Lake Del Valle forecast-informed reservoir operations (FIRO) initial viability study

Revised January 31, 2018

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Engineer's certification

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Abbreviations and terms

ACWD	Alameda County Water District
Assurance	Conditional non-exceedence probability, e.g., the likelihood that a specified threshold will not be exceeded, given the occurrence of a specified hydrometeorological event
CDEC	California Data Exchange Center (DWR)
CNRFC	California-Nevada River Forecast Center
DWR	California Department of Water Resources
EBRPD	East Bay Regional Park District
FCD	Flood control diagram
FIRO	Forecast-informed reservoir operations
Flood management pool	The polyhedron whose boundaries define the maximum volume (capacity) that can be used for flood management objectives. Equivalent to the USACE term "flood control pool."
Flood management capacity	Maximum reservoir space available in the flood management pool
HEC-DSS	HEC's data storage system
HEC-HMS	HEC's hydrologic modeling system software application
HEC-ResSim	HEC's reservoir system simulation software application
NWS	National Weather Service
Pool	A polyhedron whose boundaries define a maximum volume (capacity) within the reservoir to be used for an authorized purpose, e.g., flood management or water supply
Runoff capture	The amount of watershed runoff captured by the reservoir, i.e., the change in storage over a given period. For Lake Del Valle, runoff capture is calculated as reservoir inflow less reservoir outflow absent the inflow from and diversions to the SBA.
SBA	South Bay Aqueduct
SCVWD	Santa Clara Valley Water District
Stakeholder Agencies	ACWD, EBRPD, SCVWD, and Zone 7
Storage	Actual quantity of water in a defined volume of the reservoir at a given time

Table A allocation	The maximum amount of State Water Project water that the State agreed to make available for delivery to a participating contractor during the year.
TOC	Top of conservation pool elevation
USACE	US Army Corps of Engineers
USGS	US Geological Survey
Water conservation capacity	Maximum reservoir space available in the water conservation pool
Water conservation pool	The polyhedron whose boundaries define the maximum volume (capacity) that can be used for any non-flood-management authorized purpose
WCM	Water control manual
Water supply availability	Water supply that is available to meet consumption demands at a given time
Water supply capacity	Maximum reservoir space in the water conservation pool allocated to water supply
Zone	Volume within the reservoir defined by operational thresholds
Zone 7	Zone 7 of the Alameda County Flood Control and Water Conservation District or Zone 7 Water Agency

Executive summary

Motivation for this study

Alameda County Water District (ACWD), Santa Clara Valley Water District (SCVWD), and Zone 7 of the Alameda County Flood Control and Water Conservation District (Zone 7 Water Agency or Zone 7), collectively referred to as the South Bay Contractors (SBCs, or "agencies") of the State Water Project (SWP), rely on water deliveries from the Sacramento-San Joaquin Delta (Delta) via the South Bay Aqueduct (SBA) to serve over 2.5 million residents in the San Francisco Bay Area. Lake Del Valle Reservoir (Lake Del Valle) is an off-stream storage facility for the SBA that provides regulatory storage, local water supply storage for two of the SBCs who have pre-established water rights, flood control for Arroyo del Valle and Alameda Creek, and recreation. As part of the SWP infrastructure, Lake Del Valle is owned and operated by the California Department of Water Resources (DWR). However, due to partial federal funding under the Flood Control Act of 1962, Lake Del Valle is regulated by the United States Army Corps of Engineers (USACE) as a non-federal dam and must operate within the flood management guidelines outlined in its Water Control Manual (WCM). Recreation facilities at Lake Del Valle are managed by the East Bay Regional Parks District (EBRPD).

Increased storage in Lake Del Valle would improve water supply availability and reduce the extent of water shortage emergencies caused by delivery disruptions from the Delta and extreme dry conditions. In addition, increased storage could be a valuable benefit to DWR operations as well as to the 2.5 million Bay Area residents that depend on the Delta in the event of a catastrophe such as an earthquake or flooding. In March 2016, the SBCs submitted a concept paper to the California Water Commission's Water Storage Investment Program. The concept paper outlined a study to increase emergency water supply through reoperation of the reservoir while complying with Lake Del Valle's flood management requirements and maintaining or enhancing the functions of the existing recreational facilities. The concept paper advocated modernizing the flood management rules prescribed in the 1978 water control manual (WCM) through use of a forecast-informed reservoir operation (FIRO) approach, which relies on modern weather and water forecasting to optimize reservoir storage and releases.

Scope of FIRO Initial Viability Study

The SBCs and EBRPD (collectively, Stakeholder Agencies) identified three potential methods for increasing water supply availability as follows:

- Forecast-informed reservoir operations (FIRO). FIRO is an operational scheme in which forecasted inflow information is used to reallocate variable flood management capacity to the water conservation pool temporarily and to make operation decisions.
- Permanent reallocation of flood management capacity to the water conservation pool. Reallocation is a set volume by which the water conservation pool is increased and the flood control pool is decreased. (The total capacity of the reservoir is unchanged.)
- Structural changes (for example, a dam raise) to increase total capacity. Structural changes such as dam and spillway raises add

capacity to the reservoir. At Lake Del Valle, such changes would be anticipated to increase the water conservation pool, while maintaining the total flood management capacity.

The Stakeholder Agencies wish to know how FIRO alone or in combination with one of the other potential methods might affect:

- Water supply availability at Lake Del Valle in terms of runoff capture and storage.
- Flood management operations at Lake Del Valle.
- Inundation frequency of recreational facilities at Lake Del Valle.

Analytical approach

The analytical approach for this FIRO initial viability study used historical streamflow data over a 45-year period (1969 through 2015) to simulate a variety of operational outcomes at Lake Del Valle that would require either a planned major deviation from or a revision to WCM rules (USACE Sacramento District 1978). FIRO is based on the idea that modern forecasting and modeling tools can optimize the balance between flood control and water supply more effectively than the existing WCMs by providing adaptive, real-time forecasting. This study modeled a variety of scenarios where portions of the flood control pool in Lake Del Valle were reallocated to the water conservation pool, with reservoir releases in the model triggered by real historical flows "projected" from simulated 5-day forecasts.

A breakdown of the analytical approach for this FIRO initial viability study included the following steps:

1. Development of metrics for assessing the impacts to water supply, flood management, and recreational facilities from the implementation of FIRO alone and with other defined reallocation and structural configurations.
2. Refinement of the Lake Del Valle HEC-ResSim reservoir operations model developed and provided by Zone 7.
3. Definition of baseline (no-change) operations and the operational alternatives (i.e., FIRO alone, reallocation with FIRO, and structural changes with FIRO).
4. Development of a period of hydrologic record to be used as input into the HEC-ResSim model.
5. Configuration of the Lake Del Valle HEC-ResSim model for baseline operations, and simulation of baseline operations.
6. Configuration of the Lake Del Valle HEC-ResSim model for FIRO alone, reallocation with FIRO, and structural change with FIRO, and simulation of those operational alternatives.
7. Analysis, comparison, and interpretation of results from those simulations.

Findings

This study shows that FIRO coupled with either reallocation of the flood control pool or structural changes can increase water supply availability through increases in storage while meeting Lake Del Valle's flood management requirements (per the USACE WCM), given the modeled hydrologic conditions. However, all such scenarios require relocation of the

EBRPD's recreational facilities. Furthermore, all examined alternatives have only very limited potential to enhance runoff capture in Lake Del Valle. Downstream impacts on the alternative scenarios are summarized below:

- FIRO alone. FIRO alone provides a minimal increase in mean monthly average storage of 103 ac-ft per year, and essentially matches the baseline scenario in terms of flood management and recreational impacts. No significant increase in average annual runoff capture was demonstrated.
- Permanent reallocation of flood management capacity to the water conservation pool with FIRO. The reallocation-with-FIRO alternatives provide increases in mean monthly average storage that range from 4,933 ac-ft per year up to 22,062 ac-ft per year. Flood management requirements (per the USACE WCM) are met under all reallocation-with-FIRO scenarios for the modeled period (November 1969 to September 2015). However, storage reallocation with FIRO increases the frequency and magnitude of high release rates (those greater than 2,000 cfs) from the reservoir, with releases greater than 2,000 cfs made off storm peak so as not to exceed downstream thresholds defined by the WCM. More studies are needed to determine the extent of flood management impacts such as increased erosion downstream. Recreational facilities require relocation under all reallocation-with-FIRO alternatives. The reallocation-with-FIRO alternatives showed very minimal average annual runoff capture increases ranging from 36 ac-ft up to 152 ac-ft.
- Structural changes (for example, a dam raise) to increase total capacity with FIRO. Structural changes with FIRO (which added 5,000 ac-ft to the water conservation pool) provide an increase in mean monthly average storage of 4,942 ac-ft per year and a minimal increase in average annual runoff capture of 36 ac-ft. The flood management impact is similar to the baseline scenario. Recreational facilities require relocation.

A brief summary of the findings is provided in Table 1. Table 22 provides a more complete summary of the potential impacts to water supply, flood management, and recreational facilities by alternative, and detailed results can be found in Appendix III through Appendix IX.

Table 1. Brief summary of findings

Reoperation alternative (1)	Water supply availability (2)	Potential impacts (as compared to baseline) on: Flood management (3)	Recreational facilities (4)
FIRO alone	• Slight increase in storage • No increase in runoff capture	Similar to baseline	Similar to baseline
5,000 ac-ft reallocation with FIRO	• Increase in storage proportional to reallocation volume • Slight increase in runoff capture	• Increased pool elevations and downstream flows for largest events and least likely flows • Most-likely flows have a similar probability of exceedence as baseline	• Increased number of days and probability that recreational facilities are inundated • Kayak rental and sewage lift station facilities will need relocation
10,500 ac-ft reallocation with FIRO			
15,000 ac-ft reallocation with FIRO			
25,500 ac-ft reallocation with FIRO			
Structural changes to add 5,000 ac-ft with FIRO	• Increase in storage proportional to reallocation volume • Slight increase in runoff capture	Similar to baseline	

Limitations of this study

Because of the methods, data, and assumptions employed in this initial viability study, the analyses and results are limited in their applicability. In the calculations of storage and runoff capture, the model did not distinguish between Table A water (deliveries from the State Water Project Stored in Lake Del Valle) and local inflows when assigning volumes to storage. Rather, reservoir fill took all types of water and storage was calculated simply as the volume of water in the reservoir. Runoff capture was calculated as the volume of additional reservoir inflows stored in the water conservation pool above the historical baseline. Water rights and agency-specific storage use in Lake Del Valle also did not factor into the study.

In terms of data considerations, the historical streamflow data used in the study was considered "perfect" and no statistical errors were introduced to the model. As a result, all modeling output is precise and based on the perfect input assumption. However, in the analysis of the study's findings, only model output of significant magnitude is discussed. In addition, the streamflow data used to generate the hydrologic dataset spans only 45 years of historical record, and as a result, is not intended to cover the full range of storm

severity that could be experienced in the basin. Specifically, the peak historic events of 1995 and 1998 have return periods of approximately 15 and 20 years respectively (more common than the 100-year storm); more severe storm events would need to be evaluated in future studies. [These return period estimates are based on the USGS peak streamflow data for Alameda Creek near Niles (USGS 2017) and the regulated peak flow-frequency curve on Plate 3 of the Lake Del Valle WCM.] The hydrologic dataset used for the HEC-ResSim model also remained a constant input value and was not iteratively adjusted to account for changes in reservoir operations under different model scenarios.

In terms of FIRO assumptions, the 5-day forecast used in the model was simulated by using real historical values from the historical inflow data series, allowing the simulated forecast to perfectly predict future inflow. This "perfect" forecast is an optimistic representation of FIRO, but was chosen for clarity. Despite these limitations, the study provides a sound basis for deciding whether to pursue further investigations into the feasibility and effectiveness of FIRO, alone or with reallocation, to increase water supply availability in Lake Del Valle.

Future steps to implement reservoir reoperations

Future steps to implementing FIRO, alone or in combination with another alternative, are as follows:

- Implementing FIRO alone could be accomplished through approval of a planned major deviation by the US Army Corps of Engineers (USACE) San Francisco District (USACE South Pacific Division 2013). The USACE guidance explaining the deviation process is provided as Appendix X. DWR would operate Lake Del Valle according to the deviation guidelines provided by the USACE.
- Implementing any reallocation alternative would require a formal revision to the WCM. Changing the WCM would be a considerable, multi-year effort. More studies are also required to evaluate downstream impacts of the modified release patterns and rates from Lake Del Valle reoperation under more severe storm conditions.
- Implementing structural changes would require a planning study, a dam design, and a WCM revision (also a multi-year effort).

Motivation for this study

Alameda County Water District (ACWD), Santa Clara Valley Water District (SCVWD), and Alameda County Flood Control and Water Conservation District (Zone 7), collectively referred to as the South Bay Contractors (SBCs, or "agencies") of the State Water Project (SWP), rely on water deliveries from the Sacramento-San Joaquin Delta (Delta) via the South Bay Aqueduct (SBA) to serve over 2.5 million residents in the San Francisco Bay Area. Lake Del Valle Reservoir (Lake Del Valle) is an off-stream storage facility for the SBA that provides regulatory storage, local water supply storage for two of the SBCs who have pre-established water rights, flood control for Arroyo del Valle and Alameda Creek, and recreation. As part of the SWP infrastructure, Lake Del Valle is owned and operated by the California Department of Water Resources (DWR). However, due to partial federal funding under the Flood Control Act of 1962, Lake Del Valle is regulated by the United States Army Corps of Engineers (USACE) as a non-federal dam and must operate within the flood management guidelines outlined in its water control manual (WCM). Recreation facilities at Lake Del Valle are managed by the East Bay Regional Parks District (EBRPD).

The SBCs are situated south of the Delta but upstream of any major water storage facilities within the southern portions of the SWP, and are therefore uniquely vulnerable to delivery disruptions from the Delta. Lake Del Valle plays an important role in the augmentation of water deliveries to the SBCs when disruptions occur. However, because of limited storage and operational rigidity under the WCM, only short duration disruptions in water deliveries from the Delta can be accommodated. On January 31, 2014, DWR announced a 0% Table A allocation (i.e. no water deliveries from the State Water Project) for the first time in its 54-year history. Although the allocation was subsequently raised to 5%, Table A water was available only after September 1, after the high summer demand season. Furthermore, the extreme dry conditions resulted in highly impaired water quality in the Delta, requiring that supplies in Lake Del Valle be used for water quality blending to meet regulatory water quality standards. All three agencies declared water shortage emergencies as a result of the disrupted Delta deliveries.

Increased storage in Lake Del Valle would improve water supply availability and reduce the extent of water shortage emergencies caused by extreme dry conditions. In addition, increased storage could be a valuable benefit to DWR operations as well as to the 2.5 million Bay Area residents that depend on the Delta in the event of a catastrophe such as an earthquake or flooding. Building upon the 2001 and 2009 Delta Water Supply Reliability Studies that assessed the costs and benefits of increasing storage capacity in Lake Del Valle, the SBCs submitted a concept paper to the California Water Commission's Water Storage Investment Program in March of 2016. The concept paper outlined a study to increase emergency water supply through reoperation of the reservoir while complying with Lake Del Valle's flood management requirements and maintaining or enhancing the functions of the existing recreational facilities. Reoperation of Lake Del Valle would require either approval of a planned major deviation under the existing WCM or a revision to the WCM rules. Specifically, the concept paper advocated modernizing the flood management rules prescribed in the 1978 WCM through use of a forecast-informed reservoir operation (FIRO) approach,

which relies on modern weather and water forecasting to optimize reservoir storage and releases.

The rationale for using FIRO to determine the viability of increasing water supply availability at Lake Del Valle was multifold. The FIRO management strategy was developed initially and tested for proof-of-concept on Lake Mendocino by a coalition of government agencies (including USACE). The August 2017 Preliminary Viability Assessment (PVA) for the Lake Mendocino project determined that FIRO was viable as a management strategy for the study case and could further benefit water supply and environmental flows without diminishing flood control or dam safety—in other words, FIRO supported adjustments to Lake Mendocino's WCM. In addition, the methodology behind the FIRO approach was designed to transfer to other watersheds and reservoir operations. Incorporation of FIRO would also prime the SBCs to benefit directly from the $19 million Proposition 84 Integrated Regional Water Management grant awarded to the San Francisco Bay Region for Atmospheric Quantitative Precipitation Information (AQPI) systems. AQPI explores large-scale, long-range precipitation predictions that help inform reservoir operation and flood risk estimation, and is expected to assist with the improved forecasting necessary for the FIRO program at Lake Mendocino and for any future FIRO adopters in the region.

The SBCs and EBRPD (collectively, the Stakeholder Agencies) are undertaking the studies shown in Table 2 to test the feasibility of proposals listed in the concept paper.

Table 2. Feasibility studies related to this FIRO initial viability study

No. (1)	Element (2)	Description (3)	Conducted by (4)
1	Lake Del Valle forecast informed reservoir operations (FIRO) initial viability study *(This study)*	Critical first test. Evaluate whether flood protection, public safety, and recreation currently provided by the dam/reservoir can be maintained if water supply availability were to be increased through FIRO-based alternatives, including FIRO with storage reallocation and FIRO with the construction of additional storage.	David Ford Consulting Engineers
2	Valuation studies	Assess value of all recreational facilities. Used for cost assumptions if reoperation were to result in need to relocate and expand recreation facilities.	VFA, Inc.
3	Conceptual engineer design to accommodate lowering lake levels	Preliminary engineering study to modify or relocate recreation facilities to become unavailable when lake levels are drawn down below current minimums (boating facilities and water treatment plant intake).	KSN Engineers

No. (1)	Element (2)	Description (3)	Conducted by (4)
4	Yield analysis	Integrated operational modeling to see if Arroyo Valle water supply yield can be increased under existing water rights permits held by Zone 7 and ACWD.	ACWD and Zone 7 Staff
5	Water quality blending analysis	SBA model for blending in dry years to assess benefit of extending limited Delta supply through blending.	ACWD, SCVWD, and Zone 7 Staff

Description of the watershed

Del Valle Dam and Reservoir, shown in Figure *1*, are located on the Arroyo Del Valle, part of the Alameda Creek watershed, just south of Livermore, CA. The watershed area above the reservoir is 146 sq mi and ranges in elevation from 701.70 ft (the typical winter reservoir pool elevation) to 4,089.00 ft (the peak of Eylar Mountain). The Arroyo Del Valle is a tributary to the Arroyo de la Laguna, itself a major tributary of Alameda Creek. Ultimately, the Alameda Creek watershed drains into southern San Francisco Bay.

There are two other reservoirs in the basin, Calaveras Reservoir and Lake Turner (San Antonio Dam). These reservoirs are located on Calaveras and San Antonio creeks, respectively. Both are operated by the San Francisco Public Utilities Commission. Both reservoirs are operated primarily for water supply and historically have little to no effect on flood flows downstream (USACE 1978).

Description of the dam and reservoir

Del Valle Dam and Reservoir were authorized by the federal Flood Control Act of 1962, and federally funded in part. As noted above, the dam is operated by DWR under USACE regulations for non-federal dams. In general, the reservoir is operated to supply water via the SBA and to manage flood flows downstream at the Niles US Geological Survey (USGS) gage.

Del Valle Dam is an earthen embankment structure with a crest elevation of 773.00 ft and crest length of 880.00 ft. Lake Del Valle has 40,000 ac-ft of conservation storage capacity and 37,000 ac-ft of flood management capacity. The dam has five valves at varying elevations for water supply outlets, two 6-ft by 7-ft flood control gates at an invert of 609.05 ft, and an uncontrolled morning glory spillway with a crest elevation of 745.00 ft.

Three potential methods for increasing water supply availability

The Stakeholder Agencies identified three potential methods for increasing water supply availability as follows:

- Forecast-informed reservoir operations (FIRO). FIRO is an operational scheme in which forecasted inflow information is used to reallocate variable flood management capacity to water conservation capacity temporarily and to make operation decisions.

- Permanent reallocation of flood management capacity to water conservation capacity. Reallocation shifts a set volume from the reservoir's flood management capacity to its water conservation capacity, i.e., the top of conservation (TOC) pool elevation is moved upward. (The total capacity of the reservoir is unchanged.)
- Structural changes (for example, a dam raise) to increase total capacity. Structural changes such as dam and spillway raises add capacity to the reservoir. At Lake Del Valle, such changes would be anticipated to increase the water conservation capacity, while maintaining the same flood management capacity.

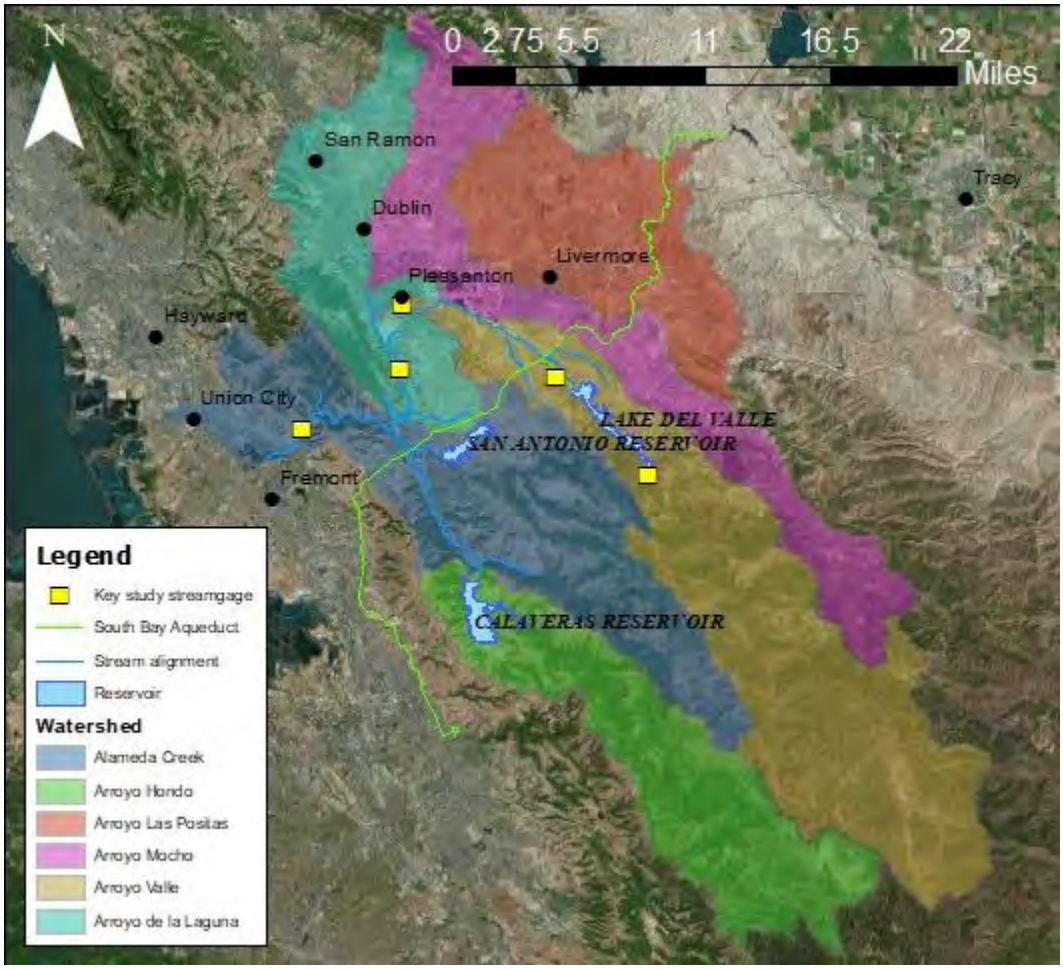

Figure 1*. Lake Del Valle study area*

FIRO definition and components

Lake Del Valle is operated in accordance with the rules documented in its water control manual (WCM) (USACE 1978). The WCM, developed at the time of the reservoir's construction using the best available information, uses fixed volumes allocated to the flood control pool and the water conservation pool. These volumes vary seasonally but are independent of inflow forecasts.

In contrast, forecast-informed reservoir operations (FIRO) is a management strategy that uses modeling, forecasting tools, and improved information to adjust the current reservoir operating procedures to better balance water

supply and flood management needs. FIRO allows operators to use space reserved for flood management to store water for water supply temporarily when forecasts show that corresponding space in the flood management pool will likely not be needed. Similarly, when the forecast indicates a need for the flood management pool to contain the future higher flows, FIRO establishes formal rules for releasing water in anticipation of the impending flood management need. Figure 2 shows an example comparison of traditional operations and hypothetical FIRO for illustrative purposes only.

FIRO entails some risk: anticipatory releases are made with the understanding that future inflows or local flows may fail to occur as forecasted. In that case, the space reallocated for water supply may remain unfilled, resulting in a loss of water supply due to the prior release. In addition, some risk exists that large releases made in anticipation of future flooding that does not occur may cause unnecessary channel damage downstream.

The components of a FIRO system include:

- Shared vision and understanding of operational goals.
- Policy to use variable flood management capacity to enhance water supply availability.
- Adaptive operational rules.
- A decision support system.
- Meteorological monitoring.
- Meteorological forecasting.
- Watershed monitoring.
- Watershed forecasting.

Figure 3 shows these components all contributing to FIRO at Lake Del Valle.

Implementation of FIRO requires changes to the reservoir operation rules. Thus, FIRO implementation requires that the USACE grant permission for a planned major deviation from the WCM. Implementation of any reallocation alternative or structural change alternative would require a revision to the WCM. The process for working with the USACE to bring about these changes is described in the "Synthesis of findings and next steps" section of this report.

