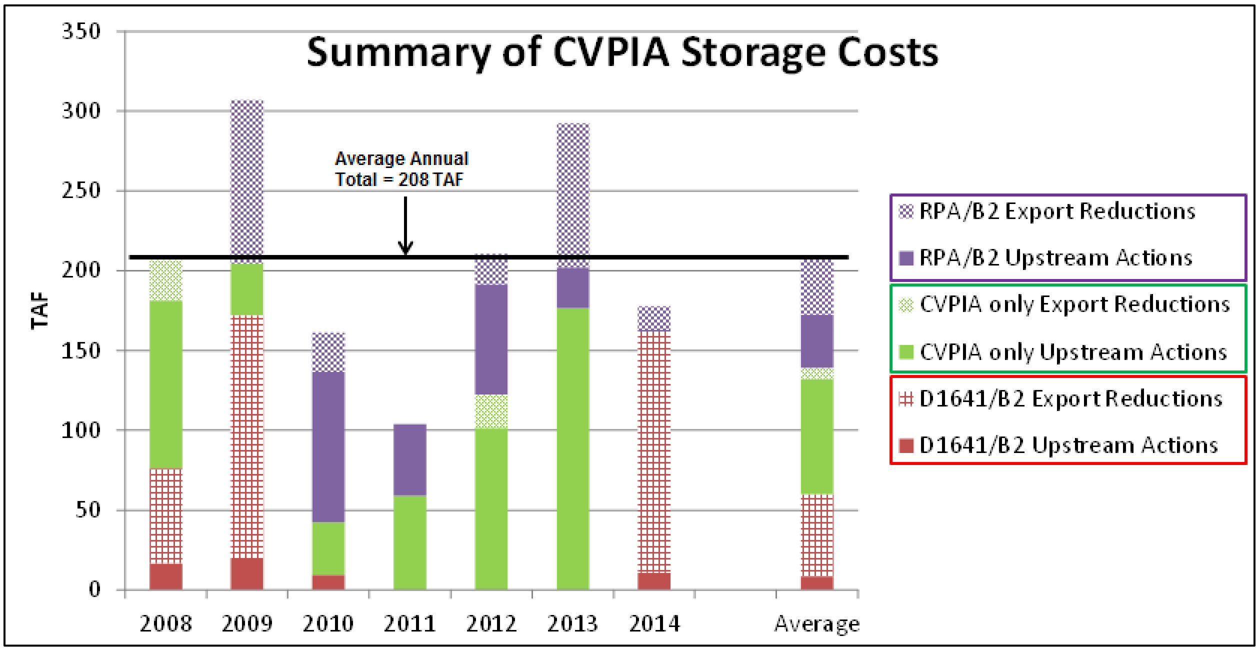


**Figure 14. Components of the Storage Costs for Meeting CVPIA Responsibilities, 2008-2014**

**Table 7. Estimated Average Annual Storage Requirements Used to Meet B2 Water Supply Objectives (TAF)**

| B2 Objective | Trinity | Shasta | Folsom | New Melones | Total |
|---|---|---|---|---|---|
| B2 – Water Supply | 24.1 | 43.7 | 9.6 | 1.6 | 79.0 |

# Omitted-Purpose Analysis

The omitted-purpose analysis considered the size of the multi-purpose project with a single purpose hypothetically removed. The multi-purpose project without a given purpose (omitted-purpose project) would exclude the size (storage capacity) required to meet omitted-purpose benefit levels, while maintaining the storage capacity to provide the benefits for all other purposes. For all purposes, it was concluded that the multi-purpose without sizes were all full capacity. The quantitative background to support that conclusion is summarized below.

- Multi-purpose without water supply, multi-purpose without water quality, and multi-purpose without flood control can be identified as full capacity since these sizes are driven by the need for the reservoirs to operate through their full range of elevations in order to generate an equivalent amount of power as provided by the full multi-purpose project. In other words, the power purpose is what drives the multi-purpose-without sizes for water supply, water quality, and flood control.

- Multi-purpose without power is also full capacity, since CalSim 2 model results demonstrate at least one period where the reservoirs operate from full capacity to dead pool without re-filling in order to satisfy the water supply, flood control, and water quality purposes. Power is an ancillary benefit of reservoir releases in CalSim 2 – i.e., there is no logic to produce releases that target power production – it is a byproduct of releases to satisfy other operational criteria.

    - Figure 15 shows two multi-purpose without power sequences for Friant. The June 1922–August 1924 period shows the without-power use of full capacity driven by water supply. The June 1982–October 1983 period shows an extreme case of the without power use of full capacity driven by flood control.

    - Figure 16 shows the period of June 1983 through October 1991 for New Melones Reservoir, where the full capacity of the conservation pool is used to meet multiple purposes other than power.

    - Figure 17 and Tables 8 and 9 show the period from May 1975 through October 1977 for the north-of-Delta facilities Trinity, Shasta, and Folsom. Note that Trinity does not exactly meet the criteria, as its storage in this period has a max of 2431 (full capacity is 2447) and a min of 372 (dead pool is 240). However, considering the integrated nature of CVP reservoir operations, the divergence from absolute max and absolute min for total NOD storage is well within the sensitivity of the costing analysis which would inform this aspect of the SCRB analysis.

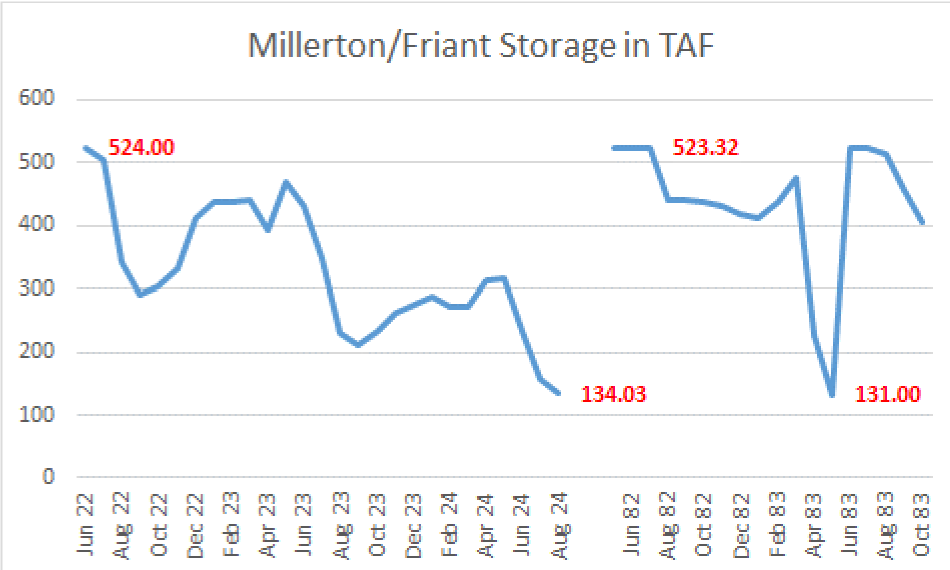


**Figure 15. Two Examples of Multi-Purpose Without Power Use of Full Conservation Storage in Millerton**

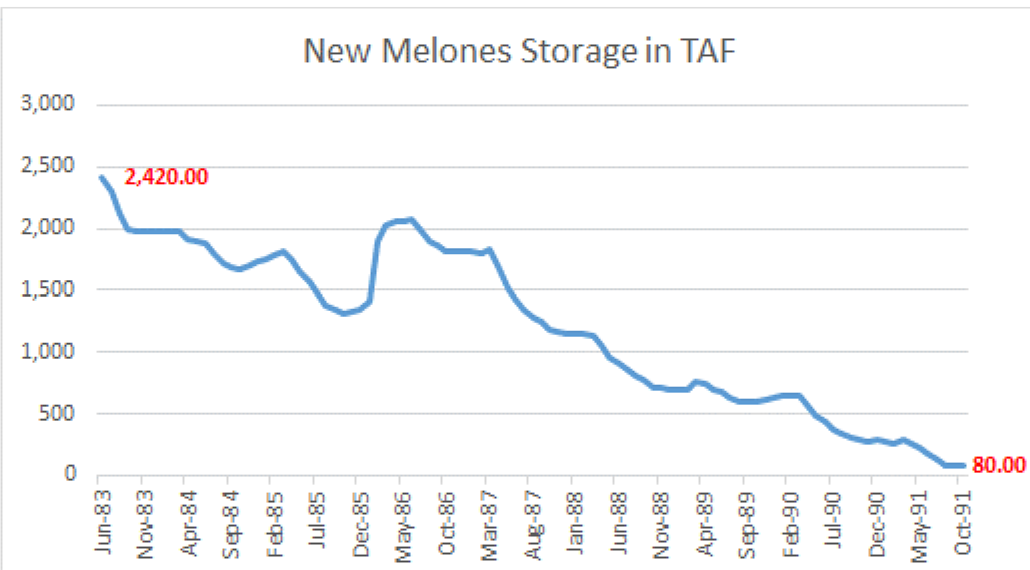


**Figure 16. Example of Multi-Purpose Without Power Use of Full Conservation Storage in New Melones**

**Table 8. CVP NOD Max and Min Storage for the Period in Figure 17**

| Storage Facility | Max. Physical Capacity | Min. Physical Capacity | Max. Model Results | Min. Model Results |
|---|---|---|---|---|
| Trinity | 2447 | 240 | 2431 | 372 |
| Shasta | 4552 | 550 | 4552 | 550 |
| Folsom | 967 | 90 | 967 | 90 |
| **Totals** | **7966** | **880** | **7950** | **1012** |
| **Difference (actual-ideal)** | | | **-16** | **132** |

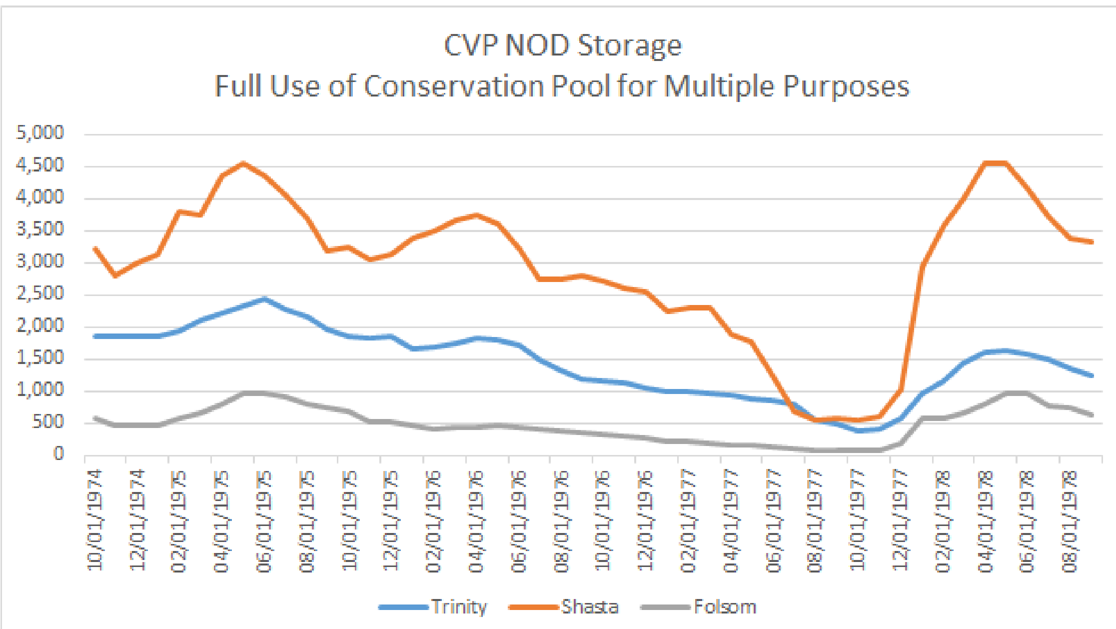


**Figure 17. Example of Multi-Purpose Without Power Use of Full Conservation Storage by CVP NOD Facilities**

**Table 9. Full Data for the Figure 17 Plot**

| Date | Trinity | Shasta | Folsom |
|---|---|---|---|
| **5/31/1975** | 2,321 | 4,552 | 967 |
| **6/30/1975** | 2,431 | 4,349 | 967 |
| **7/31/1975** | 2,270 | 4,042 | 919 |
| **8/31/1975** | 2,150 | 3,700 | 792 |
| **9/30/1975** | 1,969 | 3,189 | 733 |
| **10/31/1975** | 1,850 | 3,243 | 695 |
| **11/30/1975** | 1,841 | 3,039 | 529 |
| **12/31/1975** | 1,850 | 3,134 | 526 |
| **1/31/1976** | 1,663 | 3,369 | 461 |
| **2/29/1976** | 1,694 | 3,480 | 415 |
| **3/31/1976** | 1,742 | 3,668 | 428 |
| **4/30/1976** | 1,819 | 3,740 | 434 |
| **5/31/1976** | 1,793 | 3,601 | 456 |
| **6/30/1976** | 1,714 | 3,222 | 434 |
| **7/31/1976** | 1,495 | 2,757 | 408 |
| **8/31/1976** | 1,314 | 2,737 | 385 |
| **9/30/1976** | 1,178 | 2,811 | 357 |
| **10/31/1976** | 1,154 | 2,711 | 334 |
| **11/30/1976** | 1,132 | 2,608 | 308 |
| **12/31/1976** | 1,044 | 2,545 | 267 |
| **1/31/1977** | 1,000 | 2,254 | 230 |
| **2/28/1977** | 991 | 2,293 | 215 |
| **3/31/1977** | 977 | 2,286 | 197 |
| **4/30/1977** | 947 | 1,877 | 174 |
| **5/31/1977** | 894 | 1,770 | 167 |
| **6/30/1977** | 861 | 1,251 | 134 |
| **7/31/1977** | 790 | 702 | 95 |
| **8/31/1977** | 545 | 550 | 90 |
| **9/30/1977** | 491 | 570 | 90 |
| **10/31/1977** | 372 | 550 | 90 |

# Single Purpose Facility Sizing Model

The single purpose facility Sizing Model is essentially CalSim 2 with no operations logic. It uses nearly the same schematic network as CalSim 2, removing only the details of canal operations below the south Delta pumping plants (Delta-Mendota Canal below Jones Pumping Plant and California Aqueduct below Banks Pumping Plant). Inputs to the Sizing Model include all of the hydrology – rim inflows, local inflows, and Depletion Service Area (DSA) accretion/depletion terms. Stream-groundwater interactions are dynamic, as are weir spills. Delta Cross Channel gates are closed if the flow at Hood exceeds 25,000 cfs, but otherwise there are no rules about closures.

All Sizing Model runs fix all SWP operations using pre-set time series. This includes Feather River operations such as Oroville and Thermolito release and evaporation, all deliveries, channel flows, and stream groundwater interaction. Inflows from the Yuba River and Bear River systems, SWP deliveries to the North Bay Aqueduct, and exports at Banks Pumping Plant are fixed. The outcome of this locked operation is a pre-determined set of flows entering the Sacramento River from the Feather River – flows which, depending on the time step, reflect some combination of controlled release for delivery or Delta outflow and uncontrolled flow which may be available for CVP purposes. Flows that were the result of a specific action to enable delivery are delivered at the North Bay Aqueduct or Banks. Flows that were the result of a specific action to meet a Delta standard under a Coordinated Operations Agreement (COA) sharing relationship are identified by the Flow Tracker and set as a requirement for Delta outflow so that CVP deliveries do not have access to this flow resource.

All Sizing Model runs fix all CVP deliveries and associated groundwater pumping and return flow. Non-project deliveries are also fixed.

The list below summarizes the preceding discussion of Sizing Model inputs and assumptions:

- CalSim 2 schematic network (minus Delta-Mendota Canal below Jones and California Aqueduct below Banks)
- CalSim 2 hydrology
    - rim inflows,
    - local inflows,
    - local accretions,
    - DSA accretions/depletions,
    - local loss assumptions
- Dynamic stream-groundwater interactions
- Weir spills determined by flow/spill relationships
- Delta Cross Channel Gates closed if flow at Hood exceeds 25,000 CFS
- Fixed SWP operations (Feather River, North Bay Aqueduct, Banks Pumping Plant)

- Fixed non-project deliveries (Delta consumptive use, all other non-project deliveries)
- Fixed CVP delivery operations
    - surface diversion
    - groundwater pumping
    - return flow

Sizing Model functionality is illustrated by the example in Figures 18, 19, and 20. A simple example system has one inflow, one reservoir, one delivery, and one flow requirement. For this simple example, the reservoir has no dead pool.

Figure 18 represents a normal operation, equivalent to a general CalSim 2 scenario run. Delivery is affected by an allocation strategy, outflow is a combination of a requirement and spill, and conservation storage is tapped to satisfy system requirements when inflow is not sufficient. The full range of storage capacity is exercised during the range of water supply conditions portrayed.

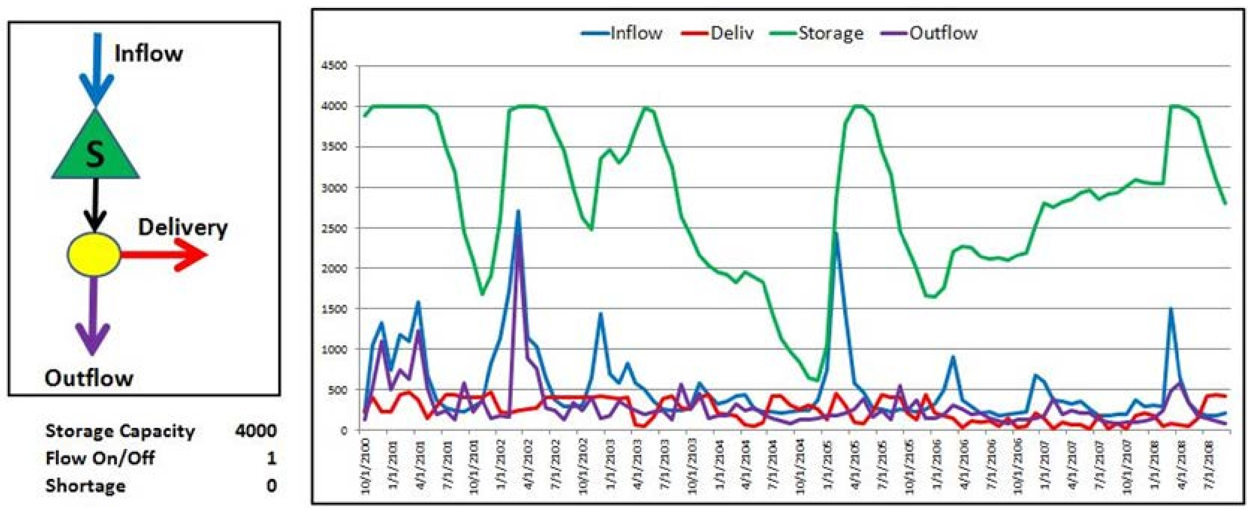


**Figure 18. Normal Operation of the Simple Example System, Equivalent to a Normal CalSim 2 Run**

Figure 19 represents the first step in the Sizing Model analysis. To find the single purpose facility size for the deliveries determined in Figure 18, all other project purposes are removed from required operations; in this case the required outflow is no longer imposed. As long as inflows can meet delivery, storage stays full, and inflow that is not needed for delivery and cannot be stored goes to outflow as spill. Once the inflow is not sufficient to meet delivery needs, releases are made from storage to satisfy the delivery. Under these conditions, outflow is zero because there is no requirement to meet a flow standard – it is a *single purpose water supply operation*. Figure 19 shows a modest need for reservoir storage to meet the deliveries; much of the storage capacity is not used, so clearly a smaller size reservoir would do.

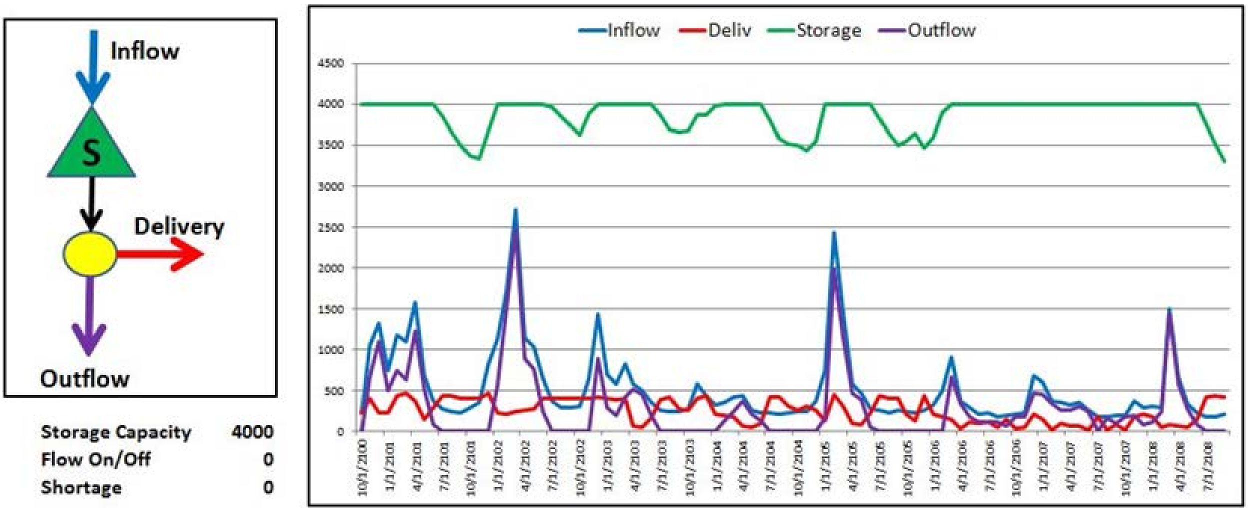


**Figure 19. Removal of Operations Unrelated to Single Purpose in Question in Simple Example System**

Figure 20 shows the final step of the Sizing Model analysis. The reservoir size has been dropped from 4000 to 697, which is just large enough to always be able to satisfy the delivery capabilities determined under the normal operation in Figure 18. During the period of record of this example study, there is one point, indicated by the black circle, when the reservoir storage is completely used up. This is what defines the single purpose alternative storage for this simple example system. In a real reservoir with non-zero dead pool, storage would be reduced so that the largest depletion reached the top of dead pool.

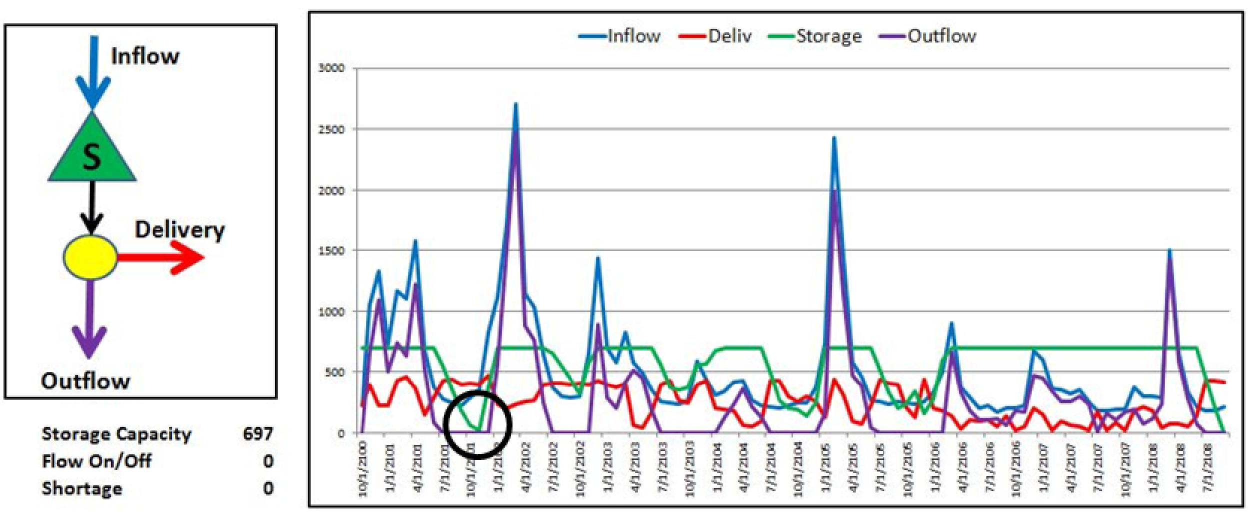


**Figure 20. Sizing Model Applied to Simple Example System, Identifying Minimum Required Storage**

# Flow Tracker

The Flow Tracker was created to identify SWP releases of stored water from Oroville that were specifically to meet Delta requirements for water quality or outflow. As discussed previously, the Sizing Model was developed to fix SWP operations on the Feather River, deliveries to the North Bay Aqueduct, and Banks Pumping Plant exports. Any SWP release for its own water supply would be taken as SWP delivery, and other water from the Feather River would be available to the fixed CVP deliveries in the lower Sacramento River or at Jones Pumping Plant. But if an SWP storage release was made specifically to meet a Delta standard, the Sizing Model would need to know this so it could avoid making this water available to meet the CVP water supply purpose. Without considering this, the CVP water supply SPA would be underestimated.

Seven types of flows were identified and tracked:

- CVP release of water that passes through a reservoir without being stored
- CVP release of previously stored water
- SWP release of water that passes through a reservoir without being stored
- SWP release of previously stored water
- Non-Project flow – accretions or other local inflow that has not passed through a reservoir
- Groundwater – seepage to stream channels from groundwater
- Return flow – flow in any channel that is the result of return flow from delivery operations

The Flow Tracker, like the Sizing Model, uses the same network schematic as CalSim 2. It takes as input the merged inputs and outputs of a CalSim 2 run. The Flow Tracker determines what flow types are for each channel and delivery arc in the system by following just two principles: One, that every channel or diversion arc is the sum of its flow types, and two, that mass balance of each flow type at each node must be maintained. Storage nodes need specific logic, depending on their characteristics, to assign flow types to evaporation, delivery, and release.

The user determines the disposition of flow types throughout the system through weights assigned to each flow type for each diversion. This enables the tool to be used for a wide variety of purposes in CVP/SWP system analysis. For this application, the ultimate goal of the analysis was to determine the SWP release for Delta standards, but there were additional sensible considerations as well. Non-project deliveries and weir flows would be expected to be satisfied without stored water releases, for example. A matrix of flow types and delivery types was constructed, with each flow type having a progression of weights for the delivery types that it could serve.

Non-project inflow, groundwater, and return flow were given the highest weights so these types of flow would be used first. The idea was to use it as high up in the system as possible – even by project delivery – while at the same time reserving what was necessary to meet non-project demands system-wide. Pass-through inflow was encouraged to be used first by non-project uses and then by project deliveries, considering the source of the release. For example, CVP release of pass-through inflow (CVPI) would have a higher weight for a CVP delivery than for SWP export. Diversions of stored water releases were weighted lower than all other flow types. Penalties were imposed for use of another project's stored water release. No weights were imposed on flow types for Delta outflow. The outcome of this weighting scheme was that the only time that stored water release would go to Delta outflow was if all other water types had been used already by deliveries and exports, and the release was actually necessary to meet a Delta requirement. This was the information needed for the Sizing Model.

RECLAMATION
*Managing Water in the West*

# CVP Cost Allocation Study

## November 19, 2013

## Description of Analytical Tools

### Name
CalSim2

### Author/Developer
California Department of Water Resources and U.S. Bureau of Reclamation

### Category
Reservoir-river simulation model, long term water supply reliability planning model

### Main Features and Capabilities
- Monthly time step; 82-year period of record
- Spatial scale – CVP/SWP project extent. Extended Sacramento/San Joaquin river basins and associated imported water sources and export delivery areas.
- Simulation of CVP/SWP operations
  - using historical rainfall and runoff hydrology that has been adjusted to represent water supply and demands at a consistent level of development, and
  - depicting a consistent regulatory environment.
- Developed in WRIMS – a general-purpose river system modeling environment with a LP/MILP solution algorithm

### Applications
CalSim2 is widely accepted as the planning model for depicting CVP/SWP system operations and has been used in numerous system-wide studies since it was first released in 2002, including multiple CALFED storage investigations, Operations Criteria and Plan (OCAP) 2004, OCAP 2008, DWR Delivery Reliability Reports, San Joaquin River Restoration, and the Bay Delta Conservation Plan (BDCP).

### Calibration/Validation/Sensitivity Analysis
Because of the evolving nature of CVP/SWP facilities, demands, and governing regulations, true calibration/validation practices are not feasible with a model like CalSim2. DWR performed an historical simulation study (DWR, 2003) which demonstrated the model's ability to match historical operations when driven by time-evolving inputs reflecting historical demand levels and operating criteria.

Sensitivity/uncertainty analysis has been performed to determine sensitivity to a broad range of input data (DWR 2005).

### Peer Review

Peer reviews of CalSim2 were conducted under the CALFED study program for the system-wide model (Close et al, 2003), and following an update to San Joaquin basin representation (Ford et al, 2006).

## Anatomy of CalSim2

### Conceptual Basis

CalSim2 depicts the water supply reliability of the CVP/SWP system, operating within the extended Sacramento and San Joaquin River Basins at a specific level of development and given fixed assumptions about project facilities and operations criteria.

### Hydrology

The historical hydrology record has been affected by a particular sequence of natural characteristics (rainfall, temperature, runoff) and human impact (facility development, land use, population, regulations). Historical data is “unimpaired” by backing out the impacts of human activity to return to a data set that reflects a native condition, and then it is “re-impaired” by imposing a particular assumption about land use and urban demand. The resulting data set thus reflects the historical trace of precipitation and temperature, but local accretions/depletions, consumptive use demand, and urban demand reflect a consistent current or future level of irrigation and urban land use. The period of record used by the CalSim2 model is 1922-2003. The spatial resolution at which the hydrology balances and land-use analysis is performed is shown in Figure 1.