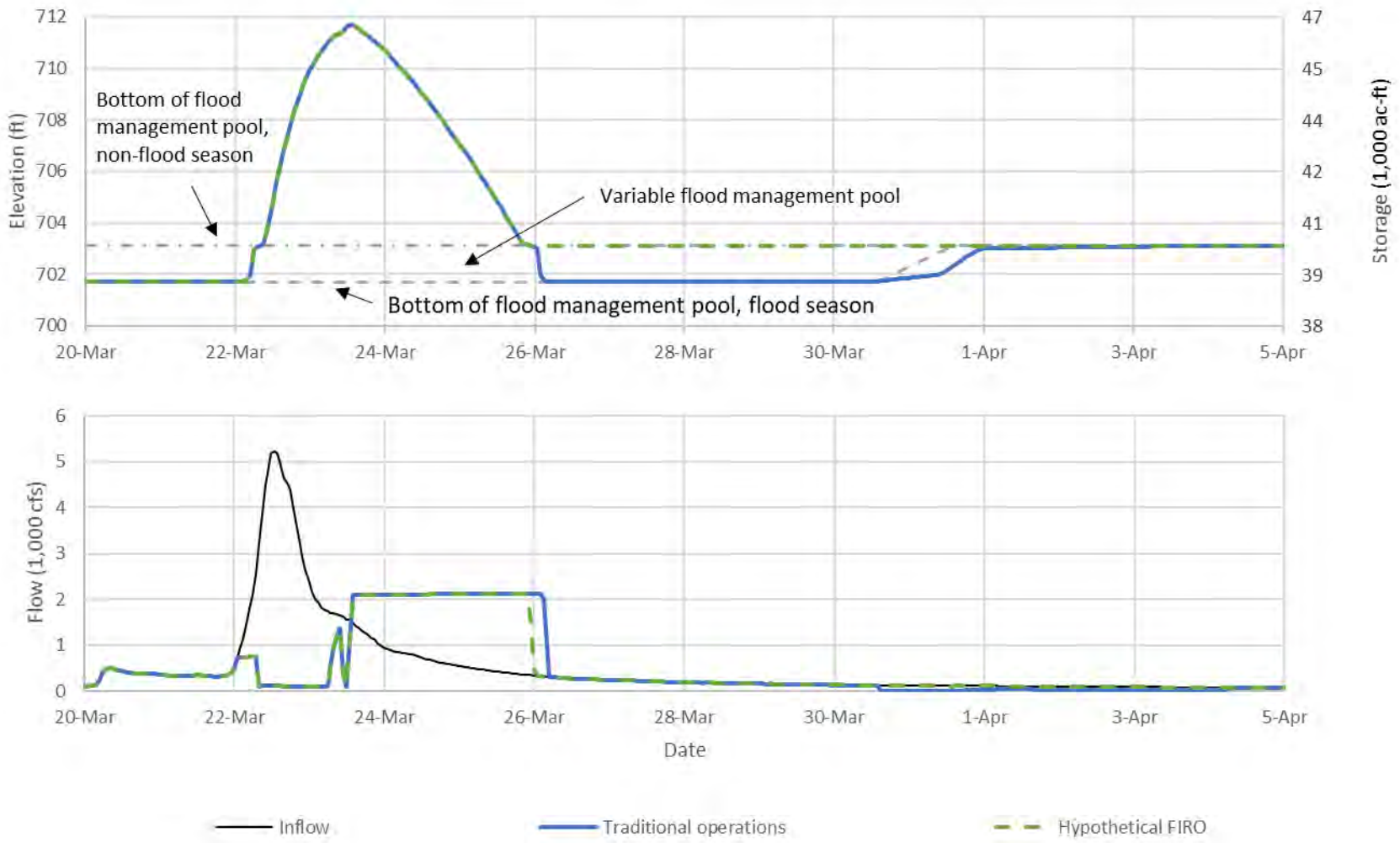

Figure 2. Example comparison of traditional flood-management operations (shown in blue) and hypothetical FIRO (shown in dashed green) for illustrative purposes only. The top portion of this figure shows that with FIRO, water could be stored temporarily in the variable flood management space when this space is likely not needed.

Figure 3. Components of forecast-informed reservoir operations (FIRO)

Scope of this study

The Stakeholder Agencies sought to learn if FIRO alone or in combination with one of the other potential methods could enhance water supply availability at Lake Del Valle while minimizing impacts to flood management and recreational facilities. At the start of this study, they posed the questions listed in column 2 of Table 3. Column 3 of Table 3 shows the answers to those questions.

Table 3. Answers to the questions asked by the Stakeholder Agencies

No. (1)	Question posed by Stakeholder Agencies (2)	Answer (3)
1	What are the components of a FIRO system at Lake Del Valle Reservoir? Who will provide these components? What agencies will be involved and need to be coordinated with?	Components of a FIRO system (and likely provider): • Policy to use variable flood management capacity to enhance water supply availability, including clear operational targets (USACE). • Adaptive operational rules (DWR proposes with stakeholder input and USACE accepts). • A decision support system (Stakeholder Agencies). • Meteorological monitoring (Stakeholder Agencies). • Meteorological forecasting (NOAA, State). • Watershed and stream forecasting (California-Nevada River Forecast Center [CNRFC] of the National Weather Service [NWS]). • Involvement and coordination will be required of these agencies: Stakeholder Agencies, CA Department of Water Resources (DWR), USACE.
2	What policy and procedural shifts are required by the agencies involved to implement FIRO?	For implementation of FIRO alone, no change in WCM needed. However, a planned major deviation must be approved by the USACE San Francisco District. For reallocation of flood management capacity to the water conservation pool, an update to the WCM is needed (with or without FIRO).
3	Will FIRO alone at Lake Del Valle improve water supply availability? If so, when and how are improvements made?	• FIRO alone would increase average annual runoff capture by 1 ac-ft. • FIRO increases mean monthly average (by 103 ac-ft), start-of-season (by 284 ac-ft), and end-of-season (by 59 ac-ft) storages compared to baseline.
4	If FIRO alone improves water supply availability, are there any negative impacts on flood management? If so, when and how are these impacts made?	FIRO alone would not worsen negative impacts on flood management compared to baseline. (In this study, negative impacts [for example, increased peak reservoir releases, pool elevations, and downstream flows] are assumed to occur when flows exceed target thresholds defined in the WCM.)
5	If FIRO alone improves water supply availability, are there any negative impacts on recreation facilities at Lake Del Valle? If so, when, where, and how are these impacts made?	FIRO alone would not worsen negative impacts on recreation facilities compared to baseline. (In this study, negative impacts are assumed to occur when flows exceed target thresholds defined in the WCM.)
6	Will reallocation with FIRO improve water supply availability? If so, when and how are improvements made?	• Reallocation with FIRO would enhance water supply availability compared to baseline and compared to FIRO alone. • Reallocation with FIRO increases mean monthly average, start-of-season, and

No. (1)	Question posed by Stakeholder Agencies (2)	Answer (3)
		end-of-season storages compared to baseline and compared to FIRO alone. Specifically, the increases (from baseline) are 4,933 ac-ft; 5,093 ac-ft; and 4,885 ac-ft for 5,000 ac-ft of reallocation with FIRO, and the increases are 22,208 ac-ft; 22,617 ac-ft; and 22,062 ac-ft for a 25,500 ac-ft of reallocation with FIRO. Increases in average annual runoff capture range from 36 ac-ft under 5,000 ac-ft reallocation with FIRO up to 152 ac-ft under 25,500 ac-ft reallocation with FIRO.
7	If reallocation with FIRO improves water supply availability, are there any negative impacts on flood management? If so, when and how are these impacts made?	Reallocation with FIRO would not worsen negative impacts on flood management compared to baseline and compared to FIRO alone. (In this study, negative impacts are assumed to occur when flows exceed target thresholds defined in the WCM.)

8	If reallocation with FIRO improves water supply availability, are there any negative impacts on recreation facilities at Lake Del Valle? If so, when, where, and how are these impacts made?	• Reallocation with FIRO impacts recreation facilities.
		• Average annual number of days in which threshold pool elevations are exceeded increased proportionally with increasing reallocation volume.
		• The assurance that a given reservoir pool elevation is not exceeded decreases proportionally with increasing reallocation volume.
		• Increased assurance of greater pool elevations impact recreation facilities as follows:
		  • The kayak rental (elevation 705.00 ft) and sewage lift stations (elevation 705.50 ft) are inundated more frequently because water supply reallocation volume requires a top-of-conservation pool elevation higher than these facilities. For example, the minimum water supply reallocation volume (5,000 ac-ft) requires a top-of-conservation pool elevation of 709.91 ft, which is almost 5 ft higher than the kayak rental facilities.
		  • The EBRPD intake (elevation 678.40 ft) and the bottom of the boat ramp (elevation 680.00 ft) are exposed less frequently than under baseline and FIRO only.

9	Will structural changes to the dam with FIRO improve water supply availability? If so, when and how are improvements made?	• Structural changes with FIRO would enhance water supply availability compared to baseline. • Structural changes with FIRO increase mean monthly average (by 4,942 ac-ft), start-of-season, and end-of-season storages compared to baseline. Average annual runoff capture is increased by 36 ac-ft.
10	If structural changes with FIRO improve water supply availability, are there any	Structural changes with FIRO would not worsen negative impacts on flood management compared to baseline.

No. (1)	Question posed by Stakeholder Agencies (2)	Answer (3)
	negative impacts on flood management? If so, when and how are these impacts made?	

11	If structural changes with FIRO improve water supply availability, are there any negative impacts on recreation facilities at Lake Del Valle? If so, when, where, and how are these impacts made?	• Structural changes with FIRO impact recreation facilities.
		• Average annual number of days in which threshold pool elevations are exceeded increases compared to baseline. For example, the average number of days elevation 703.10 ft is exceeded increases by 187 days per year (from 1 day per year) compared to baseline.
		• The assurance that a reservoir pool elevation is not exceeded decreases from the baseline assurance. For example, the assurance that elevation 703.10 ft is not exceeded decreases to 48.8% (from 99.6%) compared to the baseline.
		• Increased assurance of greater pool elevations impact recreation facilities as follows:
		  • The kayak rental (elevation 705.00 ft) and sewage lift stations (elevation 705.50 ft) are inundated more frequently compared to the baseline because the increased water conservation volume requires a top-of-conservation pool elevation higher than these facilities. For example, the increased volume (5,000 ac-ft) requires a top-of-conservation pool elevation of 709.91 ft, which is almost 5 ft higher than the kayak rental facilities. The frequency of this inundation is similar to that of 5,000 ac-ft reallocation with FIRO.
		  • The EBRPD intake (elevation 678.40 ft) and the bottom of the boat ramp (elevation 680.00 ft) are exposed less frequently compared to baseline and FIRO only. The frequency of this exposure is similar to that of 5,000 ac-ft reallocation with FIRO.

Analytical approach

Analysis methods

This analysis assessed the viability of FIRO by simulating reservoir operations of Lake Del Valle and flows throughout the watershed for 45 years of record (November 1969 to September 2015). The reservoir operations simulation software application HEC-ResSim, version 3.3.1.100 (USACE HEC 2016a), was used to simulate the following alternatives:

- Baseline operations: Reservoir operations were simulated as defined by the WCM, given historical hydrology (reservoir inflows and downstream local flows) developed from observed data. Under existing WCM rules, the top of conservation pool elevation (TOC) equals 701.70 ft from November 1 to March 31, and 703.10 ft from April 1 to October 31 (with a bottom elevation of 638.00 ft).
- FIRO alone: Reservoir operations were simulated with historical hydrology using the WCM ruleset modified with FIRO components. For this alternative, the FIRO components include a modified TOC series set equal to 703.10 ft (40,000 ac-ft of capacity with a bottom elevation of 638.00 ft) throughout the year, unless the 5-day forecasted inflow volume exceeds 1,000 ac-ft, at which time the TOC returns to the seasonally defined TOC in the WCM (701.70 ft, providing 39,000 ac-ft of capacity).
- Reallocation with FIRO: Reservoir operations of historical hydrology were simulated using the WCM ruleset modified with FIRO components and a reallocation of flood management capacity to the water conservation pool. Four different reallocation alternatives were analyzed with increases in water supply capacity of 5,000 ac-ft, 10,500 ac-ft, 15,000 ac-ft, and 25,500 ac-ft. (These values are based on proposed water supply capacity increases analyzed in the 2009 *Delta water supply reliability study final report* [CDM 2009].) For each alternative, the water supply capacity reallocation and FIRO components include a modified TOC series set equal to the reallocation TOC throughout the year, unless the 5-day forecasted inflow volume exceeds 1,000 ac-ft, at which time the water in the conservation pool would be drawn down to accommodate the forecasted inflow volume.
- Structural changes with FIRO: Here reservoir operations of historical hydrology were simulated using the WCM ruleset modified with FIRO components and hypothetical dam and spillway raises to accommodate 5,000 ac-ft of additional water conservation capacity. For this alternative, the other TOC elevations are adjusted consistently with this increase in capacity and the FIRO components include modified TOC series set equal to 709.91 ft (45,000 ac-ft of capacity with a bottom elevation of 638.00 ft) throughout the year, unless the 5-day forecasted inflow volume exceeds 1,000 ac-ft, at which time the TOC returns to a seasonally defined TOC of 708.58 ft (with a bottom elevation of 638.00 ft).

A 5-day forecast inflow volume is used here because it is a conservative threshold for triggering pre-releases from a reservoir based on past experience with similar studies and reservoir operations. These values would be refined before implementation of FIRO at Lake Del Valle.

Figure 4 is a visual representation of the alternatives examined in this study.

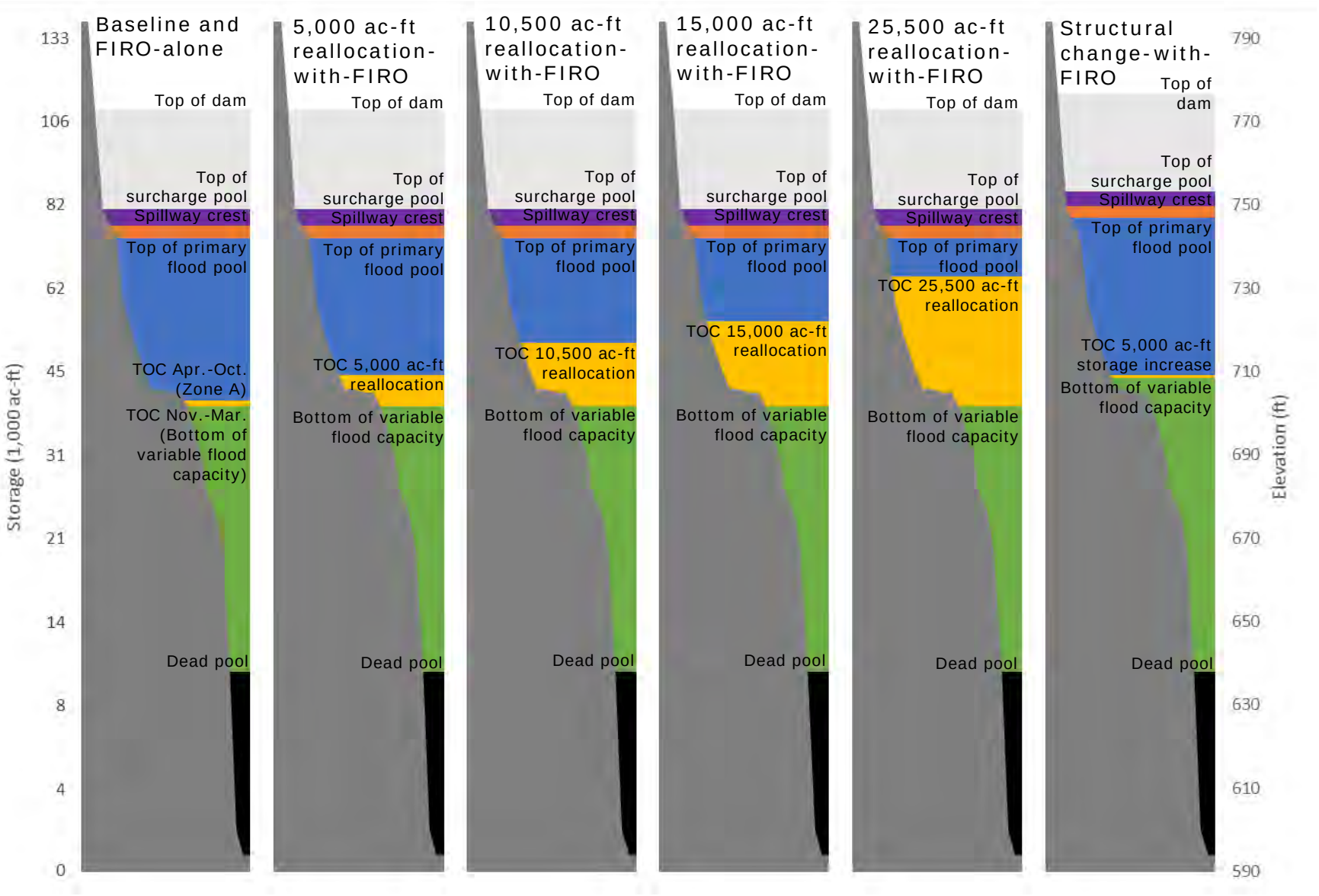

Figure 4. Representation of storage alternatives analyzed

Analysis metrics

The alternative simulation results were compared to those of baseline operations. The 7 metrics listed in Table 4 were used to assess water supply availability, flood management, and recreational facilities impacts. Table 5 shows the thresholds used to analyze event maximum flows at downstream locations, and Table 6 shows the reservoir pool elevation thresholds. The flow thresholds correspond to the damaging flow thresholds listed in the WCM. The reservoir pool elevation thresholds correspond to the operational zone elevations from the water control diagram (in the WCM). The water control diagram is included with this report as Appendix XI.

Table 4. Analysis metrics used to assess water supply availability, flood management, and impacts to recreational facilities

ID (1)	Metric (2)	Used to assess: Water supply availability (3)	Flood management (4)	Recreational facilities (5)
1	Monthly and annual watershed runoff capture	√		
2	Start-of-season/end-of-season storage	√		
3	Monthly average reservoir storage	√		
4	Daily reservoir storage	√		√
5	Event maximum downstream flows		√	
6	Event maximum reservoir release		√	
7	Event maximum reservoir elevations		√	√

Table 5. Downstream flow thresholds

ID (1)	Location (2)	Flow threshold (cfs) (3)
1	Livermore	7,000[1]
2	Pleasanton	7,000[1]
3	Verona	12,000[1]
4	Niles	10,000[2] 13,000[1]

1. Damaging flow threshold (maximum channel capacity) as defined in the WCM.
2. Threshold at which Highway 84 in Niles Canyon is closed (personal conversation with ACWD and Zone 7 staff on 2/24/2017).

Table 6. Reservoir pool elevation thresholds (as defined in the WCM)

ID (1)	Top of pool (zone) elevation (ft) (2)	Bottom of pool (zone) elevation (ft) (3)	Storage volumes (ac-ft) (4)	Zone name (5)	Notes (6)
1	701.70	638.00	29,000	Zone A (top of conservation)	November 1 through March 31
2	703.10		30,000	Zone A (top of conservation)	April 1 through October 31
3	715.00	701.70 or 703.10	9,000 or 10,000	Flood control zone 1	Primary flood pool (bottom elevation varies seasonably)
4	727.00	715.00	10,000	Flood control zone 2	
5	742.00	727.00	15,000	Flood control zone 3	
6	745.00	742.00	3,000	Flood control zone 4	Spillway crest elevation and top of secondary flood pool
7	749.00	745.00	4,000	Flood control zone 5	Top of spillway surcharge operation pool
8	773.00	749.00	29,000	Flood control zone 6	Top of dam

Hydrologic dataset development

The hydrologic dataset used in this analysis spans 45 years of record: November 1969 to September 2015. This dataset was developed using streamgage data from the US Geological Survey (USGS), the California Data Exchange Center (CDEC) of the California Department of Water Resources (DWR), and Zone 7. Dataset development was completed as follows:

1. Relevant streamgages in the watershed were identified.
2. Data sources for those streamgages were identified and all available streamflow data were obtained.
3. The dataset was enhanced as described below.
4. An hourly reservoir inflow time series was developed.
5. Local flow time series downstream of the reservoir were developed.

Data sources and availability

Figure 5 shows the five streamgages used to develop the hydrologic dataset for this study:

- Arroyo Valle below Lang Canyon near Livermore (USGS gage ID# 11176400).
- Arroyo Valle near Livermore (USGS gage ID# 11176500).
- Arroyo Valle at Pleasanton (USGS gage ID# 11176600).
- Arroyo de la Laguna at Verona (USGS gage ID# 11176900).
- Alameda Creek near Niles (USGS gage ID# 11179000).

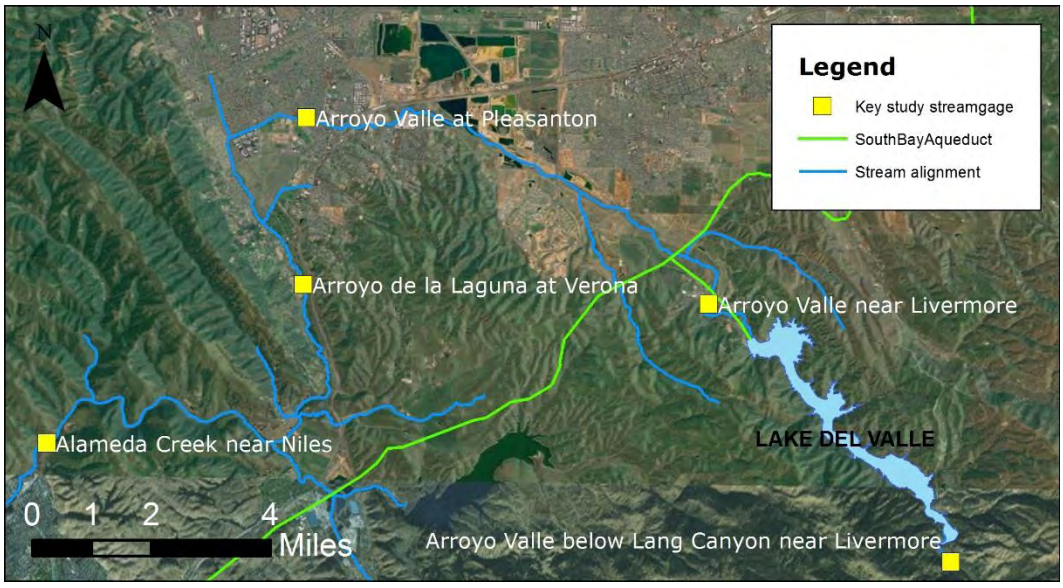

Figure 5. Lake Del Valle study streamgages

All readily available streamflow data were obtained for these five gages. Figure 6 shows the data availability for each gage. In general, most data were obtained from the USGS. However, supplemental data were obtained from Zone 7 as follows:

- At the Pleasanton gage, 15-minute instantaneous data for the period of January 3, 1986, to September 30, 1988, and for October 1, 1991, to September 30, 2010. (Zone 7 took ownership and operation of the Pleasanton gage in 1986.)
- At the Pleasanton gage, daily flows for the period of October 1, 1969, to September 30, 2015.
- At the Verona gage, daily flows for the period of October 1, 1969, to September 30, 2015.

The data obtained were reviewed, and a common time window for the hydrologic dataset development was identified: November 1969 to September 2015. This window is based on the availability of streamflow data at Verona and the reservoir inflows provided by Zone 7.

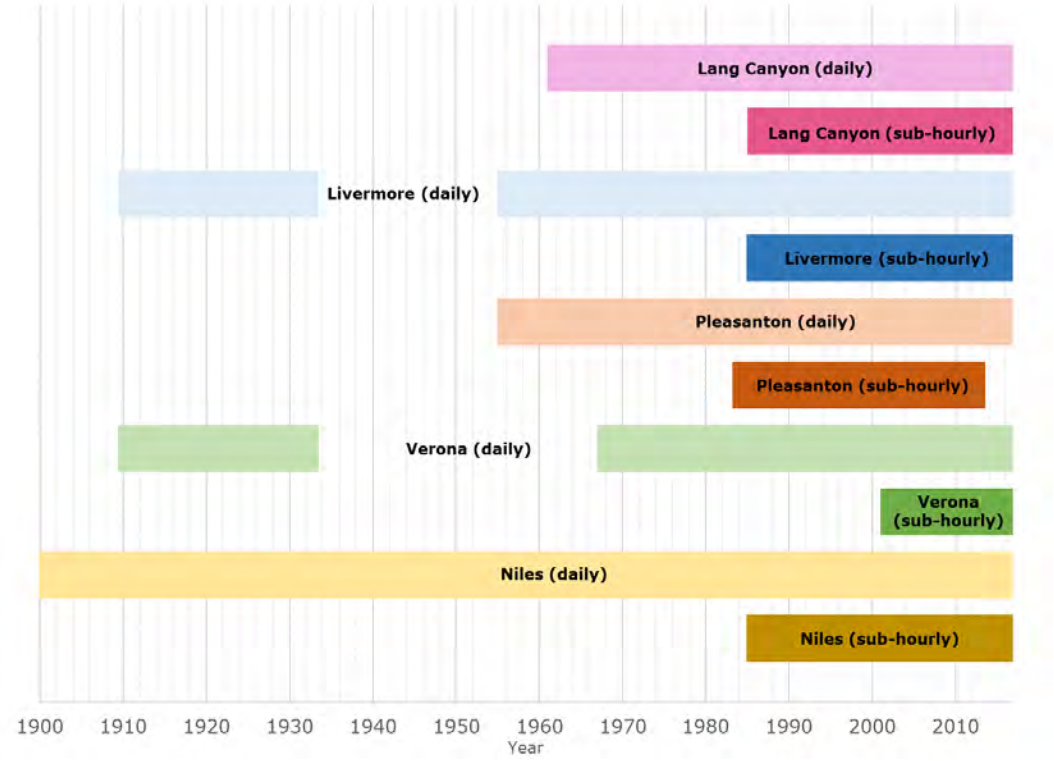

Figure 6. Data availability at the five streamgages used in this study

Data enhancements

The data obtained at the four streamgages downstream of the reservoir were enhanced to develop the hydrologic dataset as follows:

1. Converted each data series to Pacific Standard Time (PST) (GMT -8:00).
2. Extracted data for the selected period of record time window (November 1969 to September 2015).
3. Filled in missing daily data obtained from the USGS at the Pleasanton and Verona gages with those data from Zone 7.
4. Converted daily data to hourly time series with a smoothing algorithm. This algorithm was developed by Rob Thompson of the USACE Sacramento District, and was used in a major hydrology study of the

Central Valley (USACE 2015). This method generates a cumulative daily flow time-series, fits a curve to the data points, and then differentiates the curve on an hourly basis. This routine generates a more realistic hydrograph shape than if hourly flows are constant and equal to the daily average, while still preserving daily volumes.

5. Converted all 15-minute instantaneous data series (obtained from the USGS or Zone 7) to hourly time series by averaging flow over each hour period.
6. Filled in missing hourly time series values created in step 5 with those created in step 4.
7. Verified that the resulting hourly hydrologic dataset is complete with no missing data. Figure 7 shows the data sources over the period of record for the key streamgage locations.

Appendix I contains additional details on development of the hydrologic dataset.

Reservoir inflow development

Zone 7 provided the daily reservoir inflow time series. This daily inflow time series is appropriate for assessment of water supply metrics; however, assessment of flood management metrics requires a finer resolution time scale. An hourly inflow time series for Lake Del Valle was developed as follows:

1. Converted the daily data to hourly data using the USACE smoothing algorithm for the period of November 1969 through October 1987.
2. Computed the daily reservoir inflow volumes from the daily reservoir time series provided by Zone 7 for the period of November 1969 through September 2015.
3. Converted the 15-minute data available (October 1987 through September 2015) for the streamgage located on the Arroyo Valle just upstream of Lake Del Valle below Lang Canyon (USGS gage ID# 11176400) to an hourly average time series.
4. Reviewed the hourly series developed in step 3 and identified missing values.
5. Estimated these missing values using linear interpolation.
6. Computed the daily volumes of the time series developed in step 5.
7. Computed daily time series of scale factors by dividing the reservoir volumes (step 2) by the daily gage volumes (step 6).
8. Scaled the hourly time series developed in step 5 using the scaling factor series from step 7.
9. Appended the scaled hourly time series developed in step 8 to that developed in step 1 to complete the hourly inflow series.