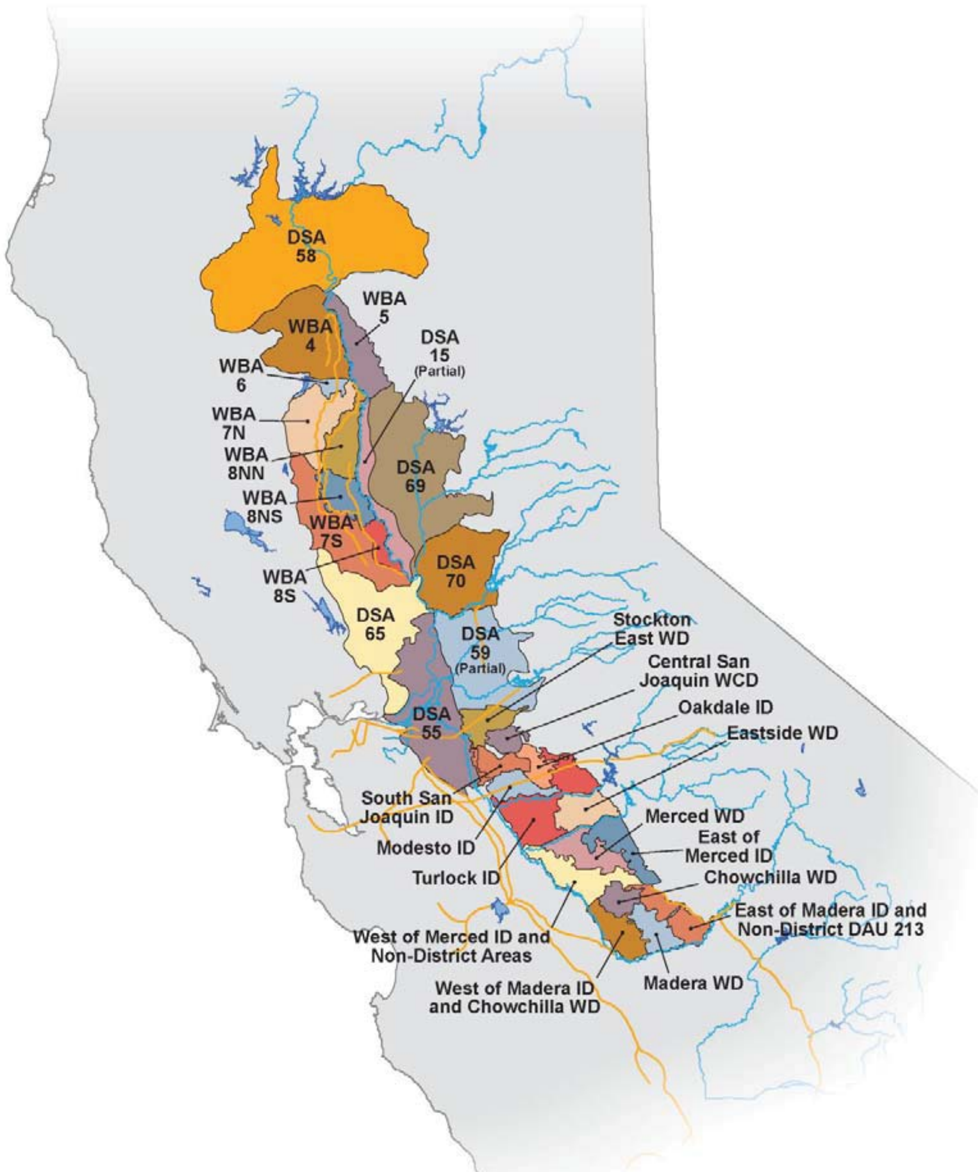


Figure 1 – Depletion Analysis Regions used by CalSim2 (Depletion Study Areas, Water Budget Areas)

## Surface Water/Groundwater Interaction

Groundwater has a limited representation in CalSim2. Within the Sacramento Valley floor, groundwater is explicitly modeled using a multiple-cell approach based on depletion study area boundaries. There are a total of 12 groundwater cells. Stream-aquifer interaction, groundwater pumping, recharge from irrigation, and sub-surface flow between groundwater cells are calculated dynamically. All other groundwater flow components are preprocessed as part of the hydrology development and represented in CalSim2 as fixed time series'. In areas of high groundwater, CalSim2 calculates groundwater inflow to the stream as a function of the groundwater head and stream stage. In areas of low groundwater elevation where the groundwater table lies below the streambed, CalSim2 assumes a hydraulic disconnect between the stream and aquifer. In this case seepage is only a function of stream stage.

## Agriculture Demands

CalSim2 demands north of the Delta (NOD) are determined in the hydrology development process and depicted as lumped time series (monthly) values for the areas shown above. Land use-based demands are calculated using the Consumptive Use (CU) model, which simulates soil moisture conditions for 13 different crop types over the historical period. Irrigation demand is triggered when soil moisture falls below a specified minimum. The CU model calculates the crop consumptive use of applied water. The consumptive use is subsequently multiplied by water use efficiency factors to obtain the regional water requirement to be met from stream diversions or groundwater pumping. Agricultural demands in the Delta are represented more simply as an overall mass balance between precipitation and crop evapotranspiration.

**Non-recoverable losses** are assumed to be 10 to 15 percent of the crop consumptive use of applied water. Non-recoverable loss factors are used to determine the portion of the supply that will return to the system as surface return flow or as deep percolation to groundwater. Efficiency factors may vary by month and by year.

Agricultural demands south of the Delta (SOD) are depicted as project contract obligations. SOD CVP demands are assumed to be fixed at maximum contract amount and do not vary year to year. SWP agricultural demands on the west side of the San Joaquin Valley are capped to the full assigned amount, but are reduced in wetter years using an index developed from annual Kern River inflows to Lake Isabella.

## M&I Demands

Indoor urban water use is considered non-consumptive and is not dynamically represented by the model. Outdoor urban water use is treated as an irrigation demand and is combined with the agricultural demands. M&I diversions, although not entirely consumptive, can have a large influence on reservoir operations. Surface water diversions serving both indoor and outdoor M&I uses for the American and Lower Sacramento River areas have therefore been included in CalSim2 because they partially determine the operation of Folsom Lake. Outdoor urban demand is calculated by the CU model, with the irrigated area computed as a fixed fraction of the total urban area as measured by DWR in land use surveys.

CVP and SWP SOD M&I demands are based on contract amounts. CVP demands are assumed to equal contract amounts and do not vary. SWP M&I demands south of the Delta are split into Metropolitan Water District of Southern California (MWDSC) and others. MWDSC demands are either set at full contract amounts or are determined through a process of iteration between CalSim2 and MWDSC's integrated resource planning simulation (IRPSIM) model, and vary from year to year. Other SWP M&I contractors' demands are fixed at their full designated amount.

### Project/Non-Project Split

Demands are disaggregated in CalSim2 into project demands and non-project demands. Project demands are subject to reduced water allocations based on CVP and SWP contract provisions, while non-project demands are satisfied from sources other than project storage and project conveyance facilities and are reduced as a function of water availability in the absence of project operations. For each Depletion Study Area (DSA), project demands are calculated as a fixed percentage of the total land use-based demand. The split between project and non-project demands is determined by comparing project acreage within each DSA to the total crop acreage within the DSA.

### Total Demands/Contracts

Model diversions represent CVP project, SWP project, local project, or non-project operations which collectively meet the depletion area demands. Annual total CVP and SWP demands are summarized in Table 1 by category.

**Table 1 – CVP and SWP Demands at a 2020 Level of Development**

| | 2020 LOD | |
|---|---|---|
| | North of Delta | South of Delta |
| **CVP** | | |
| • Settlement/Exchange | 2194 | 840 |
| • Agriculture | 378 | 1937 |
| • M&I | 557 | 164 |
| • Refuges | 189 | 281 |
| **SWP** | | |
| • Feather River Service Area | 796 | 0 |
| • Agriculture | 0 | 1032 |
| • M&I | 114 | 3024 |

### CVP/SWP Project Allocation

CalSim2 assesses project water supplies based on storage conditions and forecasted inflow and determines project allocations based on rule curves that depict tradeoffs between current year delivery and carryover water supply. Estimates of export capacity through south delta pumps also affect allocation determination. SWP allocation is first determined in January, and updated every month based on evolving forecast data until May. CVP allocation is first determined in March and updated in April and May.

## Storage Operations

- Flood Control: Flood control rules are imposed on all system reservoirs, maintaining required flood space in anticipation of spring runoff.
- CVP reservoir balancing: CalSim2 seeks to maintain a balance amongst storage levels in Trinity, Shasta, and Folsom, based on rules that consider the time of year, water supply conditions, and refill potential of each facility.
- San Luis Rule Curve: Target storage levels are set through the filling period (~ Oct-Mar) to guide the projects' releases from north of delta reservoirs for storage in San Luis Reservoir. The same philosophy is also used to dole out the use of storage reserves to each project through the water operations year, considering both seasonal demands and projected export capacities.

## Delta Water Quality

The State Water Resources Control Board (SWRCB) specifies water quality standards for the Delta. Currently the CVP and SWP share the obligation to meet these standards as defined by the Coordinated Operation Agreement. Salinity standards must be translated into flow equivalents to be modeled in CalSim-II. However flow-salinity relationships in the Delta are non-linear. CalSim2 uses DWR's Artificial Neural Network (ANN) model to simulate the flow-salinity relationships for the Delta by estimating the salinity at water quality stations in the Delta. The ANN model correlates DWR's Delta Simulation Model (DSM2) model-generated salinity at key locations in the Delta with Delta inflows, Delta exports, and Delta Cross Channel operations by estimating electrical conductivity at the following four locations for the purpose of modeling Delta water quality standards: Old River at Rock Slough, San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville. In its estimates, the ANN model considers antecedent conditions up to 148 days, and considers a "carriage-water" type of effect associated with Delta exports. CalSim2 passes antecedent (previous month) flow conditions and known (or estimated) current month flows to an ANN dynamic link library (DLL). The DLL returns coefficients for a linear constraint that binds Sacramento River Delta inflows to Delta exports based on a piecewise linear approximation of the flow-salinity relationship

## Coordinated Operations Agreement (COA)

The COA is both an operations agreement and a water rights settlement defined by the SWRCB Decision 1485. Decision 1485 ordered the CVP and SWP to guarantee certain conditions for water quality protection for agricultural, M&I, and fish and wildlife use. The purpose of the COA is to ensure that the CVP and the SWP each obtains its share of water from the Delta and bears its share of obligations to protect the other beneficial uses of water in the Delta and Sacramento Valley. The COA balance equations and COA sharing formulas are coded in the model as goals, used as constraints in the LP problem formulation. CalSim2 uses mixed integer programming to determine in which of the two possible conditions the model is operating under for the given month – Balanced Water Conditions or Excess Water Conditions.

## Other Operations Criteria

Multiple state water resources control board plans and decisions, environmental regulations, water rights, and legislative mandates collectively guide and constrain the operations of both the CVP/SWP.

- Joint Point of Diversion – SWP wheeling of 128 taf/yr for CVP Cross-Valley Canal users through Banks Pumping Plant is represented in all simulations as the first priority after SWP discretionary operations are satisfied. Further wheeling by SWP of CVP water when unused Banks capacity exists is possible under (1) surplus conditions when SWP has filled San Luis and satisfied its Article 21 demand, and (2) balanced conditions when SWP no longer wishes to move Oroville water to San Luis.
- D-1641 – significant elements include the 1995 WQCP standards, net Delta outflow requirements, the Vernalis Adaptive Management Plan, X2 standard, export/inflow (E/I) ratio, pulse period export limits, Delta cross-channel gate closure requirements, and Rio Vista and Vernalis flow standards.
- CVPIA 3406(b)(2) – the 800,000 acre-feet of Central Valley Project yield dedicated through the Central Valley Project Improvement Act for fish, wildlife, and habitat restoration purposes is managed to augment river flows and curtail Delta exports. Flows reflecting the dynamic (b)(2) operation depicted in the 2008 OCAP studies are incorporated into current versions of CalSim2 as flow requirements. Export curtailments are not represented specifically, as it is commonly understood that these criteria are covered by the more recent constraints of the Biological Opinions.
- Reasonable and prudent actions (RPA's) in the 2008 Fish and Wildlife Service (FWS) and 2009 National Marine Fisheries Service (NMFS) Biological Opinions – certain RPA's are implemented in CalSim2, as developed through a coordinated process between Federal and State agencies.

A comprehensive list of all criteria for the CalSim2 study used to define CVP deliveries for Cost Allocation Study reservoir sizing analysis is provided at the end of this Tech Memo.

## Theoretical Basis

Flows, deliveries, and storage conditions in the reservoir river system are defined as decision variables and weighted to designate system priorities. Constraints on the values of these decision variables can be expressed as hard constraints that cannot be violated (such as canal capacity, maximum reservoir storage), or as soft constraints with penalties for deviating from user-specified target values. Soft constraints are converted to auxiliary slack and surplus variables with weights set by the associated penalties. Weighted decision variables and the slack and surplus variables all become elements of the objective function. The dynamic evaluation of constraint coefficients at run time allows both hard and soft constraints to be conditionally determined based on the state of the system – they can vary with water supply, water year type, timestep, or any other user-defined category.

Multiple simulations can be layered within a single timestep to accommodate constraints that tier off of interim conditions. Previously determined values for decision variables, from previous cycles or timesteps, can be accessed for use in constructing current cycle or timestep constraints.

The use of a mixed-integer programming solver enables the use of binary integers to construct "either-or" type constraints, which are useful for such applications as weir operations or dynamic switch settings.

## Numerical Basis

Solutions in CalSim2 are resolved by the XA solver, which is tasked with maximizing the value of the objective function constructed as the sum of each decision variable multiplied by its weight and each slack or surplus variable multiplied by its associated penalty. Solutions are also conditioned by the values of several integer variables depicting the status of weir flows and the COA balance. An Artificial Neural Network (ANN) depicts the relationships between flow and salinity at several locations in the interior Delta, based on and serving as a surrogate for the DSM2 model.

## Input and Output

Inputs include rim inflows, local accretions/depletions, delivery requirements, consumptive use requirements, irrigation efficiencies, return flow functions, stream/groundwater interaction parameters, contract amounts, reservoir bathymetry, flood control rules, physical capacities, and environmental and legal criteria which control operations. Outputs include average monthly river channel flows and deliveries, including Delta outflows and exports, end-of-month storage conditions, and information on governing regulations.

## Data Management

ASCII text ".wresl" files contain scripting language variable definitions and goals statements. ASCII text ".table" files contain relational (lookup) input data. HEC-DSS (USACE 1995) files hold input time series data and store time series results.

## Software

CalSim2 is developed in WRIMS (Water Resources Integrated Modeling System) – a generalized reservoir-river basin simulation modeling environment that allows for specification of user-defined system variables and associated constraints or goals. Solutions are determined by the XA Linear Programming/ Mixed Integer Linear Programming (LP/MILP) solver (Byer 2001) which is integrated with WRIMS as a dynamic linked library. WRIMS is produced and maintained by the California Department of Water Resources. The software platform is free, and links to the latest available versions can be acquired by contacting wrims2.group.developers@gmail.com. A hardware license (~ $1200) is required to use XA, and this solver is necessary to run CalSim2 models. Smaller models may be run using free public-domain LP solvers that are available with the WRIMS package. WRIMS runs under Microsoft Windows.

## References

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**CVP CAS CalSim2 Input and Assumptions Table**

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| Planning horizon[a] | 2030 | Same as Current Operations | Same as Current Operations |
| Period of simulation | 82 years (1922-2003) | Same as Current Operations | Same as Current Operations |
| **Hydrology** | | | |
| Inflows/Supplies | Historical with modifications for operations upstream of rim reservoirs | Same as Current Operations | Same as Current Operations |
| Level of development | Projected 2020/2030 level[b] | Same as Current Operations | Same as Current Operations |
| **Demands, Water Rights, CVP/SWP Contracts** | | | |
| **Sacramento River Region (excluding American River)** | | | |
| CVP[c] | Land-use based,<br>full build-out of contract amounts | Same as Current Operations | Same as Current Operations |
| SWP (FRSA)[d] | Land-use based,<br>limited by contract amounts | Same as Current Operations | Same as Current Operations |
| Non-CVP/SWP | Land use based, limited by water rights and SWRCB Decisions | Same as Current Operations | Same as Current Operations |
| Antioch Water Works | Pre-1914 water right | Same as Current Operations | Same as Current Operations |
| Federal refuges[e] | Firm Level 2 water needs | Same as Current Operations | Same as Current Operations |
| **Sacramento River Region - American River[f]** | | | |
| Water rights | Year 2025, full water rights | Same as Current Operations | Same as Current Operations |
| CVP | Year 2025, full contracts, including Freeport Regional Water Project | Same as Current Operations | Same as Current Operations |
| **San Joaquin River Region[g]** | | | |
| Friant Unit | Limited by contract amounts,<br>based on Friant-specific allocation policy | Same as Current Operations | Same as Current Operations |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| Lower Basin | Land-use based, based on district level operations and constraints | Same as Current Operations | Same as Current Operations |
| Stanislaus River | Land-use based for water rights, full contracts for CVP contractors[h] | Same as Current Operations | Same as Current Operations |
| **San Francisco Bay, Central Coast, Tulare Lake and South Coast Regions (CVP/SWP project facilities)** | | | |
| CVP[c] | Demand based on contract amounts | Same as Current Operations | Same as Current Operations |
| CCWD[i] | 195 TAF/yr CVP contract supply and water rights | Same as Current Operations | Same as Current Operations |
| SWP[e,j] | Demand based on Table A amounts | Same as Current Operations | Same as Current Operations |
| Article 56 | Based on 2001-08 contractor requests | Same as Current Operations | Same as Current Operations |
| Article 21 | MWD demand up to 200 TAF/month from December to March subject to conveyance capacity, KCWA demand up to 180 TAF/month and other contractor demands up to 34 TAF/month in all months, subject to conveyance capacity | Same as Current Operations | Same as Current Operations |
| North Bay Aqueduct (NBA) | 77 TAF/yr demand under SWP contracts, up to 43.7 cfs of excess flow under Fairfield, Vacaville and Benicia Settlement Agreement | Same as Current Operations | Same as Current Operations |
| Federal refuges[e] | Firm Level 2 water needs | Same as Current Operations | Same as Current Operations |
| **Facilities** | | | |
| **North Coast Region** | | | |
| Trinity Lake | 2,447 TAF capacity | Same as Current Operations | Same as Current Operations |
| **Sacramento River Region** | | | |
| Shasta Lake | 4,552 TAF capacity | Same as Current Operations | Same as Current Operations |
| Red Bluff Diversion Dam | Diversion dam operated with gates out all year, NMFS BiOp (Jun 2009) Action I.3.1[k]; assume permanent facilities in place | Diversion dam operated with gates out all year, per 2013 condition | Diversion dam operated with gates out all year, per 2013 condition |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| Upper American River[f] | PCWA American River Pump Station[l] | Same as Current Operations | Same as Current Operations |
| Lower Sacramento River | Freeport Regional Water Project | Same as Current Operations | Same as Current Operations |
| **San Joaquin River Region** | | | |
| Millerton Lake (Friant Dam) | 524 TAF capacity | Same as Current Operations | Same as Current Operations |
| New Melones Reservoir | 2,420 TAF capacity | Same as Current Operations | Same as Current Operations |
| Lower San Joaquin River | City of Stockton Delta Water Supply Project, 30-mgd capacity | Same as Current Operations | Same as Current Operations |
| **Delta Region** | | | |
| SWP Banks Pumping Plant (South Delta) | Physical capacity is 10,300 cfs but 6,680 cfs permitted capacity in all months up to 8,500 cfs during Dec 15 – Mar 15 depending on Vernalis flow conditions[m]; additional capacity of 500 cfs (up to 7,180 cfs) allowed for Jul – Sep for reducing impact of NMFS BiOp (Jun 2009) Action IV.2.1 Phase II[k] on SWP[n] | Physical capacity is 10,300 cfs but permitted capacity 6,680 cfs in all months plus an additional 1/3 of Vernalis flow (up to 8,500 cfs) from Dec 15 through Mar 15 per SWRCB D-1641[m] | Physical capacity is 10,300 cfs but permitted capacity 6,680 cfs in all months; limited to 3,000 cfs in May-June and 4,000 cfs in July per SWRCB D-1485. |
| CVP C.W. Bill Jones Pumping Plant (Tracy PP) | Permit capacity is 4,600 cfs in all months (allowed for by the Delta-Mendota Canal–California Aqueduct Intertie) | Same as Current Operations | Same as Current Operations |
| Upper Delta-Mendota Canal Capacity | Full capacity 4,600 cfs including 400 cfs Delta-Mendota Canal–California Aqueduct Intertie | Same as Current Operations | Same as Current Operations |
| CCWD Intakes | Los Vaqueros storage capacity, 160 TAF; Rock Slough, Old River and Middle River intakes (Alternative Intake Project or AIP) | Same as Current Operations | Same as Current Operations |
| Head of Old River Gate | Temporary Head of Old River Barrier installed in the fall months | Same as Current Operations | Same as Current Operations |
| Fremont Weir | Spills above 54,274 cfs Sacramento River flow at Verona; Assumes an operable notch[o] in the Fremont Weir, which allows spills above 15,530 cfs Sacramento River flow at Verona of up to 6,000 cfs during Dec 1 – Apr 30. 100 cfs spills during Sep 1 – Jun 30 to support fish passage. | No Weir Notch | No Weir Notch |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| **San Francisco Bay Region** | | | |
| South Bay Aqueduct (SBA) | SBA rehabilitation, 430 cfs capacity from junction with California Aqueduct to Alameda County FC&WSD Zone 7 diversion point | Same as Current Operations | Same as Current Operations |
| **Regulatory Standards** | | | |
| **North Coast Region** | | | |
| Trinity River | | | |
| Minimum flow below Lewiston Dam | Dec 2000 Trinity River Record of Decision (369-815 TAF/yr); August-September release of 50 TAF for Lower Klamath River Flows assumed in every year | Pre-ROD condition; Annual release volume of 340 TAF/yr. | Pre-ROD condition; Annual release volume of 340 TAF/yr. |
| Trinity Reservoir end-of-September minimum storage | Trinity EIS Preferred Alternative (600 TAF as able) | Same as Current Operations[t] | Same as Current Operations[t] |
| **Sacramento River Region** | | | |
| Clear Creek | | | |
| Minimum flow below Whiskeytown Dam | Downstream water rights, 1963 Reclamation Proposal to USFWS and NPS, predetermined CVPIA 3406(b)(2) flows[p], and NMFS BiOp (Jun 2009) Action I.1.1[k] | Downstream water rights, 1963 Reclamation Proposal to USFWS and NPS | Downstream water rights, 1963 Reclamation Proposal to USFWS and NPS |
| Upper Sacramento River | | | |
| Shasta Lake end-of-September minimum storage | NMFS 2004 Winter-run Biological Opinion, (1900 TAF in non-critically dry years), and NMFS BiOp (Jun 2009) Action I.2.1[k] | None | None |
| Minimum flow below Keswick Dam | SWRCB WR 90-5, predetermined CVPIA 3406(b)(2) flows[p], and NMFS BiOp (Jun 2009) Action I.2.2[k] | 3250 cfs | SWRCB WR 90-5 |
| Feather River | | | |
| Minimum flow below Thermalito Diversion Dam | 2006 Settlement Agreement (700 / 800 cfs) | 1983 DWR, DFG Agreement (600 cfs) | 1983 DWR, DFG Agreement (600 cfs) |
| Minimum flow below Thermalito Afterbay outlet | 1983 DWR, DFG Agreement (750-1,700 cfs) | Same as Current Operations | Same as Current Operations |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| Yuba River | | | |
| Minimum flow below Daguerre Point Dam | D-1644 Operations (Lower Yuba River Accord)[n] | Same as Current Operations[t] | Same as Current Operations[t] |
| American River | | | |
| Minimum flow below Nimbus Dam | American River Flow Management Standard as required by NMFS BiOp (Jun 2009) Action II.1[k] | SWRCB D-893 | SWRCB D-893 |
| Minimum Flow at H Street Bridge | SWRCB D-893 | Same as Current Operations | Same as Current Operations |
| Lower Sacramento River | | | |
| Minimum flow near Rio Vista | SWRCB D-1641 | SWRCB D-1641 | SWRCB D-1485 |
| **San Joaquin River Region** | | | |
| Mokelumne River | | | |
| Minimum flow below Camanche Dam | FERC 2916-029, 1996 (Joint Settlement Agreement) (100-325 cfs) | Same as Current Operations | Same as Current Operations |
| Minimum flow below Woodbridge Diversion Dam | FERC 2916-029, 1996 (Joint Settlement Agreement) (25-300 cfs) | Same as Current Operations | Same as Current Operations |
| Stanislaus River | | | |
| Minimum flow below Goodwin Dam | Flows required for NMFS BiOp (Jun 2009) Action III.1.3[k] | 1987 USBR, DFG Agreement | 1987 USBR, DFG Agreement |
| Minimum dissolved oxygen | SWRCB D-1422 | Same as Current Operations | Same as Current Operations |
| Merced River | | | |
| Minimum flow below Crocker-Huffman Diversion Dam | Davis-Grunsky (180-220 cfs, Nov-Mar), and Cowell Agreement | Same as Current Operations | Same as Current Operations |
| Minimum flow at Shaffer Bridge | FERC 2179 (25-100 cfs) | Same as Current Operations | Same as Current Operations |
| Tuolumne River | | | |
| Minimum flow at Lagrange Bridge | FERC 2299-024, 1995 (Settlement Agreement) (94-301 TAF/yr) | Same as Current Operations | Same as Current Operations |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| San Joaquin River | | | |
| San Joaquin River below Friant Dam/ Mendota Pool | San Joaquin River Restoration Program releases from Friant are represented, as they affect delivery capability. Noted that the program recapture/recirculation component is yet to be defined, so releases proceed down the San Joaquin River. | Release of 117 TAF/yr for losses and water rights | Release of 117 TAF/yr for losses and water rights |
| Maximum salinity near Vernalis | SWRCB D-1641 | Same as Current Operations | SWRCB D-1422 |
| Minimum flow near Vernalis | SWRCB D-1641[q] | SWRCB D-1641 | None |
| **Sacramento River – San Joaquin Delta Region** | | | |
| Delta Outflow Index (Flow and Salinity) | SWRCB D-1641 and USFWS BiOp (Dec 2008) Action 4 (Fall X2 Requirement) | SWRCB D-1641 | SWRCB D-1485 |
| Delta Cross Channel gate operation | SWRCB D-1641 with additional days closed from Oct 1 – Jan 31 based on NMFS BiOp (Jun 2009) Action IV.1.2[k] (closed during flushing flows from Oct 1 – Dec 14 unless adverse water quality conditions) | SWRCB D-1641 | SWRCB D-1485 |
| South Delta exports (Jones PP and Banks PP) | SWRCB D-1641. Vernalis flow-based export limits Apr 1 – May 31 as required by NMFS BiOp (Jun, 2009) Action IV.2.1[k] (additional 500 cfs allowed for Jul – Sep for reducing impact on SWP)[n] | SWRCB D-1641 | SWRCB D-1485 |
| Combined Flow in Old and Middle River (OMR) | FWS BiOp (Dec 2008) Actions 1 through 3 and NMFS BiOp (Jun 2009) Action IV.2.3[k] | None | None |
| **Operations Criteria: River-Specific** | | | |
| **Sacramento River Region** | | | |
| Upper Sacramento River | | | |
| Flow objective for navigation (Wilkins Slough) | NMFS BiOp (Jun 2009) Action I.4[k]; 3,500 – 5,000 cfs based on CVP water supply condition | 3,500 – 5,000 cfs based on CVP water supply condition | 3,500 – 5,000 cfs based on CVP water supply condition |
| American River | | | |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| Folsom Dam flood control | Variable 400/600 flood control diagram (without outlet modifications) as a surrogate for upcoming water control manual update | Same as Current Operations | Same as Current Operations |
| Feather River | | | |
| Flow at Mouth of Feather River (above Verona) | Maintain CDFW/DWR flow target of 2,800 cfs for Apr – Sep dependent on Oroville inflow and FRSA allocation | Same as Current Operations | Same as Current Operations |
| **Operations Criteria: Systemwide** | | | |
| **CVP water allocation** | | | |
| Settlement / Exchange | 100% (75% in Shasta critical years); Exchange Contractors CVP allocation reduced in a post-processed analysis to maintain Shasta storage above 1.1 MAF, with water supply replaced up to CVP allocation by Friant resources, as available. | Fixed Allocations to Current Operations for unique purposes of this study | Fixed Allocations to Current Operations for unique purposes of this study |
| Refuges | 100% (75% in Shasta critical years) | Fixed Allocations to Current Operations for unique purposes of this study | Fixed Allocations to Current Operations for unique purposes of this study |
| Agriculture Service | 100%-0% based on supply; South-of-Delta allocations are additionally limited due to D-1641,USFWS BiOp (Dec 2008) and NMFS BiOp (Jun 2009) export restrictions[k] | Fixed Allocations to Current Operations for unique purposes of this study | Fixed Allocations to Current Operations for unique purposes of this study |
| Municipal & Industrial Service | 100%-50% based on supply; South-of-Delta allocations are additionally limited due to D-1641,USFWS BiOp (Dec 2008) and NMFS BiOp (Jun 2009) export restrictions[k] | Fixed Allocations to Current Operations for unique purposes of this study | Fixed Allocations to Current Operations for unique purposes of this study |
| **SWP water allocation** | | | |
| North of Delta (FRSA) | Contract specific | Fixed Allocations to Current Operations for unique purposes of this study | Fixed Allocations to Current Operations for unique purposes of this study |
| South of Delta (including North Bay Aqueduct) | Based on supply; equal prioritization between Ag and M&I based on Monterey Agreement; allocations are additionally limited due to D-1641 and USFWS BiOp (Dec 2008) and NMFS BiOp (Jun 2009) export restrictions[k] | Fixed Allocations to Current Operations for unique purposes of this study | Fixed Allocations to Current Operations for unique purposes of this study |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| **CVP/SWP coordinated operations** | | | |
| Sharing of responsibility for in-basin-use | 1986 Coordinated Operations Agreement (FRWP EBMUD and 2/3 of the North Bay Aqueduct diversions considered as Delta Export; 1/3 of the North Bay Aqueduct diversion as in-basin-use) | Same as Current Operations | Same as Current Operations |
| Sharing of surplus flows | 1986 Coordinated Operations Agreement | Same as Current Operations | Same as Current Operations |
| Sharing of total allowable export capacity for project-specific priority pumping | Equal sharing of export capacity under SWRCB D-1641,USFWS BiOp (Dec 2008) and NMFS BiOp (Jun 2009) export restrictions[k] | Equal sharing of export capacity under SWRCB D-1641 export limits | None Assumed |
| Water transfers | Acquisitions by SWP contractors are wheeled at priority in Banks Pumping Plant over non-SWP users; LYRA included for SWP contractors[n] | None Assumed | None Assumed |
| Sharing of total allowable export capacity for lesser priority and wheeling-related pumping | Cross Valley Canal wheeling (max of 128 TAF/yr), CALFED ROD defined Joint Point of Diversion (JPOD) | Same as Current Operations | Banks “payback” wheeling for CVP capacity reduced by D-1485 striped bass export limits |
| San Luis Reservoir | San Luis Reservoir is allowed to operate to a minimum storage of 100 TAF | Same as Current Operations | Same as Current Operations |
| **CVPIA 3406(b)(2)[p]** | | | |
| Policy Decision | Per May 2003 Dept. of Interior Decision: | No representation | No representation |
| Allocation | 800 TAF, 700 TAF in 40-30-30 dry years, and 600 TAF in 40-30-30 critical years as a function of Ag allocation | No representation | No representation |
| Actions | Pre-determined upstream fish flow objectives below Whiskeytown and Keswick Dams, non-discretionary NMFS BiOp (Jun 2009) actions for the American and Stanislaus Rivers, and NMFS BiOp (Jun 2009) and USFWS BiOp (Dec 2008) actions leading to export restrictions[k] | No representation | No representation |
| Accounting | Releases for non-discretionary USFWS BiOp (Dec 2008) and NMFS BiOp (Jun 2009)[k] actions may or may not always be | No representation | No representation |

| | Current Operations | H-1641 | H-1485 |
|---|---|---|---|
| | deemed (b)(2) actions; in general, it is anticipated, that accounting of these actions using (b)(2) metrics, the sum would exceed the (b)(2) allocation in many years; therefore no additional actions are considered and no accounting logic is included in the model [p] | | |
| **Water Management Actions** | | | |
| **Water Transfer Supplies (long term programs)** | | | |
| Lower Yuba River Accord[r] | Yuba River acquisitions for reducing impact of NMFS BiOp export restrictions[k] on SWP | No representation | No representation |
| Phase 8 | None | None | None |

[a] These assumptions were developed by the Department of the Interior, Bureau of Reclamation for the November 2015 Coordinated Long-Term Operation of the Central Valley Project and State Water Project Final Environmental Impact Statement. Restoration of at least 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh required by the 2008 USFWS BiOp and restoration of at least 17,000 to 20,000 acres of floodplain rearing habitat for juvenile winter-run and spring-run Chinook salmon and Central Valley steelhead in the Yolo Bypass and/or suitable areas of the lower Sacramento River required by the NMFS 2009 BiOp are not included in the assumptions because environmental documents of projects regarding these actions were not completed. Fremont Weir notch was assumed as a placeholder for Action I.6.1.

[b] The San Joaquin Valley hydrology reflects draft 2030 land-use assumptions developed by Reclamation. The Sacramento Valley hydrology reflects 2020 land-use assumptions associated with Bulletin 160-98.

[c] CVP contract amounts have been updated according to amended contracts as appropriate. Assumptions regarding CVP agricultural and M&I service contracts, exchange contract amounts, Refuge Level 2 contract amounts and Settlement Contract amounts are documented in the Delivery Specifications section, Appendix 5A of the November 2015 Coordinated Long-Term Operation of the Central Valley Project and State Water Project Final EIS (LTO-App5A).

[d] SWP contract amounts have been updated as appropriate based on recent Table A transfers/agreements. Assumptions regarding SWP agricultural and M&I contract amounts are documented in the Delivery Specifications attachments of the LTO-App5A.

[e] Water needs for federal refuges have been reviewed and updated as appropriate. Assumptions regarding firm Level 2 refuge water needs are documented in the Delivery Specifications attachments of the LTO-App5A. Refuge Level 4 (and incremental Level 4) water is not analyzed.

[f] Assumptions regarding American River water rights and CVP contracts are documented in the Delivery Specifications attachments of the LTO-App5A. The Sacramento Area Water Forum agreement, and any diversion reductions, are not included except for federal actions.

[g] The CalSim II representation of the San Joaquin River model reflects the difficulties of on-going groundwater overdraft problems. The 2030 level of development representation of the San Joaquin River Basin does not make any attempt to offer solutions to groundwater overdraft problems. In addition a dynamic groundwater simulation is not yet developed for the San Joaquin River Valley. Groundwater extraction/ recharge and stream-groundwater interaction are static assumptions and may not accurately reflect a response to simulated actions. These limitations should be considered in the analysis of results.

[h] The model operates the Stanislaus River by allocating water for SEWD & CSJWCD, Vernalis water quality dilution and Vernalis D1641 base flow requirements based on the New Melones Index. OID & SSJID deliveries are based on their 1988 agreement and Ripon DO requirements are represented by a static set of minimum instream flow requirements during Jun thru Sep. Instream flow requirements for fish below Goodwin are based on NMFS BiOp Action III.1.3.

[i] The actual amount diverted is operated in conjunction with supplies from the Los Vaqueros project. The Los Vaqueros storage capacity is 160 TAF and associated water rights for Delta excess flows are included.

[j] It is assumed that SWP Contractors exercise full demand for Table A allocations of 4.1 MAF/year and that SWP Contractors can take delivery of all Table A allocations and Article 21 supplies. Article 56 provisions are assumed and allow for SWP Contractors to manage storage and delivery conditions such that full Table A allocations can be delivered. Article 21 deliveries are limited in wet years under the assumption that demand is decreased in these conditions. Article 21 deliveries for the NBA are dependent on excess conditions only, all other Article 21 deliveries also require that San Luis Reservoir be at capacity and that Banks PP and the California Aqueduct have available capacity to divert from the Delta for direct delivery.

[k] Assumptions developed in cooperation among Reclamation, National Marine Fisheries Service, Fish and Wildlife Service, and CA Department of Fish and Wildlife for implementation of the USFWS BiOp (Dec 15th 2008) and NMFS BiOp (June 4th 2009).

[l] The American River pumping facility upstream of Folsom Lake is included. The diversion is assumed to be 35.5 TAF/yr.

[m] USACE permit for Clifton Court Forebay Intakes (assumed for Banks PP in CalSim II) allows for an average diversion rate of 6,680 cfs in all months. Diversion rate can increase up to 1/3 of the rate of San Joaquin River flow at Vernalis during Dec 15th – Mar 15th up to a maximum diversion of 8,500 cfs, if Vernalis flow exceeds 1,000 cfs.

[n] Acquisitions of Component 1 water under the Lower Yuba River Accord, and use of 500 cfs dedicated capacity at Banks PP during Jul – Sep, are assumed to be used to reduce as much of the impact of the Apr – May Delta export actions on SWP contractors as possible.

[o] Fremont Weir notch assumed to represent the NMFS BO (Jun, 2009) Action I.6.1: Restoration of Floodplain Rearing Habitat action, and is only for use in the modeling as a placeholder, while the proposed changes associated with this RPA are still in development under a separate multi-agency process.

[p] CVPIA (b)(2) fish actions are not dynamically determined in the CalSim2 model, nor is (b)(2) accounting done in the model. Since the USFWS BiOp and NMFS BiOp were issued, the Department of the Interior (Interior) has exercised its discretion to use (b)(2) in the delta by accounting some or all of the export reductions required under those biological opinions as (b)(2) actions. It is therefore assumed for modeling purposes that (b)(2) availability for other delta actions will be limited to covering the CVP's VAMP export reductions. Similarly, since the USFWS BiOp and NMFS BiOp were issued, Interior has exercised its discretion to use (b)(2) upstream by accounting some or all of the release augmentations (relative to the hypothetical (b)(2) base case) below Whiskeytown, Nimbus and Goodwin as (b)(2) actions. It is therefore assumed for modeling purposes that (b)(2) availability for other upstream actions will be limited to covering Sacramento releases, in the fall and winter. For modeling purposes, pre-determined timeseries of minimum instream flow requirements are specified below Whiskeytown and Keswick. The timeseries are based on the Aug 2008 BA Study 7.0 and Study 8.0 simulations which did include dynamically determined (b)(2) actions.

[q] Vernalis base flows as required by D1641 Table 3 are included in the model. Vernalis pulse flow requirements are not included. However, pulse flows required by NMFS BO (Jun, 2009) Action III.1.3 are included in the model.

[r] The Yuba River is not dynamically modeled in CalSim2. Yuba River hydrology and availability of water acquisitions under the Lower Yuba River Accord and D-1644 are based on modeling performed and provided by the Lower Yuba River Accord EIS/EIR study team.

[s] Only acquisitions of Lower Yuba River Accord Component 1 water are included.

[t] Where the purpose of identifying operational differences incurred by the Water Quality Control Plan were not influenced by CalSim2 assumptions, specific inputs for D-1641 or D-1485 era conditions were not developed.

| Table 1. Trinity | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAF | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1922 | 1781 | 1754 | 1755 | 1751 | 1766 | 1815 | 1918 | 1997 | 2043 | 1931 | 1782 | 1609 |
| 1923 | 1554 | 1526 | 1529 | 1546 | 1569 | 1621 | 1740 | 1698 | 1630 | 1491 | 1299 | 1161 |
| 1924 | 1144 | 1136 | 1127 | 1016 | 1076 | 1068 | 1012 | 931 | 878 | 800 | 698 | 630 |
| 1925 | 623 | 699 | 746 | 649 | 920 | 1058 | 1358 | 1343 | 1262 | 1113 | 1034 | 974 |
| 1926 | 956 | 954 | 975 | 979 | 1126 | 1229 | 1450 | 1344 | 1274 | 1139 | 1045 | 963 |
| 1927 | 927 | 1085 | 1284 | 1393 | 1631 | 1809 | 2036 | 2025 | 2051 | 1929 | 1789 | 1622 |
| 1928 | 1531 | 1560 | 1568 | 1617 | 1726 | 1933 | 2089 | 2027 | 1935 | 1830 | 1652 | 1481 |
| 1929 | 1419 | 1347 | 1339 | 1147 | 1174 | 1225 | 1241 | 1284 | 1215 | 1041 | 940 | 858 |
| 1930 | 833 | 819 | 950 | 969 | 1071 | 1200 | 1316 | 1219 | 1177 | 1116 | 960 | 873 |
| 1931 | 848 | 837 | 827 | 839 | 861 | 922 | 945 | 905 | 886 | 815 | 624 | 557 |
| 1932 | 508 | 468 | 471 | 418 | 440 | 593 | 682 | 706 | 708 | 632 | 535 | 470 |
| 1933 | 451 | 449 | 446 | 444 | 446 | 563 | 712 | 700 | 818 | 773 | 677 | 614 |
| 1934 | 596 | 587 | 597 | 658 | 748 | 893 | 977 | 948 | 917 | 845 | 600 | 534 |
| 1935 | 451 | 516 | 553 | 529 | 613 | 674 | 888 | 922 | 933 | 871 | 773 | 694 |
| 1936 | 680 | 674 | 677 | 790 | 928 | 1044 | 1217 | 1147 | 1108 | 1033 | 944 | 866 |
| 1937 | 840 | 826 | 814 | 802 | 804 | 905 | 1128 | 1273 | 1340 | 1236 | 1079 | 1008 |
| 1938 | 991 | 1139 | 1358 | 1450 | 1607 | 1868 | 2175 | 2349 | 2294 | 2265 | 2123 | 1905 |
| 1939 | 1811 | 1796 | 1813 | 1824 | 1838 | 1946 | 2021 | 1911 | 1714 | 1483 | 1239 | 1081 |
| 1940 | 1002 | 930 | 996 | 1174 | 1500 | 1802 | 2029 | 1966 | 1850 | 1670 | 1495 | 1360 |
| 1941 | 1304 | 1284 | 1408 | 1629 | 1880 | 2100 | 2300 | 2420 | 2447 | 2270 | 2150 | 1975 |
| 1942 | 1850 | 1837 | 1850 | 1900 | 2000 | 2079 | 2266 | 2325 | 2397 | 2270 | 2150 | 1975 |
| 1943 | 1850 | 1845 | 1850 | 1900 | 2000 | 2100 | 2283 | 2173 | 2100 | 1956 | 1811 | 1640 |
| 1944 | 1552 | 1522 | 1510 | 1464 | 1498 | 1557 | 1596 | 1652 | 1564 | 1349 | 1160 | 1080 |
| 1945 | 1055 | 1085 | 1162 | 1220 | 1383 | 1431 | 1569 | 1534 | 1442 | 1299 | 1141 | 1069 |
| 1946 | 1064 | 1119 | 1311 | 1441 | 1496 | 1618 | 1837 | 1832 | 1738 | 1607 | 1436 | 1298 |
| 1947 | 1238 | 1231 | 1243 | 1235 | 1301 | 1420 | 1508 | 1416 | 1402 | 1277 | 1088 | 1009 |
| 1948 | 1029 | 1043 | 1043 | 1238 | 1263 | 1288 | 1473 | 1467 | 1547 | 1512 | 1375 | 1329 |
| 1949 | 1275 | 1282 | 1284 | 1277 | 1309 | 1526 | 1786 | 1787 | 1737 | 1592 | 1419 | 1280 |
| 1950 | 1218 | 1185 | 1172 | 1203 | 1262 | 1383 | 1537 | 1541 | 1523 | 1401 | 1241 | 1103 |
| 1951 | 1204 | 1320 | 1577 | 1667 | 1885 | 1986 | 2172 | 2104 | 2020 | 1890 | 1715 | 1545 |
| 1952 | 1492 | 1497 | 1644 | 1704 | 1894 | 2060 | 2300 | 2411 | 2447 | 2270 | 2150 | 1975 |
| 1953 | 1850 | 1845 | 1850 | 1900 | 2000 | 2100 | 2262 | 2222 | 2315 | 2270 | 2150 | 1960 |
| 1954 | 1850 | 1850 | 1850 | 1900 | 2000 | 2100 | 2300 | 2272 | 2204 | 2067 | 1931 | 1769 |
| 1955 | 1712 | 1733 | 1774 | 1792 | 1821 | 1851 | 1897 | 1896 | 1881 | 1661 | 1485 | 1346 |
| 1956 | 1283 | 1267 | 1575 | 1900 | 2000 | 2100 | 2283 | 2386 | 2304 | 2187 | 2077 | 1924 |
| 1957 | 1850 | 1826 | 1818 | 1808 | 1956 | 2100 | 2218 | 2234 | 2211 | 2067 | 1923 | 1759 |
| 1958 | 1847 | 1850 | 1850 | 1900 | 2208 | 2100 | 2300 | 2420 | 2430 | 2270 | 2150 | 1975 |
| 1959 | 1850 | 1850 | 1835 | 1900 | 2000 | 2100 | 2272 | 2171 | 2053 | 1825 | 1613 | 1418 |
| 1960 | 1357 | 1318 | 1296 | 1295 | 1428 | 1616 | 1738 | 1683 | 1690 | 1517 | 1359 | 1220 |
| 1961 | 1159 | 1170 | 1232 | 1276 | 1468 | 1565 | 1756 | 1784 | 1819 | 1673 | 1500 | 1363 |
| 1962 | 1303 | 1278 | 1285 | 1302 | 1400 | 1459 | 1785 | 1751 | 1685 | 1537 | 1384 | 1247 |
| 1963 | 1349 | 1397 | 1563 | 1604 | 1884 | 1959 | 2216 | 2240 | 2181 | 2036 | 1890 | 1721 |
| 1964 | 1627 | 1697 | 1732 | 1800 | 1805 | 1835 | 1858 | 1750 | 1691 | 1558 | 1358 | 1226 |
| 1965 | 1172 | 1205 | 1724 | 1900 | 1988 | 2054 | 2278 | 2185 | 2114 | 1977 | 1846 | 1713 |
| 1966 | 1653 | 1707 | 1729 | 1800 | 1860 | 2058 | 2300 | 2301 | 2226 | 2090 | 1859 | 1697 |
| 1967 | 1608 | 1685 | 1819 | 1900 | 2000 | 2100 | 2205 | 2310 | 2401 | 2270 | 2150 | 1975 |
| 1968 | 1850 | 1850 | 1850 | 1900 | 2000 | 2100 | 2191 | 2077 | 1971 | 1791 | 1618 | 1452 |
| 1969 | 1396 | 1389 | 1445 | 1582 | 1699 | 1854 | 2176 | 2414 | 2334 | 2210 | 2066 | 1927 |
| 1970 | 1850 | 1850 | 1850 | 1900 | 2000 | 2100 | 2161 | 2061 | 1917 | 1742 | 1566 | 1398 |
| 1971 | 1321 | 1415 | 1540 | 1763 | 1893 | 2081 | 2238 | 2272 | 2281 | 2257 | 2116 | 1975 |
| 1972 | 1850 | 1850 | 1850 | 1900 | 2000 | 2100 | 2234 | 2163 | 2113 | 1964 | 1790 | 1622 |
| 1973 | 1568 | 1604 | 1708 | 1861 | 2000 | 2100 | 2269 | 2318 | 2265 | 2125 | 1902 | 1734 |
| 1974 | 1705 | 1850 | 1850 | 1900 | 2000 | 2100 | 2300 | 2384 | 2367 | 2270 | 2150 | 1975 |
| 1975 | 1850 | 1843 | 1847 | 1859 | 1948 | 2100 | 2225 | 2321 | 2431 | 2270 | 2150 | 1969 |
| 1976 | 1850 | 1841 | 1850 | 1663 | 1694 | 1742 | 1819 | 1793 | 1714 | 1495 | 1314 | 1178 |
| 1977 | 1154 | 1132 | 1044 | 1000 | 991 | 977 | 947 | 894 | 861 | 790 | 545 | 491 |
| 1978 | 372 | 400 | 590 | 976 | 1154 | 1427 | 1618 | 1622 | 1567 | 1480 | 1345 | 1235 |
| 1979 | 1174 | 1168 | 1160 | 1185 | 1236 | 1382 | 1493 | 1560 | 1526 | 1402 | 1243 | 1105 |
| 1980 | 1109 | 1171 | 1238 | 1457 | 1745 | 1877 | 2037 | 1942 | 1844 | 1721 | 1546 | 1408 |

Table 1. Trinity

TAF

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 1346 | 1321 | 1350 | 1447 | 1585 | 1703 | 1811 | 1744 | 1688 | 1541 | 1346 | 1208 |
| 1982 | 1146 | 1389 | 1713 | 1801 | 2000 | 2100 | 2300 | 2318 | 2187 | 2071 | 2012 | 1962 |
| 1983 | 1850 | 1850 | 1850 | 1900 | 2000 | 2100 | 2300 | 2420 | 2447 | 2270 | 2150 | 1975 |
| 1984 | 1850 | 1850 | 1850 | 1900 | 1991 | 2100 | 2218 | 2183 | 2124 | 1989 | 1797 | 1658 |
| 1985 | 1569 | 1698 | 1755 | 1732 | 1770 | 1819 | 1965 | 1888 | 1813 | 1587 | 1348 | 1210 |
| 1986 | 1148 | 1141 | 1157 | 1286 | 1760 | 2092 | 2101 | 1998 | 1887 | 1711 | 1536 | 1400 |
| 1987 | 1346 | 1313 | 1303 | 1312 | 1388 | 1590 | 1737 | 1691 | 1546 | 1320 | 1109 | 1001 |
| 1988 | 953 | 937 | 1090 | 1171 | 1256 | 1336 | 1367 | 1311 | 1299 | 1138 | 1041 | 963 |
| 1989 | 940 | 963 | 981 | 919 | 947 | 1291 | 1495 | 1386 | 1271 | 1108 | 1010 | 933 |
| 1990 | 955 | 958 | 953 | 1019 | 1044 | 1132 | 1172 | 1141 | 1159 | 1105 | 1007 | 930 |
| 1991 | 907 | 894 | 879 | 863 | 868 | 944 | 993 | 1017 | 1017 | 954 | 858 | 781 |
| 1992 | 758 | 746 | 741 | 746 | 884 | 1000 | 1233 | 1227 | 1192 | 1127 | 891 | 780 |
| 1993 | 757 | 744 | 766 | 825 | 964 | 1339 | 1520 | 1689 | 1804 | 1787 | 1656 | 1520 |
| 1994 | 1460 | 1450 | 1459 | 1385 | 1419 | 1487 | 1532 | 1507 | 1395 | 1216 | 1011 | 934 |
| 1995 | 911 | 899 | 885 | 1285 | 1539 | 1972 | 2211 | 2286 | 2271 | 2270 | 2150 | 1975 |
| 1996 | 1850 | 1840 | 1850 | 1900 | 2000 | 2100 | 2259 | 2215 | 2151 | 2014 | 1866 | 1727 |
| 1997 | 1664 | 1670 | 1850 | 1900 | 1985 | 2076 | 2117 | 1930 | 1732 | 1551 | 1344 | 1206 |
| 1998 | 1129 | 1145 | 1187 | 1497 | 1820 | 2100 | 2276 | 2410 | 2447 | 2270 | 2150 | 1975 |
| 1999 | 1850 | 1850 | 1850 | 1900 | 2000 | 2100 | 2294 | 2334 | 2355 | 2221 | 2087 | 1950 |
| 2000 | 1850 | 1850 | 1850 | 1900 | 2000 | 2100 | 2300 | 2292 | 2306 | 2176 | 2029 | 1819 |
| 2001 | 1759 | 1727 | 1716 | 1716 | 1747 | 1917 | 2016 | 1978 | 1805 | 1593 | 1371 | 1237 |
| 2002 | 1168 | 1216 | 1289 | 1519 | 1629 | 1731 | 1938 | 1848 | 1749 | 1600 | 1424 | 1286 |
| 2003 | 1223 | 1186 | 1369 | 1682 | 1793 | 1948 | 2148 | 2214 | 2289 | 2173 | 1965 | 1800 |

| Table 2. Shasta | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAF | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1922 | 2759 | 2628 | 2769 | 2911 | 3287 | 3731 | 4332 | 4552 | 4182 | 3700 | 3302 | 3069 |
| 1923 | 2965 | 2764 | 2899 | 3106 | 3249 | 3385 | 3846 | 3623 | 3286 | 2878 | 2584 | 2567 |
| 1924 | 2476 | 2395 | 2375 | 2524 | 2732 | 2752 | 2537 | 2246 | 1886 | 1564 | 1255 | 1100 |
| 1925 | 1080 | 1242 | 1351 | 1684 | 2866 | 3236 | 3916 | 4051 | 3793 | 3340 | 2929 | 2811 |
| 1926 | 2696 | 2672 | 2703 | 2744 | 3489 | 3647 | 3926 | 3780 | 3344 | 2790 | 2284 | 2162 |
| 1927 | 2112 | 2565 | 3003 | 3452 | 3571 | 4214 | 4552 | 4552 | 4224 | 3734 | 3340 | 2669 |
| 1928 | 2581 | 2675 | 2785 | 3012 | 3506 | 3965 | 4541 | 4494 | 3965 | 3276 | 2869 | 2491 |
| 1929 | 2319 | 2247 | 2318 | 2583 | 2768 | 2939 | 2983 | 2859 | 2583 | 2102 | 1765 | 1674 |
| 1930 | 1551 | 1474 | 2014 | 2213 | 2611 | 3105 | 3246 | 3222 | 2862 | 2428 | 2170 | 2121 |
| 1931 | 2007 | 1984 | 1973 | 2053 | 2138 | 2348 | 2109 | 1914 | 1651 | 1256 | 1075 | 1100 |
| 1932 | 1064 | 1070 | 1248 | 1476 | 1592 | 2049 | 2176 | 2382 | 2218 | 2003 | 1759 | 1663 |
| 1933 | 1561 | 1539 | 1533 | 1542 | 1578 | 2175 | 2344 | 2441 | 2256 | 1959 | 1427 | 1264 |
| 1934 | 1168 | 1134 | 1257 | 1542 | 1857 | 2130 | 2141 | 2027 | 1725 | 1307 | 1130 | 1100 |
| 1935 | 1073 | 1168 | 1202 | 1559 | 1870 | 2260 | 3299 | 3618 | 3297 | 2876 | 2515 | 2415 |
| 1936 | 2322 | 2263 | 2255 | 2912 | 3796 | 4091 | 4309 | 4236 | 3982 | 3457 | 3042 | 2907 |
| 1937 | 2734 | 2607 | 2571 | 2547 | 2626 | 3290 | 3987 | 4231 | 4060 | 3701 | 3401 | 3271 |
| 1938 | 3215 | 3732 | 3790 | 4104 | 4039 | 3894 | 4058 | 4552 | 4422 | 3977 | 3625 | 3069 |
| 1939 | 3091 | 2949 | 3108 | 3242 | 3367 | 3783 | 3647 | 3447 | 3116 | 2568 | 2205 | 2185 |
| 1940 | 2102 | 2007 | 2142 | 3034 | 3252 | 3435 | 4131 | 4139 | 3750 | 3150 | 2769 | 2631 |
| 1941 | 2540 | 2300 | 3263 | 3317 | 3423 | 3940 | 4456 | 4552 | 4442 | 4150 | 3700 | 3173 |
| 1942 | 3068 | 2725 | 3316 | 3389 | 3516 | 3795 | 4451 | 4552 | 4467 | 4103 | 3700 | 3159 |
| 1943 | 3030 | 2706 | 2958 | 3541 | 3848 | 4118 | 4552 | 4552 | 4275 | 3703 | 3350 | 2902 |
| 1944 | 2817 | 2422 | 2410 | 2500 | 2814 | 3140 | 3175 | 3197 | 3010 | 2568 | 2321 | 2259 |
| 1945 | 2190 | 2337 | 2609 | 2817 | 3514 | 3762 | 3929 | 4070 | 3863 | 3428 | 3116 | 2991 |
| 1946 | 2959 | 3216 | 3265 | 3622 | 3805 | 4124 | 4297 | 4269 | 3900 | 3429 | 3099 | 3026 |
| 1947 | 2838 | 2882 | 2999 | 3007 | 3268 | 3792 | 3917 | 3646 | 3426 | 2808 | 2513 | 2415 |
| 1948 | 2488 | 2499 | 2502 | 3067 | 3149 | 3485 | 4380 | 4552 | 4500 | 3943 | 3564 | 3400 |
| 1949 | 3234 | 3195 | 3212 | 3205 | 3351 | 4071 | 4398 | 4447 | 4047 | 3402 | 3027 | 2972 |
| 1950 | 2853 | 2776 | 2715 | 2950 | 3290 | 3666 | 4050 | 4047 | 3745 | 3334 | 3039 | 3008 |
| 1951 | 3176 | 3252 | 3322 | 3624 | 3794 | 4221 | 4279 | 4434 | 3999 | 3334 | 2973 | 2754 |
| 1952 | 2657 | 2614 | 3306 | 3604 | 3739 | 4022 | 4290 | 4552 | 4466 | 4150 | 3700 | 3322 |
| 1953 | 3198 | 2848 | 3292 | 3366 | 3654 | 4086 | 4440 | 4552 | 4500 | 4026 | 3700 | 3172 |
| 1954 | 3116 | 2922 | 3033 | 3552 | 3661 | 4106 | 4546 | 4552 | 4253 | 3650 | 3305 | 3019 |
| 1955 | 2916 | 2819 | 3069 | 3157 | 3310 | 3479 | 3710 | 3895 | 3624 | 3125 | 2858 | 2880 |
| 1956 | 2850 | 2940 | 3252 | 3252 | 3288 | 3970 | 4503 | 4552 | 4334 | 3998 | 3700 | 3105 |
| 1957 | 3079 | 2661 | 2601 | 2675 | 3334 | 4129 | 4406 | 4552 | 4240 | 3637 | 3293 | 3152 |
| 1958 | 3250 | 3156 | 3338 | 3531 | 4433 | 3416 | 4173 | 4552 | 4500 | 4150 | 3700 | 3295 |
| 1959 | 3181 | 2778 | 2765 | 3648 | 3777 | 4221 | 4263 | 4148 | 3635 | 3092 | 2702 | 2846 |
| 1960 | 2678 | 2501 | 2439 | 2651 | 3363 | 4035 | 4124 | 4265 | 3798 | 3200 | 2932 | 2895 |
| 1961 | 2758 | 2838 | 3287 | 3487 | 3914 | 4280 | 4408 | 4423 | 4061 | 3423 | 2985 | 2893 |
| 1962 | 2692 | 2782 | 3078 | 3180 | 3675 | 4199 | 4420 | 4358 | 4013 | 3420 | 3067 | 2995 |
| 1963 | 3250 | 3252 | 3349 | 3461 | 3944 | 4226 | 4137 | 4552 | 4289 | 3712 | 3382 | 2811 |
| 1964 | 2882 | 3102 | 3159 | 3503 | 3723 | 3871 | 3738 | 3633 | 3440 | 2897 | 2681 | 2696 |
| 1965 | 2658 | 2744 | 3252 | 3368 | 3713 | 3874 | 4500 | 4546 | 4207 | 3770 | 3502 | 3046 |
| 1966 | 2887 | 2935 | 3055 | 3539 | 3934 | 4229 | 4552 | 4436 | 3889 | 3260 | 2927 | 2694 |
| 1967 | 2600 | 2937 | 3335 | 3551 | 3920 | 4033 | 4479 | 4552 | 4500 | 4114 | 3700 | 3264 |
| 1968 | 3200 | 2935 | 3014 | 3190 | 3654 | 4226 | 4290 | 4226 | 3775 | 3181 | 2968 | 2953 |
| 1969 | 2909 | 2980 | 3318 | 3358 | 3480 | 4030 | 4434 | 4552 | 4331 | 3935 | 3578 | 3200 |
| 1970 | 3200 | 3034 | 3317 | 3252 | 3431 | 4021 | 4065 | 4008 | 3756 | 3180 | 2920 | 2357 |
| 1971 | 2233 | 2645 | 3319 | 3515 | 3848 | 3873 | 4369 | 4552 | 4469 | 3974 | 3685 | 3244 |
| 1972 | 3200 | 2864 | 3008 | 3344 | 3726 | 4249 | 4505 | 4461 | 4006 | 3392 | 3087 | 3148 |
| 1973 | 3146 | 3252 | 3346 | 3552 | 3636 | 4162 | 4461 | 4532 | 4088 | 3471 | 3223 | 3034 |
| 1974 | 3107 | 3252 | 3267 | 3252 | 3694 | 3416 | 4289 | 4552 | 4351 | 4150 | 3700 | 3311 |
| 1975 | 3218 | 2809 | 2984 | 3141 | 3790 | 3756 | 4341 | 4552 | 4349 | 4042 | 3700 | 3189 |
| 1976 | 3243 | 3039 | 3134 | 3369 | 3480 | 3668 | 3740 | 3601 | 3222 | 2757 | 2737 | 2811 |
| 1977 | 2711 | 2608 | 2545 | 2254 | 2293 | 2335 | 1976 | 1938 | 1509 | 1064 | 1015 | 1100 |
| 1978 | 1078 | 1122 | 1557 | 3467 | 4093 | 4526 | 4552 | 4552 | 4167 | 3718 | 3382 | 3319 |
| 1979 | 3164 | 2887 | 2792 | 2869 | 3193 | 3697 | 3965 | 4179 | 3796 | 3293 | 3121 | 3097 |
| 1980 | 3135 | 3244 | 3367 | 3528 | 3292 | 3940 | 4231 | 4226 | 3847 | 3413 | 3124 | 3109 |

| Table 2. Shasta | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAF | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 3047 | 2736 | 2859 | 3138 | 3546 | 4148 | 4385 | 4217 | 3562 | 2934 | 2601 | 2584 |
| 1982 | 2595 | 3252 | 3276 | 3616 | 3530 | 3953 | 4094 | 4488 | 4343 | 4029 | 3700 | 3400 |
| 1983 | 3250 | 3252 | 3328 | 3371 | 3252 | 3667 | 4074 | 4552 | 4500 | 4150 | 3700 | 3400 |
| 1984 | 3250 | 3252 | 3285 | 3650 | 3994 | 4246 | 4491 | 4503 | 4198 | 3595 | 3407 | 2827 |
| 1985 | 2903 | 3252 | 3360 | 3459 | 3631 | 3843 | 3945 | 3671 | 3230 | 2790 | 2496 | 2477 |
| 1986 | 2463 | 2437 | 2590 | 3135 | 3252 | 3534 | 3969 | 3962 | 3563 | 3206 | 2920 | 2948 |
| 1987 | 2975 | 2686 | 2654 | 2792 | 3132 | 3867 | 3803 | 3510 | 2934 | 2409 | 2211 | 2206 |
| 1988 | 2037 | 2016 | 2510 | 2883 | 2908 | 3045 | 3080 | 3058 | 2628 | 2006 | 1721 | 1654 |
| 1989 | 1526 | 1725 | 1806 | 1992 | 2096 | 3470 | 3923 | 3656 | 3301 | 2687 | 2355 | 2389 |
| 1990 | 2521 | 2506 | 2504 | 2747 | 2841 | 3106 | 2924 | 3092 | 2945 | 2254 | 1979 | 1929 |
| 1991 | 1875 | 1857 | 1842 | 1722 | 1752 | 2175 | 2337 | 2319 | 2055 | 1742 | 1538 | 1480 |
| 1992 | 1373 | 1236 | 1233 | 1268 | 1911 | 2392 | 2655 | 2364 | 1849 | 1473 | 1082 | 1100 |
| 1993 | 1002 | 909 | 1136 | 1784 | 2510 | 3969 | 4450 | 4552 | 4500 | 3895 | 3623 | 3291 |
| 1994 | 3154 | 2750 | 2823 | 3071 | 3296 | 3469 | 3308 | 3219 | 2774 | 2154 | 1791 | 1717 |
| 1995 | 1551 | 1519 | 1564 | 3252 | 3743 | 3417 | 4217 | 4552 | 4500 | 4150 | 3700 | 3400 |
| 1996 | 3250 | 2836 | 3201 | 3567 | 3503 | 4010 | 4432 | 4552 | 4340 | 3904 | 3640 | 3210 |
| 1997 | 2972 | 2779 | 3252 | 3252 | 3737 | 3956 | 4015 | 3779 | 3431 | 2918 | 2746 | 2297 |
| 1998 | 2087 | 2045 | 2287 | 3339 | 3252 | 3504 | 4329 | 4552 | 4500 | 4150 | 3700 | 3400 |
| 1999 | 3250 | 3252 | 3349 | 3640 | 3570 | 3980 | 4518 | 4552 | 4322 | 3847 | 3573 | 3196 |
| 2000 | 3024 | 2642 | 2638 | 3336 | 3282 | 3976 | 4552 | 4552 | 4191 | 3618 | 3304 | 3105 |
| 2001 | 2976 | 2636 | 2612 | 2768 | 3205 | 3700 | 3810 | 3615 | 3166 | 2680 | 2510 | 2577 |
| 2002 | 2324 | 2477 | 3142 | 3678 | 4022 | 4411 | 4475 | 4289 | 3812 | 3295 | 3002 | 2930 |
| 2003 | 2735 | 2650 | 3291 | 3515 | 3772 | 4253 | 4552 | 4552 | 4245 | 3531 | 3281 | 3081 |