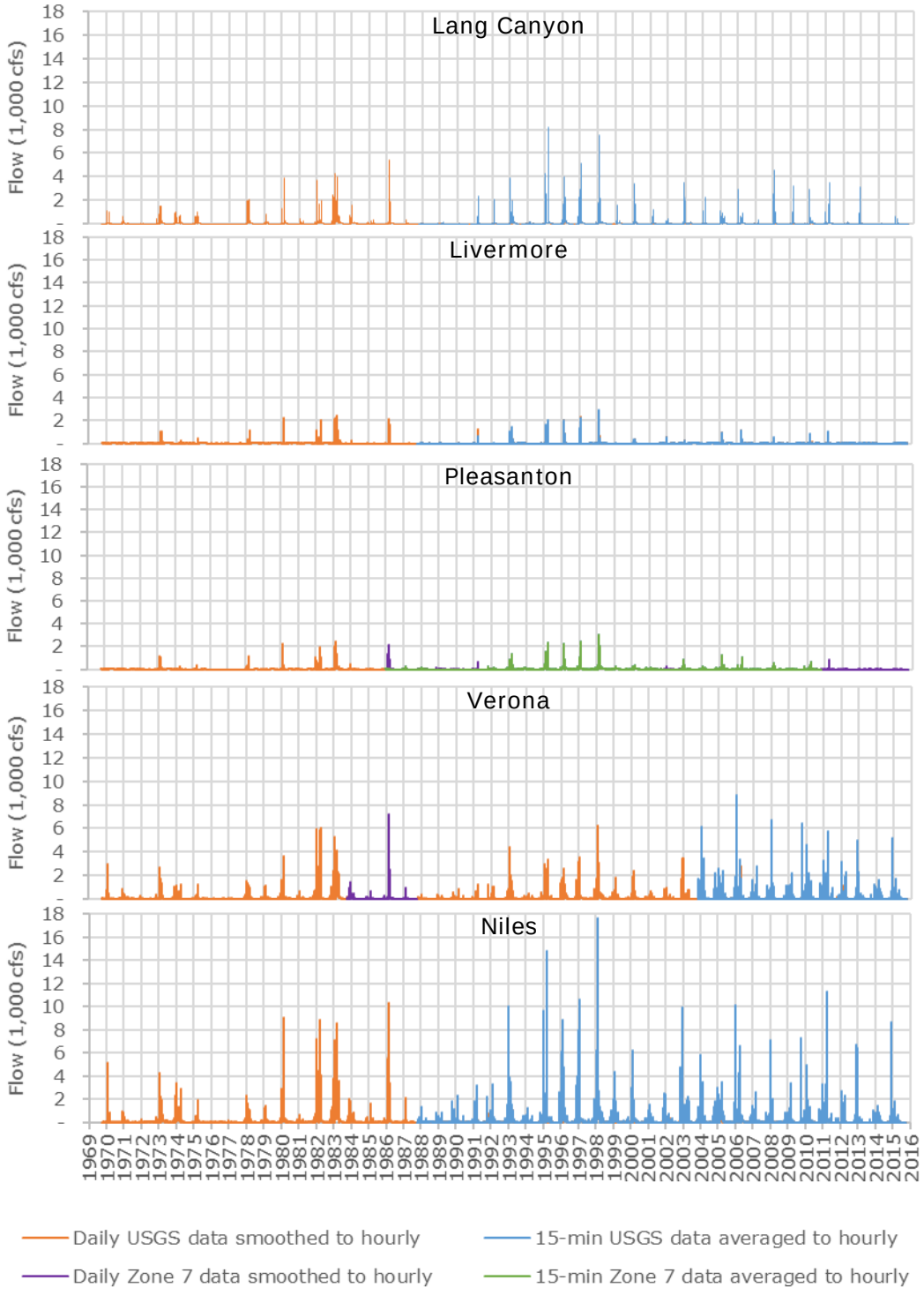

Figure 7. Flows and data sources for hydrologic dataset development at the five key streamgage locations

Local flow time series development

The HEC-ResSim model (detailed in the next section) requires local flow boundary conditions at three locations downstream of Lake Del Valle: Pleasanton, Verona, and Niles. Local flows represent the runoff of the

contributing area between two points; for example, Lake Del Valle and the streamgage at Pleasanton. Also required is a cumulative local flow series at Niles that represents the contributions of the watershed between Lake Del Valle and Niles. These local flow series were developed as follows:

1. Configured the HEC-ResSim model to represent reaches downstream of the Livermore gage (USGS gage ID# 11176500).
2. Routed the observed streamgage flow time series at the Livermore gage downstream to Pleasanton.
3. Computed the local flow at Pleasanton by subtracting the routed flow (step 2) from the observed flow time series record at Pleasanton. (In this computation, all negative values were set equal to 0 cfs.)
4. Routed the observed streamgage flow time series at the Livermore gage and the local flow computed in step 3 at Pleasanton downstream to Verona.
5. Computed the local flow at Verona by subtracting the routed flow (step 4) from the observed flow time series record at Verona. (In this computation, all negative values were set equal to 0 cfs.)
6. Routed the observed streamgage flow time series at the Livermore gage in addition to the local flows computed in steps 3 and 5 at Pleasanton and Verona downstream to Niles.
7. Computed the local flow at Niles by subtracting the routed flow (step 4) from the observed flow time series record at Verona. (In this computation, all negative values were set equal to 0 cfs.)
8. Computed a cumulative local flow time series by routing the observed streamgage flow time series at the Livermore gage in addition to the local flows computed in steps 3 and 5 at Pleasanton and Verona downstream to Niles and adding the Niles local flow series computed in step 7.

HEC-ResSim model

HEC-ResSim "is used to model reservoir operations at one or more reservoirs for a variety of goals and constraints. The software simulates reservoir operations for flood management, low flow augmentation and water supply for planning studies, detailed reservoir regulation plan investigations, and real-time decision support… HEC-ResSim is a decision support tool that meets the needs of modelers performing reservoir project studies as well as meeting the needs of reservoir regulators during real-time events" (http://www.hec.usace.army.mil/software/hec-ressim/).

The HEC-ResSim model configuration provided by Zone 7 to complete this analysis was enhanced as follows:

1. Converted the model from HEC-ResSim version 3.1 to version 3.3.1.100. This is a developmental version of HEC-ResSim provided by USACE Hydrologic Engineering Center (HEC). This updated version was used because of its enhancements to the computational algorithms that improve routing and release decision accuracy and reduce computation times.
2. Developed a new reservoir network with routing reaches from Lake Del Valle to Niles. The reaches represent the Arroyo Del Valle, the Arroyo de la Laguna (starting at its confluence with the Arroyo Del Valle), and Alameda Creek (starting at its confluence with the Arroyo de la Laguna).
3. Configured Lake Del Valle physical properties consistent with the previous reservoir representation and modified properties as needed to be consistent with the WCM. Here physical properties refer to the storage-area-elevation curves, outlet rating curves, and so on.
4. Integrated Muskingum-Cunge routing model parameters from an HEC-HMS rainfall-runoff model provided by Zone 7 into the HEC-ResSim Arroyo Del Valle reaches.
5. Configured routing in the Arroyo de la Laguna and Alameda Creek consistent with the routing models and parameters listed in the WCM.
6. Configured model flow time series input locations including Lake Del Valle inflow, SBA returns to the Arroyo Del Valle via turnout (TO) #2, and local flows at Pleasanton, Verona, and Niles.
7. Configured these alternatives: baseline, FIRO-alone, reallocation-with-FIRO, and structural changes-with-FIRO. These alternatives are detailed below.

Figure 8 shows a screen capture of the HEC-ResSim model schematic. Additional HEC-ResSim model documentation is included in Appendix II.

Baseline operations

Baseline operations represent the Lake Del Valle reservoir and river system as it exists and is operated currently (as defined by the WCM). It serves as the baseline configuration against which the alternatives are compared. For the baseline operation, a strict interpretation of the operational rules defined in the WCM was used to simulate operations for the period of record.

Table 8 lists the pool elevations defined by the WCM and configured in the HEC-ResSim operations set used in the baseline simulations. Table 8 also describes the rules governing reservoir operations for each pool.

FIRO-alone alternative

The FIRO-alone alternative represents what would happen if Lake Del Valle was operated to consider forecast information. Specifically, the reservoir is operated to use all the variable flood space throughout the year. To do this FIRO is simulated by developing a TOC series set equal to 703.10 ft (40,000 ac-ft of conservation storage capacity) throughout the year, unless the 5-day forecasted inflow volume exceeds 1,000 ac-ft, at which time the TOC returns to the seasonally defined TOC from the WCM (701.70 ft). Figure 9 shows, as an example, this FIRO-based TOC as compared to the baseline TOC for the year 1986. [1986 was chosen because it is the largest event, by 5-day volume, in the dataset used for this analysis.]

Here, the 5-day forecast was developed directly from the inflow series. Therefore, the forecast series is "perfect," in that the forecasted volume is the same as the inflow volume to Lake Del Valle. This is an optimistic idealization of FIRO. In a real-world scenario, the forecast will not be perfect, however a perfect forecast measures viability of FIRO.

For this alternative, the reservoir operations set is based on the WCM. However, the TOC is configured as a time series to account for FIRO.

Permanent reallocation-with-FIRO alternatives

The permanent reallocation-with-FIRO alternatives represent what would happen if some of the current flood management space was reallocated to water supply instead. Four different reallocation alternatives were analyzed with increasing reallocations to the water supply pool. (These values are based on proposed water supply capacity increases analyzed in the *Delta water supply reliability study final report* [CDM 2009].) Table 7 lists each reallocation volume and associated TOC elevation.

For each alternative, the reallocation-with-FIRO components include a modified TOC series set equal to the reallocation elevation throughout the year, unless the 5-day forecasted inflow volume exceeds 1,000 ac-ft, at which time the water conservation pool is drawn down to accommodate the forecast inflow volume. As an example, in Figure 9 the largest reallocation TOC alternative (25,500 ac-ft) is compared to the baseline TOC for the year 1986, the year of historical record with the maximum 5-day volume in ac-ft (see Table 17). Again, a perfect forecast was used to develop these TOC series, thus simulating FIRO.

Table 7. Reallocation-with-FIRO alternatives TOC capacities and elevations

ID (1)	Reallocated capacity (ac-ft) (2)	Associated TOC elevation (ft) (3)
1	5,000	709.91
2	10,500	716.81
3	15,000	722.09
4	25,500	732.80

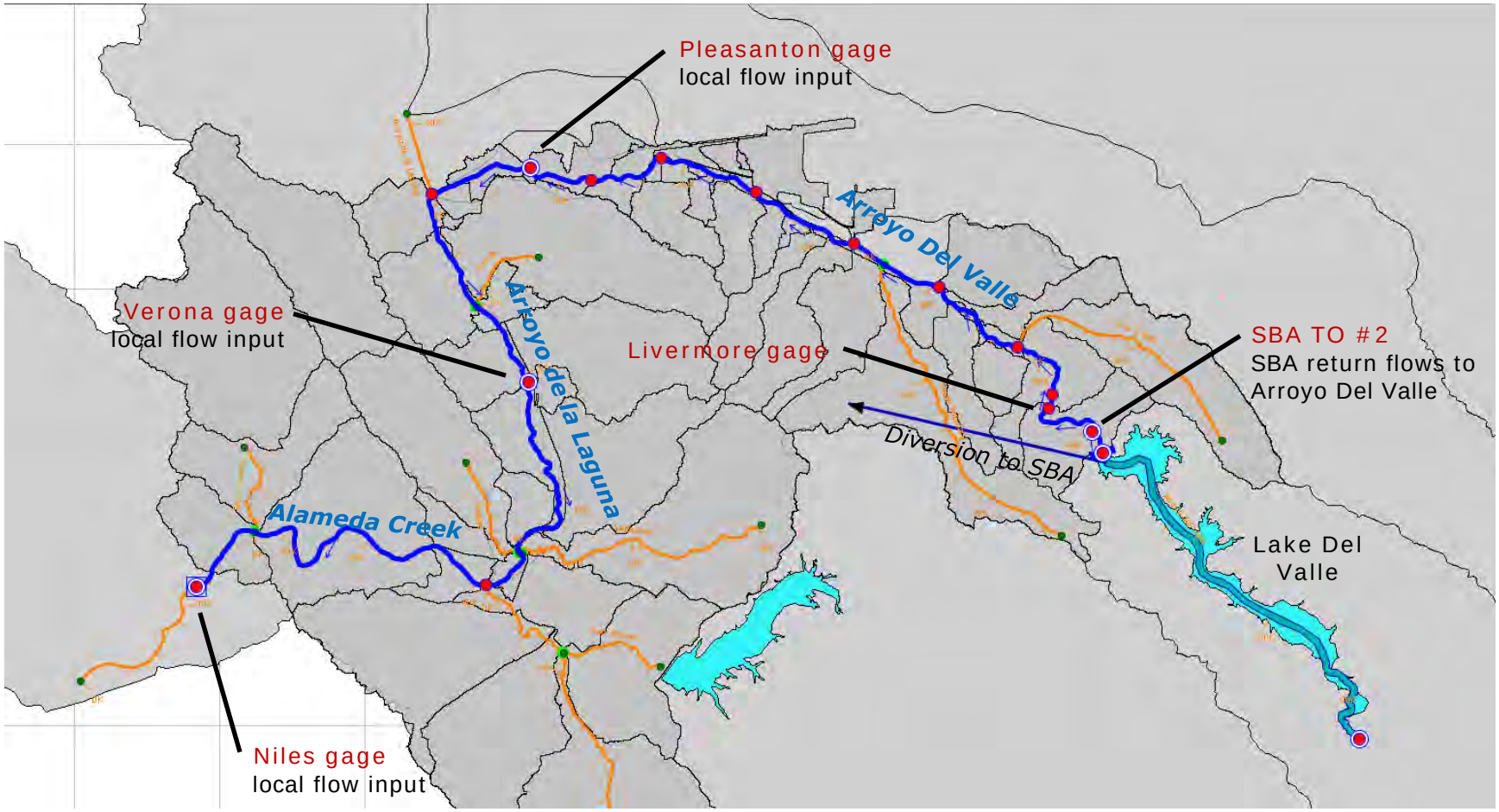

Figure 8. Annotated screen capture of HEC-ResSim model schematic (with labels added for clarity)

Table 8. Summary of Lake Del Valle reservoir operations configured in HEC-ResSim and defined by the WCM

Zone ID (1)	Top of pool (zone) elevation (ft) (2)	Operations if cumulative local flow at Niles is: Rising (3)	Receding (4)	Notes (5)
A	701.70-703.10[1,2]	• Regulate for conservation. • Limit change in releases to 1,000 cfs per hour.		Conservation pool

1	715.00[3]	• If Niles cumulative local flow is:
		  • Less than or equal to 5,000 cfs, maintain previous release.
		  • Greater than 5,000 cfs, no releases.
		• Limit change in releases to 1,000 cfs per hour.
			• If Niles cumulative local flow is less than or equal to 6,000 cfs:
			  • Release to maintain maximum objective flow at Niles of 6,000 cfs.
			  • Maximum releases of 2,000 cfs.
			• If Niles cumulative local flow is greater than 6,000 cfs, maximum releases of 2,000 cfs.
			• Limit change in releases to 1,000 cfs per hour.
				Primary flood pool (flood control zones 1-3)

2	727.00[4]		• If Niles cumulative local flow is less than or equal to 8,000 cfs:
			  • Release to maintain maximum objective flow at Niles of 8,000 cfs.
			  • Maximum releases of 3,000 cfs.
			• If Niles cumulative local flow is greater than 8,000 cfs, maximum releases of 2,000 cfs.
			• Limit change in releases to 1,000 cfs per hour.	

3	742.00		• If Niles cumulative local flow is less than or equal to 9,500 cfs:
			  • Release to maintain maximum objective flow at Niles of 9,500 cfs.
			  • Maximum releases of 2,000 cfs.
			• If Niles cumulative local flow is greater than 9,500 cfs, maximum release of 2,000 cfs.
			• Limit change in releases to 1,000 cfs per hour.	

4	745.00	• If pool is rising:
		  • When pool reaches 742.0 ft, release 400 cfs.
		  • Increase releases by 400 cfs per 0.50 ft of pool increase until 2,400 cfs.
		  • Maintain maximum total (controlled and uncontrolled) releases of 2,400 cfs.
		• If pool is falling, limit total (controlled and uncontrolled) releases to 7,000 cfs.
				Spillway crest and top of secondary flood pool (flood control zone 4)

5	749.00	• No controlled releases	• No controlled releases	Surcharge operation pool (flood control zone 5)
6	773.00	• No controlled releases	• No controlled releases	Top of dam (flood control zone 6)

1. Varies seasonally; TOC elevation equals 701.70 from November 1 to March 31, and 703.10 from April 1 to October 31.
2. Valid for baseline and FIRO-alone alternative. For the reallocation-with-FIRO and structural changes-with-FIRO alternatives the TOC is fixed to the desired reallocation volume and varies base on inflow forecast volume as listed in Table 7.
3. This zone is configured in the baseline, FIRO-alone alternative, 5,000 ac-ft reallocation-with-FIRO alternative, and the structural changes-with-FIRO alternative. For the larger reallocation-with-FIRO alternatives, the maximum TOC is greater than this elevation.
4. This zone is configured in the baseline; FIRO-alone alternative; 5,000 ac-ft, 10,500 ac-ft, and 15,000 ac-ft reallocation-with-FIRO alternatives; and the structural changes-with-FIRO alternative. For the 25,500 reallocation-with-FIRO alternative, the maximum TOC is greater than this elevation.

Structural changes-with-FIRO alternative

The structural changes-with-FIRO alternative represents a hypothetical raise of the dam and spillway to accommodate 5,000 ac-ft of additional capacity. For this alternative, the water conservation pool is increased by 5,000 ac-ft and the FIRO components include modified TOC series set equal to 709.91 ft (45,000 ac-ft of water supply capacity) throughout the year, unless the 5-day forecasted inflow volume exceeds 1,000 ac-ft, at which time the TOC returns to the seasonally defined TOC elevation of 708.58 ft. As an example, in Figure 9 the structural-changes-with-FIRO TOC (5,000 ac-ft) is compared to the baseline TOC for the year 1986. As with the other alternatives, a perfect forecast was used to develop this TOC time series.

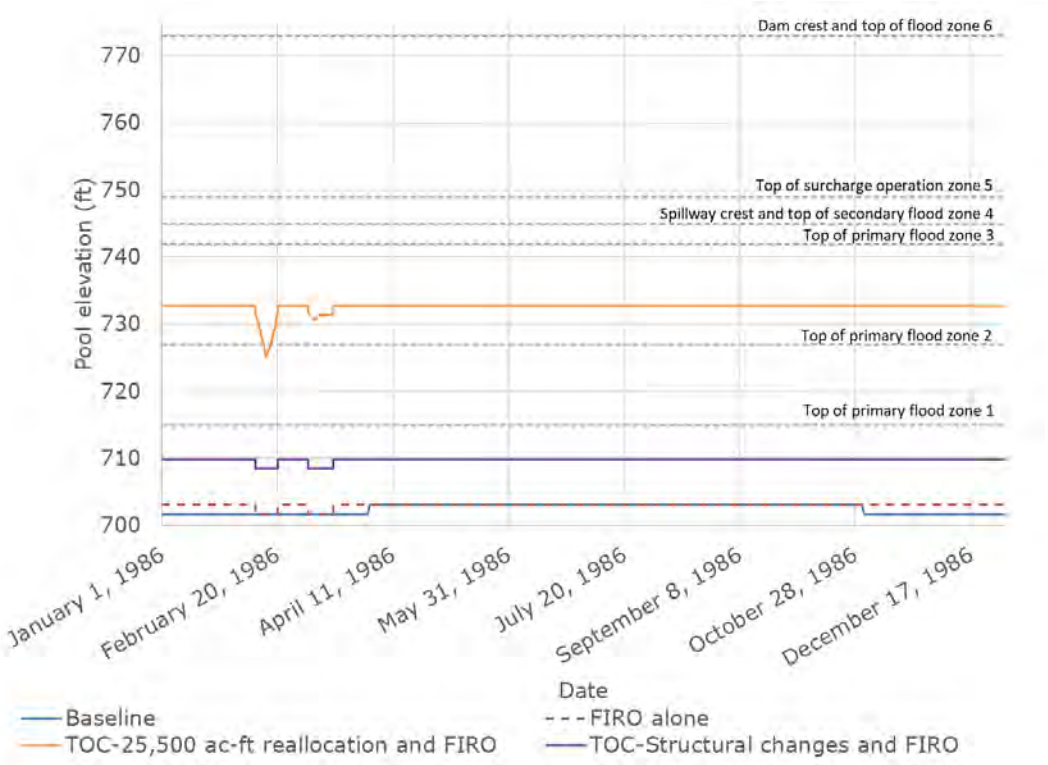

Figure 9. Comparison of alternative TOC time series in 1986

Findings

Impacts on water supply

The HEC-ResSim simulation results were reviewed and synthesized, and average monthly and combined 12-month monthly average runoff capture values were computed. In addition, the mean average monthly, start-of-season, and end-of-season storage values were computed. Table 9 lists and Figure 10 shows the computed average monthly and combined 12-month monthly average runoff capture values; their differences from the baseline are shown in Table 10 and Figure 11. Table 11 lists and Figure 12 shows the computed mean average monthly storage values; their differences from the baseline are shown in Table 12 and Figure 13. The minimum, average, maximum start-of-season, and end-of-season storage values are shown in Table 13; their differences from the baseline are shown in Table 14. Figure 14 and Figure 15 compare the assurance that reservoir pool storage would not be exceeded among the alternatives.

In general, the mean average monthly storage values increased for each month and for all alternatives. The minimum average monthly storage values generally increased during the summer months for all reallocation alternatives and the structural change alternative as compared to the baseline. Similarly, the start-of-season and end-of-season storage values generally increased for all alternatives. In addition, the assurance that a given reservoir storage value is not exceeded generally decreased. Specifically:

Definition: Assurance – The conditional probability that a given value is not exceeded. For example, Lake Del Valle has critical storage value associated conservation equal to 39,000 ac-ft from Nov. to March. For baseline conditions, this is approximately an 85% assurance that this value will not be exceeded. For FIRO alone, there is decrease in assurance to approximately 80%. This decrease in assurance signifies an increase in the likelihood that storage exceeds the critical value.

- Baseline operations have average monthly runoff capture values that range from 29 ac-ft to 4,482 ac-ft, with an annual average of 1,257 ac-ft.
- Baseline operations have average monthly storage values that range from 26,482 ac-ft to 38,442 ac-ft.
- Baseline operations have mean start-of-season and end-of-season storage values equal to 36,485 ac-ft and 28,465 ac-ft, respectively.
- FIRO alone increases the monthly runoff capture during the winter months between 15 ac-ft and 106 ac-ft. However, runoff capture is reduced in April and May by 206 ac-ft and 32 ac-ft because FIRO-alone operation requires less runoff to be captured to refill the 1,000 ac-ft of variable flood space in the spring.
- FIRO alone increases mean average monthly storage between 58 ac-ft and 295 ac-ft, with the largest increases in February and March. This suggests FIRO can enhance water supply availability.

- FIRO alone increases start-of-season and end-of-season storage values. The mean start-of-season and end-of-season storages increase from the baseline by 284 ac-ft and 59 ac-ft, respectively. The minimum and maximum values also increased, suggesting water supply operation improvement in both dry and wet years.
- FIRO alone has the largest decreases in assurance that a given storage value is not exceeded between 39,000 ac-ft and 40,000 ac-ft. This suggests FIRO can enhance water supply availability.
- Each reallocation-with-FIRO alternative increases mean average monthly storage values. These increases are proportional to the reallocated volume and are generally largest in March through September. This suggests reallocation with FIRO can enhance water supply availability.
- Each reallocation-with-FIRO alternative increases start-of-season and end-of-season storage values. These increases are generally consistent with the reallocated volume. For example, start-of-season and end-of-season increases in storage values from the baseline for 5,000 ac-ft reallocation with FIRO are 5,093 ac-ft and 4,885 ac-ft, respectively. The minimum and maximum values also increased, suggesting water supply operation improvement in both dry and wet years.
- Each reallocation-with-FIRO alternative decreases the assurance that a given storage value is not exceeded. These decreases are generally consistent with the reallocated volume. This suggests reallocation with FIRO can enhance water supply availability.
- Structural changes with FIRO increase mean average monthly storage values. These values are consistent with 5,000 ac-ft reallocation with FIRO. This suggests structural changes with FIRO can enhance water supply availability.
- Structural changes with FIRO increase start-of-season and end-of-season storage values. The mean start-of-season and end-of-season storage increases from the baseline are 5,120 ac-ft and 4,882 ac-ft, respectively. These values are similar to 5,000 ac-ft reallocation with FIRO. The minimum and maximum values also increased, suggesting water supply operation improvement in both dry and wet years.
- Structural changes with FIRO decreases the assurance that a given storage value is not exceeded. These decreases are generally consistent with 5,000 ac-ft reallocation with FIRO. This suggests structural changes with FIRO can enhance water supply availability.

Table 9. Summary of average monthly runoff capture (ac-ft)

ID (1)	Scenario (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Combined 12-month monthly average (15)
1	Baseline	4,482	3,350	2,655	1,085	164	56	51	29	129	150	455	2,212	1,257
2	FIRO alone	4,579	3,457	2,681	879	132	56	51	29	129	150	455	2,227	1,258
3	5,000 ac-ft reallocation with FIRO	4,602	3,509	2,754	1,004	241	86	52	30	129	150	455	2,232	1,294
4	10,500 ac-ft reallocation with FIRO	4,664	3,624	2,765	1,059	326	112	74	58	131	150	455	2,238	1,329
5	15,000 ac-ft reallocation with FIRO	4,699	3,725	2,792	1,076	435	115	74	58	131	150	455	2,244	1,354
6	25,500 ac-ft reallocation with FIRO	4,791	4,128	2,844	1,108	468	147	74	58	131	150	455	2,244	1,409
7	Structural changes with FIRO	4,627	3,542	2,719	981	241	86	52	30	129	150	455	2,232	1,294

Table 10. Summary of differences from baseline in average monthly runoff capture (ac-ft) (positive values are an increase from baseline operations)

ID (1)	Scenario (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Combined 12-month monthly average (15)
1	FIRO alone	97	106	26	-206	-32	0	0	0	0	0	0	15	1
2	5,000 ac-ft reallocation with FIRO	120	159	99	-81	77	30	1	1	0	0	0	20	36
3	10,500 ac-ft reallocation with FIRO	182	273	110	-26	163	56	23	28	2	0	0	26	71
4	15,000 ac-ft reallocation with FIRO	217	374	137	-9	272	59	23	28	2	0	0	32	97
5	25,500 ac-ft reallocation with FIRO	309	778	189	23	304	91	23	28	2	0	0	32	152
6	Structural changes with FIRO	145	191	64	-104	77	30	1	1	0	0	0	20	36

Table 11. Summary of mean monthly average storage (ac-ft)

ID (1)	Scenario (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	Baseline	29,395	32,385	35,333	37,350	38,442	38,248	37,533	36,557	34,432	30,235	26,854	26,482
2	FIRO alone	29,509	32,587	35,628	37,492	38,515	38,308	37,592	36,616	34,491	30,294	26,912	26,541
3	5,000 ac-ft reallocation with FIRO	34,207	37,260	40,414	42,353	43,479	43,294	42,547	41,525	39,360	35,133	31,624	31,241
4	10,500 ac-ft reallocation with FIRO	39,008	42,109	45,360	47,312	48,478	48,307	47,541	46,496	44,306	40,053	36,419	36,027
5	15,000 ac-ft reallocation with FIRO	42,765	45,927	49,234	51,183	52,396	52,253	51,453	50,374	48,153	43,890	40,160	39,761
6	25,500 ac-ft reallocation with FIRO	51,046	54,444	57,941	59,903	61,098	60,941	60,073	58,919	56,634	52,346	48,406	47,993
7	Structural changes with FIRO	34,225	37,347	40,445	42,357	43,476	43,291	42,544	41,522	39,357	35,130	31,621	31,238

Table 12. Summary of differences from baseline in mean monthly average storage (ac-ft) (positive values are an increase from baseline operations)

ID (1)	Scenario (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	FIRO alone	113	202	295	142	73	60	60	59	59	59	58	59
2	5,000 ac-ft reallocation with FIRO	4,811	4,875	5,081	5,003	5,037	5,046	5,015	4,968	4,928	4,898	4,770	4,759
3	10,500 ac-ft reallocation with FIRO	9,612	9,724	10,027	9,962	10,036	10,059	10,008	9,939	9,874	9,818	9,565	9,545
4	15,000 ac-ft reallocation with FIRO	13,370	13,542	13,901	13,833	13,954	14,005	13,921	13,817	13,721	13,655	13,306	13,279
5	25,500 ac-ft reallocation with FIRO	21,650	22,059	22,608	22,553	22,657	22,693	22,540	22,362	22,202	22,112	21,552	21,511
6	Structural changes with FIRO	4,830	4,962	5,112	5,007	5,034	5,043	5,012	4,965	4,925	4,895	4,767	4,756

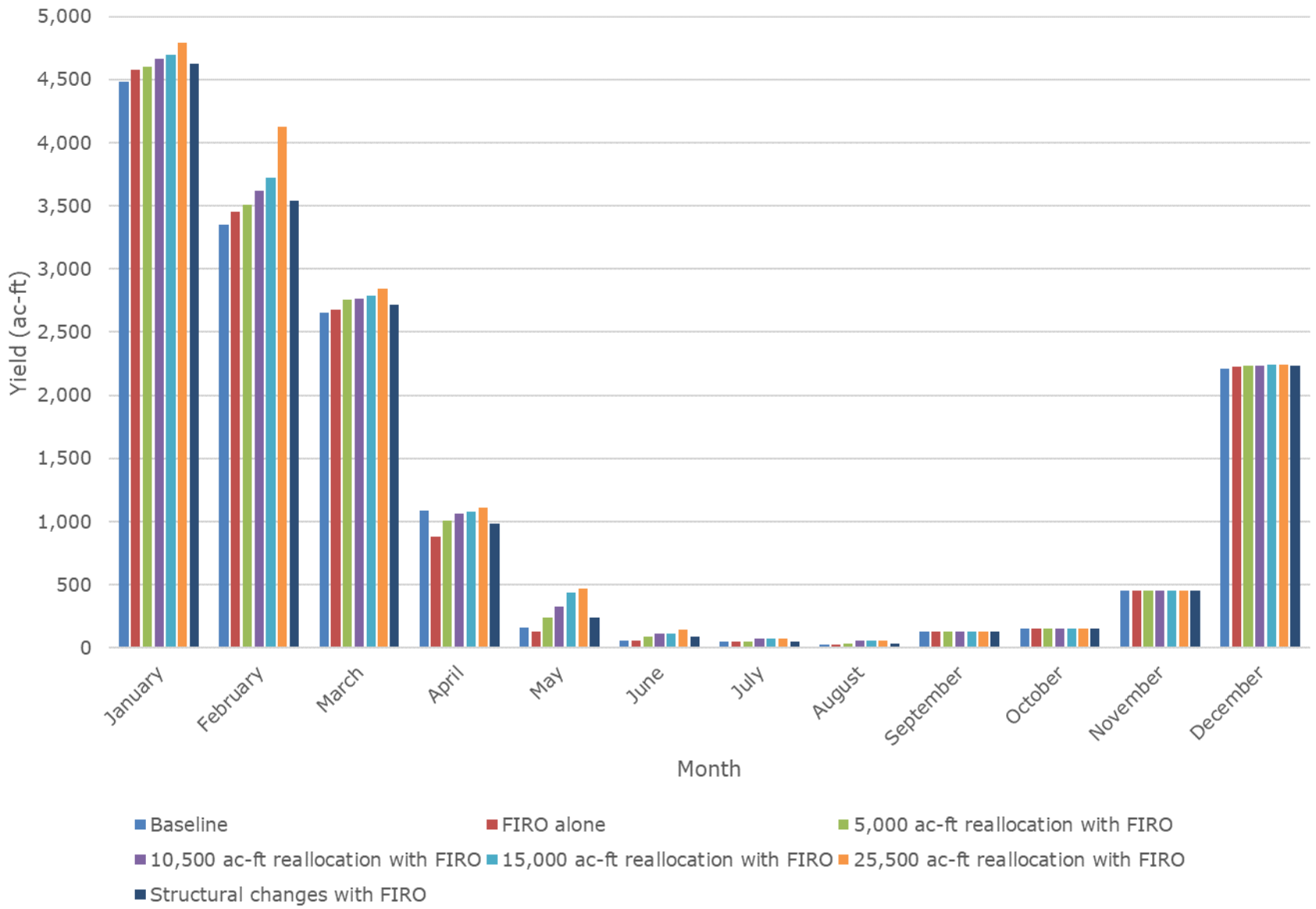

Figure 10. Summary of average monthly runoff capture

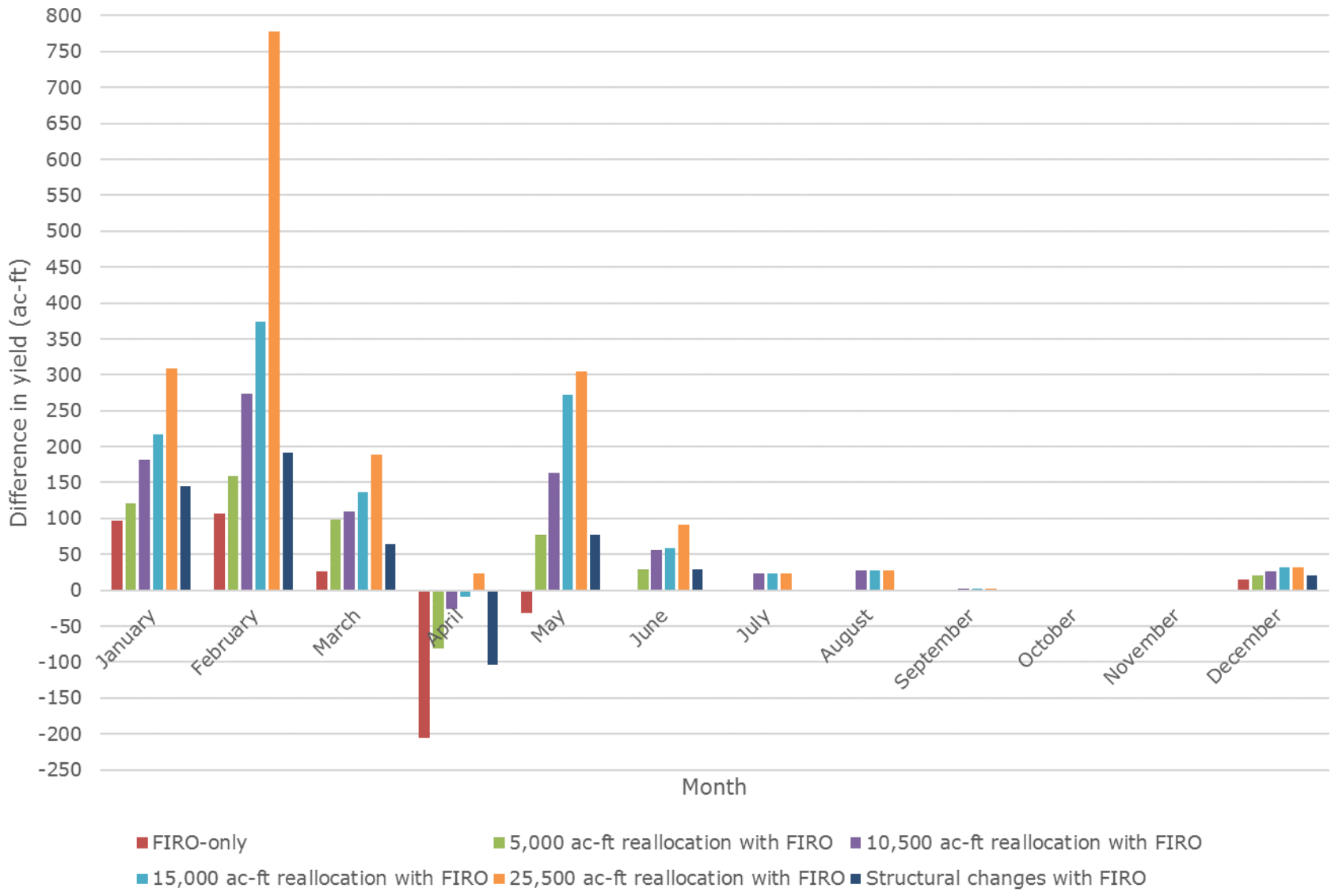

Figure 11. Summary of differences from baseline in average monthly runoff capture (positive values are an increase from baseline operations)

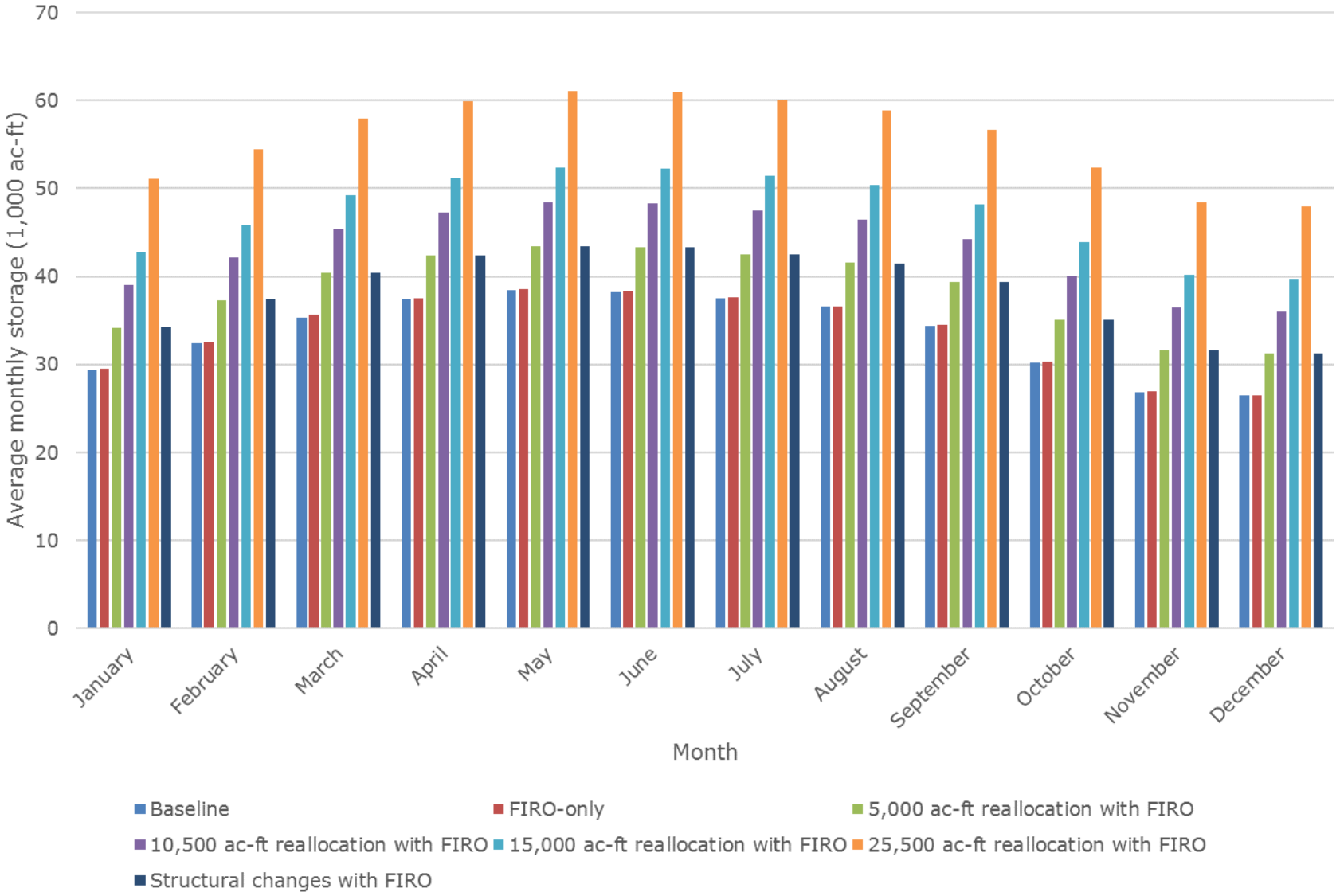

Figure 12. Summary of mean monthly average storage

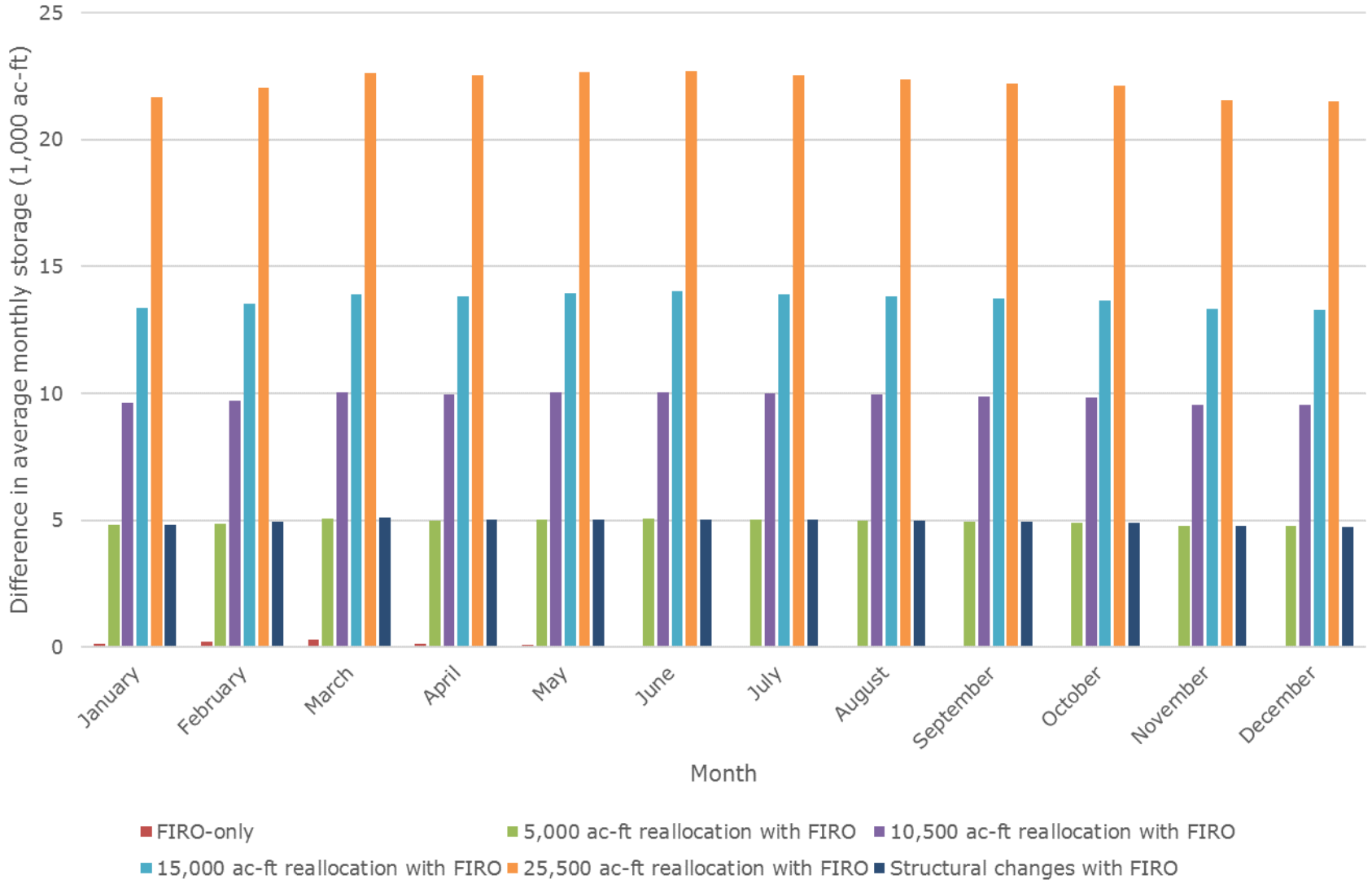

Figure 13. Summary of differences from baseline in mean monthly average storage (positive values are an increase from baseline operations)

Table 13. Summary of start-of-season and end-of-season storage values

ID (1)	Scenario (2)	Minimum		Mean		Maximum	
		Start-of-season storage[1] (ac-ft) (3)	End-of-season storage[2] (ac-ft) (4)	Start-of-season storage[1] (ac-ft) (5)	End-of-season storage[2] (ac-ft) (6)	Start-of-season storage[1] (ac-ft) (7)	End-of-season storage[2] (ac-ft) (8)
1	Baseline	27,502	21,600	36,485	28,465	41,712	37,514
2	FIRO alone	27,502	21,600	36,769	28,524	41,712	37,738
3	5,000 ac-ft reallocation with FIRO	32,170	26,354	41,578	33,349	45,758	42,487
4	10,500 ac-ft reallocation with FIRO	34,742	31,305	46,505	38,258	50,500	47,521
5	15,000 ac-ft reallocation with FIRO	34,742	32,848	50,383	42,087	54,903	51,703
6	25,500 ac-ft reallocation with FIRO	34,742	32,848	59,102	50,527	64,800	61,207
7	Structural changes with FIRO	32,167	26,351	41,606	33,346	46,823	42,484

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 14. Summary of differences from baseline in start-of-season and end-of-season storage values (positive values are an increase from baseline operations)

ID (1)	Scenario (2)	Minimum		Mean		Maximum	
		Start-of-season storage[1] (ac-ft) (3)	End-of-season storage[2] (ac-ft) (4)	Start-of-season storage[1] (ac-ft) (5)	End-of-season storage[2] (ac-ft) (6)	Start-of-season storage[1] (ac-ft) (7)	End-of-season storage[2] (ac-ft) (8)
1	FIRO alone	0	0	284	59	0	224
2	5,000 ac-ft reallocation with FIRO	4,667	4,754	5,093	4,885	4,046	4,973
3	10,500 ac-ft reallocation with FIRO	7,240	9,704	10,020	9,794	8,788	10,007
4	15,000 ac-ft reallocation with FIRO	7,240	11,248	13,897	13,623	13,191	14,189
5	25,500 ac-ft reallocation with FIRO	7,240	11,248	22,617	22,062	23,088	23,693
6	Structural changes with FIRO	4,664	4,751	5,120	4,882	5,111	4,970

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

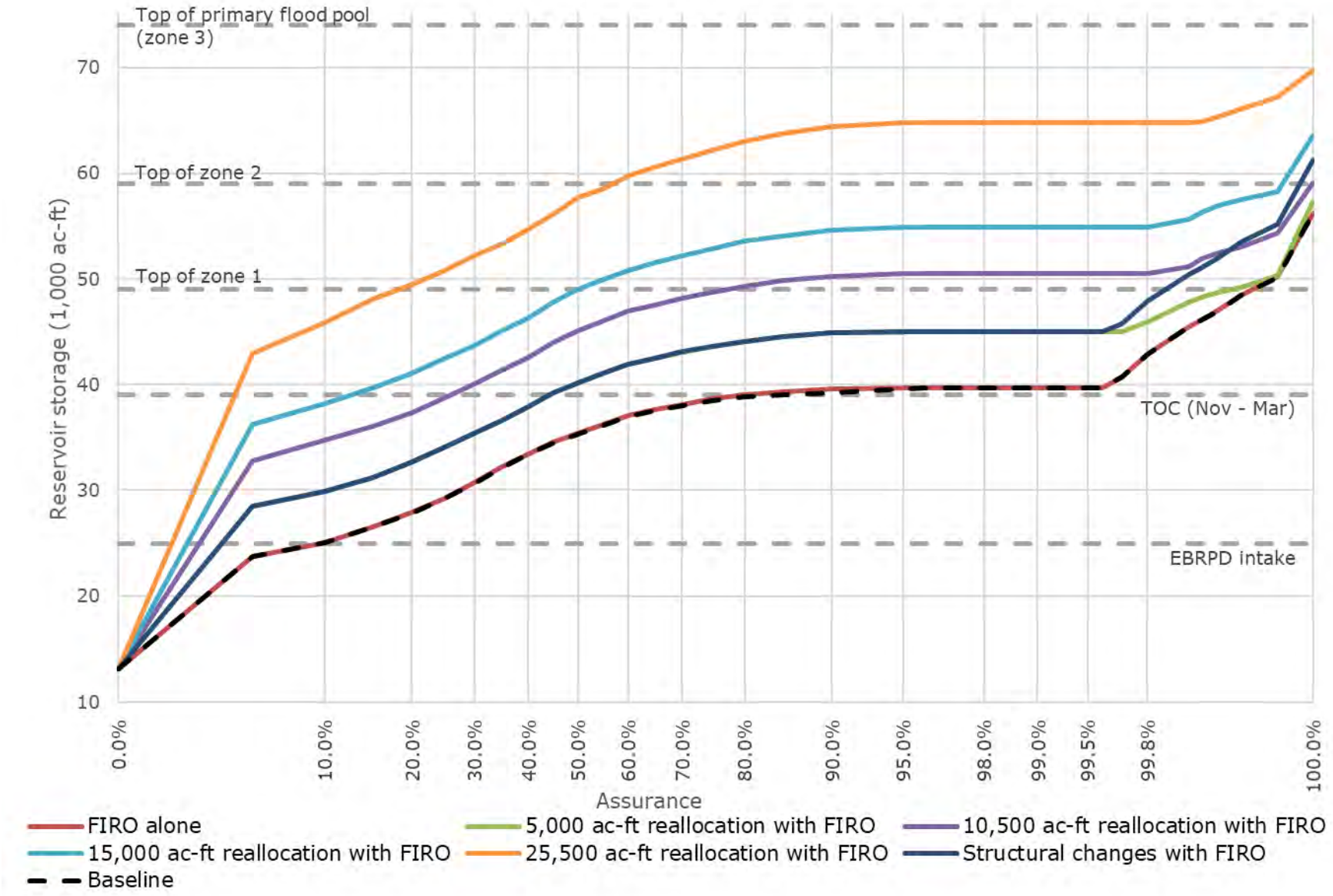

Figure 14. Assurance (conditional probability) that Lake Del Valle storage does not exceed a given value

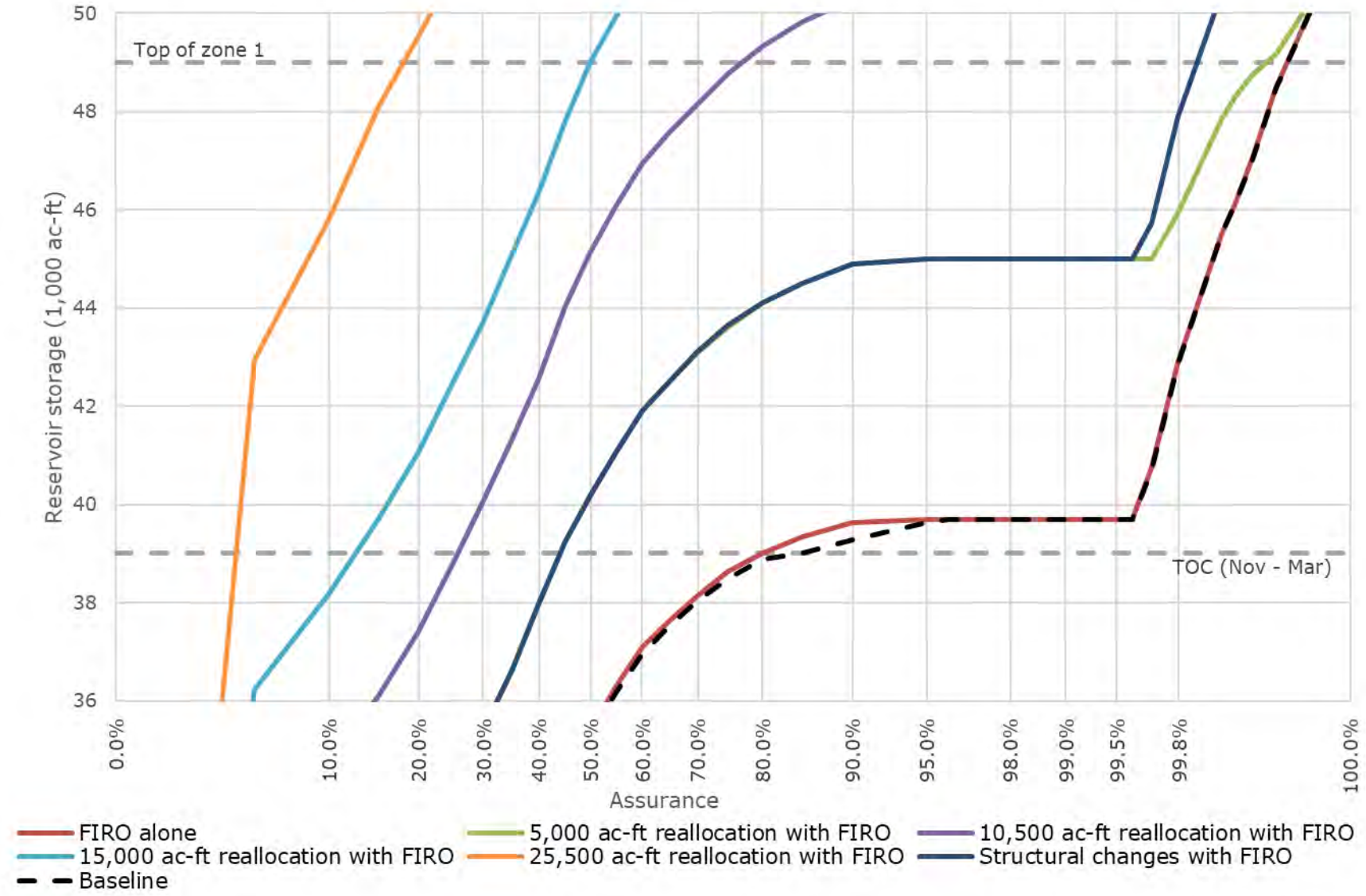

Figure 15. Assurance (conditional probability) that Lake Del Valle storage does not exceed a given value: comparison of storages between 36,000 ac-ft and 50,000 ac-ft

Impacts on recreation facilities

The HEC-ResSim simulation results were reviewed and synthesized, and the average annual and maximum annual number of days in which pool elevation thresholds were exceeded was computed. Table 15 lists the average annual number of days each threshold was exceeded for the simulated period of record; their differences from the baseline are shown in Table 16. Table 17 lists the maximum annual number of days each threshold was exceeded for the simulated period of record; their differences from the baseline are shown in Table 18. Figure 18 and Figure 19 compare the assurance a reservoir pool elevation would not be exceeded by alternative.