Table 3. Folsom

TAF

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 489 | 430 | 457 | 460 | 567 | 662 | 792 | 967 | 967 | 942 | 792 | 556 |
| 1923 | 512 | 463 | 567 | 567 | 511 | 599 | 792 | 967 | 967 | 773 | 734 | 707 |
| 1924 | 533 | 485 | 434 | 367 | 431 | 432 | 465 | 484 | 448 | 324 | 317 | 306 |
| 1925 | 317 | 352 | 413 | 467 | 567 | 656 | 792 | 967 | 904 | 681 | 535 | 502 |
| 1926 | 452 | 418 | 408 | 367 | 505 | 609 | 792 | 779 | 602 | 442 | 355 | 355 |
| 1927 | 318 | 465 | 559 | 565 | 553 | 647 | 792 | 967 | 967 | 789 | 739 | 607 |
| 1928 | 554 | 442 | 458 | 455 | 478 | 635 | 792 | 915 | 813 | 508 | 449 | 399 |
| 1929 | 343 | 325 | 314 | 272 | 280 | 377 | 418 | 479 | 462 | 381 | 329 | 297 |
| 1930 | 269 | 269 | 425 | 529 | 567 | 659 | 792 | 816 | 675 | 480 | 418 | 382 |
| 1931 | 319 | 311 | 274 | 246 | 233 | 282 | 307 | 327 | 334 | 315 | 300 | 228 |
| 1932 | 154 | 169 | 268 | 363 | 567 | 664 | 792 | 967 | 967 | 900 | 792 | 659 |
| 1933 | 503 | 439 | 400 | 344 | 302 | 321 | 378 | 457 | 463 | 286 | 307 | 319 |
| 1934 | 300 | 302 | 380 | 474 | 562 | 655 | 620 | 492 | 299 | 255 | 218 | 143 |
| 1935 | 90 | 146 | 190 | 290 | 381 | 469 | 792 | 967 | 967 | 832 | 792 | 752 |
| 1936 | 676 | 567 | 539 | 567 | 562 | 651 | 792 | 967 | 967 | 771 | 734 | 706 |
| 1937 | 521 | 473 | 443 | 399 | 567 | 664 | 792 | 967 | 967 | 845 | 770 | 710 |
| 1938 | 592 | 567 | 567 | 567 | 567 | 662 | 792 | 967 | 967 | 942 | 792 | 707 |
| 1939 | 592 | 507 | 484 | 436 | 414 | 536 | 621 | 615 | 539 | 367 | 316 | 314 |
| 1940 | 298 | 289 | 286 | 567 | 557 | 626 | 792 | 967 | 957 | 710 | 627 | 436 |
| 1941 | 381 | 388 | 567 | 567 | 566 | 658 | 792 | 967 | 967 | 942 | 792 | 563 |
| 1942 | 515 | 454 | 567 | 564 | 556 | 650 | 792 | 967 | 967 | 942 | 792 | 581 |
| 1943 | 527 | 449 | 567 | 556 | 529 | 625 | 792 | 967 | 967 | 777 | 734 | 510 |
| 1944 | 454 | 389 | 349 | 305 | 337 | 447 | 498 | 629 | 576 | 452 | 395 | 356 |
| 1945 | 316 | 403 | 496 | 509 | 558 | 656 | 792 | 967 | 967 | 742 | 681 | 591 |
| 1946 | 558 | 567 | 567 | 564 | 558 | 649 | 792 | 967 | 939 | 692 | 610 | 577 |
| 1947 | 493 | 519 | 540 | 487 | 547 | 661 | 755 | 776 | 657 | 448 | 401 | 384 |
| 1948 | 367 | 361 | 344 | 444 | 445 | 463 | 783 | 956 | 967 | 866 | 781 | 743 |
| 1949 | 673 | 567 | 558 | 503 | 498 | 664 | 792 | 967 | 892 | 667 | 552 | 514 |
| 1950 | 455 | 422 | 382 | 567 | 565 | 658 | 792 | 967 | 949 | 736 | 695 | 663 |
| 1951 | 584 | 449 | 367 | 384 | 407 | 599 | 792 | 967 | 918 | 639 | 577 | 470 |
| 1952 | 438 | 427 | 567 | 567 | 566 | 661 | 792 | 967 | 967 | 942 | 792 | 627 |
| 1953 | 591 | 483 | 526 | 566 | 558 | 622 | 792 | 967 | 967 | 896 | 792 | 676 |
| 1954 | 569 | 501 | 495 | 512 | 564 | 656 | 792 | 866 | 789 | 481 | 432 | 395 |
| 1955 | 339 | 326 | 388 | 451 | 468 | 503 | 587 | 741 | 714 | 577 | 512 | 477 |
| 1956 | 425 | 404 | 524 | 460 | 458 | 616 | 792 | 967 | 967 | 942 | 792 | 714 |
| 1957 | 559 | 438 | 419 | 382 | 546 | 652 | 732 | 967 | 967 | 718 | 629 | 579 |
| 1958 | 542 | 529 | 567 | 567 | 557 | 656 | 792 | 967 | 967 | 942 | 792 | 619 |
| 1959 | 566 | 466 | 436 | 477 | 567 | 650 | 735 | 752 | 709 | 382 | 338 | 350 |
| 1960 | 298 | 261 | 228 | 222 | 441 | 654 | 710 | 745 | 701 | 573 | 508 | 482 |
| 1961 | 420 | 408 | 396 | 337 | 346 | 403 | 471 | 530 | 502 | 292 | 238 | 233 |
| 1962 | 213 | 226 | 260 | 262 | 567 | 664 | 792 | 907 | 903 | 673 | 602 | 536 |
| 1963 | 712 | 567 | 567 | 544 | 499 | 629 | 792 | 967 | 967 | 781 | 730 | 652 |
| 1964 | 592 | 544 | 567 | 567 | 564 | 556 | 623 | 707 | 686 | 525 | 464 | 427 |
| 1965 | 366 | 387 | 428 | 425 | 443 | 612 | 792 | 967 | 945 | 837 | 792 | 583 |
| 1966 | 506 | 504 | 525 | 546 | 549 | 644 | 792 | 827 | 765 | 500 | 462 | 451 |
| 1967 | 404 | 448 | 567 | 563 | 552 | 636 | 792 | 967 | 967 | 942 | 792 | 610 |
| 1968 | 592 | 504 | 500 | 520 | 547 | 640 | 715 | 735 | 680 | 394 | 368 | 352 |
| 1969 | 316 | 374 | 499 | 543 | 527 | 637 | 792 | 967 | 967 | 942 | 792 | 592 |
| 1970 | 569 | 515 | 567 | 453 | 446 | 611 | 691 | 785 | 760 | 502 | 458 | 362 |
| 1971 | 320 | 445 | 567 | 567 | 558 | 648 | 792 | 952 | 961 | 877 | 792 | 605 |
| 1972 | 560 | 487 | 551 | 561 | 567 | 646 | 745 | 845 | 793 | 529 | 482 | 455 |
| 1973 | 415 | 470 | 567 | 559 | 555 | 652 | 792 | 967 | 876 | 664 | 615 | 547 |
| 1974 | 515 | 567 | 567 | 505 | 499 | 622 | 792 | 967 | 967 | 942 | 792 | 624 |
| 1975 | 578 | 474 | 468 | 462 | 567 | 662 | 792 | 967 | 967 | 919 | 792 | 733 |
| 1976 | 695 | 529 | 526 | 461 | 415 | 428 | 434 | 456 | 434 | 408 | 385 | 357 |
| 1977 | 334 | 308 | 267 | 230 | 215 | 197 | 174 | 167 | 134 | 95 | 90 | 90 |
| 1978 | 90 | 90 | 197 | 567 | 567 | 657 | 792 | 967 | 960 | 783 | 732 | 627 |
| 1979 | 562 | 492 | 456 | 535 | 567 | 657 | 792 | 967 | 773 | 626 | 580 | 547 |
| 1980 | 519 | 544 | 567 | 481 | 457 | 621 | 792 | 967 | 967 | 942 | 792 | 592 |

| Table 3. Folsom | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAF | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 544 | 456 | 431 | 421 | 417 | 566 | 654 | 679 | 620 | 417 | 387 | 383 |
| 1982 | 366 | 546 | 433 | 459 | 402 | 590 | 792 | 967 | 967 | 942 | 792 | 752 |
| 1983 | 712 | 565 | 565 | 556 | 543 | 628 | 792 | 967 | 967 | 942 | 792 | 752 |
| 1984 | 712 | 472 | 406 | 427 | 458 | 615 | 786 | 967 | 944 | 708 | 661 | 592 |
| 1985 | 563 | 567 | 567 | 538 | 557 | 639 | 792 | 829 | 651 | 496 | 416 | 396 |
| 1986 | 349 | 378 | 477 | 551 | 440 | 593 | 792 | 967 | 967 | 775 | 731 | 523 |
| 1987 | 484 | 444 | 414 | 372 | 401 | 519 | 571 | 554 | 465 | 265 | 212 | 212 |
| 1988 | 208 | 216 | 302 | 414 | 434 | 469 | 515 | 514 | 462 | 386 | 326 | 299 |
| 1989 | 265 | 332 | 387 | 409 | 456 | 642 | 792 | 826 | 621 | 461 | 393 | 378 |
| 1990 | 357 | 381 | 385 | 416 | 435 | 550 | 635 | 662 | 579 | 448 | 392 | 386 |
| 1991 | 312 | 275 | 227 | 213 | 205 | 331 | 418 | 492 | 491 | 420 | 299 | 226 |
| 1992 | 227 | 251 | 288 | 281 | 464 | 592 | 636 | 560 | 440 | 241 | 202 | 173 |
| 1993 | 157 | 149 | 238 | 567 | 553 | 637 | 792 | 967 | 967 | 848 | 761 | 618 |
| 1994 | 560 | 452 | 430 | 362 | 360 | 393 | 450 | 495 | 477 | 364 | 306 | 265 |
| 1995 | 244 | 274 | 383 | 546 | 530 | 618 | 792 | 967 | 967 | 942 | 792 | 752 |
| 1996 | 592 | 475 | 567 | 557 | 494 | 621 | 792 | 967 | 967 | 851 | 792 | 595 |
| 1997 | 502 | 430 | 512 | 370 | 394 | 591 | 774 | 933 | 906 | 647 | 592 | 378 |
| 1998 | 337 | 339 | 362 | 567 | 555 | 646 | 792 | 967 | 967 | 942 | 792 | 750 |
| 1999 | 712 | 567 | 567 | 560 | 560 | 654 | 782 | 967 | 967 | 830 | 792 | 591 |
| 2000 | 534 | 431 | 407 | 564 | 558 | 656 | 792 | 967 | 903 | 612 | 563 | 537 |
| 2001 | 495 | 430 | 416 | 378 | 390 | 501 | 603 | 655 | 571 | 447 | 395 | 402 |
| 2002 | 378 | 426 | 567 | 567 | 563 | 655 | 792 | 906 | 859 | 627 | 540 | 503 |
| 2003 | 442 | 433 | 555 | 562 | 551 | 646 | 793 | 967 | 967 | 707 | 660 | 559 |

Table 4. Friant

TAF

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 215 | 233 | 292 | 360 | 439 | 424 | 196 | 276 | 524 | 503 | 342 | 292 |
| 1923 | 303 | 333 | 413 | 439 | 439 | 441 | 392 | 468 | 430 | 347 | 229 | 211 |
| 1924 | 235 | 261 | 275 | 287 | 271 | 273 | 314 | 316 | 233 | 159 | 134 | 159 |
| 1925 | 160 | 177 | 207 | 239 | 313 | 292 | 293 | 365 | 360 | 283 | 191 | 182 |
| 1926 | 207 | 226 | 247 | 262 | 294 | 295 | 382 | 496 | 433 | 277 | 171 | 176 |
| 1927 | 180 | 219 | 267 | 307 | 423 | 438 | 349 | 442 | 490 | 402 | 255 | 213 |
| 1928 | 233 | 309 | 348 | 378 | 387 | 438 | 450 | 515 | 436 | 277 | 183 | 183 |
| 1929 | 165 | 158 | 166 | 174 | 168 | 145 | 161 | 244 | 228 | 171 | 142 | 176 |
| 1930 | 153 | 135 | 138 | 149 | 163 | 147 | 213 | 222 | 239 | 168 | 140 | 175 |
| 1931 | 158 | 148 | 153 | 162 | 166 | 133 | 184 | 205 | 162 | 131 | 131 | 151 |
| 1932 | 155 | 153 | 216 | 287 | 439 | 441 | 325 | 356 | 473 | 424 | 268 | 220 |
| 1933 | 231 | 255 | 268 | 292 | 282 | 278 | 264 | 193 | 258 | 227 | 164 | 181 |
| 1934 | 183 | 179 | 213 | 253 | 276 | 314 | 402 | 382 | 284 | 188 | 158 | 169 |
| 1935 | 160 | 167 | 195 | 253 | 314 | 281 | 242 | 374 | 508 | 388 | 243 | 209 |
| 1936 | 227 | 258 | 275 | 311 | 439 | 479 | 448 | 523 | 501 | 380 | 242 | 205 |
| 1937 | 213 | 235 | 268 | 300 | 439 | 479 | 358 | 524 | 524 | 421 | 265 | 220 |
| 1938 | 238 | 266 | 428 | 439 | 429 | 479 | 362 | 307 | 524 | 524 | 422 | 346 |
| 1939 | 357 | 374 | 394 | 434 | 439 | 478 | 523 | 505 | 387 | 251 | 158 | 168 |
| 1940 | 183 | 177 | 179 | 294 | 387 | 449 | 389 | 523 | 504 | 336 | 180 | 156 |
| 1941 | 166 | 188 | 274 | 383 | 439 | 479 | 348 | 364 | 463 | 475 | 324 | 243 |
| 1942 | 247 | 271 | 351 | 439 | 439 | 466 | 402 | 354 | 466 | 442 | 287 | 229 |
| 1943 | 241 | 295 | 336 | 412 | 439 | 479 | 456 | 523 | 496 | 379 | 244 | 210 |
| 1944 | 217 | 243 | 262 | 289 | 301 | 310 | 260 | 323 | 319 | 251 | 177 | 184 |
| 1945 | 199 | 246 | 299 | 338 | 439 | 458 | 346 | 416 | 470 | 406 | 265 | 226 |
| 1946 | 273 | 354 | 439 | 439 | 439 | 453 | 417 | 524 | 494 | 360 | 225 | 201 |
| 1947 | 226 | 296 | 379 | 424 | 439 | 466 | 456 | 521 | 417 | 266 | 172 | 180 |
| 1948 | 177 | 178 | 184 | 193 | 185 | 131 | 136 | 225 | 292 | 216 | 165 | 189 |
| 1949 | 194 | 192 | 210 | 227 | 236 | 211 | 239 | 336 | 355 | 234 | 160 | 176 |
| 1950 | 193 | 202 | 218 | 256 | 320 | 298 | 338 | 410 | 398 | 278 | 175 | 181 |
| 1951 | 202 | 357 | 381 | 439 | 439 | 456 | 378 | 380 | 347 | 256 | 178 | 184 |
| 1952 | 192 | 198 | 261 | 398 | 439 | 397 | 291 | 485 | 524 | 521 | 408 | 343 |
| 1953 | 336 | 341 | 373 | 439 | 439 | 442 | 415 | 369 | 314 | 269 | 187 | 189 |
| 1954 | 189 | 191 | 204 | 230 | 264 | 275 | 316 | 440 | 410 | 294 | 191 | 178 |
| 1955 | 192 | 206 | 236 | 273 | 299 | 284 | 240 | 258 | 316 | 226 | 165 | 179 |
| 1956 | 181 | 180 | 351 | 351 | 439 | 479 | 392 | 388 | 446 | 412 | 289 | 240 |
| 1957 | 265 | 294 | 312 | 344 | 367 | 364 | 293 | 302 | 369 | 282 | 188 | 188 |
| 1958 | 206 | 220 | 261 | 298 | 378 | 426 | 348 | 474 | 524 | 502 | 371 | 313 |
| 1959 | 310 | 317 | 323 | 359 | 407 | 475 | 523 | 497 | 400 | 254 | 147 | 178 |
| 1960 | 179 | 170 | 169 | 176 | 200 | 189 | 274 | 308 | 272 | 185 | 155 | 172 |
| 1961 | 153 | 151 | 176 | 188 | 198 | 166 | 230 | 235 | 198 | 136 | 136 | 161 |
| 1962 | 167 | 175 | 205 | 234 | 401 | 367 | 320 | 393 | 466 | 389 | 249 | 214 |
| 1963 | 233 | 259 | 270 | 304 | 439 | 452 | 325 | 341 | 424 | 379 | 252 | 222 |
| 1964 | 243 | 315 | 355 | 383 | 371 | 369 | 358 | 357 | 315 | 210 | 161 | 175 |
| 1965 | 161 | 176 | 299 | 439 | 439 | 417 | 286 | 298 | 326 | 289 | 240 | 220 |
| 1966 | 236 | 339 | 412 | 439 | 439 | 478 | 520 | 523 | 425 | 261 | 157 | 163 |
| 1967 | 151 | 162 | 367 | 439 | 439 | 399 | 292 | 326 | 524 | 524 | 444 | 363 |
| 1968 | 302 | 290 | 299 | 323 | 306 | 351 | 405 | 435 | 354 | 219 | 167 | 187 |
| 1969 | 167 | 179 | 223 | 351 | 372 | 326 | 191 | 375 | 524 | 524 | 445 | 354 |
| 1970 | 318 | 320 | 344 | 439 | 439 | 479 | 415 | 426 | 414 | 290 | 200 | 197 |
| 1971 | 197 | 219 | 288 | 353 | 386 | 376 | 336 | 339 | 323 | 240 | 172 | 186 |
| 1972 | 201 | 218 | 272 | 308 | 332 | 386 | 354 | 359 | 319 | 199 | 133 | 176 |
| 1973 | 175 | 189 | 227 | 294 | 385 | 379 | 257 | 493 | 524 | 398 | 254 | 216 |
| 1974 | 243 | 336 | 426 | 439 | 439 | 479 | 424 | 478 | 495 | 377 | 246 | 209 |
| 1975 | 229 | 262 | 294 | 329 | 365 | 395 | 239 | 319 | 496 | 390 | 240 | 212 |
| 1976 | 256 | 302 | 327 | 342 | 339 | 370 | 391 | 380 | 269 | 162 | 132 | 176 |
| 1977 | 182 | 182 | 194 | 211 | 217 | 219 | 240 | 213 | 181 | 141 | 131 | 152 |
| 1978 | 152 | 152 | 230 | 388 | 439 | 479 | 393 | 413 | 524 | 524 | 434 | 439 |
| 1979 | 393 | 391 | 400 | 439 | 439 | 479 | 438 | 523 | 509 | 363 | 228 | 200 |
| 1980 | 222 | 262 | 291 | 380 | 405 | 479 | 475 | 452 | 461 | 524 | 416 | 349 |

| Table 4. Friant | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAF | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 354 | 368 | 388 | 422 | 437 | 462 | 465 | 512 | 432 | 268 | 177 | 184 |
| 1982 | 178 | 230 | 286 | 392 | 439 | 447 | 524 | 524 | 524 | 523 | 440 | 440 |
| 1983 | 439 | 432 | 418 | 412 | 439 | 475 | 228 | 131 | 524 | 524 | 515 | 456 |
| 1984 | 406 | 437 | 407 | 439 | 439 | 478 | 385 | 440 | 401 | 296 | 209 | 207 |
| 1985 | 231 | 283 | 324 | 360 | 375 | 380 | 434 | 487 | 396 | 252 | 159 | 179 |
| 1986 | 182 | 202 | 262 | 341 | 393 | 479 | 421 | 491 | 524 | 456 | 313 | 273 |
| 1987 | 301 | 322 | 335 | 359 | 362 | 389 | 443 | 457 | 356 | 205 | 140 | 152 |
| 1988 | 135 | 139 | 157 | 205 | 224 | 219 | 277 | 295 | 251 | 174 | 149 | 172 |
| 1989 | 154 | 143 | 156 | 170 | 186 | 209 | 320 | 363 | 304 | 196 | 156 | 179 |
| 1990 | 175 | 173 | 184 | 201 | 213 | 207 | 297 | 287 | 230 | 171 | 152 | 166 |
| 1991 | 152 | 140 | 142 | 143 | 136 | 146 | 152 | 193 | 240 | 175 | 143 | 184 |
| 1992 | 170 | 168 | 183 | 201 | 244 | 239 | 343 | 388 | 287 | 194 | 158 | 173 |
| 1993 | 158 | 151 | 175 | 347 | 439 | 479 | 313 | 387 | 450 | 437 | 291 | 236 |
| 1994 | 252 | 270 | 289 | 317 | 321 | 356 | 392 | 409 | 349 | 229 | 156 | 172 |
| 1995 | 195 | 219 | 259 | 439 | 439 | 479 | 333 | 288 | 524 | 524 | 489 | 385 |
| 1996 | 293 | 270 | 286 | 337 | 434 | 479 | 371 | 488 | 490 | 381 | 246 | 211 |
| 1997 | 226 | 325 | 429 | 351 | 422 | 479 | 447 | 523 | 432 | 290 | 159 | 150 |
| 1998 | 170 | 204 | 239 | 334 | 439 | 479 | 440 | 350 | 524 | 524 | 452 | 363 |
| 1999 | 308 | 309 | 330 | 380 | 392 | 419 | 364 | 423 | 449 | 312 | 204 | 198 |
| 2000 | 213 | 225 | 238 | 306 | 382 | 439 | 407 | 519 | 519 | 360 | 226 | 199 |
| 2001 | 219 | 246 | 262 | 285 | 289 | 332 | 341 | 449 | 379 | 241 | 164 | 177 |
| 2002 | 167 | 171 | 222 | 276 | 304 | 288 | 353 | 404 | 375 | 260 | 168 | 173 |
| 2003 | 166 | 212 | 250 | 303 | 339 | 327 | 273 | 331 | 399 | 269 | 182 | 182 |

Table 5. New Melones

TAF

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 1649 | 1654 | 1679 | 1700 | 1807 | 1800 | 1766 | 1935 | 2133 | 2074 | 1979 | 1918 |
| 1923 | 1865 | 1877 | 1943 | 1970 | 1970 | 1895 | 1900 | 1977 | 1960 | 1897 | 1799 | 1756 |
| 1924 | 1713 | 1703 | 1715 | 1726 | 1727 | 1669 | 1563 | 1445 | 1358 | 1281 | 1206 | 1178 |
| 1925 | 1145 | 1146 | 1155 | 1161 | 1293 | 1367 | 1350 | 1459 | 1488 | 1427 | 1329 | 1281 |
| 1926 | 1223 | 1211 | 1212 | 1210 | 1269 | 1281 | 1303 | 1238 | 1162 | 1072 | 989 | 946 |
| 1927 | 913 | 927 | 979 | 1020 | 1157 | 1224 | 1253 | 1326 | 1353 | 1273 | 1180 | 1140 |
| 1928 | 1119 | 1148 | 1169 | 1179 | 1220 | 1384 | 1383 | 1447 | 1383 | 1278 | 1179 | 1128 |
| 1929 | 1082 | 1084 | 1088 | 1090 | 1100 | 1085 | 1027 | 966 | 927 | 850 | 776 | 737 |
| 1930 | 697 | 687 | 688 | 705 | 735 | 787 | 772 | 728 | 739 | 677 | 611 | 573 |
| 1931 | 550 | 565 | 566 | 574 | 581 | 564 | 481 | 382 | 331 | 280 | 224 | 199 |
| 1932 | 154 | 160 | 210 | 238 | 343 | 376 | 386 | 558 | 642 | 625 | 567 | 529 |
| 1933 | 495 | 486 | 495 | 503 | 509 | 503 | 451 | 425 | 450 | 388 | 319 | 280 |
| 1934 | 255 | 255 | 272 | 291 | 322 | 345 | 260 | 157 | 109 | 80 | 80 | 80 |
| 1935 | 80 | 80 | 80 | 100 | 80 | 129 | 265 | 472 | 544 | 501 | 437 | 400 |
| 1936 | 386 | 394 | 407 | 478 | 655 | 733 | 830 | 995 | 1072 | 1011 | 932 | 897 |
| 1937 | 868 | 864 | 879 | 899 | 996 | 1096 | 1118 | 1285 | 1315 | 1225 | 1132 | 1080 |
| 1938 | 1039 | 1041 | 1122 | 1194 | 1377 | 1516 | 1647 | 1921 | 2140 | 2108 | 2023 | 1979 |
| 1939 | 1941 | 1931 | 1940 | 1954 | 1967 | 1986 | 1876 | 1745 | 1659 | 1567 | 1478 | 1436 |
| 1940 | 1381 | 1359 | 1360 | 1456 | 1588 | 1672 | 1740 | 1845 | 1820 | 1722 | 1630 | 1574 |
| 1941 | 1523 | 1513 | 1548 | 1597 | 1678 | 1705 | 1716 | 1853 | 1906 | 1848 | 1757 | 1698 |
| 1942 | 1652 | 1644 | 1688 | 1774 | 1849 | 1827 | 1900 | 2039 | 2181 | 2148 | 2052 | 2000 |
| 1943 | 1950 | 1970 | 1970 | 1970 | 1970 | 2030 | 2125 | 2142 | 2144 | 2066 | 1971 | 1907 |
| 1944 | 1849 | 1835 | 1833 | 1829 | 1835 | 1856 | 1754 | 1686 | 1656 | 1568 | 1470 | 1413 |
| 1945 | 1386 | 1416 | 1437 | 1470 | 1595 | 1677 | 1633 | 1715 | 1801 | 1738 | 1645 | 1599 |
| 1946 | 1576 | 1600 | 1682 | 1742 | 1794 | 1762 | 1780 | 1855 | 1816 | 1725 | 1635 | 1588 |
| 1947 | 1543 | 1554 | 1571 | 1582 | 1597 | 1582 | 1458 | 1347 | 1280 | 1190 | 1105 | 1063 |
| 1948 | 1043 | 1039 | 1039 | 1037 | 1007 | 1021 | 1022 | 1062 | 1169 | 1108 | 1034 | 998 |
| 1949 | 975 | 972 | 983 | 990 | 996 | 1021 | 978 | 1001 | 991 | 917 | 845 | 805 |
| 1950 | 758 | 739 | 745 | 790 | 853 | 906 | 908 | 1014 | 1086 | 1023 | 949 | 921 |
| 1951 | 907 | 1182 | 1573 | 1678 | 1772 | 1861 | 1841 | 1836 | 1779 | 1688 | 1596 | 1542 |
| 1952 | 1499 | 1510 | 1560 | 1697 | 1784 | 1814 | 1866 | 2140 | 2322 | 2300 | 2130 | 2000 |
| 1953 | 1927 | 1927 | 1943 | 1970 | 1970 | 1903 | 1846 | 1766 | 1820 | 1770 | 1683 | 1628 |
| 1954 | 1573 | 1571 | 1581 | 1593 | 1600 | 1644 | 1583 | 1629 | 1579 | 1487 | 1396 | 1342 |
| 1955 | 1285 | 1290 | 1304 | 1331 | 1336 | 1337 | 1300 | 1238 | 1215 | 1123 | 1032 | 981 |
| 1956 | 934 | 939 | 1189 | 1448 | 1564 | 1553 | 1565 | 1704 | 1808 | 1762 | 1673 | 1634 |
| 1957 | 1579 | 1572 | 1584 | 1598 | 1635 | 1671 | 1559 | 1575 | 1616 | 1528 | 1442 | 1385 |
| 1958 | 1330 | 1328 | 1330 | 1376 | 1452 | 1527 | 1673 | 1969 | 2115 | 2065 | 1973 | 1912 |
| 1959 | 1849 | 1844 | 1854 | 1876 | 1927 | 1943 | 1824 | 1672 | 1596 | 1508 | 1420 | 1408 |
| 1960 | 1348 | 1334 | 1334 | 1337 | 1374 | 1387 | 1341 | 1269 | 1222 | 1144 | 1071 | 1018 |
| 1961 | 954 | 971 | 988 | 992 | 1000 | 996 | 950 | 892 | 838 | 778 | 718 | 684 |
| 1962 | 641 | 646 | 653 | 657 | 736 | 769 | 772 | 797 | 853 | 800 | 723 | 674 |
| 1963 | 646 | 652 | 672 | 722 | 835 | 873 | 902 | 1087 | 1137 | 1086 | 1011 | 980 |
| 1964 | 968 | 998 | 1016 | 1049 | 1060 | 1046 | 977 | 913 | 885 | 810 | 737 | 688 |
| 1965 | 667 | 688 | 903 | 1105 | 1208 | 1263 | 1315 | 1401 | 1490 | 1449 | 1381 | 1336 |
| 1966 | 1275 | 1305 | 1336 | 1369 | 1399 | 1418 | 1371 | 1351 | 1267 | 1172 | 1083 | 1022 |
| 1967 | 974 | 979 | 1055 | 1153 | 1177 | 1206 | 1279 | 1474 | 1761 | 1817 | 1734 | 1683 |
| 1968 | 1623 | 1631 | 1642 | 1660 | 1717 | 1761 | 1653 | 1561 | 1492 | 1399 | 1308 | 1247 |
| 1969 | 1212 | 1233 | 1239 | 1536 | 1737 | 1792 | 1934 | 2174 | 2320 | 2279 | 2130 | 2000 |
| 1970 | 1958 | 1964 | 1970 | 1970 | 1970 | 1986 | 1928 | 1918 | 1912 | 1813 | 1714 | 1664 |
| 1971 | 1616 | 1641 | 1704 | 1758 | 1799 | 1760 | 1706 | 1691 | 1722 | 1653 | 1561 | 1508 |
| 1972 | 1452 | 1464 | 1507 | 1540 | 1558 | 1556 | 1428 | 1401 | 1340 | 1251 | 1162 | 1120 |
| 1973 | 1085 | 1091 | 1117 | 1225 | 1365 | 1478 | 1439 | 1547 | 1538 | 1443 | 1347 | 1302 |
| 1974 | 1284 | 1330 | 1404 | 1514 | 1589 | 1651 | 1740 | 1857 | 1889 | 1823 | 1725 | 1669 |
| 1975 | 1637 | 1644 | 1665 | 1688 | 1749 | 1786 | 1756 | 1765 | 1894 | 1827 | 1746 | 1689 |
| 1976 | 1661 | 1672 | 1689 | 1695 | 1703 | 1646 | 1556 | 1449 | 1358 | 1277 | 1209 | 1163 |
| 1977 | 1129 | 1126 | 1121 | 1108 | 1078 | 1017 | 944 | 883 | 853 | 791 | 732 | 706 |
| 1978 | 654 | 643 | 659 | 733 | 816 | 956 | 1059 | 1193 | 1295 | 1260 | 1171 | 1160 |
| 1979 | 1108 | 1117 | 1133 | 1195 | 1308 | 1429 | 1392 | 1494 | 1397 | 1296 | 1200 | 1154 |
| 1980 | 1128 | 1141 | 1150 | 1450 | 1698 | 1715 | 1746 | 1790 | 1862 | 1852 | 1761 | 1710 |