In general, the number of days per year that elevation 703.10 ft was exceeded increased for all alternatives in comparison to the baseline alternative. In addition, the elevations of the kayak rental (705.00 ft) and sewage lift station (705.50 ft) are exceeded more frequently and the elevations of the EBRPD intake (678.40 ft) and the bottom of the boat ramp (680.00 ft) are exposed less frequently for the reallocation and structural change alternatives. Specifically:

- For baseline operations, the pool elevation exceeds 703.10 ft for one day per year on average. On average, the other thresholds were not exceeded.
- For baseline operations, the maximum number of days in which the pool elevation exceeded 703.10 ft was 15 days, and the maximum number of days in which the pool elevation exceeded 715.00 ft was two days per year.
- For baseline operations, there is approximately 99.7% assurance that the pool elevation will be below the kayak rental and sewage lift station facilities, and there is approximately a 10% assurance that the pool elevation will be below the EBRPD intake and the bottom of the boat ramp.
- FIRO alone does not increase the average annual number of days in which elevation 703.10 ft is exceeded. This suggests FIRO-only operations would have similar impacts on recreational facilities to baseline operations.
- FIRO alone does not increase the maximum annual number of days at which elevations 703.10 ft and 715.00 ft are exceeded. This suggests FIRO-alone operations would have similar impacts on recreational facilities to baseline operations.
- FIRO alone has similar assurance that a given elevation would not be exceeded compared to the baseline. This suggests FIRO-only operations would have similar impacts on recreational facilities to baseline operations.
- Each reallocation-with-FIRO alternative increases the average annual number of days in which pool elevations 703.10 ft and 715.00 ft are exceeded. (An increase in the number of days in which 703.10 ft is exceeded is expected as all reallocation volumes require a TOC elevation greater than 703.10 ft.) The average annual number of days in which these elevations are exceeded increases proportionally to the reallocation volume. In addition, a reallocation volume of 25,500 ac-ft increases the average annual number of days in which pool elevation 727.00 ft is

exceeded by 184 days. (This is expected, as a 25,500 ac-ft reallocation volume results in a base TOC elevation equal to 732.80 ft.) On average, the other thresholds were not exceeded. This suggests reallocation and FIRO would impact recreational facilities on more days per year compared to baseline operations.

- Each reallocation-with-FIRO alternative increases the maximum annual number of days in which pool elevations 703.10 ft and 715.00 ft are exceeded. In addition, reallocation volumes greater than 10,500 ac-ft increase the maximum annual number of days in which pool elevation 727.0 ft is exceeded. The maximum annual number of days in which these elevations are exceeded increases proportionally to the reallocation volume. The other thresholds are not exceeded. This suggests reallocation-with-FIRO would impact recreational facilities on more days per year compared to baseline operations.
- Structural changes with FIRO increase both the average and maximum average annual number of days in which elevations 703.10 ft, 715.00 ft, and 727.00 ft are exceeded. The other thresholds are not exceeded. This suggests a structural change with FIRO could impact recreational facilities on more days per year compared to baseline operations.
- The storage-reallocation and structural-change alternatives all have decreased assurance that a given elevation would not be exceeded compared to the baseline. In addition, the 5,000 ac-ft and structural-change alternatives have similar assurances to each other, while the remaining reallocation alternatives have proportional decreases in assurance that an elevation would not be exceeded. This suggests the reallocation of flood management volume will impact recreation facilities on a more frequent basis.

Table 15. Summary of annual average number of days in which Lake Del Valle pool elevation thresholds are exceeded

ID (1)	Scenario (2)	Days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	Baseline	1.3	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0
2	FIRO-alone	1.3	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0
3	5,000 ac-ft reallocation with FIRO	188.7	168.7	154.8	147.7	137.7	114.3	90.6	60.7	0.9	0.7	0.6	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0
4	10,500 ac-ft reallocation with FIRO	253.8	242.3	231.0	225.5	220.6	210.3	201.5	192.5	179.5	163.8	150.1	128.8	105.0	82.3	0.0	0.0	0.0	0.0	0.0
5	15,000 ac-ft reallocation with FIRO	302.8	291.5	280.5	275.7	271.5	261.8	251.1	241.8	232.2	219.8	210.3	200.1	191.2	178.4	0.0	0.0	0.0	0.0	0.0
6	25,500 ac-ft reallocation with FIRO	345.9	343.9	341.9	341.1	340.5	338.7	335.5	332.2	326.0	320.1	314.9	307.2	302.2	292.0	153.8	0.0	0.0	0.0	0.0
7	Structural changes with FIRO	188.7	168.7	154.9	147.7	137.7	114.5	91.5	60.8	1.2	1.1	0.9	0.8	0.7	0.6	0.0	0.0	0.0	0.0	0.0

Table 16. Summary of differences from baseline in annual average number of days in which Lake Del Valle pool elevation thresholds are exceeded (positive values are an increase from baseline operations)

ID (1)	Scenario (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	FIRO-alone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5,000 ac-ft reallocation with FIRO	187.4	167.7	153.9	146.8	136.8	113.6	90.0	60.2	0.5	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
3	10,500 ac-ft reallocation with FIRO	252.5	241.2	230.0	224.6	219.8	209.6	200.9	192.0	179.1	163.5	149.8	128.6	104.9	82.2	0.0	0.0	0.0	0.0	0.0
4	15,000 ac-ft reallocation with FIRO	301.5	290.4	279.5	274.8	270.7	261.0	250.5	241.3	231.7	219.5	210.1	199.9	191.0	178.3	0.0	0.0	0.0	0.0	0.0
5	25,500 ac-ft reallocation with FIRO	344.6	342.8	341.0	340.2	339.7	338.0	334.9	331.7	325.6	319.8	314.7	307.0	302.1	291.9	153.8	0.0	0.0	0.0	0.0
6	Structural changes with FIRO	187.4	167.6	153.9	146.8	136.9	113.8	90.9	60.2	0.8	0.7	0.7	0.6	0.5	0.5	0.0	0.0	0.0	0.0	0.0

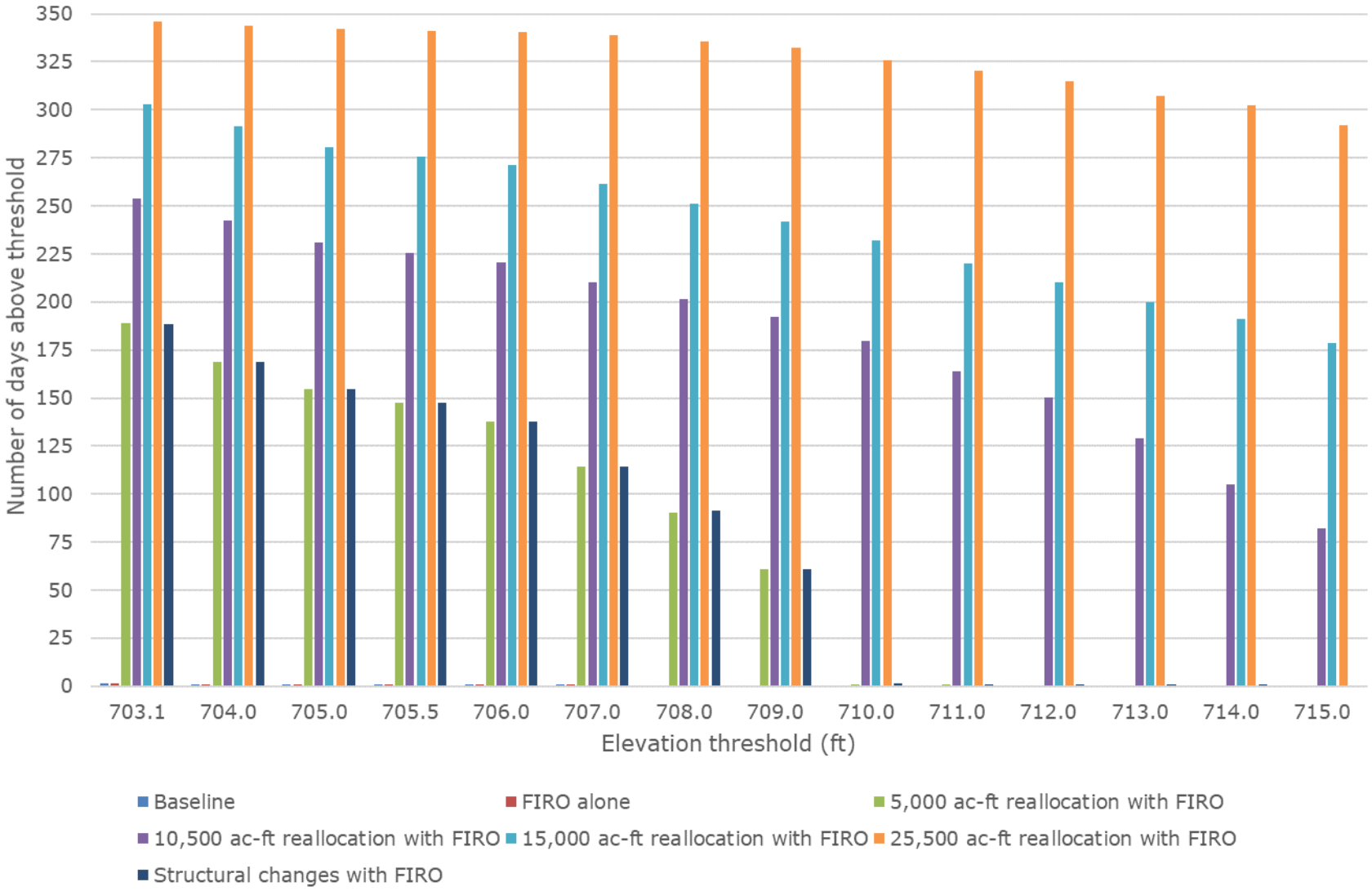

Figure 16. Summary of annual average number of days in which Lake Del Valle pool elevation thresholds are exceeded: elevations 703.10 ft to 715.00 ft

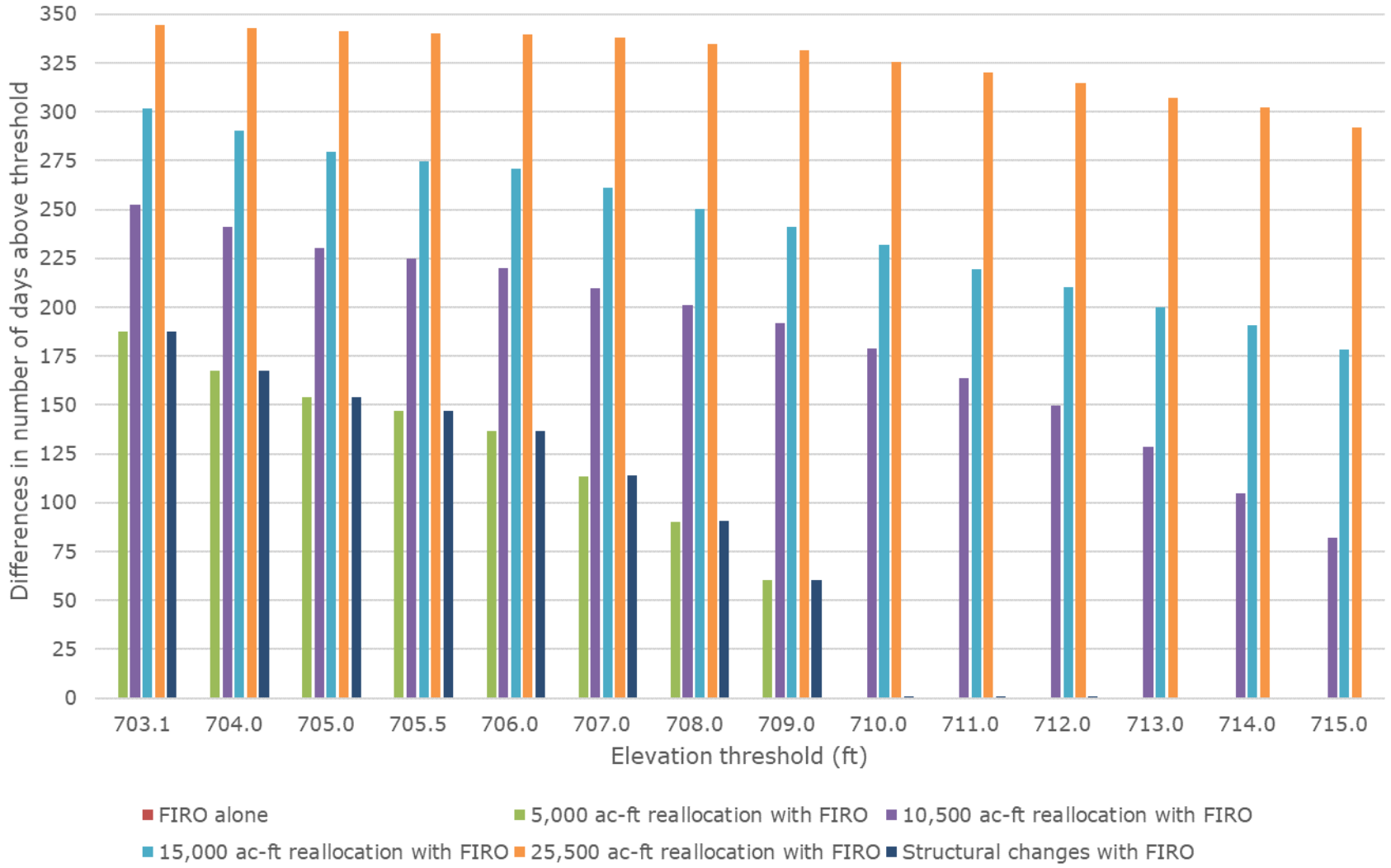

Figure 17. Summary of differences from baseline in annual average number of days in which Lake Del Valle pool elevation thresholds are exceeded: elevations 703.10 ft to 715.00 ft (positive values are an increase from baseline operations)

Table 17. Summary of annual maximum number of days in which Lake Del Valle pool elevation thresholds are exceeded

ID (1)	Scenario (2)	Days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	Baseline	14.5	12.5	11.1	10.1	9.3	8.7	7.8	6.8	6.1	5.3	4.6	3.9	3.1	2.7	0.0	0.0	0.0	0.0	0.0
2	FIRO-alone	14.5	12.5	11.2	10.1	9.3	8.8	7.8	6.9	6.1	5.4	4.7	4.0	3.1	2.7	0.0	0.0	0.0	0.0	0.0
3	5,000 ac-ft reallocation with FIRO	309.6	298.7	294.5	270.5	258.0	246.0	235.1	183.0	8.9	6.8	5.0	4.3	3.5	3.0	0.0	0.0	0.0	0.0	0.0
4	10,500 ac-ft reallocation with FIRO	359.6	354.5	343.1	338.4	326.8	322.1	317.6	313.3	308.3	298.5	291.8	251.6	245.8	232.8	0.2	0.0	0.0	0.0	0.0
5	15,000 ac-ft reallocation with FIRO	366.0	366.0	366.0	366.0	366.0	365.0	361.7	357.3	353.5	339.3	324.4	319.6	315.0	309.8	1.5	0.0	0.0	0.0	0.0
6	25,500 ac-ft reallocation with FIRO	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	304.0	0.0	0.0	0.0	0.0
7	Structural changes with FIRO	309.5	298.7	294.5	269.9	258.0	247.9	239.3	182.9	13.6	12.1	10.2	8.8	8.1	7.3	1.2	0.0	0.0	0.0	0.0

Table 18. Summary of differences from baseline in annual maximum number of days in which Lake Del Valle pool elevation thresholds are exceeded (positive values are an increase from baseline operations)

ID (1)	Scenario (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	FIRO-alone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5,000 ac-ft reallocation with FIRO	295.1	286.2	283.4	260.4	248.8	237.3	227.3	176.2	2.8	1.5	0.4	0.4	0.4	0.3	0.0	0.0	0.0	0.0	0.0
3	10,500 ac-ft reallocation with FIRO	345.1	342.0	332.0	328.3	317.5	313.4	309.9	306.4	302.3	293.2	287.3	247.7	242.7	230.0	0.2	0.0	0.0	0.0	0.0
4	15,000 ac-ft reallocation with FIRO	351.5	353.5	354.9	355.9	356.8	356.3	353.9	350.5	347.4	333.9	319.8	315.7	311.9	307.1	1.5	0.0	0.0	0.0	0.0
5	25,500 ac-ft reallocation with FIRO	351.5	353.5	354.9	355.9	356.8	357.3	358.3	359.2	359.9	360.7	361.4	362.1	362.9	363.3	304.0	0.0	0.0	0.0	0.0
6	Structural changes with FIRO	295.0	286.2	283.4	259.8	248.7	239.2	231.5	176.0	7.5	6.8	5.6	4.9	5.0	4.6	1.2	0.0	0.0	0.0	0.0

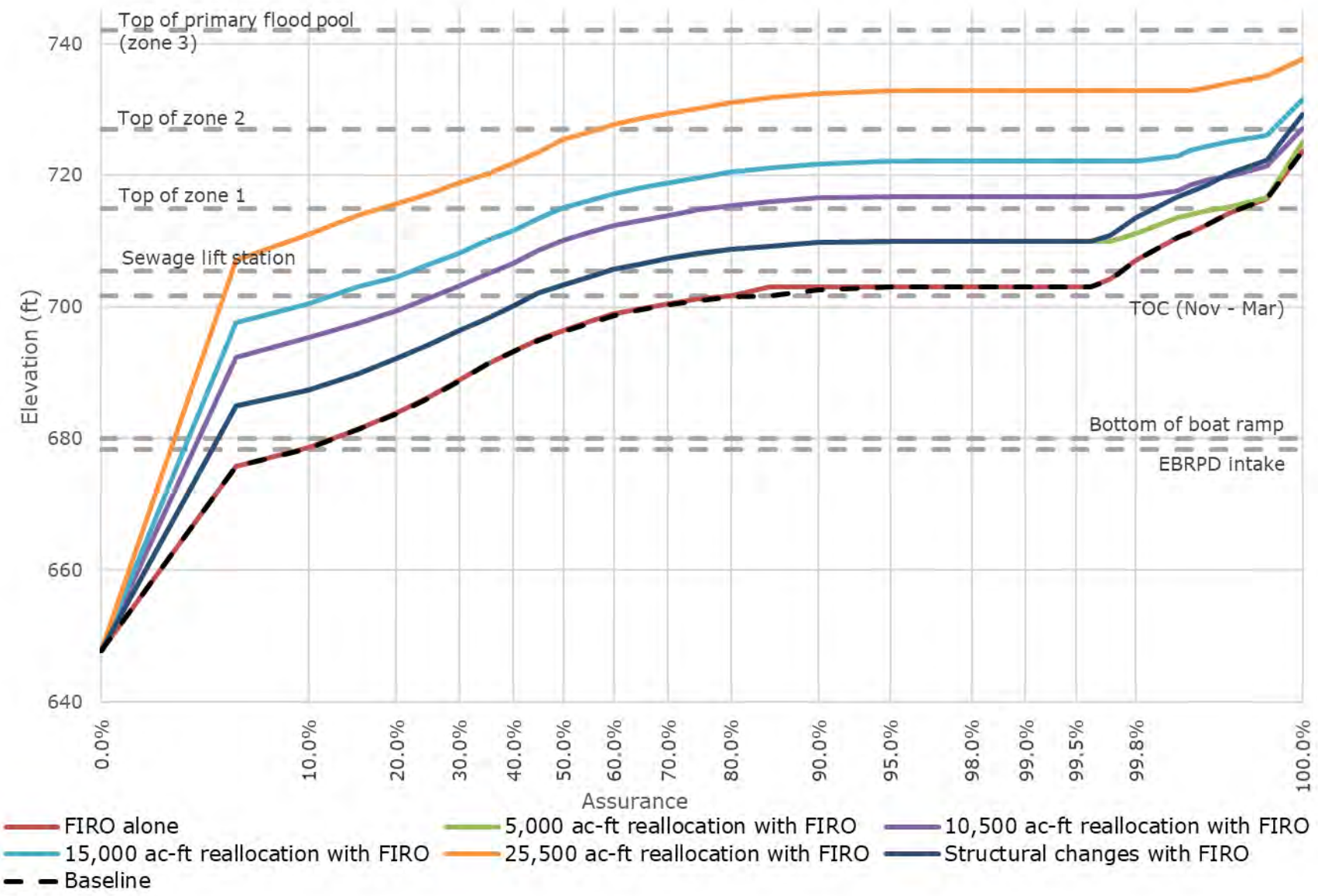

Figure 18. Lake Del Valle pool elevation non-exceedence comparison

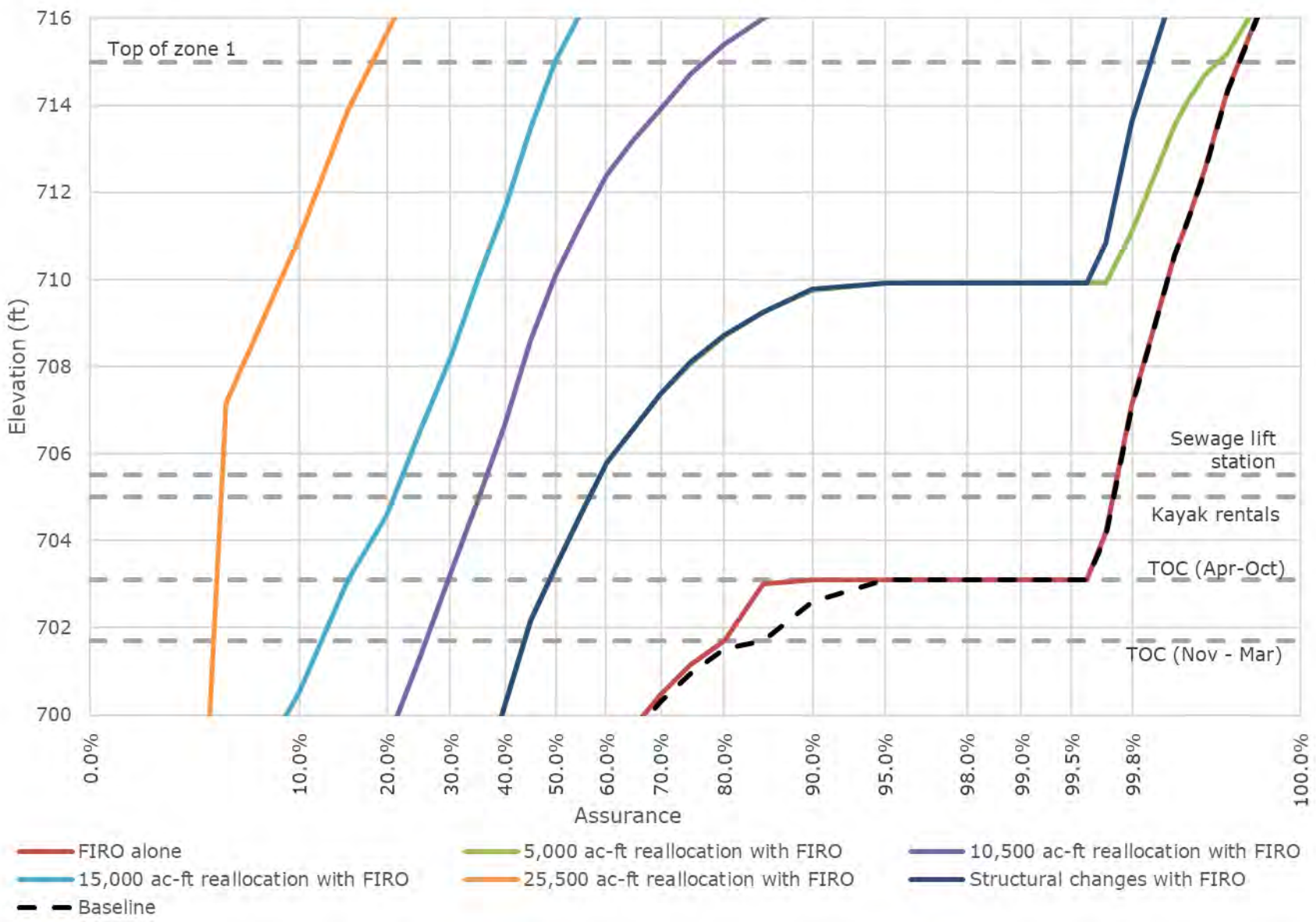

Figure 19. Lake Del Valle pool elevation non-exceedence comparison: elevations 700.00 ft to 715.00 ft

Impacts on flood management

The reservoir inflow series were reviewed, and the largest flood event each water year was identified using visual inspection. These events are listed in Table 19 and depicted in Figure 20. These events were defined conservatively, with the event start criteria being when reservoir inflow rises and/or pool elevation is greater than TOC, and with the event end criteria being when inflow, release, and/or pool elevation return to the elevation prior to the event.

Using these event definitions, the HEC-ResSim simulation results were reviewed and synthesized compared to the baseline, and the number of flood events in which specific pool elevation and downstream flow thresholds are exceeded was counted. Table 20 lists the number of events specific reservoir elevations are exceeded; their differences from the baseline are shown in Table 21. Figure 21 through Figure 25 compare the assurance reservoir releases and downstream flows would not be exceeded by alternative.

In general, increases in storage volumes increase the number of events that exceed the pool elevation thresholds. In addition, the downstream damaging flow thresholds were exceeded only at Niles for all alternatives, and only for two events (1995 and 1998). The assurance that a given flow threshold is not exceeded for any alternative is similar to those of the baseline alternatives. Specifically:

- Baseline operations have nine events that exceeded a pool elevation of 703.10 ft and two events that exceeded a pool elevation of 715.00 ft. No higher thresholds were exceeded.
- FIRO alone has the same number of events that exceed the same thresholds as the baseline. This suggests FIRO alone would have similar flood management performance as baseline operations.
- Each reallocation-with-FIRO alternative increases the number of events in which pool elevations 703.10 ft and 715.00 ft are exceeded. In addition, reallocation volumes greater than 10,500 ac-ft increase the number of events in which pool elevation 727.00 ft is exceeded. The number of events increases proportionally to the reallocation volume. The other thresholds are not exceeded. This suggests reallocation with FIRO could increase the maximum reservoir release required for flood management more frequently.
- Structural changes with FIRO increase the number of events in which pool elevations 703.10 ft, 715.00 ft, and 727.00 ft are exceeded. The higher thresholds are not exceeded. This suggests structural changes with FIRO may increase the maximum reservoir release required for flood management more frequently.
- For all simulated alternatives, there is approximately a 99% assurance the reservoir releases and downstream flows would not change from the baseline (Figure 21 through Figure 25). Differences in assurance that a given flow is exceeded generally decreases in this upper range of flows. This suggests that the flow regime would not change except for the largest, and rarest, flows, and changes may be beneficial impacts to flood management goals.

- All alternatives exceed the downstream channel capacity flow threshold at Niles (13,000 cfs) in two events: 1995 and 1998. Figure 26 and Figure 27 show that the cumulative local flow between Lake Del Valle and Niles was greater than the threshold and close to the total flow for these events. In addition, 7 events exceed the 10,000 cfs flow threshold at Niles for baseline, FIRO only, 10,500 ac-ft reallocation with FIRO, and structural changes with FIRO. The other alternatives exceed 10,000 cfs in 6 events. No other downstream flow thresholds were exceeded. This suggests that Lake Del Valle can be re-operated without adversely impacting downstream flood management goals as defined in the USACE WCM.