| Table 5. New Melones | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAF | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 1667 | 1657 | 1674 | 1717 | 1725 | 1764 | 1678 | 1556 | 1453 | 1353 | 1266 | 1226 |
| 1982 | 1198 | 1253 | 1381 | 1583 | 1881 | 2030 | 2220 | 2326 | 2389 | 2300 | 2130 | 2000 |
| 1983 | 1970 | 1970 | 1970 | 1970 | 1970 | 2030 | 2080 | 2204 | 2420 | 2300 | 2130 | 2000 |
| 1984 | 1970 | 1970 | 1970 | 1970 | 1970 | 1977 | 1908 | 1902 | 1874 | 1800 | 1725 | 1686 |
| 1985 | 1669 | 1705 | 1741 | 1753 | 1787 | 1819 | 1743 | 1648 | 1564 | 1469 | 1385 | 1349 |
| 1986 | 1320 | 1327 | 1341 | 1416 | 1889 | 2030 | 2056 | 2056 | 2078 | 1983 | 1895 | 1861 |
| 1987 | 1821 | 1814 | 1821 | 1809 | 1807 | 1828 | 1697 | 1529 | 1428 | 1347 | 1277 | 1241 |
| 1988 | 1187 | 1168 | 1156 | 1155 | 1151 | 1127 | 1055 | 959 | 909 | 857 | 809 | 771 |
| 1989 | 719 | 705 | 700 | 695 | 694 | 769 | 745 | 701 | 686 | 640 | 594 | 600 |
| 1990 | 607 | 614 | 635 | 643 | 651 | 642 | 567 | 491 | 438 | 379 | 334 | 309 |
| 1991 | 285 | 271 | 285 | 278 | 261 | 299 | 266 | 221 | 183 | 121 | 80 | 80 |
| 1992 | 80 | 80 | 95 | 101 | 145 | 182 | 142 | 80 | 80 | 80 | 80 | 80 |
| 1993 | 80 | 80 | 80 | 222 | 320 | 473 | 529 | 661 | 761 | 695 | 639 | 610 |
| 1994 | 601 | 625 | 661 | 686 | 705 | 670 | 610 | 554 | 492 | 417 | 352 | 315 |
| 1995 | 285 | 292 | 322 | 508 | 582 | 897 | 993 | 1230 | 1496 | 1612 | 1558 | 1538 |
| 1996 | 1513 | 1510 | 1544 | 1619 | 1807 | 1919 | 1935 | 2046 | 2051 | 1968 | 1891 | 1849 |
| 1997 | 1842 | 1875 | 1970 | 2116 | 1970 | 1977 | 1917 | 1900 | 1842 | 1757 | 1675 | 1647 |
| 1998 | 1611 | 1623 | 1648 | 1759 | 1962 | 2030 | 2060 | 2120 | 2349 | 2300 | 2130 | 2000 |
| 1999 | 1970 | 1970 | 1970 | 1970 | 1970 | 1993 | 1975 | 1976 | 1992 | 1916 | 1846 | 1812 |
| 2000 | 1785 | 1780 | 1794 | 1849 | 1958 | 1972 | 1956 | 1936 | 1895 | 1806 | 1731 | 1701 |
| 2001 | 1699 | 1711 | 1741 | 1750 | 1779 | 1811 | 1729 | 1625 | 1530 | 1426 | 1327 | 1271 |
| 2002 | 1210 | 1209 | 1243 | 1283 | 1283 | 1330 | 1304 | 1241 | 1165 | 1086 | 1013 | 981 |
| 2003 | 951 | 967 | 1018 | 1067 | 1075 | 1104 | 1094 | 1091 | 1060 | 991 | 926 | 894 |

| Table 6. NOD CVP Ag Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1922 | 80 | 0 | 0 | 0 | 0 | 8 | 745 | 941 | 1221 | 1340 | 1077 | 540 |
| 1923 | 17 | 0 | 0 | 0 | 0 | 83 | 243 | 504 | 578 | 690 | 556 | 155 |
| 1924 | 75 | 7 | 0 | 0 | 0 | 7 | 34 | 37 | 42 | 46 | 37 | 18 |
| 1925 | 0 | 0 | 0 | 0 | 0 | 0 | 117 | 366 | 657 | 816 | 653 | 266 |
| 1926 | 123 | 0 | 0 | 0 | 0 | 11 | 27 | 135 | 210 | 229 | 179 | 91 |
| 1927 | 11 | 0 | 0 | 0 | 0 | 8 | 566 | 963 | 1173 | 1415 | 1144 | 569 |
| 1928 | 28 | 0 | 0 | 0 | 0 | 0 | 195 | 498 | 640 | 706 | 570 | 280 |
| 1929 | 99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1930 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 120 | 185 | 201 | 163 | 67 |
| 1931 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1932 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1933 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1934 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1935 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 240 | 383 | 416 | 336 | 161 |
| 1936 | 25 | 2 | 0 | 0 | 0 | 3 | 172 | 378 | 450 | 599 | 486 | 228 |
| 1937 | 89 | 14 | 0 | 0 | 0 | 0 | 125 | 325 | 367 | 450 | 365 | 182 |
| 1938 | 15 | 0 | 0 | 0 | 0 | 0 | 281 | 914 | 1364 | 1485 | 1200 | 480 |
| 1939 | 74 | 2 | 0 | 0 | 79 | 76 | 210 | 171 | 236 | 255 | 208 | 81 |
| 1940 | 26 | 5 | 0 | 0 | 0 | 0 | 313 | 623 | 1067 | 1182 | 955 | 458 |
| 1941 | 23 | 0 | 0 | 0 | 0 | 0 | 114 | 606 | 1331 | 1538 | 1244 | 617 |
| 1942 | 44 | 0 | 0 | 0 | 0 | 0 | 123 | 737 | 1369 | 1520 | 1228 | 594 |
| 1943 | 186 | 0 | 0 | 0 | 0 | 1 | 247 | 707 | 934 | 1043 | 847 | 422 |
| 1944 | 133 | 3 | 0 | 0 | 0 | 6 | 95 | 147 | 208 | 242 | 196 | 97 |
| 1945 | 22 | 0 | 0 | 0 | 0 | 0 | 248 | 377 | 557 | 690 | 557 | 277 |
| 1946 | 1 | 0 | 0 | 0 | 0 | 16 | 592 | 724 | 899 | 959 | 791 | 382 |
| 1947 | 136 | 0 | 0 | 0 | 0 | 0 | 229 | 344 | 386 | 504 | 405 | 204 |
| 1948 | 2 | 0 | 0 | 0 | 9 | 18 | 47 | 460 | 940 | 1341 | 1078 | 463 |
| 1949 | 99 | 7 | 0 | 0 | 0 | 0 | 294 | 488 | 739 | 806 | 649 | 318 |
| 1950 | 130 | 1 | 0 | 0 | 0 | 2 | 186 | 254 | 303 | 338 | 272 | 124 |
| 1951 | 3 | 0 | 0 | 0 | 0 | 22 | 587 | 632 | 1013 | 1110 | 894 | 441 |
| 1952 | 7 | 0 | 0 | 0 | 0 | 0 | 458 | 970 | 1128 | 1398 | 1144 | 559 |
| 1953 | 217 | 0 | 0 | 0 | 0 | 42 | 421 | 901 | 1206 | 1429 | 1050 | 578 |
| 1954 | 169 | 0 | 0 | 0 | 0 | 0 | 305 | 850 | 1135 | 1302 | 917 | 513 |
| 1955 | 171 | 0 | 0 | 0 | 0 | 38 | 173 | 284 | 344 | 377 | 305 | 127 |
| 1956 | 45 | 0 | 0 | 0 | 0 | 86 | 647 | 774 | 1203 | 1412 | 1142 | 502 |
| 1957 | 89 | 27 | 0 | 0 | 0 | 38 | 467 | 575 | 870 | 950 | 768 | 146 |
| 1958 | 0 | 2 | 0 | 0 | 0 | 0 | 133 | 681 | 1231 | 1467 | 1228 | 601 |
| 1959 | 210 | 27 | 0 | 0 | 0 | 25 | 525 | 646 | 753 | 820 | 646 | 137 |
| 1960 | 133 | 20 | 0 | 0 | 0 | 0 | 149 | 221 | 324 | 353 | 285 | 141 |
| 1961 | 48 | 0 | 0 | 0 | 0 | 0 | 201 | 367 | 466 | 546 | 433 | 189 |
| 1962 | 78 | 0 | 0 | 0 | 0 | 0 | 434 | 679 | 828 | 962 | 769 | 368 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 106 | 756 | 1361 | 1526 | 1233 | 606 |
| 1964 | 41 | 0 | 0 | 0 | 0 | 34 | 235 | 242 | 262 | 311 | 247 | 107 |
| 1965 | 12 | 0 | 0 | 0 | 0 | 34 | 164 | 722 | 923 | 1013 | 671 | 407 |
| 1966 | 163 | 0 | 0 | 0 | 0 | 24 | 585 | 755 | 886 | 963 | 776 | 381 |
| 1967 | 158 | 0 | 0 | 0 | 0 | 2 | 122 | 873 | 1041 | 1503 | 1214 | 595 |
| 1968 | 206 | 0 | 0 | 0 | 0 | 1 | 393 | 631 | 735 | 900 | 621 | 361 |
| 1969 | 60 | 0 | 0 | 0 | 0 | 2 | 528 | 1025 | 1209 | 1370 | 1110 | 543 |
| 1970 | 89 | 4 | 0 | 0 | 0 | 1 | 397 | 620 | 669 | 809 | 653 | 325 |
| 1971 | 59 | 0 | 0 | 0 | 0 | 38 | 695 | 633 | 916 | 1043 | 840 | 399 |
| 1972 | 149 | 1 | 0 | 0 | 3 | 145 | 361 | 375 | 449 | 513 | 415 | 157 |
| 1973 | 2 | 0 | 0 | 0 | 0 | 0 | 476 | 884 | 1146 | 1249 | 1009 | 473 |
| 1974 | 19 | 0 | 0 | 0 | 0 | 0 | 331 | 1026 | 1351 | 1253 | 1212 | 606 |
| 1975 | 62 | 2 | 0 | 0 | 0 | 0 | 387 | 1016 | 1312 | 1382 | 1126 | 575 |
| 1976 | 9 | 4 | 0 | 0 | 74 | 37 | 54 | 71 | 79 | 87 | 60 | 30 |
| 1977 | 13 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 175 | 932 | 1364 | 1490 | 1201 | 452 |
| 1979 | 242 | 0 | 0 | 0 | 0 | 0 | 165 | 366 | 482 | 525 | 413 | 192 |
| 1980 | 9 | 0 | 0 | 0 | 0 | 0 | 333 | 649 | 855 | 1016 | 830 | 403 |

| Table 6. NOD CVP Ag Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 132 | 11 | 0 | 0 | 0 | 0 | 234 | 557 | 868 | 946 | 766 | 325 |
| 1982 | 6 | 0 | 0 | 0 | 0 | 0 | 202 | 943 | 1167 | 1520 | 1233 | 368 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 818 | 1298 | 1532 | 1179 | 481 |
| 1984 | 167 | 0 | 0 | 0 | 0 | 30 | 654 | 867 | 981 | 1095 | 827 | 427 |
| 1985 | 39 | 0 | 0 | 0 | 0 | 0 | 370 | 647 | 793 | 873 | 698 | 221 |
| 1986 | 86 | 0 | 0 | 0 | 0 | 0 | 218 | 510 | 730 | 796 | 643 | 213 |
| 1987 | 115 | 14 | 0 | 0 | 0 | 0 | 154 | 210 | 249 | 270 | 218 | 108 |
| 1988 | 28 | 0 | 0 | 0 | 0 | 1 | 6 | 7 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 182 | 320 | 360 | 422 | 338 | 18 |
| 1990 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 5 | 2 | 0 | 0 | 0 | 0 | 470 | 647 | 1148 | 1547 | 1229 | 631 |
| 1994 | 116 | 0 | 0 | 0 | 0 | 26 | 443 | 443 | 749 | 821 | 663 | 325 |
| 1995 | 92 | 0 | 0 | 0 | 0 | 0 | 361 | 703 | 1181 | 1490 | 1204 | 595 |
| 1996 | 241 | 32 | 0 | 0 | 0 | 0 | 386 | 563 | 1339 | 1518 | 1230 | 570 |
| 1997 | 58 | 0 | 0 | 0 | 0 | 52 | 648 | 710 | 810 | 961 | 715 | 346 |
| 1998 | 84 | 0 | 0 | 0 | 0 | 0 | 270 | 240 | 1173 | 1484 | 1197 | 535 |
| 1999 | 104 | 0 | 0 | 0 | 0 | 0 | 490 | 962 | 1164 | 1399 | 1116 | 559 |
| 2000 | 187 | 0 | 0 | 0 | 0 | 0 | 357 | 750 | 1259 | 1518 | 1245 | 527 |
| 2001 | 2 | 2 | 0 | 0 | 0 | 1 | 135 | 253 | 305 | 354 | 286 | 122 |
| 2002 | 32 | 0 | 0 | 0 | 0 | 34 | 636 | 610 | 849 | 927 | 749 | 371 |
| 2003 | 151 | 0 | 0 | 0 | 0 | 0 | 169 | 708 | 1370 | 1530 | 1076 | 615 |

Table 7. NOD CVP M&I Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 309 | 245 | 211 | 186 | 220 | 234 | 416 | 444 | 529 | 528 | 485 | 416 |
| 1923 | 282 | 245 | 211 | 186 | 146 | 225 | 282 | 387 | 394 | 405 | 372 | 275 |
| 1924 | 167 | 144 | 106 | 155 | 179 | 203 | 337 | 301 | 366 | 351 | 256 | 167 |
| 1925 | 91 | 94 | 175 | 150 | 180 | 202 | 325 | 364 | 430 | 435 | 380 | 234 |
| 1926 | 164 | 109 | 96 | 157 | 188 | 207 | 250 | 343 | 403 | 372 | 308 | 201 |
| 1927 | 98 | 220 | 167 | 142 | 172 | 241 | 384 | 461 | 518 | 533 | 490 | 419 |
| 1928 | 288 | 181 | 211 | 186 | 212 | 201 | 329 | 387 | 407 | 411 | 381 | 332 |
| 1929 | 235 | 117 | 99 | 156 | 186 | 155 | 271 | 284 | 286 | 294 | 208 | 139 |
| 1930 | 95 | 79 | 148 | 124 | 151 | 180 | 295 | 343 | 376 | 379 | 324 | 228 |
| 1931 | 128 | 87 | 79 | 141 | 170 | 191 | 321 | 311 | 322 | 335 | 238 | 158 |
| 1932 | 100 | 85 | 166 | 141 | 75 | 215 | 330 | 353 | 407 | 376 | 313 | 207 |
| 1933 | 139 | 103 | 88 | 149 | 180 | 171 | 288 | 295 | 330 | 318 | 228 | 153 |
| 1934 | 87 | 87 | 155 | 130 | 159 | 209 | 327 | 341 | 378 | 361 | 286 | 196 |
| 1935 | 117 | 220 | 87 | 149 | 96 | 169 | 219 | 399 | 446 | 446 | 405 | 325 |
| 1936 | 147 | 107 | 94 | 155 | 179 | 208 | 333 | 373 | 414 | 421 | 372 | 289 |
| 1937 | 156 | 123 | 93 | 155 | 186 | 184 | 323 | 390 | 414 | 428 | 394 | 319 |
| 1938 | 183 | 237 | 180 | 155 | 186 | 234 | 383 | 462 | 535 | 531 | 488 | 342 |
| 1939 | 207 | 249 | 141 | 186 | 220 | 195 | 335 | 317 | 401 | 399 | 365 | 285 |
| 1940 | 136 | 126 | 94 | 153 | 177 | 214 | 405 | 452 | 521 | 525 | 483 | 413 |
| 1941 | 286 | 203 | 211 | 186 | 220 | 235 | 305 | 428 | 560 | 563 | 515 | 372 |
| 1942 | 291 | 244 | 211 | 186 | 220 | 234 | 300 | 429 | 556 | 555 | 508 | 366 |
| 1943 | 238 | 181 | 211 | 186 | 220 | 233 | 347 | 466 | 516 | 524 | 481 | 413 |
| 1944 | 310 | 206 | 139 | 184 | 211 | 201 | 316 | 347 | 376 | 378 | 337 | 210 |
| 1945 | 123 | 226 | 170 | 145 | 175 | 202 | 355 | 364 | 392 | 407 | 373 | 355 |
| 1946 | 137 | 228 | 180 | 155 | 186 | 222 | 435 | 445 | 513 | 512 | 475 | 377 |
| 1947 | 228 | 180 | 211 | 186 | 220 | 199 | 343 | 373 | 404 | 426 | 374 | 237 |
| 1948 | 121 | 106 | 94 | 155 | 100 | 190 | 266 | 424 | 541 | 566 | 516 | 402 |
| 1949 | 254 | 181 | 211 | 186 | 220 | 199 | 375 | 362 | 437 | 438 | 404 | 336 |
| 1950 | 210 | 128 | 116 | 165 | 197 | 192 | 335 | 385 | 432 | 423 | 373 | 225 |
| 1951 | 117 | 236 | 180 | 155 | 186 | 248 | 433 | 431 | 521 | 524 | 482 | 411 |
| 1952 | 238 | 181 | 211 | 186 | 212 | 234 | 396 | 465 | 501 | 531 | 491 | 345 |
| 1953 | 241 | 243 | 211 | 186 | 220 | 231 | 379 | 449 | 508 | 529 | 476 | 355 |
| 1954 | 290 | 181 | 141 | 186 | 220 | 220 | 366 | 470 | 513 | 531 | 473 | 417 |
| 1955 | 317 | 207 | 211 | 186 | 220 | 176 | 329 | 378 | 421 | 421 | 371 | 275 |
| 1956 | 151 | 106 | 179 | 155 | 179 | 275 | 410 | 422 | 521 | 523 | 482 | 337 |
| 1957 | 199 | 264 | 202 | 186 | 220 | 202 | 369 | 391 | 499 | 501 | 459 | 350 |
| 1958 | 177 | 238 | 199 | 174 | 207 | 235 | 302 | 456 | 526 | 544 | 512 | 361 |
| 1959 | 240 | 263 | 203 | 186 | 220 | 241 | 394 | 400 | 453 | 453 | 419 | 290 |
| 1960 | 210 | 178 | 124 | 173 | 198 | 183 | 341 | 370 | 430 | 400 | 325 | 222 |
| 1961 | 146 | 233 | 180 | 155 | 186 | 202 | 300 | 345 | 402 | 406 | 375 | 307 |
| 1962 | 185 | 118 | 182 | 110 | 188 | 202 | 413 | 423 | 499 | 493 | 446 | 362 |
| 1963 | 273 | 262 | 203 | 178 | 211 | 234 | 319 | 456 | 547 | 553 | 506 | 426 |
| 1964 | 275 | 181 | 202 | 186 | 141 | 222 | 374 | 362 | 402 | 414 | 362 | 295 |
| 1965 | 129 | 236 | 179 | 154 | 185 | 223 | 291 | 462 | 517 | 511 | 447 | 394 |
| 1966 | 267 | 175 | 207 | 182 | 216 | 258 | 426 | 437 | 501 | 503 | 466 | 377 |
| 1967 | 237 | 270 | 210 | 186 | 220 | 234 | 302 | 481 | 518 | 556 | 502 | 363 |
| 1968 | 237 | 243 | 141 | 186 | 212 | 202 | 386 | 422 | 452 | 462 | 412 | 369 |
| 1969 | 234 | 254 | 196 | 171 | 203 | 235 | 403 | 471 | 517 | 521 | 480 | 411 |
| 1970 | 214 | 243 | 211 | 186 | 220 | 205 | 400 | 415 | 423 | 441 | 406 | 354 |
| 1971 | 216 | 154 | 192 | 167 | 199 | 234 | 439 | 429 | 510 | 515 | 475 | 341 |
| 1972 | 315 | 242 | 211 | 186 | 212 | 224 | 351 | 379 | 399 | 410 | 379 | 293 |
| 1973 | 157 | 237 | 180 | 155 | 186 | 234 | 422 | 469 | 520 | 523 | 482 | 399 |
| 1974 | 239 | 270 | 211 | 186 | 220 | 234 | 377 | 485 | 531 | 491 | 497 | 362 |
| 1975 | 211 | 243 | 141 | 186 | 220 | 234 | 391 | 478 | 533 | 527 | 481 | 356 |
| 1976 | 182 | 248 | 203 | 186 | 214 | 217 | 303 | 315 | 346 | 343 | 290 | 190 |
| 1977 | 119 | 91 | 81 | 81 | 91 | 201 | 304 | 280 | 337 | 323 | 118 | 57 |
| 1978 | 43 | 87 | 168 | 143 | 172 | 218 | 329 | 478 | 536 | 535 | 491 | 400 |
| 1979 | 322 | 207 | 141 | 186 | 220 | 202 | 325 | 386 | 407 | 404 | 369 | 323 |
| 1980 | 177 | 237 | 180 | 155 | 179 | 230 | 382 | 445 | 495 | 497 | 468 | 399 |

Table 7. NOD CVP M&I Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 270 | 189 | 136 | 182 | 216 | 203 | 376 | 417 | 473 | 473 | 435 | 361 |
| 1982 | 212 | 256 | 198 | 173 | 205 | 234 | 308 | 506 | 551 | 569 | 520 | 315 |
| 1983 | 284 | 271 | 211 | 186 | 220 | 234 | 306 | 473 | 548 | 560 | 507 | 414 |
| 1984 | 333 | 271 | 211 | 186 | 212 | 264 | 433 | 465 | 495 | 516 | 469 | 404 |
| 1985 | 247 | 270 | 211 | 186 | 220 | 189 | 389 | 428 | 453 | 462 | 422 | 319 |
| 1986 | 187 | 158 | 195 | 171 | 203 | 202 | 343 | 395 | 430 | 432 | 398 | 300 |
| 1987 | 201 | 135 | 111 | 161 | 192 | 178 | 324 | 356 | 404 | 404 | 357 | 278 |
| 1988 | 147 | 104 | 180 | 156 | 100 | 192 | 273 | 275 | 308 | 307 | 229 | 154 |
| 1989 | 107 | 78 | 159 | 72 | 80 | 169 | 345 | 385 | 431 | 443 | 376 | 222 |
| 1990 | 128 | 106 | 94 | 155 | 186 | 178 | 278 | 261 | 331 | 301 | 248 | 136 |
| 1991 | 94 | 72 | 64 | 64 | 153 | 183 | 311 | 346 | 382 | 383 | 328 | 265 |
| 1992 | 105 | 94 | 80 | 80 | 164 | 201 | 321 | 386 | 415 | 436 | 381 | 293 |
| 1993 | 139 | 122 | 187 | 163 | 194 | 220 | 403 | 424 | 507 | 541 | 493 | 426 |
| 1994 | 302 | 253 | 205 | 186 | 220 | 241 | 390 | 381 | 442 | 439 | 393 | 319 |
| 1995 | 194 | 154 | 192 | 168 | 200 | 232 | 364 | 417 | 509 | 550 | 506 | 403 |
| 1996 | 253 | 177 | 211 | 186 | 212 | 241 | 385 | 388 | 559 | 568 | 508 | 380 |
| 1997 | 193 | 145 | 217 | 192 | 227 | 290 | 448 | 459 | 499 | 506 | 389 | 276 |
| 1998 | 169 | 143 | 219 | 194 | 229 | 235 | 371 | 354 | 558 | 580 | 532 | 441 |
| 1999 | 205 | 271 | 211 | 186 | 220 | 236 | 415 | 476 | 530 | 500 | 424 | 270 |
| 2000 | 185 | 137 | 126 | 188 | 214 | 239 | 414 | 458 | 541 | 552 | 479 | 357 |
| 2001 | 136 | 144 | 125 | 186 | 220 | 207 | 331 | 391 | 426 | 433 | 379 | 284 |
| 2002 | 161 | 237 | 187 | 163 | 103 | 214 | 432 | 426 | 465 | 506 | 467 | 403 |
| 2003 | 317 | 249 | 209 | 184 | 218 | 217 | 324 | 456 | 553 | 546 | 471 | 391 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Table 8. CVP Settlement Contract Deliveries | | | | | | | | | | | | |
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1922 | 1113 | 411 | 0 | 20 | 0 | 12 | 5691 | 5002 | 7139 | 6737 | 4974 | 1408 |
| 1923 | 884 | 133 | 0 | 0 | 0 | 515 | 4192 | 5347 | 6990 | 6866 | 5076 | 889 |
| 1924 | 1190 | 527 | 218 | 0 | 0 | 353 | 5019 | 4556 | 5891 | 5608 | 4211 | 1107 |
| 1925 | 694 | 359 | 0 | 53 | 0 | 0 | 3842 | 3935 | 6858 | 6913 | 5087 | 1234 |
| 1926 | 1341 | 437 | 168 | 0 | 0 | 239 | 2902 | 4902 | 7410 | 6847 | 4965 | 1424 |
| 1927 | 929 | 86 | 182 | 0 | 0 | 19 | 4910 | 5026 | 6764 | 6796 | 5033 | 1425 |
| 1928 | 942 | 261 | 67 | 0 | 0 | 0 | 4258 | 5150 | 7067 | 6725 | 4969 | 1368 |
| 1929 | 1276 | 223 | 79 | 101 | 0 | 132 | 5559 | 5543 | 6096 | 6713 | 4964 | 1381 |
| 1930 | 1292 | 634 | 0 | 0 | 0 | 0 | 4026 | 4751 | 7238 | 6798 | 5020 | 1185 |
| 1931 | 1243 | 428 | 263 | 0 | 0 | 480 | 5227 | 3991 | 5471 | 5736 | 4318 | 1131 |
| 1932 | 975 | 352 | 0 | 13 | 0 | 123 | 4676 | 3942 | 5869 | 5785 | 4334 | 1138 |
| 1933 | 1133 | 470 | 110 | 0 | 0 | 270 | 5196 | 4200 | 5901 | 5628 | 4223 | 1106 |
| 1934 | 901 | 556 | 0 | 71 | 0 | 74 | 4660 | 4326 | 5826 | 5767 | 4346 | 1165 |
| 1935 | 922 | 168 | 130 | 0 | 0 | 0 | 2608 | 5010 | 7440 | 6880 | 5098 | 1397 |
| 1936 | 994 | 436 | 138 | 0 | 0 | 31 | 4390 | 4796 | 6379 | 6780 | 5034 | 1355 |
| 1937 | 1306 | 634 | 140 | 0 | 0 | 0 | 4365 | 5295 | 6738 | 6815 | 5053 | 1437 |
| 1938 | 1003 | 173 | 30 | 0 | 0 | 0 | 3773 | 4844 | 7294 | 6834 | 5063 | 1192 |
| 1939 | 984 | 473 | 215 | 58 | 232 | 715 | 6645 | 4828 | 7121 | 6676 | 4975 | 1143 |
| 1940 | 1132 | 593 | 190 | 0 | 0 | 0 | 4245 | 4355 | 7216 | 6830 | 5059 | 1384 |
| 1941 | 948 | 353 | 0 | 0 | 0 | 0 | 2352 | 3974 | 7334 | 6972 | 5174 | 1463 |
| 1942 | 974 | 356 | 0 | 0 | 0 | 0 | 2491 | 4424 | 7436 | 6921 | 5131 | 1426 |
| 1943 | 1264 | 367 | 36 | 0 | 0 | 2 | 3997 | 5135 | 7101 | 6775 | 5034 | 1420 |
| 1944 | 1262 | 482 | 142 | 0 | 0 | 102 | 4929 | 4589 | 6932 | 6782 | 5021 | 1411 |
| 1945 | 1084 | 202 | 110 | 20 | 0 | 0 | 4903 | 4428 | 6728 | 6849 | 5067 | 1440 |
| 1946 | 789 | 301 | 0 | 90 | 0 | 73 | 5923 | 5114 | 7079 | 6580 | 4938 | 1329 |
| 1947 | 1231 | 353 | 24 | 118 | 0 | 27 | 5031 | 5122 | 6482 | 6883 | 5077 | 1469 |
| 1948 | 808 | 412 | 191 | 109 | 108 | 189 | 2060 | 3513 | 6569 | 7083 | 5224 | 1285 |
| 1949 | 1165 | 500 | 39 | 67 | 7 | 0 | 4832 | 4592 | 7133 | 6727 | 4956 | 1360 |
| 1950 | 1329 | 452 | 196 | 0 | 0 | 70 | 5353 | 5340 | 7123 | 6753 | 4995 | 1297 |
| 1951 | 810 | 244 | 0 | 0 | 0 | 56 | 5621 | 4364 | 7212 | 6785 | 5013 | 1399 |
| 1952 | 853 | 240 | 0 | 0 | 0 | 0 | 4499 | 5116 | 6597 | 6728 | 5025 | 1370 |
| 1953 | 1331 | 362 | 0 | 0 | 0 | 169 | 4384 | 4853 | 6897 | 6869 | 4685 | 1460 |
| 1954 | 1243 | 290 | 252 | 0 | 0 | 0 | 3587 | 5104 | 7090 | 6846 | 4584 | 1401 |
| 1955 | 1283 | 189 | 45 | 0 | 0 | 374 | 4857 | 5214 | 7104 | 6690 | 4946 | 1157 |
| 1956 | 1205 | 337 | 0 | 0 | 0 | 268 | 5099 | 4405 | 6953 | 6800 | 5036 | 1273 |
| 1957 | 945 | 595 | 272 | 0 | 0 | 179 | 4918 | 4574 | 7421 | 6936 | 5156 | 727 |
| 1958 | 822 | 521 | 101 | 0 | 0 | 0 | 2587 | 4321 | 6949 | 6764 | 5128 | 1436 |
| 1959 | 1323 | 597 | 197 | 0 | 0 | 124 | 6061 | 5444 | 7059 | 6710 | 4869 | 581 |
| 1960 | 1315 | 632 | 174 | 0 | 0 | 5 | 4873 | 4705 | 7160 | 6741 | 5002 | 1392 |
| 1961 | 1271 | 183 | 137 | 0 | 0 | 0 | 4800 | 4977 | 6869 | 6779 | 4951 | 1261 |
| 1962 | 1290 | 284 | 93 | 83 | 0 | 0 | 5322 | 5161 | 6949 | 6780 | 4978 | 1356 |
| 1963 | 719 | 477 | 89 | 0 | 0 | 0 | 2344 | 4598 | 7385 | 6948 | 5152 | 1438 |
| 1964 | 931 | 145 | 241 | 0 | 0 | 422 | 6366 | 5347 | 6667 | 6661 | 4884 | 1246 |
| 1965 | 949 | 165 | 45 | 0 | 0 | 253 | 4008 | 5254 | 7205 | 6808 | 4317 | 1427 |
| 1966 | 1353 | 141 | 128 | 3 | 0 | 111 | 5884 | 5330 | 6995 | 6610 | 4887 | 1338 |
| 1967 | 1314 | 92 | 63 | 0 | 0 | 0 | 2147 | 5081 | 6236 | 6943 | 5138 | 1421 |
| 1968 | 1301 | 428 | 190 | 0 | 0 | 0 | 5124 | 5135 | 6694 | 6804 | 4515 | 1421 |
| 1969 | 1040 | 261 | 3 | 0 | 0 | 5 | 4827 | 5322 | 6956 | 6714 | 4974 | 1369 |
| 1970 | 1046 | 479 | 0 | 0 | 0 | 8 | 5543 | 5367 | 6674 | 6715 | 4967 | 1377 |
| 1971 | 1027 | 66 | 38 | 45 | 0 | 175 | 6152 | 4451 | 6997 | 6739 | 4973 | 1319 |
| 1972 | 1278 | 446 | 53 | 78 | 22 | 692 | 5999 | 5245 | 6938 | 6778 | 5024 | 1100 |
| 1973 | 825 | 107 | 114 | 0 | 0 | 0 | 4849 | 5155 | 7170 | 6748 | 4993 | 1298 |
| 1974 | 878 | 82 | 75 | 0 | 0 | 0 | 3974 | 5235 | 7195 | 5982 | 5123 | 1486 |
| 1975 | 973 | 460 | 24 | 113 | 0 | 0 | 4272 | 5259 | 7247 | 6630 | 4921 | 1425 |
| 1976 | 800 | 504 | 238 | 123 | 233 | 924 | 5687 | 5578 | 7055 | 6742 | 4430 | 1219 |
| 1977 | 1310 | 492 | 216 | 0 | 134 | 581 | 5613 | 3444 | 5970 | 5729 | 4360 | 699 |
| 1978 | 1087 | 270 | 40 | 0 | 0 | 0 | 3252 | 5034 | 7280 | 6839 | 5054 | 1115 |
| 1979 | 1376 | 365 | 232 | 0 | 0 | 2 | 4492 | 5188 | 7265 | 6797 | 4975 | 1343 |
| 1980 | 843 | 261 | 0 | 0 | 0 | 0 | 4481 | 4837 | 6878 | 6718 | 5044 | 1384 |

Table 8. CVP Settlement Contract Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 1235 | 545 | 60 | 0 | 0 | 0 | 4225 | 4789 | 7317 | 6863 | 5099 | 1247 |
| 1982 | 821 | 107 | 39 | 0 | 0 | 0 | 2879 | 5235 | 6754 | 6981 | 5186 | 944 |
| 1983 | 768 | 138 | 112 | 0 | 0 | 0 | 2568 | 4782 | 7132 | 6972 | 4989 | 1172 |
| 1984 | 1217 | 50 | 0 | 113 | 0 | 142 | 5928 | 5489 | 6973 | 6736 | 4732 | 1344 |
| 1985 | 927 | 52 | 163 | 83 | 0 | 0 | 5052 | 5314 | 7104 | 6789 | 4975 | 944 |
| 1986 | 1091 | 179 | 115 | 0 | 0 | 0 | 4301 | 4988 | 7221 | 6813 | 5048 | 977 |
| 1987 | 1292 | 587 | 194 | 0 | 5 | 11 | 5167 | 5394 | 7088 | 6669 | 4932 | 1356 |
| 1988 | 1165 | 289 | 0 | 0 | 0 | 476 | 5000 | 4562 | 6712 | 6755 | 4996 | 1395 |
| 1989 | 1333 | 316 | 93 | 106 | 78 | 16 | 4792 | 5574 | 7012 | 6989 | 5137 | 368 |
| 1990 | 882 | 452 | 275 | 0 | 0 | 189 | 6169 | 3454 | 7202 | 6778 | 4796 | 1352 |
| 1991 | 1290 | 529 | 206 | 112 | 58 | 0 | 3594 | 4234 | 6062 | 5994 | 4499 | 1181 |
| 1992 | 1004 | 445 | 88 | 0 | 0 | 0 | 3702 | 4553 | 5742 | 5995 | 4534 | 1201 |
| 1993 | 777 | 446 | 0 | 0 | 0 | 0 | 4589 | 3841 | 6420 | 6882 | 5044 | 1454 |
| 1994 | 1092 | 342 | 167 | 0 | 0 | 153 | 4775 | 3609 | 6115 | 5815 | 4375 | 1132 |
| 1995 | 1046 | 155 | 68 | 0 | 0 | 0 | 4147 | 3990 | 6668 | 6846 | 5068 | 1419 |
| 1996 | 1389 | 628 | 0 | 0 | 0 | 0 | 4088 | 3408 | 7320 | 6900 | 5130 | 1370 |
| 1997 | 1028 | 353 | 0 | 0 | 0 | 284 | 6244 | 5207 | 6795 | 6750 | 4676 | 1279 |
| 1998 | 1045 | 110 | 134 | 0 | 0 | 0 | 3725 | 2294 | 7047 | 7077 | 5264 | 1417 |
| 1999 | 1178 | 304 | 216 | 9 | 0 | 0 | 4394 | 5139 | 6747 | 6759 | 4964 | 1385 |
| 2000 | 1239 | 353 | 271 | 0 | 0 | 2 | 4186 | 4166 | 6890 | 6878 | 5132 | 1214 |
| 2001 | 795 | 479 | 255 | 0 | 0 | 0 | 4407 | 5309 | 6912 | 6772 | 5012 | 1249 |
| 2002 | 1170 | 134 | 0 | 0 | 0 | 155 | 6193 | 4671 | 7065 | 6665 | 4926 | 1358 |
| 2003 | 1320 | 321 | 0 | 0 | 0 | 0 | 3114 | 4328 | 7439 | 6943 | 4559 | 1469 |

Table 9. NOD CVP Refuge Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 209 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1923 | 195 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1924 | 218 | 234 | 137 | 65 | 57 | 11 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1925 | 35 | 177 | 104 | 49 | 45 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1926 | 234 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1927 | 207 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1928 | 195 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1929 | 190 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1930 | 188 | 184 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1931 | 189 | 187 | 137 | 65 | 59 | 9 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1932 | 15 | 87 | 104 | 49 | 43 | 13 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1933 | 12 | 68 | 104 | 49 | 45 | 10 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1934 | 14 | 101 | 104 | 49 | 45 | 13 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1935 | 17 | 177 | 104 | 49 | 45 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1936 | 219 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1937 | 218 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1938 | 206 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1939 | 210 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1940 | 188 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1941 | 193 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1942 | 194 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1943 | 195 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1944 | 191 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1945 | 193 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1946 | 192 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1947 | 187 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1948 | 194 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1949 | 199 | 186 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1950 | 232 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1951 | 191 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1952 | 193 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1953 | 221 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1954 | 222 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1955 | 227 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1956 | 191 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1957 | 190 | 184 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1958 | 191 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1959 | 212 | 186 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1960 | 226 | 183 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1961 | 227 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1962 | 191 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1963 | 196 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1964 | 192 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1965 | 191 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1966 | 215 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1967 | 188 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1968 | 197 | 187 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1969 | 210 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1970 | 207 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1971 | 191 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1972 | 226 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1973 | 192 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1974 | 191 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1975 | 192 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1976 | 192 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1977 | 188 | 234 | 137 | 65 | 59 | 9 | 10 | 19 | 37 | 46 | 51 | 181 |
| 1978 | 12 | 177 | 104 | 49 | 45 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1979 | 193 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1980 | 199 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |

| Table 9. NOD CVP Refuge Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 190 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1982 | 192 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1983 | 193 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1984 | 194 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1985 | 202 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1986 | 187 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1987 | 192 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1988 | 192 | 234 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1989 | 192 | 196 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 225 |
| 1990 | 191 | 205 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1991 | 191 | 185 | 137 | 65 | 59 | 13 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1992 | 17 | 71 | 104 | 49 | 43 | 13 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1993 | 28 | 70 | 104 | 49 | 45 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1994 | 188 | 194 | 137 | 65 | 59 | 13 | 10 | 19 | 37 | 46 | 51 | 184 |
| 1995 | 14 | 177 | 104 | 49 | 45 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1996 | 204 | 184 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1997 | 191 | 193 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1998 | 187 | 234 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 1999 | 193 | 196 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 2000 | 193 | 193 | 137 | 65 | 57 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 2001 | 192 | 217 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 2002 | 191 | 210 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |
| 2003 | 185 | 195 | 137 | 65 | 59 | 17 | 19 | 66 | 102 | 138 | 188 | 244 |

| Table 10. SOD CVP Ag Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1922 | 922 | 703 | 973 | 1708 | 2154 | 1165 | 1894 | 2598 | 4335 | 5214 | 3757 | 1232 |
| 1923 | 780 | 595 | 823 | 1444 | 1821 | 717 | 1023 | 1515 | 2529 | 3041 | 2191 | 719 |
| 1924 | 455 | 347 | 480 | 842 | 1026 | 56 | 80 | 115 | 192 | 231 | 166 | 55 |
| 1925 | 94 | 72 | 100 | 175 | 221 | 487 | 798 | 1515 | 2529 | 3042 | 2192 | 719 |
| 1926 | 455 | 347 | 480 | 843 | 1062 | 227 | 324 | 467 | 779 | 937 | 675 | 221 |
| 1927 | 140 | 107 | 148 | 259 | 327 | 710 | 1133 | 1628 | 2716 | 3267 | 2354 | 772 |
| 1928 | 488 | 373 | 516 | 905 | 1102 | 378 | 1050 | 1506 | 2514 | 3023 | 2178 | 715 |
| 1929 | 452 | 345 | 477 | 837 | 1056 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1930 | 0 | 0 | 0 | 0 | 0 | 128 | 286 | 424 | 707 | 850 | 613 | 201 |
| 1931 | 127 | 97 | 134 | 235 | 297 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1932 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1933 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1934 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1935 | 0 | 0 | 0 | 0 | 0 | 0 | 89 | 834 | 1392 | 1674 | 1206 | 396 |
| 1936 | 250 | 191 | 264 | 464 | 564 | 614 | 876 | 1263 | 2108 | 2536 | 1827 | 599 |
| 1937 | 379 | 289 | 400 | 702 | 886 | 176 | 645 | 956 | 1596 | 1919 | 1383 | 454 |
| 1938 | 287 | 219 | 303 | 532 | 670 | 1493 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1939 | 922 | 703 | 973 | 1708 | 2154 | 263 | 465 | 671 | 1120 | 1346 | 970 | 318 |
| 1940 | 201 | 154 | 212 | 373 | 454 | 430 | 829 | 1247 | 2081 | 2503 | 1803 | 592 |
| 1941 | 374 | 285 | 395 | 693 | 874 | 1093 | 1809 | 2540 | 4239 | 5098 | 3673 | 1205 |
| 1942 | 762 | 581 | 804 | 1412 | 1781 | 1223 | 1978 | 2755 | 4598 | 5530 | 3318 | 1307 |
| 1943 | 827 | 631 | 873 | 1532 | 1932 | 1101 | 1571 | 2266 | 3781 | 4547 | 3277 | 1075 |
| 1944 | 680 | 519 | 718 | 1260 | 1534 | 257 | 366 | 528 | 882 | 1061 | 764 | 251 |
| 1945 | 159 | 121 | 167 | 294 | 371 | 531 | 979 | 1412 | 2357 | 2835 | 2043 | 670 |
| 1946 | 424 | 323 | 447 | 785 | 990 | 942 | 1349 | 1921 | 3207 | 3856 | 2779 | 911 |
| 1947 | 577 | 440 | 609 | 1068 | 1347 | 341 | 753 | 1087 | 1813 | 2181 | 1571 | 515 |
| 1948 | 326 | 249 | 344 | 604 | 736 | 244 | 631 | 864 | 1443 | 1735 | 1250 | 410 |
| 1949 | 259 | 198 | 274 | 481 | 606 | 342 | 1239 | 1787 | 2982 | 3587 | 2585 | 848 |
| 1950 | 536 | 409 | 566 | 994 | 1253 | 267 | 536 | 773 | 1291 | 1552 | 1119 | 367 |
| 1951 | 232 | 177 | 245 | 430 | 542 | 942 | 1349 | 1937 | 3232 | 3887 | 2801 | 919 |
| 1952 | 581 | 443 | 613 | 1077 | 1311 | 1405 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1953 | 922 | 703 | 973 | 1708 | 2154 | 580 | 996 | 1422 | 2373 | 2853 | 2056 | 674 |
| 1954 | 427 | 325 | 450 | 790 | 997 | 587 | 935 | 1352 | 2256 | 2714 | 1955 | 641 |
| 1955 | 406 | 309 | 428 | 752 | 948 | 429 | 613 | 884 | 1475 | 1773 | 1278 | 419 |
| 1956 | 265 | 202 | 280 | 491 | 598 | 1350 | 1864 | 2523 | 4210 | 5063 | 3280 | 1197 |
| 1957 | 757 | 577 | 799 | 1403 | 1769 | 538 | 809 | 1149 | 1918 | 2307 | 1662 | 545 |
| 1958 | 345 | 263 | 364 | 639 | 806 | 1195 | 1937 | 3034 | 5063 | 6088 | 4387 | 1439 |
| 1959 | 910 | 694 | 961 | 1687 | 2127 | 471 | 774 | 1140 | 1902 | 2288 | 1648 | 541 |
| 1960 | 342 | 261 | 361 | 634 | 772 | 164 | 550 | 793 | 1324 | 1592 | 1147 | 376 |
| 1961 | 238 | 182 | 251 | 441 | 556 | 351 | 825 | 1190 | 1986 | 2388 | 1721 | 564 |
| 1962 | 357 | 272 | 377 | 662 | 834 | 520 | 878 | 1270 | 2119 | 2548 | 1836 | 602 |
| 1963 | 381 | 291 | 402 | 706 | 890 | 725 | 1142 | 1630 | 2721 | 3272 | 2358 | 773 |
| 1964 | 489 | 373 | 516 | 906 | 1104 | 367 | 524 | 756 | 1261 | 1517 | 1093 | 359 |
| 1965 | 227 | 173 | 239 | 420 | 530 | 620 | 885 | 2214 | 3694 | 4443 | 3202 | 1050 |
| 1966 | 664 | 507 | 701 | 1231 | 1552 | 737 | 1132 | 1647 | 2748 | 3305 | 2381 | 781 |
| 1967 | 494 | 377 | 522 | 916 | 1155 | 1343 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1968 | 922 | 703 | 973 | 1708 | 2080 | 525 | 875 | 1245 | 2078 | 2499 | 1801 | 591 |
| 1969 | 374 | 285 | 394 | 692 | 873 | 1493 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1970 | 922 | 703 | 973 | 1708 | 2154 | 776 | 1278 | 1843 | 3075 | 3698 | 2665 | 874 |
| 1971 | 553 | 422 | 584 | 1024 | 1292 | 420 | 776 | 1116 | 1862 | 2240 | 1614 | 529 |
| 1972 | 335 | 255 | 353 | 620 | 755 | 613 | 874 | 1261 | 2104 | 2530 | 1823 | 598 |
| 1973 | 378 | 289 | 399 | 701 | 884 | 757 | 1289 | 1865 | 3112 | 3743 | 2697 | 885 |
| 1974 | 560 | 427 | 591 | 1037 | 1308 | 1164 | 1897 | 2608 | 4353 | 5235 | 2392 | 1237 |
| 1975 | 783 | 597 | 826 | 1450 | 1829 | 910 | 1510 | 2026 | 3381 | 4067 | 2022 | 961 |
| 1976 | 608 | 464 | 642 | 1126 | 1372 | 110 | 157 | 226 | 378 | 454 | 327 | 107 |
| 1977 | 68 | 52 | 72 | 126 | 159 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 935 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1979 | 922 | 703 | 973 | 1708 | 2154 | 425 | 778 | 1123 | 1874 | 2253 | 1624 | 533 |
| 1980 | 337 | 257 | 356 | 624 | 760 | 1073 | 1531 | 2207 | 3684 | 4430 | 3192 | 1047 |

| Table 10. SOD CVP Ag Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 662 | 505 | 699 | 1227 | 1548 | 507 | 1047 | 1528 | 2549 | 3066 | 1653 | 725 |
| 1982 | 458 | 350 | 484 | 849 | 1071 | 1300 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1983 | 922 | 703 | 973 | 1708 | 2154 | 1493 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1984 | 922 | 703 | 973 | 1708 | 2080 | 943 | 1349 | 1947 | 3249 | 3908 | 2816 | 924 |
| 1985 | 584 | 446 | 617 | 1083 | 1365 | 627 | 1054 | 1556 | 2598 | 3124 | 2251 | 738 |
| 1986 | 467 | 356 | 493 | 865 | 1091 | 601 | 1173 | 1691 | 2822 | 3394 | 2446 | 802 |
| 1987 | 508 | 387 | 536 | 940 | 1186 | 36 | 447 | 645 | 1077 | 1295 | 933 | 306 |
| 1988 | 194 | 148 | 204 | 359 | 437 | 13 | 18 | 26 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 598 | 863 | 1440 | 1732 | 1248 | 409 |
| 1990 | 259 | 198 | 273 | 480 | 605 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 951 | 1805 | 2399 | 4003 | 4814 | 1772 | 1138 |
| 1994 | 720 | 549 | 760 | 1334 | 1682 | 840 | 1180 | 1692 | 2639 | 3019 | 1866 | 803 |
| 1995 | 508 | 387 | 536 | 941 | 1186 | 1090 | 1999 | 2856 | 4766 | 5732 | 4130 | 1355 |
| 1996 | 857 | 654 | 905 | 1588 | 1933 | 976 | 1712 | 2331 | 3889 | 4677 | 2008 | 1106 |
| 1997 | 699 | 533 | 738 | 1296 | 1634 | 1096 | 1564 | 2256 | 3765 | 4528 | 1894 | 1070 |
| 1998 | 677 | 516 | 715 | 1254 | 1582 | 1364 | 2130 | 3073 | 5128 | 6167 | 4444 | 1458 |
| 1999 | 922 | 703 | 973 | 1708 | 2154 | 677 | 1179 | 1680 | 2804 | 3372 | 2430 | 797 |
| 2000 | 504 | 385 | 532 | 934 | 1137 | 720 | 1237 | 1769 | 2953 | 3551 | 2151 | 839 |
| 2001 | 531 | 405 | 560 | 984 | 1241 | 344 | 539 | 777 | 1297 | 1559 | 1124 | 369 |
| 2002 | 233 | 178 | 246 | 432 | 545 | 782 | 1124 | 1580 | 2637 | 3172 | 2286 | 750 |
| 2003 | 474 | 362 | 501 | 879 | 1108 | 597 | 936 | 1307 | 2182 | 2624 | 1890 | 620 |

Table 11. SOD CVP M&I Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 178 | 239 | 237 | 156 | 80 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1923 | 178 | 239 | 237 | 156 | 80 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1924 | 133 | 180 | 178 | 117 | 58 | 147 | 124 | 111 | 115 | 130 | 144 | 161 |
| 1925 | 107 | 144 | 143 | 94 | 48 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1926 | 133 | 180 | 178 | 117 | 60 | 159 | 134 | 120 | 124 | 140 | 156 | 175 |
| 1927 | 116 | 156 | 155 | 102 | 52 | 183 | 161 | 143 | 148 | 168 | 187 | 209 |
| 1928 | 139 | 187 | 185 | 122 | 60 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1929 | 133 | 180 | 178 | 117 | 60 | 122 | 103 | 92 | 95 | 108 | 120 | 134 |
| 1930 | 89 | 120 | 119 | 78 | 40 | 143 | 130 | 117 | 121 | 137 | 153 | 171 |
| 1931 | 114 | 153 | 151 | 100 | 51 | 138 | 116 | 103 | 107 | 121 | 135 | 151 |
| 1932 | 100 | 135 | 134 | 88 | 44 | 173 | 146 | 130 | 135 | 153 | 170 | 190 |
| 1933 | 126 | 170 | 168 | 111 | 57 | 126 | 114 | 102 | 105 | 119 | 132 | 148 |
| 1934 | 98 | 132 | 131 | 86 | 44 | 160 | 134 | 120 | 124 | 141 | 156 | 175 |
| 1935 | 116 | 156 | 155 | 102 | 52 | 122 | 111 | 138 | 143 | 162 | 180 | 201 |
| 1936 | 133 | 180 | 178 | 117 | 58 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1937 | 133 | 180 | 178 | 117 | 60 | 151 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1938 | 133 | 180 | 178 | 117 | 60 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1939 | 178 | 239 | 237 | 156 | 80 | 165 | 148 | 132 | 137 | 155 | 172 | 193 |
| 1940 | 128 | 172 | 170 | 112 | 56 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1941 | 133 | 180 | 178 | 117 | 60 | 240 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1942 | 178 | 239 | 237 | 156 | 80 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1943 | 178 | 239 | 237 | 156 | 80 | 242 | 203 | 181 | 188 | 213 | 236 | 265 |
| 1944 | 176 | 236 | 234 | 154 | 77 | 164 | 138 | 123 | 128 | 145 | 161 | 180 |
| 1945 | 120 | 161 | 159 | 105 | 54 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1946 | 133 | 180 | 178 | 117 | 60 | 215 | 182 | 161 | 166 | 189 | 210 | 235 |
| 1947 | 156 | 210 | 208 | 137 | 70 | 178 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1948 | 133 | 180 | 178 | 117 | 58 | 162 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1949 | 133 | 180 | 178 | 117 | 60 | 178 | 171 | 153 | 158 | 179 | 199 | 223 |
| 1950 | 148 | 199 | 197 | 130 | 67 | 166 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1951 | 133 | 180 | 178 | 117 | 60 | 215 | 182 | 162 | 167 | 190 | 211 | 236 |
| 1952 | 157 | 211 | 209 | 138 | 68 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1953 | 178 | 239 | 237 | 156 | 80 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1954 | 133 | 180 | 178 | 117 | 60 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1955 | 133 | 180 | 178 | 117 | 60 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1956 | 133 | 180 | 178 | 117 | 58 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1957 | 178 | 239 | 237 | 156 | 80 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1958 | 133 | 180 | 178 | 117 | 60 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1959 | 178 | 239 | 237 | 156 | 80 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1960 | 133 | 180 | 178 | 117 | 58 | 149 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1961 | 133 | 180 | 178 | 117 | 60 | 180 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1962 | 133 | 180 | 178 | 117 | 60 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1963 | 133 | 180 | 178 | 117 | 60 | 183 | 162 | 143 | 148 | 168 | 187 | 209 |
| 1964 | 139 | 187 | 185 | 122 | 60 | 182 | 153 | 137 | 142 | 161 | 179 | 200 |
| 1965 | 133 | 179 | 177 | 117 | 60 | 183 | 154 | 178 | 185 | 209 | 232 | 260 |
| 1966 | 173 | 232 | 230 | 152 | 78 | 183 | 161 | 144 | 149 | 169 | 188 | 211 |
| 1967 | 140 | 188 | 186 | 123 | 63 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1968 | 178 | 239 | 237 | 156 | 78 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1969 | 133 | 180 | 178 | 117 | 60 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1970 | 178 | 239 | 237 | 156 | 80 | 188 | 175 | 156 | 162 | 183 | 203 | 228 |
| 1971 | 151 | 203 | 201 | 133 | 68 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1972 | 133 | 180 | 178 | 117 | 58 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1973 | 133 | 180 | 178 | 117 | 60 | 185 | 176 | 157 | 163 | 185 | 205 | 230 |
| 1974 | 153 | 205 | 203 | 134 | 69 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1975 | 178 | 239 | 237 | 156 | 80 | 210 | 197 | 167 | 173 | 196 | 218 | 244 |
| 1976 | 162 | 218 | 216 | 142 | 70 | 140 | 118 | 105 | 109 | 124 | 137 | 154 |
| 1977 | 102 | 137 | 136 | 90 | 46 | 133 | 112 | 100 | 104 | 117 | 130 | 146 |
| 1978 | 97 | 130 | 129 | 85 | 44 | 214 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1979 | 178 | 239 | 237 | 156 | 80 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1980 | 133 | 180 | 178 | 117 | 58 | 237 | 199 | 178 | 184 | 209 | 232 | 260 |

| Table 11. SOD CVP M&I Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 172 | 232 | 230 | 151 | 78 | 183 | 154 | 138 | 143 | 162 | 0 | 201 |
| 1982 | 133 | 180 | 178 | 117 | 60 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1983 | 178 | 239 | 237 | 156 | 80 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1984 | 178 | 239 | 237 | 156 | 78 | 216 | 182 | 162 | 168 | 190 | 212 | 237 |
| 1985 | 157 | 212 | 210 | 138 | 71 | 183 | 154 | 139 | 144 | 163 | 181 | 203 |
| 1986 | 135 | 181 | 179 | 118 | 61 | 183 | 165 | 147 | 152 | 173 | 192 | 215 |
| 1987 | 142 | 192 | 190 | 125 | 64 | 128 | 146 | 130 | 135 | 153 | 170 | 190 |
| 1988 | 126 | 170 | 168 | 111 | 55 | 124 | 105 | 93 | 97 | 110 | 122 | 136 |
| 1989 | 91 | 122 | 121 | 79 | 41 | 122 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1990 | 133 | 180 | 178 | 117 | 60 | 122 | 103 | 92 | 95 | 108 | 120 | 134 |
| 1991 | 89 | 120 | 119 | 78 | 40 | 149 | 132 | 117 | 122 | 138 | 153 | 171 |
| 1992 | 114 | 153 | 152 | 100 | 50 | 167 | 154 | 138 | 143 | 162 | 180 | 201 |
| 1993 | 133 | 180 | 178 | 117 | 60 | 217 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1994 | 178 | 239 | 237 | 156 | 80 | 199 | 165 | 147 | 152 | 173 | 33 | 215 |
| 1995 | 143 | 192 | 190 | 125 | 64 | 240 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1996 | 178 | 239 | 237 | 156 | 78 | 221 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1997 | 178 | 239 | 237 | 156 | 80 | 241 | 202 | 181 | 187 | 212 | 236 | 264 |
| 1998 | 175 | 236 | 233 | 154 | 79 | 245 | 206 | 184 | 190 | 216 | 239 | 268 |
| 1999 | 178 | 239 | 237 | 156 | 80 | 183 | 165 | 146 | 152 | 172 | 191 | 214 |
| 2000 | 142 | 191 | 189 | 124 | 62 | 183 | 171 | 152 | 157 | 178 | 198 | 221 |
| 2001 | 147 | 198 | 196 | 129 | 66 | 179 | 154 | 138 | 143 | 162 | 180 | 201 |
| 2002 | 133 | 180 | 178 | 117 | 60 | 189 | 160 | 140 | 145 | 165 | 183 | 205 |
| 2003 | 136 | 183 | 181 | 119 | 61 | 183 | 154 | 138 | 143 | 162 | 180 | 201 |

Table 12. CVP Exchange Contractor Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1923 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1924 | 979 | 336 | 148 | 154 | 427 | 868 | 901 | 1204 | 1641 | 1865 | 1826 | 1227 |
| 1925 | 754 | 259 | 114 | 118 | 341 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1926 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1927 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1928 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1929 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1930 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1931 | 979 | 336 | 148 | 154 | 443 | 435 | 452 | 604 | 823 | 935 | 916 | 616 |
| 1932 | 754 | 259 | 114 | 118 | 329 | 868 | 901 | 1204 | 1641 | 1865 | 1826 | 1227 |
| 1933 | 754 | 259 | 114 | 118 | 341 | 868 | 901 | 1204 | 1641 | 1865 | 1826 | 1227 |
| 1934 | 754 | 259 | 114 | 118 | 341 | 867 | 901 | 1203 | 1641 | 1864 | 1826 | 1227 |
| 1935 | 754 | 259 | 114 | 118 | 341 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1936 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1937 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1938 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1939 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1940 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1941 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1942 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1943 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1944 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1945 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1946 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1947 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1948 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1949 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1950 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1951 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1952 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1953 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1954 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1955 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1956 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1957 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1958 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1959 | 979 | 336 | 148 | 154 | 443 | 1127 | 1155 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1960 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1961 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1962 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1963 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1964 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1965 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1966 | 979 | 336 | 148 | 154 | 443 | 1127 | 1037 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1967 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1968 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1969 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1970 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1971 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1972 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1973 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1974 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1975 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1976 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1977 | 979 | 336 | 148 | 154 | 443 | 348 | 361 | 483 | 658 | 748 | 732 | 492 |
| 1978 | 754 | 259 | 114 | 118 | 341 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1979 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1980 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |

| Table 12. CVP Exchange Contractor Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1982 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1983 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1984 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1985 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1986 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1987 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1988 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1989 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1990 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1991 | 979 | 336 | 148 | 154 | 443 | 868 | 901 | 1204 | 1641 | 1865 | 1826 | 1227 |
| 1992 | 754 | 259 | 114 | 118 | 329 | 867 | 901 | 1203 | 1641 | 1864 | 1826 | 1227 |
| 1993 | 754 | 259 | 114 | 118 | 341 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1994 | 979 | 336 | 148 | 154 | 443 | 868 | 901 | 1204 | 1641 | 1865 | 1826 | 1227 |
| 1995 | 754 | 259 | 114 | 118 | 341 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1996 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1997 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1998 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 1999 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 2000 | 979 | 336 | 148 | 154 | 427 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 2001 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 2002 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |
| 2003 | 979 | 336 | 148 | 154 | 443 | 1127 | 1170 | 1563 | 2132 | 2421 | 2372 | 1594 |