Table 19. Flood events used for assessment

ID (1)	Event water year[1] (2)	Start date (3)	End date (4)	Duration (days) (5)	Maximum reservoir inflow (cfs) (6)	Maximum 5-day volume (ac-ft) (7)
1	1970	1/4/1970	1/29/1970	26	1,223	5,437
2	1971	11/22/1970	1/31/1971	71	750	2,593
3	1972	12/17/1971	1/16/1972	31	128	629
4	1973	2/1/1973	2/25/1973	25	1,701	9,023
5	1974	12/16/1973	1/31/1974	47	1,014	3,703
6	1975	3/1/1975	3/30/1975	30	1,070	5,247
7	1976	1/28/1976	3/15/1976	48	134	1,252
8	1977	12/26/1976	1/15/1977	21	15	96
9	1978	12/30/1977	1/30/1978	32	1,883	11,414
10	1979	2/8/1979	2/28/1979	21	963	5,116
11	1980	2/10/1980	3/16/1980	36	3,786	20,950
12	1981	1/21/1981	1/31/1981	11	509	1,923
13	1982	12/17/1981	1/15/1982	30	3,452	12,005
14	1983	1/14/1983	2/6/1983	24	4,901	21,553
15	1984	12/19/1983	12/31/1983	13	1,908	6,253
16	1985	3/20/1985	4/8/1985	20	379	1,928
17	1986	2/8/1986	2/28/1986	21	5,785	36,523
18	1987	2/7/1987	2/18/1987	12	489	1,033
19	1988	1/10/1988	1/26/1988	17	116	411
20	1989	3/1/1989	3/26/1989	26	247	1,190
21	1990	2/9/1990	2/28/1990	20	195	1,335
22	1991	2/10/1991	3/13/1991	32	773	1,837
23	1992	2/1/1992	2/28/1992	28	2,338	6,860
24	1993	12/23/1992	2/7/1993	47	3,547	10,187
25	1994	2/6/1994	3/6/1994	29	147	1,271
26	1995	3/4/1995	3/31/1995	28	7,780	14,966
27	1996	2/14/1996	2/28/1996	15	4,512	14,661
28	1997	1/17/1997	2/2/1997	17	5,888	18,608

ID (1)	Event water year[1] (2)	Start date (3)	End date (4)	Duration (days) (5)	Maximum reservoir inflow (cfs) (6)	Maximum 5-day volume (ac-ft) (7)
29	1998	1/24/1998	3/8/1998	43	8,162	23,274
30	1999	2/1/1999	2/14/1999	14	2,105	5,032
31	2000	2/6/2000	2/17/2000	12	3,242	7,879
32	2001	2/18/2001	3/11/2001	22	1,246	3,549
33	2002	12/24/2001	1/6/2002	14	502	2,204
34	2003	12/9/2002	12/24/2003	16	3,905	8,625
35	2004	2/20/2004	2/29/2004	10	2,596	5,948
36	2005	2/10/2005	2/27/2005	18	1,118	5,208
37	2006	12/26/2005	1/6/2006	12	3,198	7,373
38	2007	2/18/2007	3/4/2007	15	453	1,344
39	2008	1/18/2008	1/31/2008	14	3,698	7,132
40	2009	2/26/2009	3/21/2009	24	2,647	4,876
41	2010	1/13/2010	1/26/2010	14	3,796	8,674
42	2011	3/13/2011	4/3/2011	22	4,356	10,917
43	2012	4/7/2012	4/18/2012	12	315	1,055
44	2013	12/17/2012	12/31/2012	15	3,328	5,024
45	2014	2/20/2014	3/16/2014	25	138	1,121
46	2015	12/6/2014	12/31/2014	26	599	2,638

1. Water year is from October 1 − September 30; for example, water year 2013 begins on October 1, 2012, and ends on September 30, 2013.

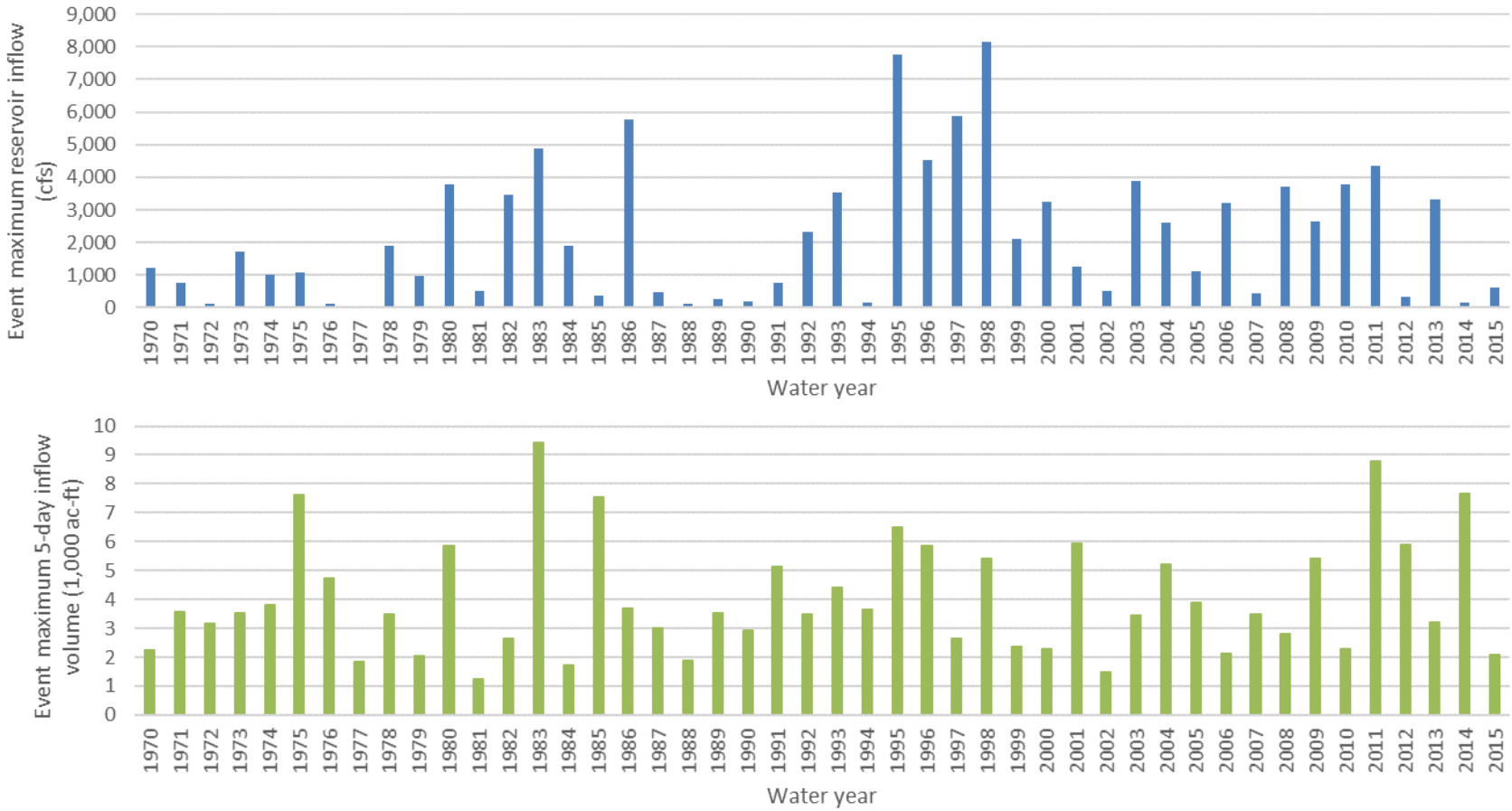

Figure 20. Comparison of event maximum reservoir inflows and inflow volumes.

Table 20. Summary of number of events that exceed Lake Del Valle pool elevation thresholds

ID (1)	Scenario (2)	Days threshold is exceeded																	
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	Baseline	9	9	8	7	7	7	6	6	6	5	3	2	2	2	0	0	0	0	0
2	FIRO-alone	9	9	8	8	7	7	6	6	6	5	3	2	2	2	0	0	0	0	0
3	5,000 ac-ft reallocation with FIRO	26	24	23	21	20	19	16	14	9	8	7	7	5	4	0	0	0	0	0
4	10,500 ac-ft reallocation with FIRO	37	36	33	32	31	29	27	27	25	24	21	19	17	15	1	0	0	0	0
5	15,000 ac-ft reallocation with FIRO	41	41	39	39	38	36	36	35	34	30	29	29	27	26	1	0	0	0	0
6	25,500 ac-ft reallocation with FIRO	44	44	43	43	43	43	43	43	42	42	42	41	40	40	23	0	0	0	0
7	Structural changes with FIRO	26	24	23	21	20	19	16	14	9	9	7	7	6	6	1	0	0	0	0

Table 21. Summary of differences from baseline in number of events that exceed Lake Del Valle elevation thresholds (positive values are an increase from baseline operations)

ID (1)	Scenario (2)	Difference in days threshold is exceeded																	
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	FIRO-alone	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	5,000 ac-ft reallocation with FIRO	17	15	15	14	13	12	10	8	3	3	4	5	3	2	0	0	0	0	0
3	10,500 ac-ft reallocation with FIRO	28	27	25	25	24	22	21	21	19	19	18	17	15	13	1	0	0	0	0
4	15,000 ac-ft reallocation with FIRO	32	32	31	32	31	29	30	29	28	25	26	27	25	24	1	0	0	0	0
5	25,500 ac-ft reallocation with FIRO	35	35	35	36	36	36	37	37	36	37	39	39	38	38	23	0	0	0	0
6	Structural changes with FIRO	17	15	15	14	13	12	10	8	3	4	4	5	4	4	1	0	0	0	0

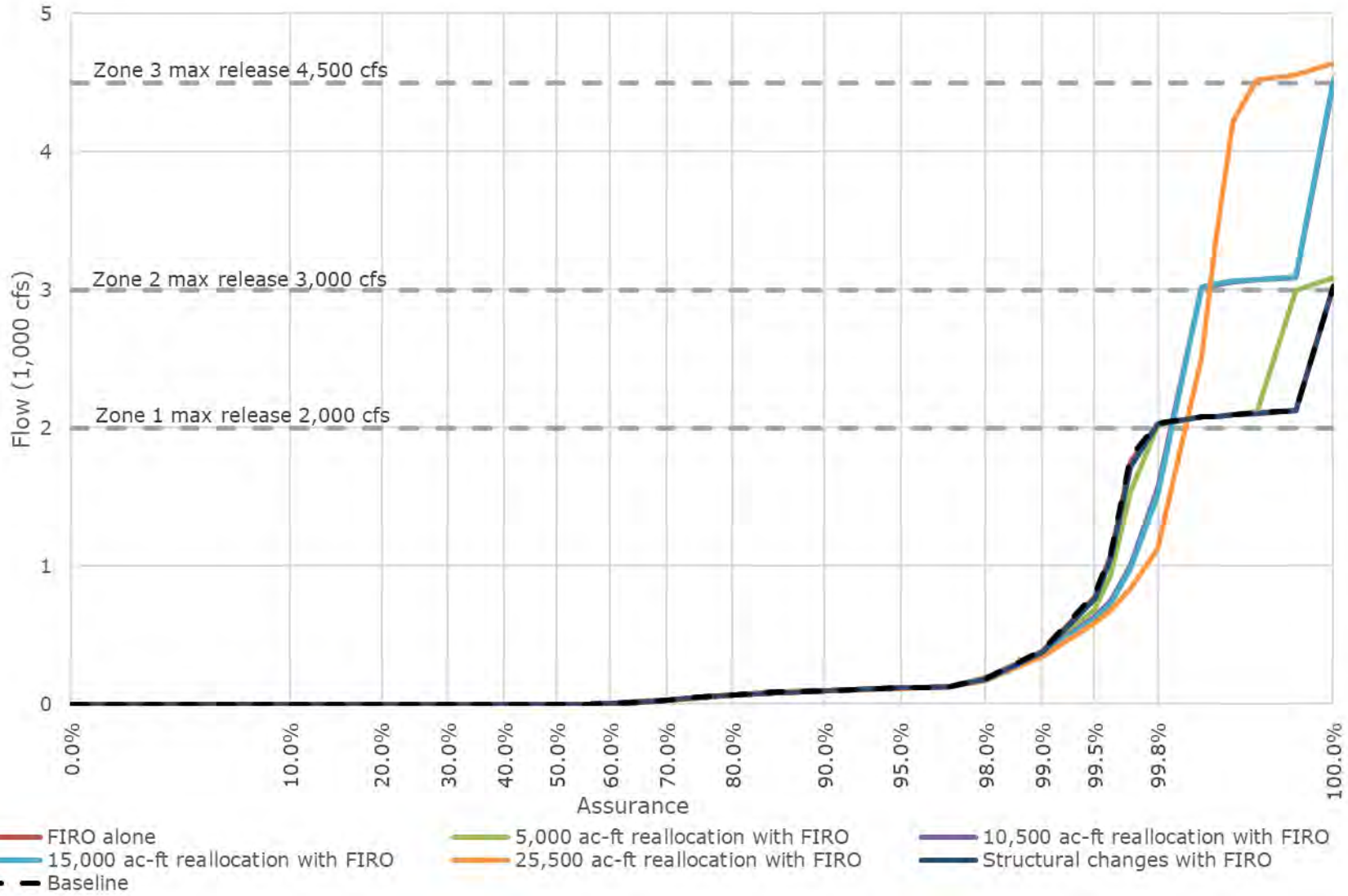

Figure 21. Lake Del Valle release assurance comparison (plateaus in assurance for a given flow threshold are a result of the maximum reservoir release objectives specified in the WCM)

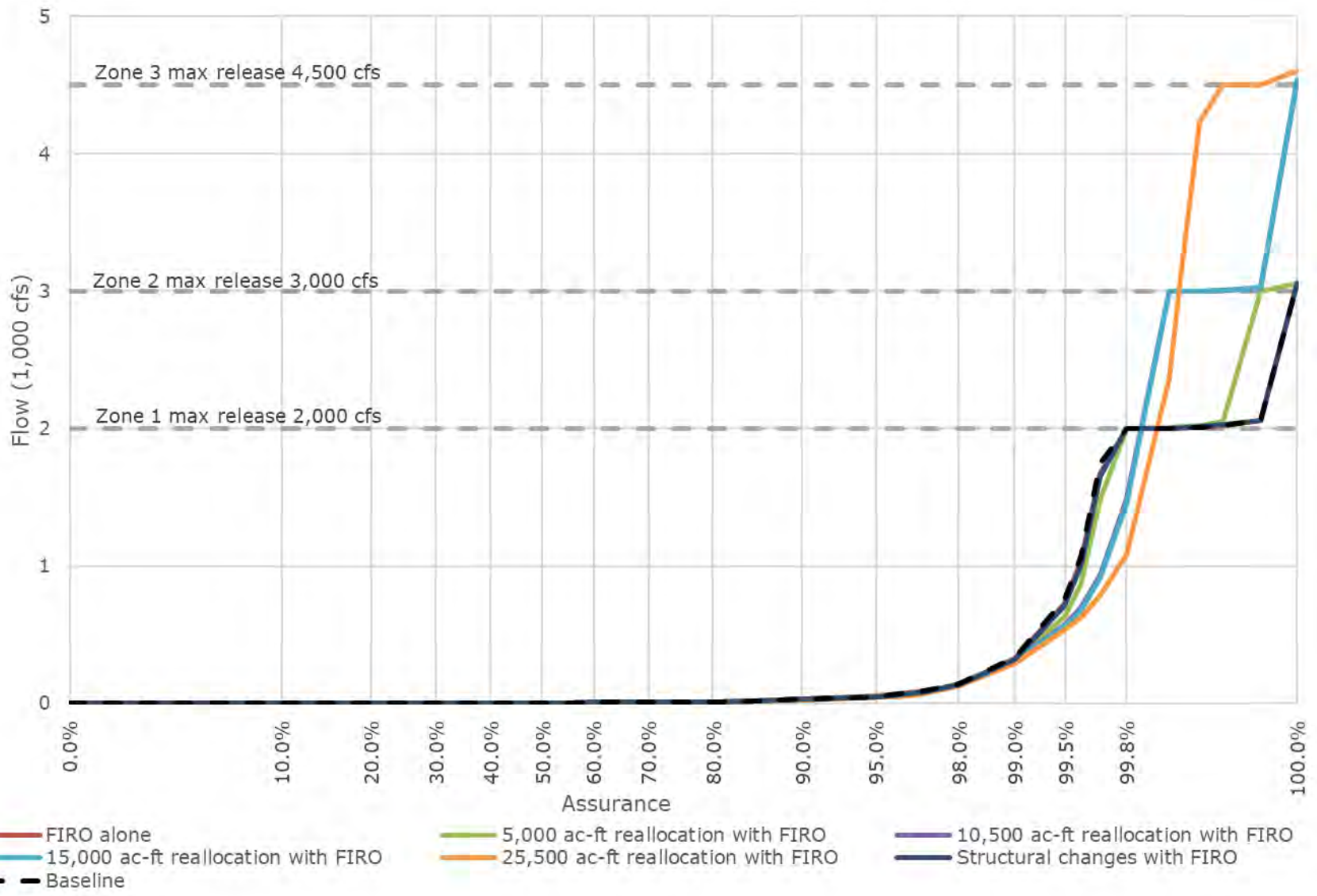

Figure 22. Livermore flow assurance comparison (maximum channel capacity is 7,000 cfs and plateaus assurance for a given flow threshold are a result of the maximum reservoir release objectives specified in the WCM)

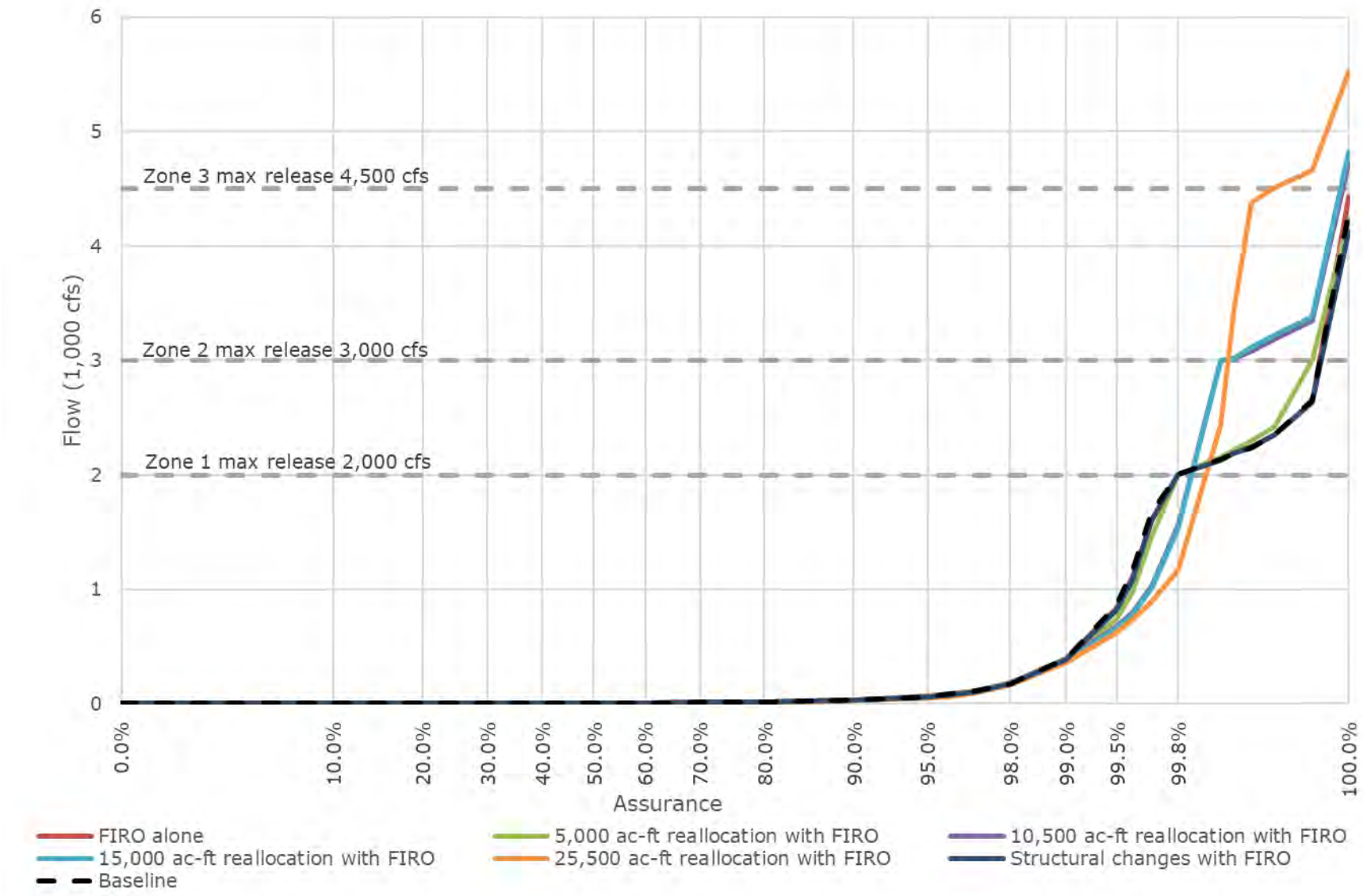

Figure 23. Pleasanton flow assurance comparison (maximum channel capacity is 7,000 cfs)

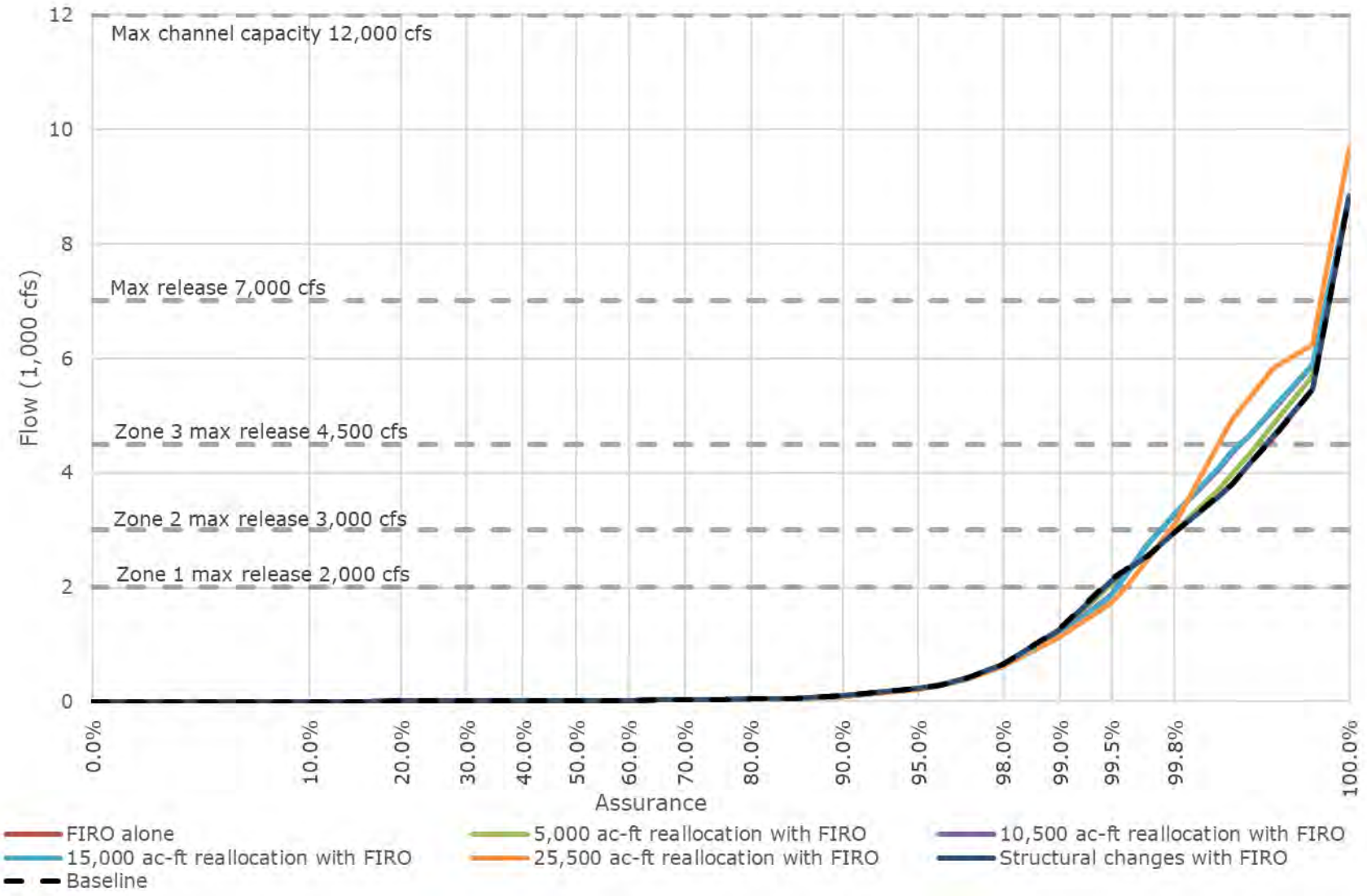

Figure 24. Verona flow assurance comparison (maximum channel capacity is 12,000 cfs)

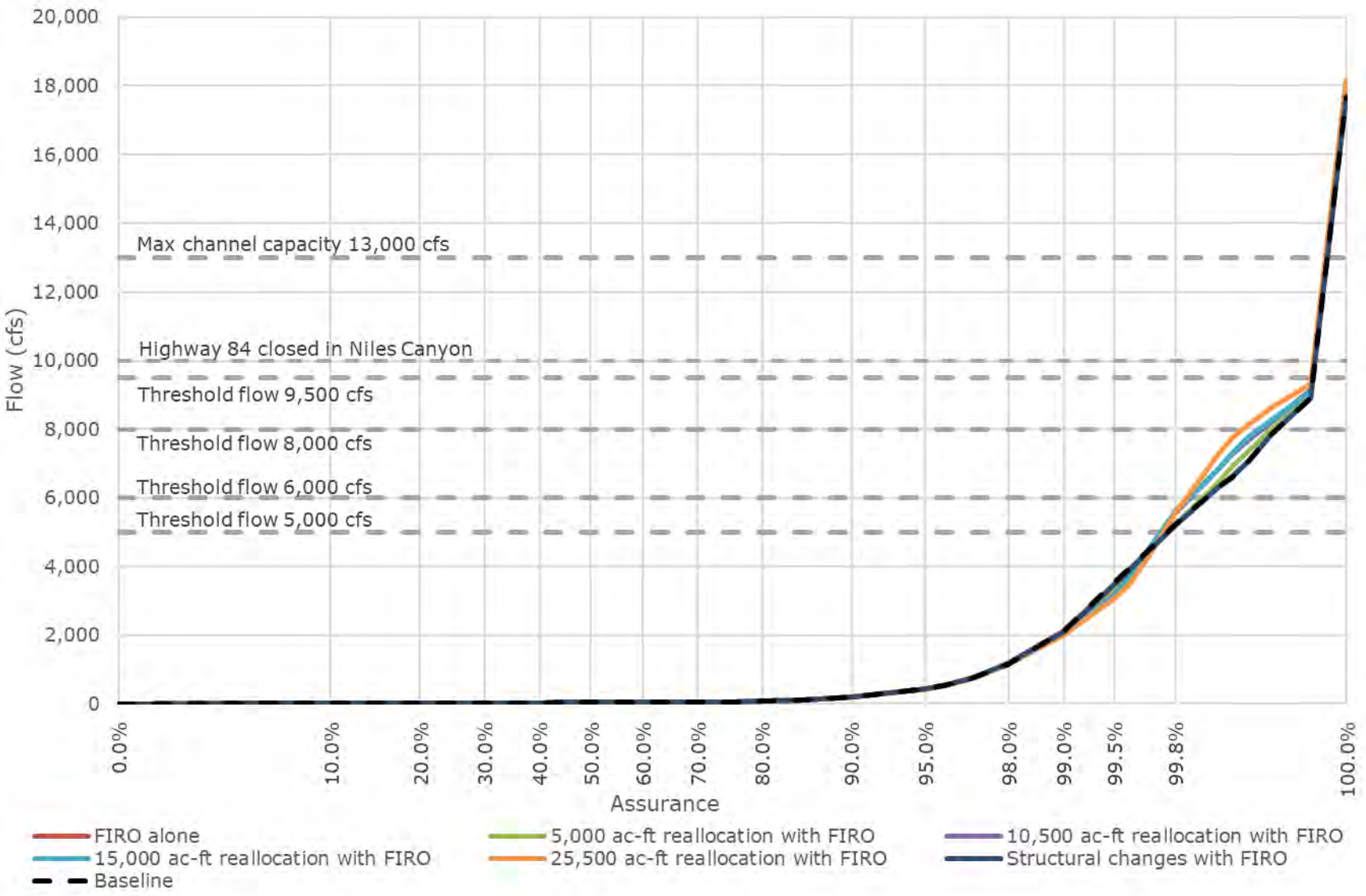

Figure 25. Niles assurance comparison (maximum channel capacity is 13,000 cfs and Highway 84 through Niles Canyon is closed when flows exceed 10,000 cfs)