Table 13. SOD CVP Refuge Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1923 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1924 | 1071 | 690 | 315 | 141 | 102 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1925 | 803 | 517 | 236 | 106 | 80 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1926 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1927 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1928 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1929 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1930 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1931 | 1071 | 690 | 315 | 141 | 106 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1932 | 803 | 517 | 236 | 106 | 77 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1933 | 803 | 517 | 236 | 106 | 80 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1934 | 803 | 517 | 236 | 106 | 80 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1935 | 803 | 517 | 236 | 106 | 80 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1936 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1937 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1938 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1939 | 1071 | 690 | 315 | 141 | 106 | 90 | 128 | 418 | 469 | 115 | 192 | 836 |
| 1940 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1941 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1942 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1943 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1944 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1945 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1946 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1947 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1948 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1949 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1950 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1951 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1952 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1953 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1954 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1955 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1956 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1957 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1958 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1959 | 1071 | 690 | 315 | 141 | 106 | 90 | 108 | 418 | 469 | 115 | 192 | 836 |
| 1960 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1961 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1962 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1963 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1964 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1965 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1966 | 1071 | 690 | 315 | 141 | 106 | 90 | 108 | 418 | 469 | 115 | 192 | 836 |
| 1967 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1968 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1969 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1970 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1971 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1972 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1973 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1974 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1975 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1976 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1977 | 1071 | 690 | 315 | 141 | 106 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1978 | 803 | 517 | 236 | 106 | 80 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1979 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1980 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |

| Table 13. SOD CVP Refuge Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 82 | 836 |
| 1982 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1983 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1984 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1985 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1986 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1987 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1988 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1989 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1990 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1991 | 1071 | 690 | 315 | 141 | 106 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1992 | 803 | 517 | 236 | 106 | 77 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1993 | 803 | 517 | 236 | 106 | 80 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1994 | 1071 | 690 | 315 | 141 | 106 | 68 | 156 | 314 | 352 | 86 | 144 | 627 |
| 1995 | 803 | 517 | 236 | 106 | 80 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1996 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1997 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1998 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 1999 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 2000 | 1071 | 690 | 315 | 141 | 102 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 2001 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 2002 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |
| 2003 | 1071 | 690 | 315 | 141 | 106 | 90 | 208 | 418 | 469 | 115 | 192 | 836 |

Table 14. SOD CVP Losses

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1923 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1924 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1925 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1926 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1927 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1928 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1929 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1930 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1931 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1932 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1933 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1934 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1935 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1936 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1937 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1938 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1939 | 114 | 83 | 85 | 110 | 181 | 167 | 104 | 329 | 512 | 568 | 472 | 185 |
| 1940 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1941 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1942 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1943 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1944 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1945 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1946 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1947 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1948 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1949 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1950 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1951 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1952 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1953 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1954 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1955 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1956 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1957 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1958 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1959 | 114 | 83 | 85 | 110 | 181 | 167 | 104 | 329 | 512 | 568 | 472 | 185 |
| 1960 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1961 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 461 | 568 | 472 | 185 |
| 1962 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1963 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1964 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1965 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1966 | 114 | 83 | 85 | 110 | 181 | 167 | 104 | 329 | 512 | 568 | 472 | 185 |
| 1967 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1968 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1969 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1970 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1971 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1972 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1973 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1974 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1975 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1976 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1977 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1978 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1979 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1980 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |

Table 14. SOD CVP Losses

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1982 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1983 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1984 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1985 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1986 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1987 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1988 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1989 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1990 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1991 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1992 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1993 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1994 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 461 | 568 | 472 | 185 |
| 1995 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1996 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1997 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1998 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 1999 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 2000 | 114 | 83 | 85 | 110 | 174 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 2001 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 2002 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |
| 2003 | 114 | 83 | 85 | 110 | 181 | 167 | 232 | 329 | 512 | 568 | 472 | 185 |

Table 15. Friant Kern Canal Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 81 | 67 | 16 | 16 | 234 | 963 | 3099 | 3528 | 4436 | 3653 | 3199 | 1789 |
| 1923 | 626 | 161 | 107 | 682 | 1305 | 816 | 1652 | 2074 | 2951 | 3102 | 2719 | 1526 |
| 1924 | 541 | 146 | 93 | 93 | 690 | 247 | 312 | 437 | 918 | 1141 | 707 | 428 |
| 1925 | 318 | 149 | 16 | 16 | 167 | 616 | 1122 | 1556 | 2269 | 2382 | 2155 | 1156 |
| 1926 | 422 | 126 | 73 | 73 | 413 | 570 | 1037 | 1435 | 2090 | 2195 | 1987 | 1069 |
| 1927 | 393 | 121 | 68 | 68 | 382 | 891 | 1744 | 2208 | 4017 | 3289 | 2882 | 1615 |
| 1928 | 570 | 151 | 98 | 98 | 731 | 638 | 1163 | 1613 | 2351 | 2468 | 2232 | 1195 |
| 1929 | 434 | 128 | 75 | 75 | 427 | 368 | 463 | 657 | 1425 | 1780 | 1075 | 630 |
| 1930 | 466 | 200 | 16 | 16 | 249 | 359 | 452 | 640 | 1386 | 1730 | 1046 | 615 |
| 1931 | 454 | 196 | 16 | 16 | 242 | 161 | 207 | 284 | 568 | 702 | 419 | 288 |
| 1932 | 217 | 114 | 16 | 16 | 193 | 899 | 1811 | 2292 | 3263 | 3429 | 3004 | 1682 |
| 1933 | 591 | 155 | 101 | 101 | 789 | 580 | 1055 | 1463 | 2134 | 2241 | 2028 | 1090 |
| 1934 | 400 | 122 | 69 | 69 | 389 | 327 | 412 | 581 | 1248 | 1557 | 946 | 560 |
| 1935 | 414 | 182 | 16 | 16 | 220 | 802 | 1624 | 2041 | 2905 | 3053 | 2676 | 1503 |
| 1936 | 534 | 145 | 92 | 92 | 471 | 1169 | 1639 | 3262 | 3283 | 3130 | 2743 | 1539 |
| 1937 | 545 | 147 | 94 | 94 | 390 | 508 | 1356 | 1911 | 4121 | 3070 | 2691 | 1511 |
| 1938 | 536 | 146 | 430 | 1263 | 1907 | 326 | 782 | 1687 | 4462 | 4487 | 3580 | 2208 |
| 1939 | 897 | 278 | 220 | 220 | 1024 | 785 | 1925 | 1376 | 2002 | 2103 | 1904 | 1026 |
| 1940 | 380 | 119 | 66 | 66 | 353 | 795 | 1567 | 2217 | 3397 | 2873 | 2519 | 1417 |
| 1941 | 506 | 140 | 87 | 87 | 573 | 1541 | 3075 | 2485 | 4362 | 3777 | 3391 | 2093 |
| 1942 | 852 | 266 | 209 | 541 | 1926 | 957 | 1886 | 3466 | 4396 | 3621 | 3172 | 1774 |
| 1943 | 625 | 160 | 106 | 102 | 2033 | 508 | 1464 | 3184 | 3250 | 3203 | 2807 | 1574 |
| 1944 | 557 | 149 | 95 | 95 | 712 | 624 | 1137 | 1577 | 2301 | 2416 | 2186 | 1171 |
| 1945 | 427 | 127 | 74 | 74 | 390 | 932 | 1855 | 2360 | 3433 | 3548 | 3107 | 1739 |
| 1946 | 610 | 158 | 595 | 1218 | 986 | 778 | 1574 | 2201 | 2774 | 2916 | 2557 | 1437 |
| 1947 | 512 | 141 | 88 | 88 | 826 | 602 | 1096 | 1519 | 2213 | 2323 | 2103 | 1128 |
| 1948 | 413 | 124 | 72 | 72 | 389 | 389 | 588 | 838 | 1840 | 2302 | 1376 | 797 |
| 1949 | 586 | 241 | 16 | 16 | 316 | 541 | 983 | 1362 | 1985 | 2085 | 1888 | 1017 |
| 1950 | 377 | 118 | 66 | 66 | 363 | 601 | 1095 | 1518 | 2212 | 2323 | 2102 | 1128 |
| 1951 | 413 | 122 | 1271 | 1271 | 1603 | 631 | 1150 | 1594 | 2325 | 2441 | 2208 | 1183 |
| 1952 | 430 | 127 | 74 | 74 | 832 | 706 | 1735 | 1742 | 4450 | 3792 | 3405 | 2101 |
| 1953 | 856 | 267 | 210 | 508 | 1100 | 680 | 1371 | 1722 | 2448 | 2638 | 2322 | 1274 |
| 1954 | 460 | 132 | 79 | 79 | 455 | 576 | 1048 | 1452 | 2116 | 2222 | 2011 | 1081 |
| 1955 | 397 | 122 | 69 | 69 | 386 | 566 | 1030 | 1428 | 2082 | 2186 | 1979 | 1065 |
| 1956 | 392 | 121 | 68 | 68 | 1567 | 1725 | 1984 | 2538 | 4236 | 3851 | 3372 | 1883 |
| 1957 | 656 | 166 | 112 | 112 | 885 | 677 | 1365 | 1714 | 2437 | 2626 | 2312 | 1269 |
| 1958 | 458 | 132 | 79 | 79 | 453 | 921 | 1609 | 2435 | 4448 | 3774 | 3389 | 2091 |
| 1959 | 852 | 266 | 209 | 209 | 889 | 583 | 1128 | 1461 | 2128 | 2235 | 2023 | 1087 |
| 1960 | 399 | 122 | 69 | 69 | 375 | 345 | 435 | 616 | 1328 | 1658 | 1005 | 592 |
| 1961 | 438 | 190 | 16 | 16 | 233 | 256 | 325 | 456 | 962 | 1197 | 739 | 445 |
| 1962 | 331 | 153 | 16 | 16 | 174 | 848 | 1719 | 2158 | 3073 | 3229 | 2830 | 1587 |
| 1963 | 561 | 150 | 96 | 96 | 1478 | 919 | 1865 | 2343 | 3337 | 3507 | 3072 | 1719 |
| 1964 | 603 | 157 | 103 | 103 | 779 | 520 | 943 | 1305 | 1901 | 1997 | 1809 | 977 |
| 1965 | 364 | 116 | 63 | 1207 | 1549 | 882 | 1789 | 2247 | 3200 | 3363 | 2946 | 1650 |
| 1966 | 581 | 153 | 100 | 567 | 987 | 676 | 1348 | 2446 | 2340 | 2456 | 2222 | 1190 |
| 1967 | 433 | 128 | 70 | 119 | 1614 | 2338 | 1115 | 1554 | 4204 | 4482 | 3626 | 2520 |
| 1968 | 1720 | 551 | 484 | 484 | 1787 | 466 | 585 | 832 | 1824 | 2282 | 1365 | 790 |
| 1969 | 582 | 240 | 16 | 16 | 313 | 636 | 541 | 1223 | 2993 | 4480 | 3423 | 2238 |
| 1970 | 1529 | 495 | 430 | 1040 | 1758 | 1127 | 1428 | 1793 | 2549 | 2680 | 2351 | 1325 |
| 1971 | 476 | 135 | 82 | 82 | 619 | 643 | 1172 | 1625 | 2372 | 2489 | 2252 | 1206 |
| 1972 | 438 | 129 | 76 | 76 | 416 | 536 | 973 | 1348 | 1962 | 2061 | 1867 | 1006 |
| 1973 | 373 | 118 | 65 | 65 | 359 | 841 | 1637 | 1955 | 4089 | 3037 | 2662 | 1495 |
| 1974 | 531 | 145 | 91 | 1291 | 1202 | 1616 | 1710 | 3360 | 4251 | 3207 | 2811 | 1576 |
| 1975 | 557 | 149 | 96 | 96 | 739 | 869 | 1721 | 2176 | 3551 | 3235 | 2835 | 1589 |
| 1976 | 561 | 150 | 96 | 96 | 719 | 376 | 473 | 671 | 1453 | 1815 | 1095 | 642 |
| 1977 | 474 | 202 | 16 | 16 | 253 | 169 | 216 | 298 | 601 | 742 | 447 | 301 |
| 1978 | 226 | 117 | 16 | 16 | 116 | 846 | 1143 | 1880 | 4325 | 4486 | 3716 | 2427 |
| 1979 | 1657 | 533 | 467 | 1039 | 2020 | 1489 | 1631 | 2933 | 3604 | 3024 | 2651 | 1489 |
| 1980 | 529 | 144 | 91 | 80 | 377 | 895 | 1125 | 3308 | 4460 | 4146 | 3559 | 2195 |

Table 15. Friant Kern Canal Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 892 | 277 | 219 | 219 | 934 | 653 | 1315 | 1650 | 2343 | 2525 | 2224 | 1222 |
| 1982 | 443 | 130 | 77 | 77 | 1636 | 2307 | 541 | 2927 | 4461 | 3969 | 3563 | 2197 |
| 1983 | 2093 | 1477 | 151 | 112 | 568 | 91 | 956 | 1480 | 2351 | 4467 | 3869 | 2873 |
| 1984 | 1959 | 1391 | 521 | 1753 | 2042 | 1257 | 1597 | 2005 | 2852 | 2998 | 2628 | 1476 |
| 1985 | 525 | 144 | 90 | 90 | 691 | 596 | 1084 | 1502 | 2187 | 2296 | 2078 | 1116 |
| 1986 | 409 | 124 | 71 | 71 | 390 | 465 | 3033 | 3448 | 4429 | 3497 | 3063 | 1714 |
| 1987 | 602 | 157 | 103 | 103 | 804 | 483 | 875 | 1209 | 1891 | 2366 | 1413 | 817 |
| 1988 | 601 | 246 | 16 | 16 | 313 | 340 | 428 | 606 | 1306 | 1630 | 988 | 583 |
| 1989 | 431 | 188 | 16 | 16 | 230 | 395 | 497 | 705 | 1533 | 1916 | 1153 | 674 |
| 1990 | 497 | 210 | 16 | 16 | 266 | 301 | 380 | 535 | 1144 | 1426 | 871 | 518 |
| 1991 | 384 | 172 | 16 | 16 | 204 | 422 | 530 | 754 | 1648 | 2060 | 1237 | 720 |
| 1992 | 530 | 222 | 16 | 16 | 275 | 363 | 457 | 646 | 1397 | 1744 | 1055 | 619 |
| 1993 | 458 | 197 | 16 | 16 | 336 | 1156 | 3131 | 3486 | 4349 | 3790 | 3319 | 1854 |
| 1994 | 647 | 165 | 111 | 111 | 871 | 491 | 890 | 1230 | 1790 | 1881 | 1705 | 923 |
| 1995 | 346 | 113 | 60 | 218 | 1530 | 1036 | 2631 | 2029 | 4076 | 4468 | 3874 | 2876 |
| 1996 | 1961 | 622 | 553 | 553 | 2045 | 829 | 2772 | 3141 | 4180 | 3268 | 2863 | 1605 |
| 1997 | 567 | 151 | 91 | 91 | 658 | 1969 | 1583 | 2591 | 2725 | 2865 | 2513 | 1413 |
| 1998 | 505 | 140 | 87 | 87 | 390 | 902 | 565 | 1578 | 2572 | 4481 | 3577 | 2657 |
| 1999 | 1813 | 578 | 511 | 511 | 1953 | 715 | 1445 | 1814 | 2579 | 2711 | 2378 | 1340 |
| 2000 | 481 | 136 | 83 | 83 | 604 | 796 | 1598 | 2007 | 3265 | 2946 | 2583 | 1452 |
| 2001 | 517 | 142 | 89 | 89 | 679 | 568 | 1033 | 1432 | 2085 | 2190 | 1983 | 1066 |
| 2002 | 393 | 121 | 68 | 68 | 381 | 518 | 940 | 1301 | 1892 | 1988 | 1801 | 972 |
| 2003 | 362 | 116 | 63 | 63 | 347 | 623 | 1136 | 1575 | 2297 | 2411 | 2182 | 1169 |

| Table 16. Madera Canal Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1922 | 0 | 0 | 0 | 0 | 2 | 0 | 476 | 957 | 1250 | 1225 | 1064 | 400 |
| 1923 | 48 | 5 | 0 | 6 | 5 | 117 | 322 | 617 | 855 | 1000 | 867 | 322 |
| 1924 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 111 | 301 | 369 | 257 | 36 |
| 1925 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 263 | 793 | 963 | 665 | 106 |
| 1926 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 238 | 711 | 865 | 597 | 94 |
| 1927 | 0 | 0 | 0 | 0 | 0 | 116 | 348 | 671 | 1072 | 1080 | 937 | 350 |
| 1928 | 38 | 2 | 1 | 1 | 3 | 0 | 0 | 277 | 834 | 1013 | 699 | 112 |
| 1929 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 159 | 457 | 557 | 386 | 58 |
| 1930 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 155 | 445 | 543 | 376 | 56 |
| 1931 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 77 | 194 | 140 | 49 | 246 |
| 1932 | 0 | 0 | 0 | 0 | 4 | 117 | 366 | 703 | 974 | 1138 | 987 | 369 |
| 1933 | 48 | 5 | 0 | 0 | 0 | 0 | 0 | 242 | 726 | 882 | 609 | 96 |
| 1934 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 142 | 403 | 491 | 341 | 50 |
| 1935 | 0 | 0 | 0 | 0 | 0 | 65 | 107 | 645 | 894 | 1045 | 906 | 337 |
| 1936 | 49 | 0 | 0 | 0 | 32 | 59 | 329 | 824 | 916 | 1011 | 876 | 326 |
| 1937 | 30 | 5 | 1 | 1 | 65 | 43 | 517 | 791 | 1101 | 987 | 855 | 317 |
| 1938 | 38 | 0 | 3 | 12 | 0 | 9 | 219 | 1124 | 1250 | 1250 | 1221 | 462 |
| 1939 | 35 | 15 | 0 | 0 | 14 | 32 | 143 | 229 | 683 | 830 | 573 | 90 |
| 1940 | 0 | 0 | 0 | 0 | 0 | 78 | 302 | 622 | 1174 | 1250 | 930 | 145 |
| 1941 | 0 | 0 | 0 | 0 | 107 | 15 | 14 | 1016 | 1250 | 1250 | 1250 | 568 |
| 1942 | 75 | 20 | 10 | 13 | 11 | 68 | 391 | 932 | 1213 | 1231 | 1069 | 402 |
| 1943 | 51 | 5 | 0 | 52 | 29 | 168 | 337 | 820 | 925 | 1041 | 903 | 336 |
| 1944 | 41 | 1 | 0 | 0 | 0 | 0 | 0 | 268 | 809 | 983 | 678 | 108 |
| 1945 | 0 | 0 | 0 | 0 | 155 | 107 | 379 | 732 | 1029 | 1190 | 1033 | 388 |
| 1946 | 48 | 5 | 5 | 12 | 14 | 109 | 301 | 617 | 789 | 923 | 800 | 296 |
| 1947 | 36 | 0 | 0 | 0 | 22 | 0 | 0 | 255 | 765 | 929 | 641 | 102 |
| 1948 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 199 | 585 | 712 | 492 | 76 |
| 1949 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 227 | 676 | 822 | 568 | 89 |
| 1950 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 255 | 764 | 929 | 641 | 102 |
| 1951 | 0 | 0 | 201 | 62 | 68 | 0 | 0 | 272 | 821 | 998 | 688 | 110 |
| 1952 | 0 | 0 | 0 | 0 | 5 | 3 | 249 | 1076 | 1250 | 1250 | 1195 | 451 |
| 1953 | 67 | 10 | 0 | 3 | 15 | 0 | 0 | 302 | 916 | 1112 | 767 | 124 |
| 1954 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 241 | 720 | 875 | 604 | 96 |
| 1955 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 237 | 709 | 861 | 595 | 94 |
| 1956 | 0 | 0 | 130 | 274 | 28 | 221 | 411 | 795 | 1215 | 1250 | 1171 | 442 |
| 1957 | 59 | 8 | 0 | 0 | 0 | 0 | 0 | 300 | 911 | 1105 | 762 | 123 |
| 1958 | 0 | 0 | 0 | 0 | 0 | 31 | 3 | 1082 | 1250 | 1250 | 1183 | 447 |
| 1959 | 66 | 10 | 0 | 0 | 0 | 0 | 11 | 242 | 724 | 880 | 608 | 96 |
| 1960 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 | 428 | 521 | 362 | 54 |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 115 | 315 | 385 | 268 | 38 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 87 | 343 | 655 | 908 | 1060 | 920 | 343 |
| 1963 | 43 | 1 | 0 | 0 | 31 | 138 | 379 | 720 | 998 | 1166 | 1012 | 379 |
| 1964 | 38 | 7 | 0 | 0 | 0 | 0 | 0 | 219 | 648 | 788 | 545 | 85 |
| 1965 | 0 | 0 | 0 | 12 | 78 | 130 | 359 | 683 | 947 | 1106 | 960 | 359 |
| 1966 | 43 | 1 | 0 | 5 | 9 | 1 | 0 | 421 | 829 | 1006 | 694 | 111 |
| 1967 | 0 | 0 | 0 | 0 | 50 | 217 | 14 | 1250 | 1250 | 1250 | 1250 | 812 |
| 1968 | 257 | 15 | 11 | 9 | 45 | 0 | 0 | 197 | 580 | 706 | 488 | 76 |
| 1969 | 0 | 0 | 0 | 114 | 0 | 3 | 285 | 1166 | 1250 | 1250 | 1156 | 646 |
| 1970 | 70 | 19 | 0 | 6 | 5 | 32 | 0 | 318 | 968 | 1175 | 810 | 131 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 279 | 845 | 1026 | 708 | 113 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 225 | 669 | 813 | 562 | 88 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 24 | 326 | 626 | 1080 | 973 | 843 | 313 |
| 1974 | 29 | 2 | 1 | 54 | 21 | 192 | 338 | 850 | 1092 | 1043 | 904 | 337 |
| 1975 | 41 | 1 | 0 | 0 | 0 | 47 | 347 | 668 | 998 | 1073 | 931 | 347 |
| 1976 | 44 | 1 | 0 | 0 | 0 | 0 | 0 | 162 | 466 | 568 | 393 | 59 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 204 | 251 | 49 | 154 |
| 1978 | 0 | 0 | 0 | 0 | 97 | 13 | 3 | 1250 | 1250 | 1250 | 1250 | 734 |
| 1979 | 171 | 10 | 0 | 6 | 2 | 21 | 317 | 755 | 949 | 967 | 838 | 311 |
| 1980 | 38 | 0 | 0 | 154 | 234 | 103 | 522 | 1064 | 1250 | 1250 | 1213 | 458 |

| Table 16. Madera Canal Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 59 | 10 | 0 | 0 | 0 | 0 | 0 | 285 | 862 | 1047 | 722 | 116 |
| 1982 | 0 | 0 | 0 | 0 | 40 | 10 | 116 | 1169 | 1250 | 1250 | 1250 | 542 |
| 1983 | 232 | 92 | 217 | 232 | 2 | 0 | 34 | 1250 | 1250 | 1250 | 1250 | 986 |
| 1984 | 193 | 102 | 226 | 64 | 38 | 184 | 308 | 590 | 818 | 957 | 829 | 307 |
| 1985 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 251 | 751 | 913 | 630 | 100 |
| 1986 | 0 | 0 | 0 | 0 | 215 | 149 | 488 | 902 | 1225 | 1162 | 1008 | 378 |
| 1987 | 47 | 8 | 0 | 0 | 0 | 0 | 0 | 204 | 601 | 731 | 505 | 79 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 148 | 421 | 513 | 356 | 53 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 169 | 491 | 597 | 414 | 63 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 132 | 371 | 453 | 315 | 46 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180 | 526 | 640 | 443 | 68 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 157 | 449 | 547 | 379 | 57 |
| 1993 | 0 | 0 | 0 | 0 | 4 | 45 | 517 | 945 | 1222 | 1250 | 1134 | 427 |
| 1994 | 55 | 5 | 0 | 0 | 0 | 0 | 0 | 207 | 612 | 744 | 514 | 80 |
| 1995 | 0 | 0 | 0 | 1 | 57 | 78 | 311 | 1250 | 1250 | 1250 | 1250 | 1113 |
| 1996 | 418 | 21 | 13 | 10 | 24 | 227 | 484 | 821 | 1092 | 1067 | 926 | 345 |
| 1997 | 35 | 3 | 98 | 698 | 136 | 246 | 304 | 684 | 1060 | 1250 | 923 | 144 |
| 1998 | 0 | 0 | 0 | 0 | 94 | 47 | 83 | 1250 | 1250 | 1250 | 1250 | 928 |
| 1999 | 198 | 56 | 43 | 34 | 57 | 0 | 0 | 323 | 984 | 1194 | 823 | 133 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 17 | 316 | 605 | 897 | 959 | 831 | 308 |
| 2001 | 8 | 7 | 5 | 4 | 4 | 0 | 0 | 238 | 710 | 863 | 596 | 94 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 218 | 646 | 785 | 543 | 85 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 268 | 807 | 980 | 676 | 108 |

Table 17. Stockton East / Central San Joaquin Deliveries

CFS

| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1922 | 145 | 103 | 90 | 76 | 76 | 85 | 118 | 299 | 458 | 501 | 385 | 227 |
| 1923 | 138 | 103 | 90 | 76 | 76 | 111 | 97 | 284 | 471 | 515 | 394 | 195 |
| 1924 | 142 | 103 | 90 | 76 | 76 | 135 | 283 | 340 | 387 | 417 | 327 | 209 |
| 1925 | 117 | 103 | 90 | 76 | 76 | 85 | 97 | 207 | 470 | 542 | 414 | 241 |
| 1926 | 156 | 103 | 90 | 76 | 76 | 5 | 0 | 110 | 211 | 237 | 164 | 69 |
| 1927 | 11 | 0 | 0 | 0 | 0 | 85 | 97 | 300 | 450 | 521 | 398 | 239 |
| 1928 | 121 | 103 | 90 | 76 | 74 | 85 | 105 | 299 | 457 | 498 | 382 | 232 |
| 1929 | 155 | 103 | 90 | 76 | 76 | 0 | 81 | 150 | 147 | 206 | 142 | 59 |
| 1930 | 19 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1931 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1932 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1933 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1934 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1935 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1936 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 121 | 200 | 237 | 164 | 58 |
| 1937 | 12 | 2 | 0 | 0 | 0 | 85 | 97 | 300 | 458 | 506 | 388 | 234 |
| 1938 | 144 | 103 | 90 | 76 | 76 | 85 | 97 | 264 | 476 | 526 | 401 | 234 |
| 1939 | 127 | 105 | 90 | 76 | 76 | 85 | 273 | 295 | 417 | 450 | 349 | 206 |
| 1940 | 138 | 106 | 90 | 76 | 74 | 85 | 97 | 318 | 460 | 498 | 382 | 231 |
| 1941 | 139 | 106 | 90 | 76 | 76 | 85 | 97 | 269 | 469 | 518 | 396 | 238 |
| 1942 | 140 | 103 | 90 | 76 | 76 | 85 | 97 | 152 | 481 | 566 | 429 | 250 |
| 1943 | 153 | 103 | 90 | 76 | 76 | 85 | 97 | 286 | 462 | 510 | 390 | 236 |
| 1944 | 146 | 103 | 90 | 76 | 74 | 85 | 185 | 299 | 443 | 481 | 371 | 226 |
| 1945 | 125 | 103 | 90 | 76 | 76 | 85 | 148 | 318 | 451 | 489 | 377 | 227 |
| 1946 | 117 | 103 | 90 | 76 | 76 | 85 | 183 | 303 | 439 | 474 | 367 | 224 |
| 1947 | 138 | 103 | 90 | 76 | 76 | 85 | 275 | 351 | 392 | 439 | 342 | 214 |
| 1948 | 117 | 103 | 90 | 76 | 74 | 0 | 0 | 53 | 220 | 264 | 182 | 76 |
| 1949 | 11 | 1 | 0 | 0 | 0 | 0 | 60 | 126 | 179 | 212 | 146 | 62 |
| 1950 | 21 | 0 | 0 | 0 | 0 | 0 | 28 | 117 | 215 | 239 | 162 | 46 |
| 1951 | 0 | 0 | 0 | 0 | 0 | 85 | 210 | 294 | 423 | 472 | 372 | 228 |
| 1952 | 130 | 103 | 90 | 76 | 74 | 85 | 97 | 298 | 461 | 499 | 378 | 236 |
| 1953 | 158 | 103 | 90 | 76 | 76 | 85 | 208 | 316 | 390 | 465 | 375 | 231 |
| 1954 | 143 | 103 | 90 | 76 | 76 | 85 | 192 | 313 | 417 | 464 | 353 | 233 |
| 1955 | 155 | 103 | 90 | 76 | 76 | 93 | 195 | 296 | 432 | 462 | 379 | 208 |
| 1956 | 150 | 103 | 90 | 76 | 74 | 85 | 220 | 297 | 449 | 476 | 360 | 203 |
| 1957 | 123 | 106 | 90 | 76 | 76 | 85 | 228 | 246 | 420 | 491 | 379 | 234 |
| 1958 | 129 | 105 | 90 | 76 | 76 | 85 | 97 | 230 | 456 | 538 | 405 | 237 |
| 1959 | 160 | 107 | 90 | 76 | 76 | 88 | 247 | 363 | 394 | 463 | 357 | 147 |
| 1960 | 151 | 106 | 90 | 76 | 74 | 0 | 76 | 129 | 164 | 209 | 145 | 61 |
| 1961 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 76 | 136 | 171 | 214 | 149 | 62 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 113 | 216 | 249 | 165 | 59 |
| 1964 | 4 | 0 | 0 | 0 | 0 | 2 | 117 | 135 | 161 | 200 | 134 | 56 |
| 1965 | 3 | 0 | 0 | 0 | 0 | 85 | 97 | 310 | 470 | 507 | 355 | 236 |
| 1966 | 152 | 103 | 90 | 76 | 76 | 85 | 262 | 330 | 402 | 433 | 340 | 214 |
| 1967 | 148 | 103 | 90 | 76 | 76 | 85 | 97 | 209 | 449 | 554 | 421 | 247 |
| 1968 | 151 | 103 | 90 | 76 | 74 | 85 | 216 | 320 | 422 | 459 | 355 | 221 |
| 1969 | 137 | 103 | 90 | 76 | 76 | 85 | 97 | 314 | 469 | 508 | 390 | 221 |
| 1970 | 129 | 103 | 90 | 76 | 76 | 85 | 180 | 331 | 422 | 470 | 363 | 224 |
| 1971 | 137 | 103 | 90 | 76 | 76 | 85 | 208 | 293 | 432 | 468 | 361 | 222 |
| 1972 | 144 | 103 | 90 | 76 | 74 | 148 | 241 | 346 | 391 | 429 | 334 | 194 |
| 1973 | 129 | 103 | 90 | 76 | 76 | 85 | 143 | 343 | 447 | 484 | 372 | 221 |
| 1974 | 117 | 103 | 90 | 76 | 76 | 85 | 97 | 305 | 460 | 479 | 410 | 244 |
| 1975 | 132 | 103 | 90 | 76 | 76 | 85 | 97 | 307 | 465 | 510 | 365 | 237 |
| 1976 | 122 | 105 | 90 | 76 | 98 | 203 | 258 | 330 | 372 | 403 | 283 | 197 |
| 1977 | 144 | 103 | 90 | 76 | 101 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 85 | 97 | 265 | 477 | 522 | 399 | 209 |
| 1979 | 157 | 103 | 90 | 76 | 76 | 85 | 118 | 315 | 462 | 489 | 384 | 233 |
| 1980 | 127 | 103 | 90 | 76 | 74 | 85 | 165 | 292 | 453 | 456 | 377 | 230 |

| Table 17. Stockton East / Central San Joaquin Deliveries | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | | | | | | | | | | | | |
| | oct | nov | dec | jan | feb | mar | apr | may | jun | jul | aug | sep |
| 1981 | 151 | 106 | 90 | 76 | 76 | 85 | 144 | 295 | 456 | 499 | 383 | 231 |
| 1982 | 119 | 103 | 90 | 76 | 76 | 85 | 97 | 285 | 482 | 552 | 419 | 173 |
| 1983 | 117 | 103 | 90 | 76 | 76 | 85 | 97 | 157 | 501 | 587 | 431 | 208 |
| 1984 | 146 | 103 | 90 | 76 | 74 | 85 | 201 | 347 | 422 | 463 | 358 | 221 |
| 1985 | 117 | 103 | 90 | 76 | 76 | 85 | 179 | 339 | 425 | 481 | 366 | 206 |
| 1986 | 131 | 103 | 90 | 76 | 76 | 85 | 103 | 297 | 472 | 516 | 396 | 181 |
| 1987 | 157 | 106 | 90 | 76 | 76 | 85 | 188 | 332 | 429 | 463 | 358 | 222 |
| 1988 | 136 | 103 | 90 | 76 | 74 | 26 | 62 | 121 | 178 | 204 | 140 | 59 |
| 1989 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 85 | 97 | 231 | 446 | 540 | 410 | 245 |
| 1996 | 158 | 103 | 90 | 76 | 74 | 85 | 97 | 182 | 479 | 567 | 429 | 252 |
| 1997 | 122 | 103 | 90 | 76 | 76 | 85 | 152 | 346 | 428 | 475 | 360 | 226 |
| 1998 | 141 | 103 | 90 | 76 | 76 | 85 | 97 | 115 | 494 | 594 | 448 | 255 |
| 1999 | 126 | 103 | 90 | 76 | 76 | 85 | 141 | 332 | 440 | 480 | 370 | 218 |
| 2000 | 146 | 103 | 90 | 76 | 74 | 85 | 117 | 281 | 447 | 528 | 401 | 236 |
| 2001 | 117 | 103 | 90 | 76 | 76 | 85 | 148 | 297 | 443 | 493 | 381 | 220 |
| 2002 | 145 | 103 | 90 | 76 | 76 | 0 | 78 | 127 | 181 | 202 | 140 | 59 |
| 2003 | 20 | 0 | 0 | 0 | 0 | 0 | 6 | 101 | 207 | 240 | 156 | 71 |