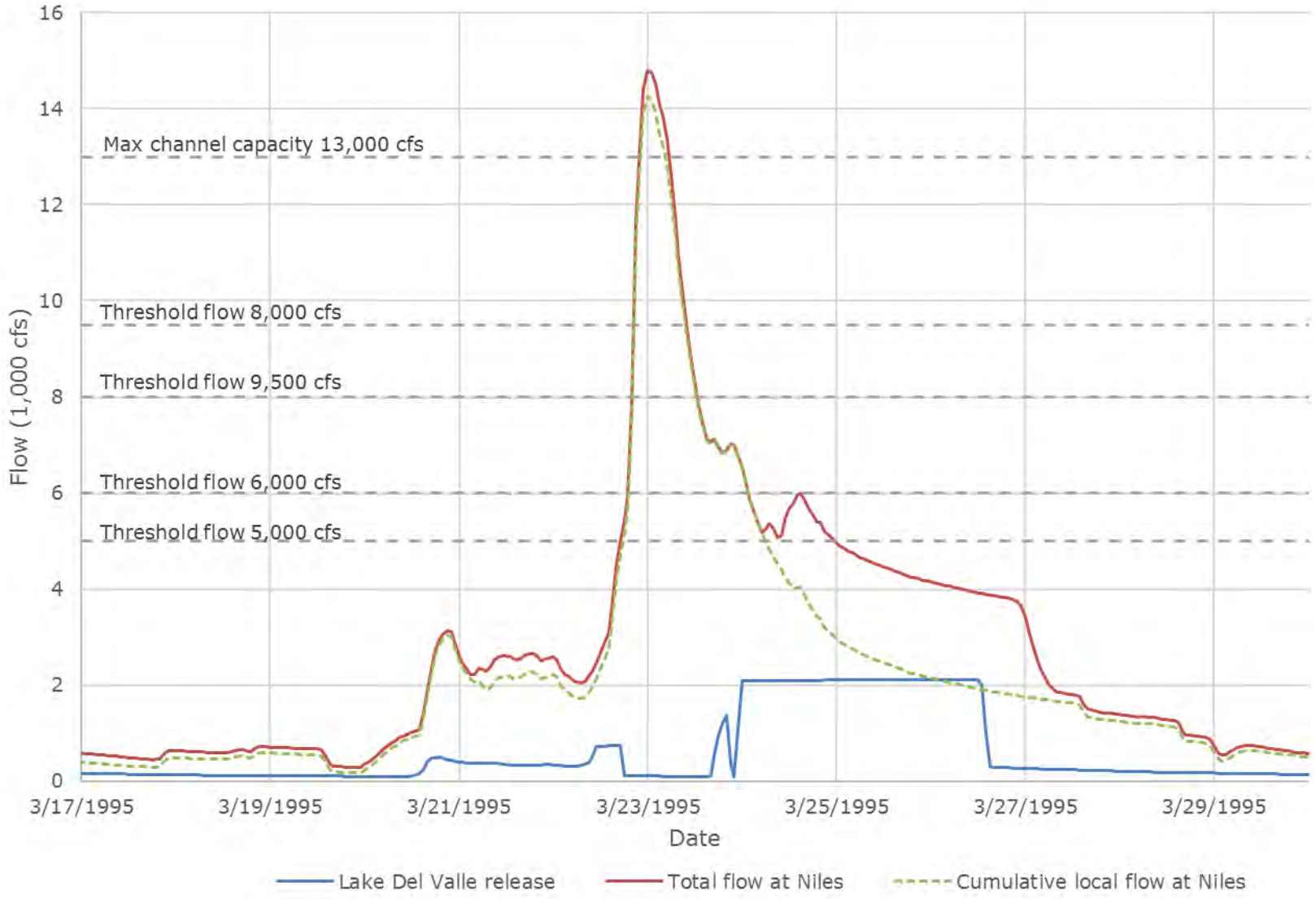

Figure 26. 1995 event hydrographs showing cumulative local flow below Lake Del Valle is greater than the 13,000 cfs threshold

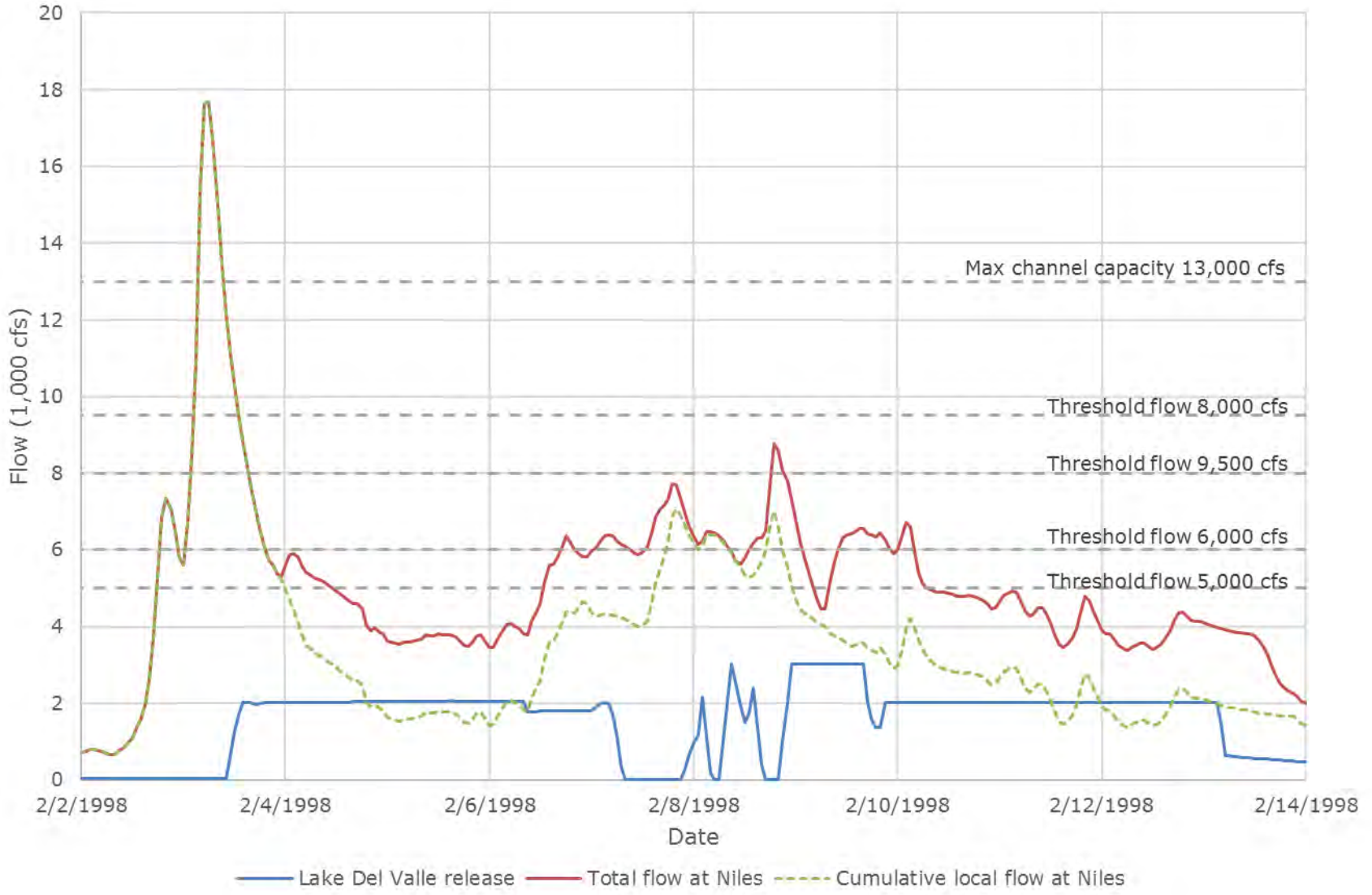

Figure 27. 1998 event hydrographs showing cumulative local flow below Lake Del Valle is greater than the 13,000 cfs threshold

Synthesis of findings

All the alternatives examined in this study have the potential to enhance water supply availability through increases in storage while also meeting flood management objectives as defined in the USACE WCM. Reallocation with FIRO and structural changes with FIRO result in more frequent inundation of recreational facilities, and would require the relocation of these facilities if implemented. In addition, all examined alternatives have only very limited potential to enhance runoff capture in Lake Del Valle, up to a maximum average increase of 152 ac-ft per year shown under 25,500 ac-ft reallocation with FIRO. Lastly, structural changes with FIRO showed similar outcomes regarding water supply, flood management, and impacts to existing recreational facilities as 5,000-ac-ft reallocation with FIRO.

Table 22 summarizes the potential impacts to water supply, flood management, and recreational facilities by alternative.

FIRO alone

Based on the historical hydrology, the analysis indicates that:

- Runoff capture is not significantly increased. Although model output shows that runoff captured increases on average by 1 ac-ft per year, the reliability of this value for conclusion purposes is insupportable if, for example, statistical error of streamgage readings were to be introduced. Under FIRO alone, average monthly water storage increases by 103 ac-ft per year, compared to baseline operations.
- Flood management is unaffected compared to baseline operations. There is approximately a 99% assurance the reservoir releases and downstream flows would not change from the baseline.
- Existing recreational facilities are not inundated with any greater frequency compared to baseline operations. The assurance that a given reservoir pool elevation is exceeded does not change above 703.10 ft (the top of the variable conservation pool). Both baseline operations and the FIRO-alone alternative have a 99.6% assurance that elevation 703.10 ft is not exceeded.

Reallocation with FIRO

Based on the historic hydrology, the analysis indicates that:

- For each reallocation volume, runoff capture and average monthly water storage increases, compared to baseline operations, as follows:
    - 5,000 ac-ft increases runoff capture on average by 36 ac-ft per year and increases average monthly storage by 4,933 ac-ft per year.
    - 10,500 ac-ft increases runoff capture on average by 71 ac-ft per year and increases average monthly storage by 9,847 ac-ft per year.
    - 15,000 ac-ft increases runoff capture on average by 97 ac-ft per year and increases average monthly storage by 13,692 ac-ft per year.
    - 25,500 ac-ft increases runoff capture on average by 152 ac-ft per year and increases average monthly storage by 22,208 ac-ft per year.

- Flood management is largely unaffected compared to baseline operations for the modeled period (November 1969 to September 2015). There is approximately a 99% assurance the reservoir releases and downstream flows would not change from the baseline. However, storage reallocation with FIRO increases the frequency and magnitude of high release rates (those greater than 2,000 cfs) from the reservoir, with releases greater than 2,000 cfs made off storm peak so as not to exceed downstream thresholds defined by the WCM. More studies are needed to determine the extent of flood management impacts such as increased erosion downstream.
- Existing recreation facilities are inundated more frequently for each reallocation volume as compared to baseline as follows:
    - 5,000 ac-ft reduces the assurance the reservoir pool elevation is below elevation 703.10 ft to approximately 50% (from 99.6% for baseline).
    - 10,500 ac-ft reduces the assurance the reservoir pool elevation is below elevation 703.10 ft to approximately 30%.
    - 15,000 ac-ft reduces the assurance the reservoir pool elevation is below elevation 703.10 ft to approximately 15%.
    - 25,500 ac-ft reduces the assurance the reservoir pool elevation is below elevation 703.10 ft to approximately 5%.

Structural changes with FIRO

Based on the historical hydrology, the analysis indicates that with structural changes and FIRO:

- Runoff capture increases on average by 36 ac-ft per year and increases average monthly water storage by 4,942 ac-ft per year, compared to baseline operations.
- Flood management is unaffected compared to baseline operations from the modeled period (November 1969 to September 2015). There is approximately a 99% assurance the reservoir releases and downstream flows would not change from the baseline. However, an increase in storage from structural changes with FIRO increases the frequency and magnitude of high release rates (those greater than 2,000 cfs) from the reservoir, with releases greater than 2,000 cfs made off storm peak so as not to exceed downstream thresholds defined by the WCM. More studies are needed to determine the extent of flood management impacts such as increased erosion downstream.
- Existing recreational facilities are inundated with greater frequency compared to baseline operations. Specifically, structural changes with FIRO reduce the assurance the reservoir pool elevation is below elevation 703.10 ft to approximately 50% (from 99.6% for baseline).

Table 22. Summary of findings

ID (1)	Reoperation alternative (2)	Potential impacts (as compared to baseline) on: Water supply availability (3)	Flood management (4)	Recreational facilities (5)
1	FIRO alone	Increases in: • Runoff capture (model output shows an average of 1 ac-ft per year, which is considered insignificant for this report). • Mean monthly average storage (103 ac-ft per year). • Start-of-season storage (284 ac-ft). • End-of-season storage (59 ac-ft).	Little to none; simulated metrics are similar to baseline. Approximately a 99% assurance the reservoir releases and downstream flows would not change from the baseline.	Little to none; simulated metrics are similar to baseline. The assurance that a given reservoir pool elevation is exceeded does not change above 703.10 ft. Both the baseline and FIRO alone have a 99.6% assurance that elevation 703.10 ft is not exceeded.
2	5,000 ac-ft reallocation with FIRO	Increases in: • Runoff capture (36 ac-ft per year). • Mean monthly average storage (4,933 ac-ft per year). • Start-of-season storage (5,093 ac-ft). • End-of-season storage (4,885 ac-ft).	Little to none; simulated metrics are similar to baseline except for largest flows. Approximately a 99% assurance the reservoir releases and downstream flows would not change from the baseline. Increases the frequency and magnitude of high flood releases rates from the reservoir (releases greater than or equal to 2,000 cfs), however releases are made off storm peak and without exceeding identified downstream thresholds defined in the USACE WCM. Downstream impacts (for example erosion) due to higher release rates would need to be evaluated.	Recreational facilities will be impacted in the following ways: • The average number of days that elevation 703.10 ft is exceeded increases by 187 days per year, and the assurance that elevation 703.10 ft is not exceeded decreases to 48.8%. • The average number of days that the kayak rental (elevation 705.00 ft) is exceeded increases by 154 days per year, and the assurance that the kayak rentals are not inundated decreases to 56.7% (from 99.7% for baseline). • The average number of days that the sewage lift station (elevation 705.50 ft) is exceeded increases by 147 days per year, and the assurance that the kayak rentals are not inundated decreases to 58.8% (from 99.7% for baseline).
3	10,500 ac-ft reallocation with FIRO	Increases in: • Runoff capture (71 ac-ft per year). • Mean monthly average storage (9,847 ac-ft). • Start-of-season storage (10,020 ac-ft per year). • End-of-season storage (9,794 ac-ft).		Recreational facilities will be impacted in the following ways: • The average number of days that elevation 703.10 ft is exceeded increases by 253 days per year, and the assurance that elevation 703.10 ft is not exceeded decreases to 29.6%. • The average number of days that the kayak rental (elevation 705.00 ft) is exceeded increases by 230 days per year, and the assurance that the kayak rentals are not inundated decreases to 35.0%. • The average number of days that the sewage lift station (elevation 705.50 ft) is exceeded increases by 225 days per year, and the assurance that the kayak rentals are not inundated decreases to 36.5%.
4	15,000 ac-ft reallocation with FIRO	Increases in: • Runoff capture (97 ac-ft per year). • Mean monthly average storage (13,692 ac-ft per year). • Start-of-season storage (13,897 ac-ft). • End-of-season storage (13,623 ac-ft).		Recreational facilities will be impacted in the following ways: • The average number of days that elevation 703.10 ft is exceeded increases by 302 days per year, and the assurance that elevation 703.10 ft is not exceeded decreases to 15.0%. • The average number of days that the kayak rental (elevation 705.00 ft) is exceeded increases by 280 days per year, and the assurance that the kayak rentals are not inundated decreases to 21.0%. • The average number of days that the sewage lift station (elevation 705.50 ft) is exceeded increases by 275 days per year, and the assurance that the kayak rentals are not inundated decreases to 22.2%.
5	25,500 ac-ft reallocation with FIRO	Increases in: • Runoff capture (152 ac-ft per year). • Mean monthly average storage (22,208 ac-ft per year). • Start-of-season storage (22,617 ac-ft). • End-of-season storage (22,062 ac-ft).		Recreational facilities will be impacted in the following ways: • The average number of days that elevation 703.10 ft is exceeded increases by 345 days per year, and the assurance that elevation 703.10 ft is not exceeded decreases to 4.5%. • The average number of days that the kayak rental (elevation 705.00 ft) is exceeded increases by 341 days per year, and the assurance that the kayak rentals are not inundated decreases to 4.7%. • The average number of days that the sewage lift station (elevation 705.50 ft) is exceeded increases by 340 days per year, and the assurance that the kayak rentals are not inundated decreases to 4.8%.

ID (1)	Reoperation alternative (2)	Potential impacts (as compared to baseline) on: Water supply availability (3)	Flood management (4)	Recreational facilities (5)
6	Structural changes to add 5,000 ac-ft with FIRO	Increases in: • Runoff capture (36 ac-ft per year). • Mean monthly average storage (4,942 ac-ft per year). • Start-of-season storage (5,120 ac-ft). • End-of-season storage (4,882 ac-ft).	Little to none; simulated metrics are similar to baseline. Approximately a 99% assurance the reservoir releases and downstream flows would not change from the baseline. Downstream impacts (for example erosion) due to higher release rates would need to be evaluated.	Recreational facilities will be impacted in the following ways: • The average number of days that elevation 703.10 ft is exceeded increases by 187 days per year, and the assurance that elevation 703.10 ft is not exceeded decreases to 48.8%. • The average number of days that the kayak rental (elevation 705.00 ft) is exceeded increases by 154 days per year, and the assurance that the kayak rentals are not inundated decreases to 56.7%. • The average number of days that the sewage lift station (elevation 705.50 ft) is exceeded increases by 147 days per year, and the assurance that the kayak rentals are not inundated decreases to 58.8%.

Detailed results can be found in Appendix III through Appendix IX.

Limitations of this study and next steps

Limitations of this study

Because of the methods, data, and assumptions employed in this initial viability study, the analyses and results are limited in their applicability. In the calculations of storage and runoff capture, the model did not distinguish between Table A water (deliveries from the State Water Project Stored in Lake Del Valle) and local inflows when assigning volumes to storage. Rather, reservoir fill took all types of water and storage was calculated simply as the volume of water in the reservoir. Runoff capture was calculated as the volume of additional reservoir inflows stored in the water conservation pool that were above the historical baseline. Water rights and agency-specific storage use in Lake Del Valle also did not factor into the study.

In terms of data considerations, the historical streamflow data used in the study were considered "perfect" and no statistical errors were introduced to the model. As a result, all modeling output is precise and based on the perfect input assumption. However, in the analysis of the study's findings, only model output of significant magnitude is discussed. In addition, the streamflow data used to generate the hydrologic dataset span only 45 years of historical record, and as a result, are not intended to cover the full range of storm severity that could be experienced in the basin. Specifically, the peak historic events of 1995 and 1998 have return periods of 15 and 20 years respectively (more common than the 100-year storm). [These return period estimates are based on the USGS peak streamflow data for Alameda Creek near Niles (USGS 2017) and the regulated peak flow-frequency curve on Plate 3 of the Lake Del Valle WCM.] The hydrologic dataset used for the HEC-ResSim model also remained a constant input value and was not adjusted iteratively to account for changes in reservoir operations under different model scenarios.

In terms of FIRO assumptions, the 5-day forecast used in the model was simulated by using real historical values from the historical inflow data series, allowing the simulated forecast to perfectly predict future inflow. This "perfect" forecast is an optimistic representation of FIRO, but was chosen for clarity.

Despite these limitations, the study provides a sound basis for deciding whether to pursue further investigations into the feasibility and effectiveness of FIRO, alone or with reallocation, to increase water supply availability in Lake Del Valle. The study's findings do not guarantee any particular outcome of such further studies.

Next steps

The findings of this initial viability study allow the Stakeholder Agencies to answer two questions:

(1) Do the synthesized results of the study suggest that implementation of FIRO alone or with reallocation would enhance water supply availability while not impairing flood management?

(2) If yes to question (1) above, what impacts do the various alternatives have to existing recreation facilities?

The answer to this question (1) is: yes, implementation of FIRO alone or with reallocation would enhance water supply availability while not impairing flood

management. The answer to question (2) is: reallocation with FIRO and structural changes with FIRO cause the existing recreation facilities to be inundated more frequently compared to baseline and FIRO only.

The next step in the Stakeholder Agencies' investigations into the viability of FIRO, with or without other measures, would be a more in-depth feasibility study. The feasibility study would answer questions such as:

- Which reoperations approach (e.g., FIRO alone, reallocation with FIRO) is most likely to achieve the reservoir's water management objectives (water supply, flood management, and recreation)?
- What decision support system and tools need to be employed to implement the selected reoperation approach? Are the systems and tools now in place adequate? If not, what investments need to be made, and which agencies will make them?

A feasibility study would include activities such as:

1. Completing a flow-frequency study including Lake Del Valle and downstream locations.
2. Enhancing the hydrologic period of record using a rainfall-runoff model.
3. Completing a critical duration study for Lake Del Valle.
4. Refining FIRO components (if needed).
5. Refining the metrics used to assess water supply enhancement and impacts to the reservoir's flood management and recreation purposes.
6. Refining the reallocation volume required (if needed).
7. Analyzing the refined operations for: (1) the period of record, and (2) design events.
8. Completing a risk analysis.

If implementation of FIRO alone proves feasible and desirable, DWR, as operator of the dam, would make a request to the USACE San Francisco District for a planned major deviation to the WCM. The requirements for such a request are provided in Section 8a of Regulation No. 10-1-04, Guidance on the Preparation of Deviations from Approved Water Control Manuals (USACE 2014). This guidance document is included with this report as Appendix X. A request for a planned major deviation includes information developed in the feasibility study:

- Description of the proposed deviation, including purpose, proposed change from the approved WCM, duration, and other details about the deviation.
- The implications of adhering to the water control plan and of employing the proposed deviation.
- Alternative deviation plans, and a risk analysis for each alternative.
- Effects of the proposed deviation on project and system operation, and on other project purposes.
- Analysis of the effect of the deviation on the probability of dam failure and consequences associated with the deviation.
- Change in flood threat with the deviation.

- Current and predicted maximum storage, elevation, river stage, and other pertinent information with and without the deviation.
- A review of the deviation under applicable environmental laws and regulations.
- A description of the coordination done with affected entities.
- Written comments from entities and individuals affected by the deviation.
- Discussion of other relevant issues.
- USACE District commander (or designee) recommendation.

Implementing any permanent reallocation alternative would require a revision to the WCM. In addition to the information required for a planned major deviation request, a revision to the WCM would require:

- Increased coordination with affected entities.
- Public comment and response.
- Additional levels of review by the USACE.
- Final authorization of the updated WCM by the US Congress.

Implementing structural changes would require a planning study, a dam design, and a WCM revision (a multi-year effort).

This initial viability study is the first step in a much larger process ultimately required to implement FIRO or permanently "redraw" the TOC curve at Lake Del Valle. To complete a planned major deviation request, or to update the WCM, more in-depth analysis must be completed to satisfy the USACE. In general, the scope of work required for a planned major deviation request or a WCM update are similar. However, the detail and level of review required for a WCM are generally greater.

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Appendix I. Streamgage data

Availability

Table 23 lists the streamflow data availability of the five gages used in the study. The streamgage name is in column 2; the gage ID# is in column 3; and the daily, hourly, and sub-hourly data availability are in columns 4-6. This data availability is depicted in Figure 28 through Figure 32.

Table 23. Streamgage data availability

ID (1)	Gage name (2)	Gage ID# (3)	Daily data availability (4)	Hourly data availability (5)	Sub-hourly data availability (6)
1	Arroyo Valle below Lang Canyon near Livermore	11176400[1]	10/01/1963-present	None	10/29/1987-present
2	Arroyo Valle near Livermore	11176500[1]	04/01/1912-09/30/1930; 10/01/1957-present	None	10/01/1987-present
		AVL[2]	None	07/21/1997-07/31/2008	05/29/1997-present
3	Arroyo Valle at Pleasanton	11176600[1]	10/01/1957-01/03/1986	None	None
4	Arroyo de la Laguna at Verona	11176900[1]	04/01/1912-09/30/1930; 10/01/1969-present	None	11/06/2003-present
5	Alameda Creek near Niles	11179000[1]	01/01/1891-present	None	10/03/1987-present
		ALN[2]	None	07/02/1997-06/24/2002 (stage only)	07/21/1997-present

1. USGS gage, accessed at http://waterdata.usgs.gov/nwis.
2. CDEC gage, accessed at http://cdec.water.ca.gov.

Volume checks

A series of volume checks were completed to understand the relationships among the daily, hourly, and instantaneous datasets. Specifically, the volumes from the synthetic hourly flows (smoothed from average daily flows) were compared to those from the 15-minute instantaneous dataset for two events. Table 24 and Table 25 summarize these volume comparisons for the February 1998 and the March 1995 events. Volumes differed by 3% or less, and generally less than 1%.

In addition, the peak 15-day volumes of the developed hourly hydrologic dataset were compared to those from the daily observed streamflow for the same two events. Table 26 and Table 27 summarize these volume comparisons for the February 1998 and March 1995 events. Volumes differed by 3% or less, and generally 1% or less.