## Introduction

There is reasonable concern about how climate change might affect the economic and hydrologic parameters that determine the CVP Cost Allocation. Analysis depicting some project benefits and single-purpose facility sizing has been performed using historical hydrology. Reclamation maintains that 1) the direction and magnitude of climate change effects on cost allocation parameters are difficult to state due to multiple areas of uncertainty, and 2) it is not cost-effective or appropriate to generate multiple cost allocations based upon economic and hydrologic conditions which are not yet known with certainty. To address concerns, a statistical investigation was undertaken to determine whether historical hydrology falls within the range of potential climate futures and thus is a suitable basis from which to perform analysis that defines the Cost Allocation. It will be demonstrated that:

1. Historic inflows to the Sacramento and San Joaquin Rivers (the selected measure of water supplies) are not statistically different from the Central Tendency of projected future inflows.
2. The range of projected future inflows brackets the historic range of inflows.
3. Historic total CVP deliveries are not statistically different than the Central Tendency of projected future deliveries.
4. The range of projected future deliveries brackets the historic range of deliveries.

## Climate Scenarios

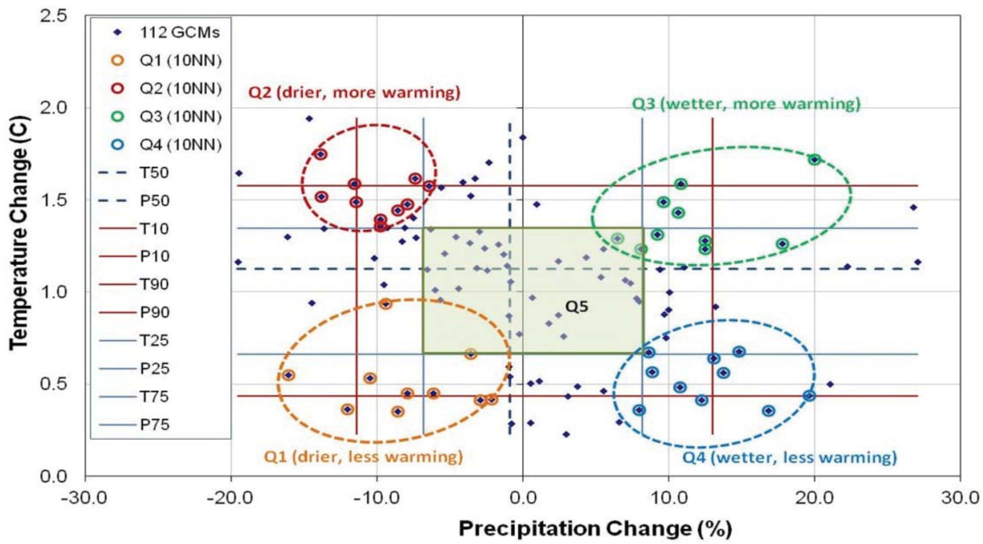
The purpose of the statistical testing was to evaluate whether the historical water supplies and deliveries are significantly different than would occur under future climate conditions. To make this assessment, water supply and delivery results from the Sacramento and San Joaquin Basins Study (SSJBS) were used. Five future climate scenarios were developed for Reclamation's recently published SSJBS (Reclamation 2016) using bias-corrected and spatially downscaled global climate model simulation results from the Coupled Model Intercomparison Project Phase 5 (CMIP5). The CMIP5 dataset consist of 175 individual climate projections which are the most recent projections made by the International Panel on Climate Change (IPCC) for the IPCC Fifth Assessment Report (IPCC 2013). The five climate scenarios were based on ensembles of individual CMIP5 temperature and precipitation projections. These future climate scenarios along with a historically based reference climate were used to simulate 21st century climate-informed inflows and demands in the Sacramento and San Joaquin Basins. For the SSJBS, the WEAP-CV model was used to simulate watershed water supply and demands. The CalLite-CV model was used to simulate water deliveries based on the WEAP-CV projected reservoir inflows and water demands. The CalLite-CV model is similar to the CalSim2 model used as the basis for water deliveries in the Cost Allocation Study. Both models simulate CVP demands, but the CalLite-CV has a more simplified representation of water management operations. Although simplified, the CalLite-CV model was calibrated to simulate CalSim2 results.

The six climate scenarios used in the statistical analyses representing potential future climate conditions include:

- No Climate Change (NoCC) – This reference climate was developed based on a historic period reconstruction developed by Liveneh (2013). The NoCC scenario has a starting date of 10/1925 and covers an 85-year period of record.
- Central Tendency (CEN, or Q5) – This ensemble includes a large number of individual projections bounded by the 25th and 75th percentiles of temperature and precipitation changes. Relative to the other potential future climate scenarios, the Q5 scenario includes a substantially greater number of individual projections than any of the other scenarios.
- Warm Dry (WD, or Q1) – This ensemble is formed from 10 individual projections that are closest to the intersection of 10th percentiles of temperature increases and precipitation decreases[1].
- Hot Dry (HD, or Q2) – This ensemble is formed from 10 individual projections that are closest to the intersection of 90th and 10th percentiles of temperature increases and percent precipitation changes respectively.
- Hot Wet (HW, or Q3) – This ensemble is formed from 10 individual projections that are closest to the intersection of 90th percentiles of temperature increases and percent precipitation changes.
- Warm Wet (HW, or Q4) – This ensemble is formed from 10 individual projections that are closest to the intersection of 10th and 90th percentiles of temperature increase and percent precipitation changes respectively.

This scenario-based approach allows the uncertainty contained in the 175 CMIP5 individual climate projections (small blue dots on Figure 1) to be represented by five future climate scenarios. Figure 1 shows the relationships between the individual climate projections and the five representative ensemble-informed climate scenarios.

[1] Note: The 10th percentile of the percent precipitation change means there are only 10% of projections that are drier. Similarly, the 90th percentile of the percent precipitation change means there are only 10% of projections that are wetter.




Notes:
The Q5 scenario is bounded by the 25th and 75th percentile joint temperature-precipitation change. Scenarios Q1-Q4 are selected to reflect the results of the 10 projections nearest each of 10th and 90th joint temperature-precipitation change bounds. Representative gridcell at American River Basin used as example; 10 NN Method.

**Figure 1. Relationship between changes in mean annual temperature and precipitation. The Y axis shows temperature change from 0 degrees to 2.5 degrees Celsius. The X axis shows precipitation change ranging from 30% less to 30% more. This figure is presented as an example of how the climate scenarios are formed from ensembles of projections and does not represent actual data used in the analyses.**

Additional information on the future climate conditions, development of climate scenarios, and simulation of hydroclimate and water delivery is available in the SSJBS Technical Report ( http://www.usbr.gov/watersmart/bsp/ ).

## Statistical Tests

Using these climate scenarios (Q1, Q2, Q3, Q4, and Q5) and the historic climate reconstruction (NoCC), the SSJBS simulated both CVP water supplies and deliveries. To evaluate the significance of differences between the historic and potential future water supplies and CVP deliveries, the medians of these results were statistically compared. The statistical analyses were performed using the nonparametric Mann-Whitney test because the distribution of these water supplies and deliveries are most likely not normally distributed. And even if they were normally distributed, a non-parametric test would still provide valid results, especially for the large water supply and delivery datasets employed in the statistical testing. The Mann-Whitney analysis tests the Null hypothesis that the medians of two datasets are not equal. For the tests performed here, the Null hypothesis is that the median of the NoCC scenario is not equal to medians of Q1, Q2, Q3, Q4, and Q5 inflow and delivery data sets. All tests were performed at a 0.05 level of significance (i.e., there is a less than 5% chance of rejecting the Null hypothesis when in fact it is true). Test results were considered significant when the P-value was less than 0.05. When the P-value is greater than or equal to 0.05, the Null hypothesis is rejected. Rejecting the Null hypothesis implies the data sets being compared are statistically different, while failing to reject (accepting) the Null hypothesis implies the data sets being compared are statistically the same.

## CalLite-CV Inflow Analyses

The Mann-Whitney analyses compared monthly inflows to the Sacramento and San Joaquin rivers by evaluating whether the NoCC median results in the 85-year historic period from 1925 to 2009 were statistically different than the medians of five climate scenarios results in the future period from 2014 to 2099. Boxplots of total monthly inflows for each of the climate scenarios are shown in Figures 2 and 3 below[2].

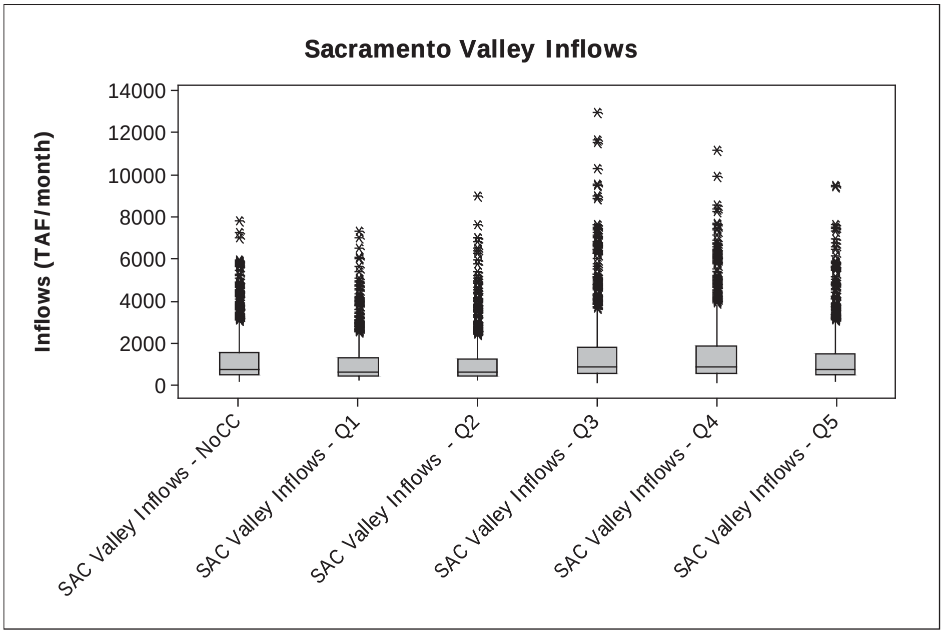



**Figure 2. Simulated Sacramento Valley monthly inflows during the 2014 to 2099 simulation period.**

[2] Note: Asterisks in Figures 2 and 3 do NOT represent statistical outliers and were included in the analyses.

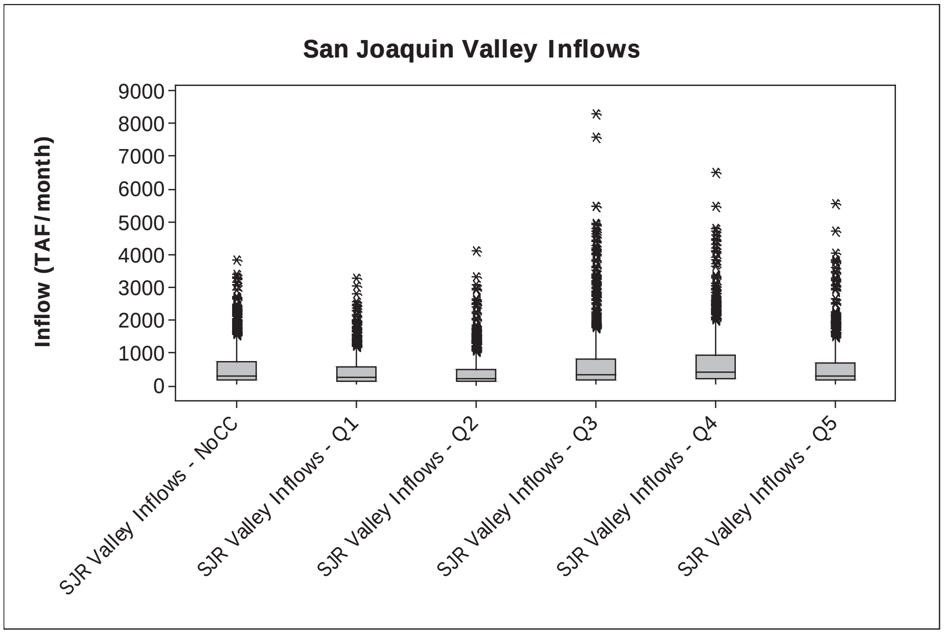



**Figure 3. Simulated San Joaquin Valley monthly inflows during the 2014 to 2099 simulation period.**

The total period inflows for the NoCC and percent differences between the NoCC and each of the climate scenarios are presented in Table 1 below.

| Total Period 2014-2099 | Climate Scenarios | | | | | |
|---|---|---|---|---|---|---|
| | NoCC | Q1 | Q2 | Q3 | Q4 | Q5 |
| Total Inflows | TAF | % Change wrt NoCC | | | | |
| SAC | 1,232,029 | -14 | -15 | 23 | 23 | 3 |
| SJR | 557,065 | -22 | -24 | 29 | 33 | 0.3 |

**Table 1.**
Note: The Sacramento River (SAC) and San Joaquin River (SJR) inflows presented in the table are the sum of the basin inflows during the 85-year simulation period from 2014 to 2099.

Mann-Whitney tests of inflows to both the Sacramento and San Joaquin Valleys reveal that the Null hypothesis that NoCC median is not equal to Q5 median is the only comparison among the five future climate scenarios that cannot be rejected (P value > 0.05). All of the other climate scenarios are significantly different from the NoCC (P value < 0.05). Furthermore, the Q1-Q4 scenario inflows bracket NoCC scenario inflows, with the wetter scenarios Q3 and Q4 having more inflow and the drier scenarios having less inflow. The Q5 inflows are not statistically different from the NoCC inflows.

The Mann-Whitney test results for each of the comparisons of NoCC with the future climate scenarios follow[3]:

**Mann-Whitney Test: SAC & SJR Valley Inflows – NoCC - Q1**

| | N | Median |
|---|---|---|
| SAC Valley Inflows - NoCC | 1020 | 756.7 |
| SAC Valley Inflows - Q1 | 1020 | 647.3 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0000

N Median

| | N | Median |
|---|---|---|
| SJR Valley Inflows - NoCC | 1020 | 318.92 |
| SJR Valley Inflows - Q1 | 1020 | 242.24 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0000

**Mann-Whitney Test: SAC & SJR Valley Inflows - NoCC - Q2**

| | N | Median |
|---|---|---|
| SAC Valley Inflows - NoCC | 1020 | 756.7 |
| SAC Valley Inflows - Q2 | 1020 | 625.1 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0000

| | N | Median |
|---|---|---|
| SJR Valley Inflows - NoCC | 1020 | 318.92 |
| SJR Valley Inflows - Q2 | 1020 | 223.68 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0000

**Mann-Whitney Test: SAC & SJR Valley Inflows - NoCC - Q3**

| | N | Median |
|---|---|---|
| SAC Valley Inflows - NoCC | 1020 | 756.7 |
| SAC Valley Inflows - Q3 | 1020 | 840.8 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0001

| | N | Median |
|---|---|---|
| SJR Valley Inflows - NoCC | 1020 | 318.92 |
| SJR Valley Inflows - Q3 | 1020 | 356.25 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0053

[3] Note: P-values > 0.05 indicate that median values of the NoCC and a particular ensemble scenario (Q1 to Q5) are NOT statistically significantly different. These P-values are highlighted in **bold** text.

**Mann-Whitney Test: SAC & SJR Valley Inflows - NoCC- Q4**

| | N | Median |
|---|---|---|
| SAC Valley Inflows - NoCC | 1020 | 756.7 |
| SAC Valley Inflows - Q4 | 1020 | 857.5 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0000

| | N | Median |
|---|---|---|
| SJR Valley Inflows - NoCC | 1020 | 318.92 |
| SJR Valley Inflows - Q4 | 1020 | 400.59 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0000

**Mann-Whitney Test: SAC & SJR Valley Inflows - NoCC - Q5**

| | N | Median |
|---|---|---|
| SAC Valley Inflows - NoCC | 1020 | 756.7 |
| SAC Valley Inflows - Q5 | 1020 | 728.2 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at **P-value = 0.7376**

| | N | Median |
|---|---|---|
| SJR Valley Inflows - NoCC | 1020 | 318.92 |
| SJR Valley Inflows - Q5 | 1020 | 305.21 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at **P-value = 0.1419**

## CalLite-CV Delivery Analysis

Statistical analyses of CVP deliveries were also performed by comparing the median of annual CalLite-CV simulated CVP deliveries in the NoCC scenario (1925-2009) with the medians of each of the five climate scenarios (Q1 to Q5) in the future period from 2014-2099. Boxplots of the total annual CVP Deliveries for the NoCC and each of the climate scenarios are shown in Figure 4.

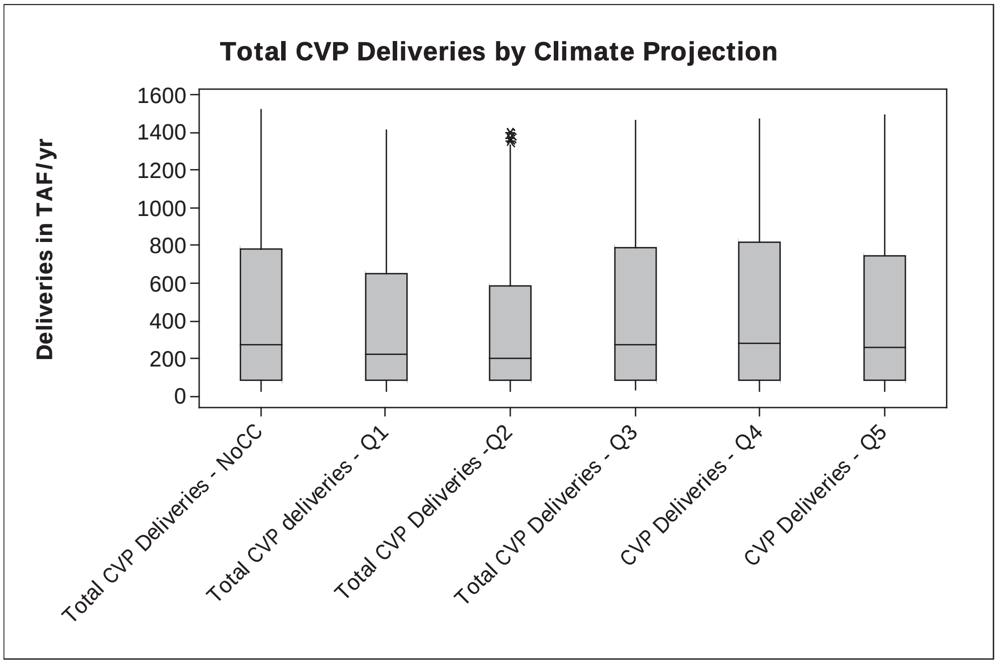



**Figure 4. Total annual CVP deliveries by climate projection from 2014 to 2099.**

The total period deliveries for the NoCC and percent differences for each of the climate scenarios are presented in Table 2 below.

| Total Period 2014-2099 | Climate Scenarios | | | | | |
|---|---|---|---|---|---|---|
| | NoCC | Q1 | Q2 | Q3 | Q4 | Q5 |
| Total Deliveries | TAF | % Change wrt NoCC | | | | |
| CVP | 458,371 | -17 | -19 | -1 | 4 | -4 |

**Table 2.**
Note: The total deliveries and percent differences presented in Table 2 are based on the sum of the annual CVP deliveries during the 85-year simulation period.

The Mann-Whitney tests of total annual CVP deliveries indicate the Null hypothesis that the median NoCC deliveries are not equal to median Q3, Q4 and Q5 deliveries is rejected (P-values > 0.05). However, the Null hypothesis cannot be rejected for the Q1 and Q2 scenarios (P-values < 0.05). Therefore, the Q3, Q4, and Q5 median deliveries are not statistically different from the NoCC deliveries. The Q5 (Central Tendency) deliveries are very slightly less than under NoCC (see NoCC – Q5 test results below). The Q3 (Hot, Wet) total deliveries are nearly the same as NoCC; while the Q4 (Warm, Wet) are slightly larger than NoCC. Both the Q1 (Warm, Dry) and Q2 (Hot, Dry) median deliveries are considerably less than the NoCC median deliveries. Thus, the Q1, Q2 and Q4 scenarios bracket the NoCC scenario deliveries while the Q3 and Q5 deliveries are nearly the same as the NoCC deliveries.

The Mann-Whitney test results comparing the NoCC median deliveries to each of the climate scenario medians are presented below[4]:

**Mann-Whitney Test: Total CVP Deliveries – NoCC - Q1**

| | N | Median |
|---|---|---|
| Total CVP Deliveries - NoCC | 1020 | 270.30 |
| Total CVP deliveries - Q1 | 1020 | 223.14 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0237

**Mann-Whitney Test: Total CVP Deliveries – NoCC - Q2**

| | N | Median |
|---|---|---|
| Total CVP Deliveries - NoCC | 1020 | 270.30 |
| Total CVP Deliveries -Q2 | 1020 | 200.23 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at P-value = 0.0001

**Mann-Whitney Test: Total CVP Deliveries – NoCC - Q3**

| | N | Median |
|---|---|---|
| Total CVP Deliveries - NoCC | 1020 | 270.30 |
| Total CVP Deliveries - Q3 | 1020 | 270.07 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at **P-value = 0.9334**

**Mann-Whitney Test: Total CVP Deliveries - NoCC- Q4**

| | N | Median |
|---|---|---|
| Total CVP Deliveries - NoCC | 1020 | 270.30 |
| CVP Deliveries - Q4 | 1020 | 279.56 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at **P-value = 0.6000**

**Mann-Whitney Test: Total CVP Deliveries - NoCC - Q5**

| | N | Median |
|---|---|---|
| Total CVP Deliveries - NoCC | 1020 | 270.30 |
| CVP Deliveries - Q5 | 1020 | 258.34 |

Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at **P-value = 0.6183**

[4] Note:  P-values > 0.05 indicate that median values of the NoCC and a particular ensemble scenario (Q1 to Q5) are NOT statistically different.  These P-values are highlighted in **bold** text.

## Seasonality Considerations

Climate change can affect the seasonal pattern of inflow as well as the total volume. Previous climate studies have indicated that inflows under climate change will be higher earlier in the water year and lower later in the water year, due to a shift in precipitation patterns and more precipitation falling as rain rather than snow (Reclamation 2016). The SSJBS inflows demonstrate this shift in monthly inflow pattern, as shown in Figure 5. However, CVP deliveries maintain a similar pattern for all climate scenarios (Figure 6).

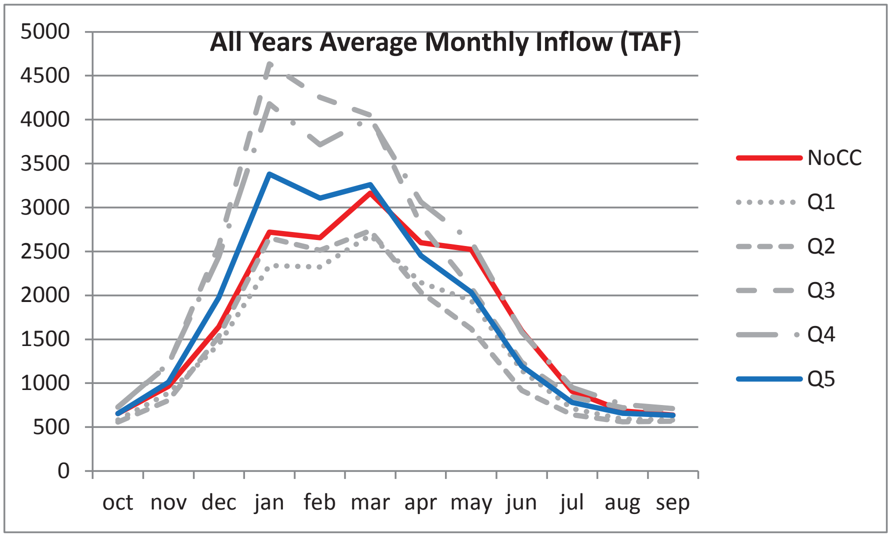



**Figure 5. Inflow patterns under the SSJBS NoCC and Q1-Q5 climate scenarios.**

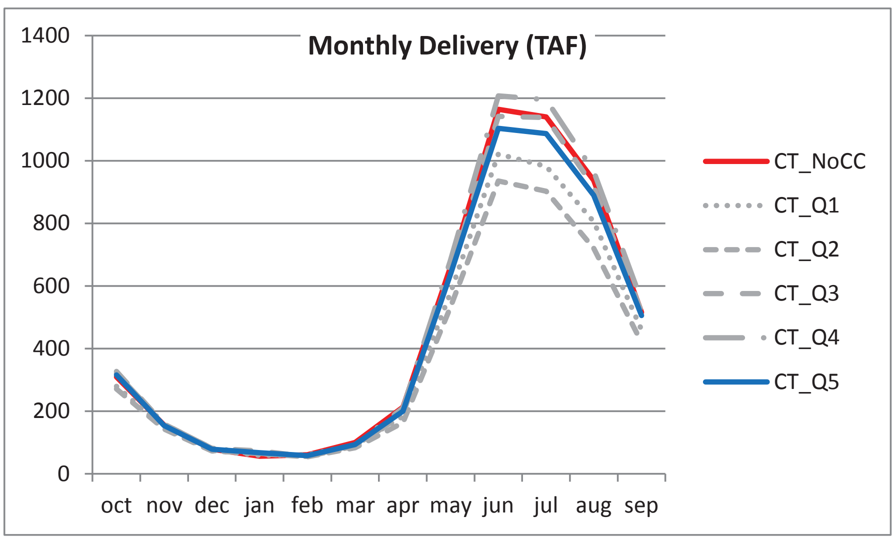



**Figure 6. Delivery patterns under the SSJBS NoCC and Q1-Q5 climate scenarios.**

## Summary and Conclusions

In the previous sections, statistical testing demonstrated that differences between the NoCC historic reference climate and Central Tendency (Q5) future inflows were not statistically significantly different. Furthermore, the NoCC inflows were bracketed by the range of inflows exhibited by the Q1 – Q4 climate scenarios. Similarly, the NoCC deliveries were demonstrated to not be statistically significantly different from the Q3, Q4, and Q5 future climate scenario water deliveries. The NoCC water deliveries were also bracketed by the range of the Q1, Q2, and Q4 future climate scenario deliveries. Finally, changes in the seasonality of inflows occurring in the future climate scenarios were shown to not have a large impact on the delivery of CVP water supplies.

These conclusions support Reclamation’s position that analysis performed with historical hydrology is a sufficient basis for determining the CVP Cost Allocation.

## References

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Livneh, B., E. A. Rosenberg, C. Lin, V. Mishra, K. Andreadis, E. P. Maurer, and D.P. Lettenmaier. 2013. A long-term hydrologically based data set of land surface fluxes and states for the conterminous U.S.: Update and extensions, Journal of Climate, DOI: 10.1175/JCLI-D-12-00508.1.