Table 24. Synthetic volume check for the February 1998 event (January 31, 1998, to February 14, 1998)

ID (1)	Streamgage location (2)	Volume accumulated from synthetic hourly data (smoothed from daily data) (ac-ft) (3)	Volume accumulated from 15-minute instantaneous data (USGS or Zone 7) (ac-ft) (4)	Percent difference (5)
1	Niles	126,621	126,606	0%
2	Verona	74,067	—	N/A
3	Pleasanton	37,807	36,531	3%
4	Livermore	32,426	32,426	0%
5	Lang Canyon	36,847	36,657	1%

Table 25. Synthetic volume check for the March 1995 event (March 17, 1995, to March 31, 1995)

ID (1)	Streamgage location (2)	Volume accumulated from synthetic hourly data (smoothed from daily data) (ac-ft) (3)	Volume accumulated from 15-minute instantaneous data (USGS or Zone 7) (ac-ft) (4)	Percent difference (5)
1	Niles	75,060	75,044	0%
2	Verona	32,386	—	N/A
3	Pleasanton	15,777	15,779	0%
4	Livermore	13,383	13,370	0%
5	Lang Canyon	16,945	16,944	0%

Table 26. Final hourly hydrologic dataset volume check for the February 1998 event (January 31, 1998, to February 14, 1998)

ID (1)	Streamgage location (2)	Volume accumulated from Zone 7 daily data (ac-ft) (3)	Volume accumulated from developed hourly hydrologic dataset (ac-ft) (4)	Percent difference (5)
1	Niles	129,442	126,606	2%
2	Verona	73,906	74,066	0%
3	Pleasanton	38,350	37,291	3%
4	Livermore	32,940	32,426	2%

Table 27. Final hourly hydrologic dataset volume check for the March 1995 event (March 17, 1995, to March 31, 1995)

ID (1)	Streamgage location (2)	Volume accumulated from Zone 7 daily data (ac-ft) (3)	Volume accumulated from developed hourly hydrologic dataset (ac-ft) (4)	Percent difference (5)
1	Niles	74,972	75,076	0%
2	Verona	32,397	32,386	0%
3	Pleasanton	15,761	15,989	1%
4	Livermore	13,382	13,370	0%

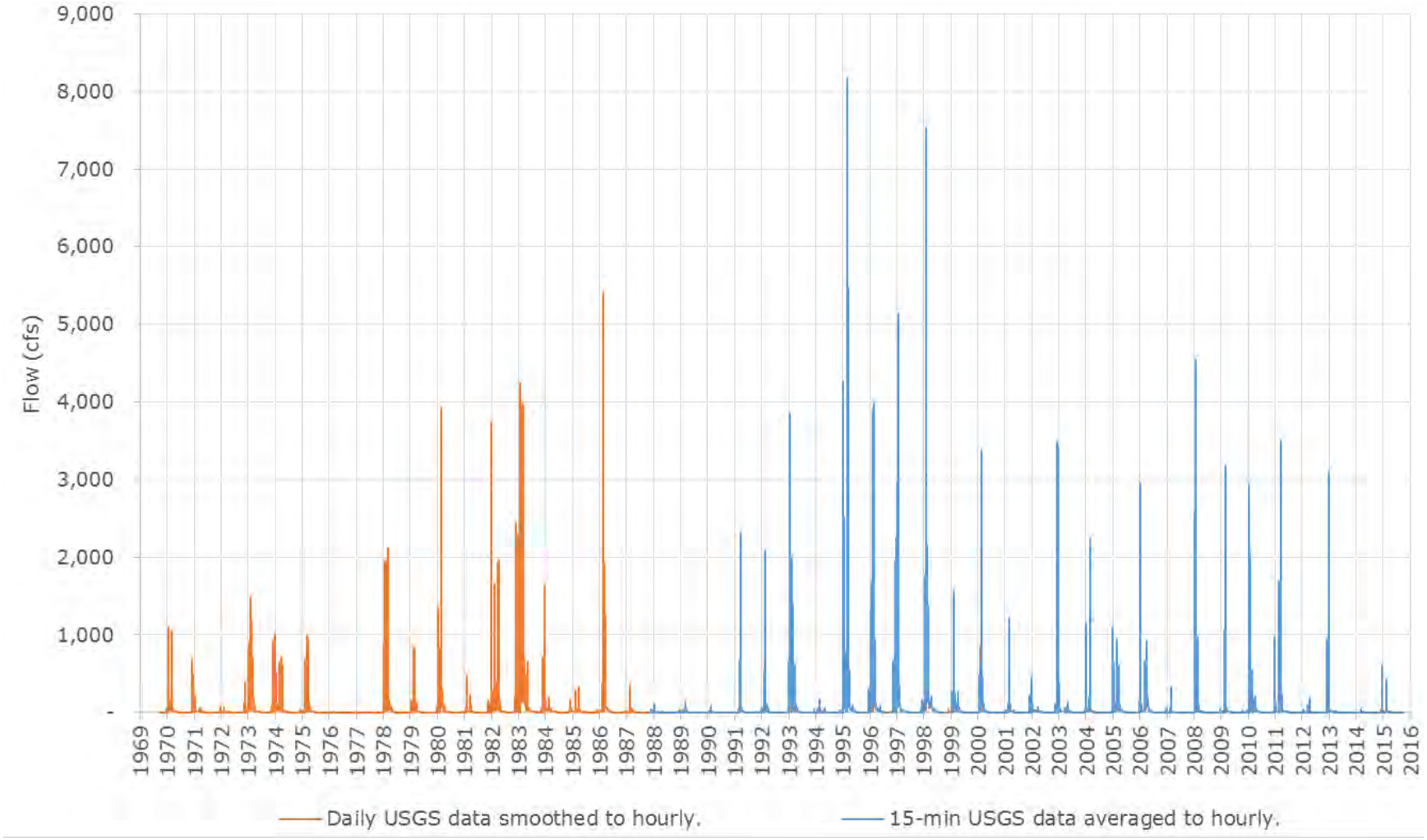

Figure 28. Flows and data sources for hydrologic dataset development at Arroyo del Valle below Lang Canyon near Livermore

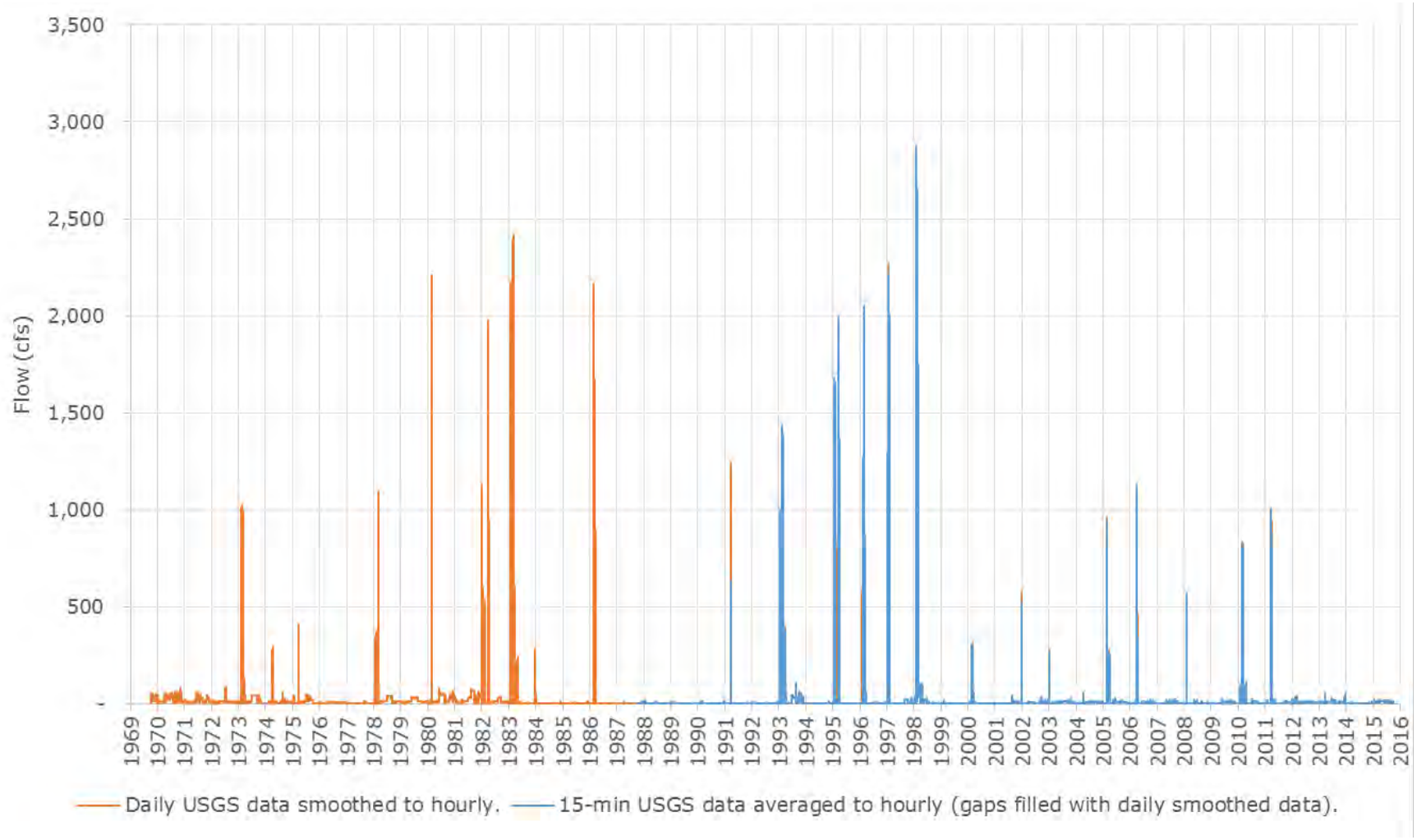

Figure 29. Flows and data sources for hydrologic dataset development at Arroyo del Valle near Livermore

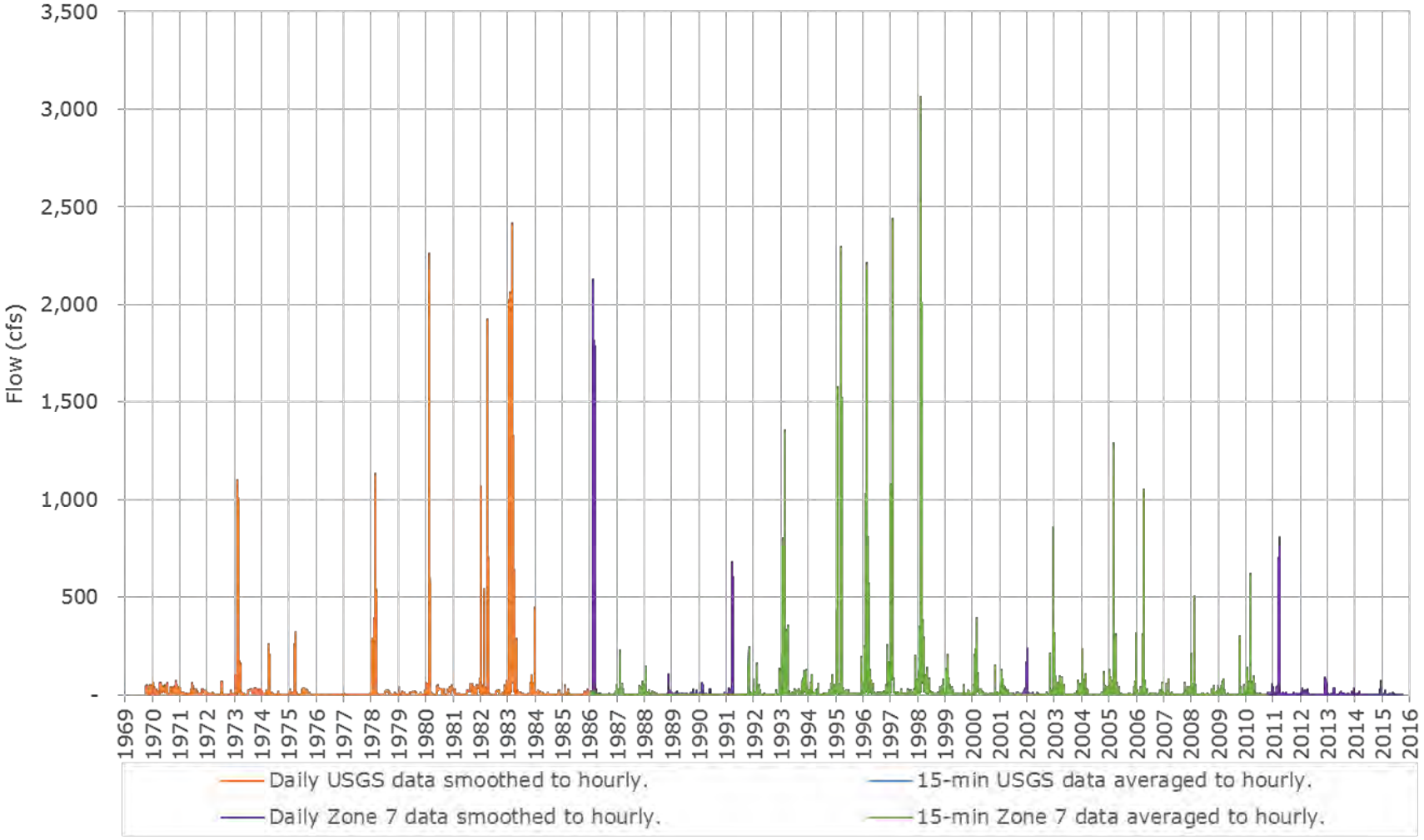

Figure 30. Flows and data sources for hydrologic dataset development at Arroyo del Valle at Pleasanton

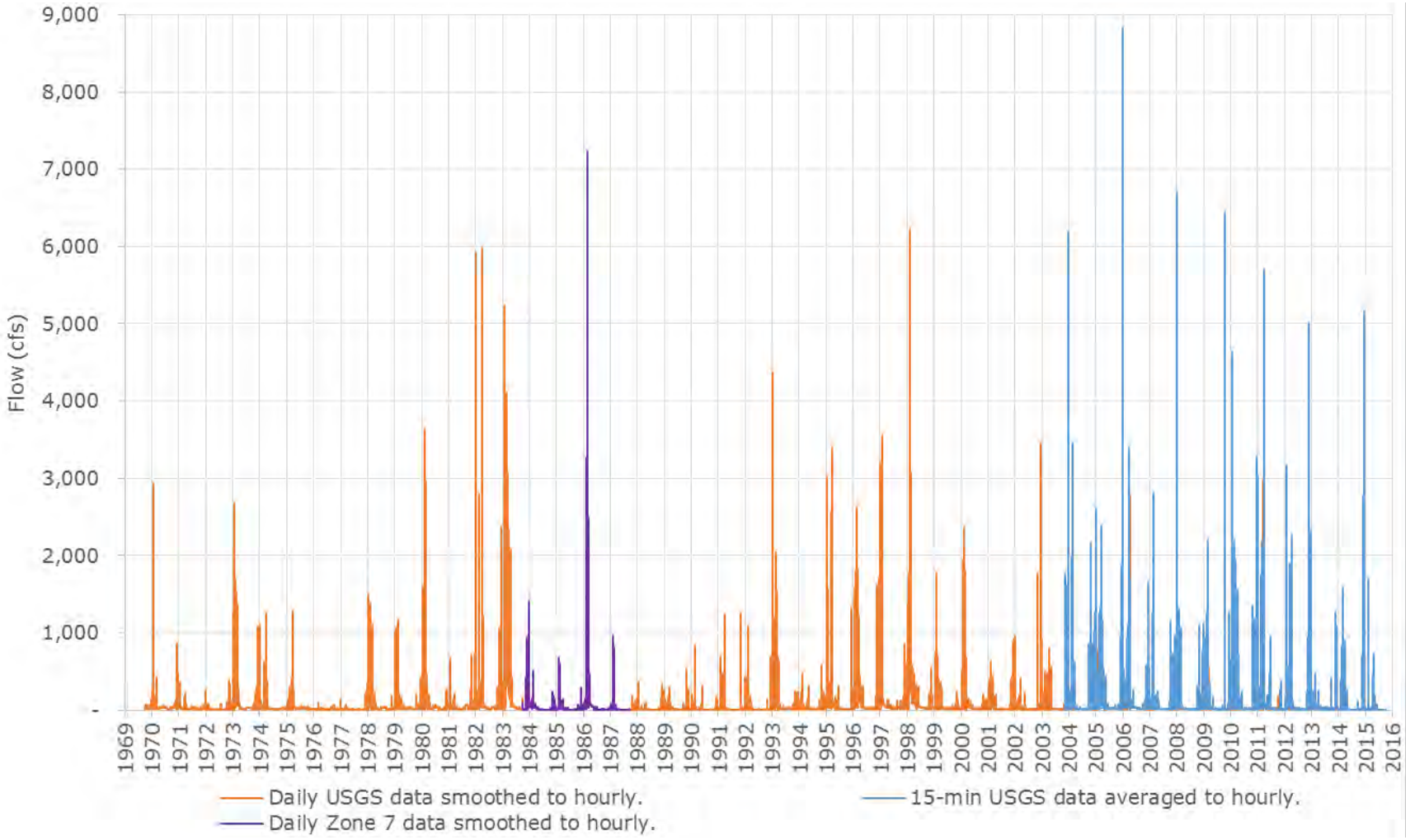

Figure 31. Flows and data sources for hydrologic dataset development at Arroyo de la Laguna at Verona

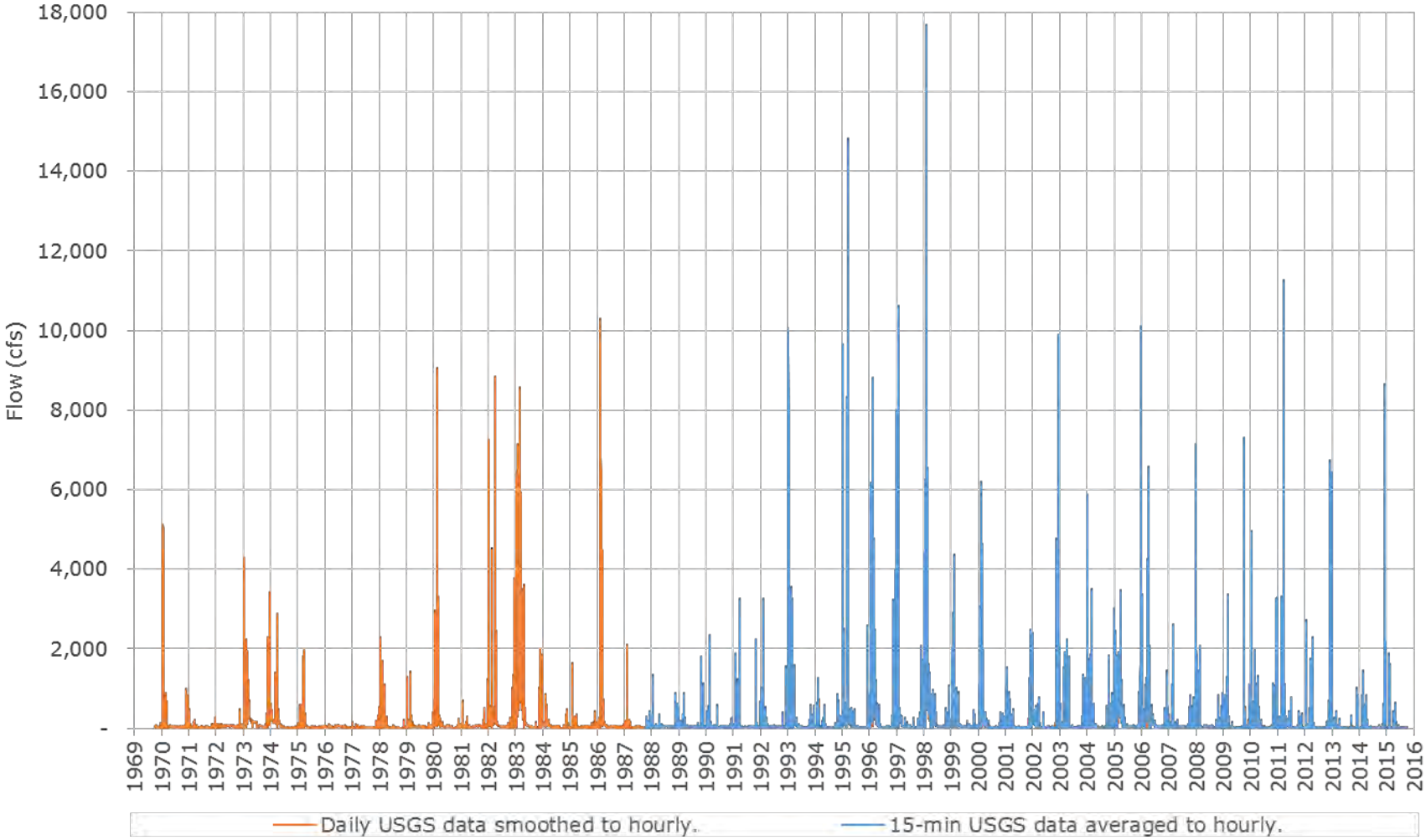

Figure 32. Flows and data sources for hydrologic dataset development at Alameda Creek near Niles

Appendix II. HEC-ResSim model configuration

Table 28 shows routing methods and parameters for the 14 routing reaches configured in the Del Valle HEC-ResSim model.

Table 28. Routing parameters configured in the HEC-ResSim model

ID (1)	HEC-ResSim routing reach (2)	Description (3)	Routing method (4)	Routing parameters (5)
1	ALV to CF de la Laguna-Alameda CK	Routing from WCM	Muskingum	K=2 hr, x=0.3 subreaches = 1
2	AV TO #1 to CF_DryCK	Mimics reach 4B from the HEC-HMS model	Muskingum Cunge	See model
3	AV TO #2 to AVL	Mimics reach 4A from the HEC-HMS model	Muskingum Cunge	See model
4	AVL to AV TO #1	No routing	Null	N/A
5	AVP to CF del Valle-de la Laguna	Streamgage Arroyo Valle at Pleasanton to CF del Valle-de la Laguna	Null	N/A
6	At ponds to DS_of_ponds	Mimics reach 7C 50-10 from the HEC-HMS model	Muskingum Cunge	See model
7	CF de la Laguna-Alameda CK to ACN	Routing from WCM	Muskingum	K=1 hr, x=0.5, subreaches = 1
8	CF del Valle-de la Laguna to ALV	Routing from WCM	Muskingum	K=2 hr, x=0.3 subreaches = 1
9	CF_DryCK to Vellecitos	Mimics reach 4C from the HEC-HMS model	Muskingum Cunge	See model
10	DS_of_ponds to FirstStreet_BR	Mimics reach 7D from the HEC-HMS model	Muskingum Cunge	See model
11	FirstStreet_BR to AVP	Mimics reach 7E from the HEC-HMS model	Muskingum Cunge	See model
12	Isabel to At_ponds	Mimics reach 7B from the HEC-HMS model	Muskingum Cunge	See model
13	LDV OUT to AV TO #2	No routing	Null	N/A
14	Vallecitos to Isabel	Mimics reach 7A from the HEC-HMS model	Muskingum Cunge	See model

Table 29 shows the operation rules configured in the HEC-ResSim model. The rule name is in column 2, a description of the rule is in column 3, and the zones in which the rules apply are in column 4.

Table 29. Operation rules configured in the HEC-ResSim model

ID (1)	Rule name (2)	Description (3)	Zones (4)
1	LDV to SBA	Specified rule used to withdraw water from storage to SBA	All except *Inactive*
2	Schedule 2g	Releases from the spillway only	Top of dam
3	Schedule 1c	Maximum release based on pool elevation (step function)	• Surcharge • Secondary flood control
4	Schedule 2f	Maximum release = 7,000 cfs	Secondary flood control
5	ROI	Allowable rate of increase = 1000 cfs/hr	• Zone 3 • Zone 2 • Zone 1 • Conservation
6	ROD	Allowable rate of decrease = 1,000 cfs/hr	• Zone 3 • Zone 2 • Zone 1 • Conservation
7	Schedule 1b	No releases. (Max rel = 0 cfs)	• Zone 3 • Zone 2 • Zone 1
8	Schedule 1a	Maintain previous release until Niles discharge exceeds 5,000 cfs or starts to recede	• Zone 3 • Zone 2 • Zone 1
9	Max Niles 9.5k cfs	Max downstream at Niles = 9500 cfs	Zone 3
10	Max Rel 4.5k cfs	Max release = 4,500 cfs	Zone 3
11	Max Niles 8k cfs	Max downstream at Niles = 8000 cfs	Zone 2
12	Max Rel 3k cfs	Max release = 2,000 cfs	Zone 2
13	Max Niles 6K cfs	Max downstream at Niles = 6000 cfs	• Zone 1 • Conservation
14	Max Rel 2k cfs	Max release = 2,000 cfs	• Zone 1 • Conservation

Appendix III. Baseline operation results

This appendix details baseline simulation results in the following tables:

- Table 30. Baseline operations: average monthly runoff capture (ac-ft) by year
- Table 31. Baseline operations: average monthly storage (ac-ft) by year
- Table 32. Baseline operations: peak monthly elevation (ft) by year
- Table 33. Baseline operations: number of days Lake Del Valle elevation thresholds are exceeded by year
- Table 34. Baseline operations: annual event results

Table 30. Baseline operations: average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	12	224	-
2	1970	10,375	1,860	6,039	334	-44	-1,168	1	0	202	615	907	6,875	2,166
3	1971	3,370	569	1,037	-2,109	-3,166	-1,201	-984	-1,303	-88	400	357	672	-204
4	1972	391	667	138	-569	-4,208	-1,181	49	31	41	363	2,029	997	-104
5	1973	10,752	3,149	2,882	1,732	572	119	50	6	6	343	969	6,905	2,290
6	1974	5,464	1,398	3,488	3,077	411	178	48	157	298	9	32	307	1,239
7	1975	425	8,594	8,090	3,488	690	125	53	2	131	5	64	96	1,814
8	1976	90	186	83	46	7	0	0	0	0	0	0	1	35
9	1977	207	59	51	2	0	0	0	0	173	0	18	282	66
10	1978	14,793	6,205	4,589	2,223	465	99	15	0	0	67	48	25	2,377
11	1979	1,264	5,859	1,970	541	218	48	68	0	18	0	98	470	880
12	1980	10,553	10,179	3,823	1,493	672	226	244	12	184	197	0	66	2,304
13	1981	1,993	636	2,724	437	138	68	80	105	18	80	615	2,250	762
14	1982	10,820	2,151	6,700	2,737	1,311	458	200	81	257	105	5,025	11,226	3,423
15	1983	10,237	3,883	4,991	6,558	4,178	943	529	263	274	192	4,843	15,568	4,372
16	1984	2,684	2,737	1,572	733	64	131	182	86	153	86	1,265	1,022	893
17	1985	525	1,682	2,722	810	-831	113	21	92	89	59	420	344	504
18	1986	611	16,353	346	836	994	353	107	70	55	118	129	157	1,677
19	1987	309	1,357	1,082	328	99	10	0	67	137	0	38	148	298
20	1988	799	228	175	40	63	0	0	6	71	123	84	293	157
21	1989	319	340	984	143	32	0	0	12	202	0	79	0	176
22	1990	97	483	148	62	6	3	0	0	0	98	220	203	110
23	1991	0	211	8,228	753	57	14	0	0	154	389	114	207	844
24	1992	337	10,004	2,089	66	-366	11	0	0	374	14	0	990	1,127
25	1993	19,233	3,211	5,078	2,021	646	283	6	55	178	314	112	149	2,607
26	1994	226	1,619	406	210	-1,020	-708	0	0	146	0	236	155	106
27	1995	14,694	1,043	6,434	2,457	1,689	658	115	2	154	74	5	1,069	2,366
28	1996	11,282	4,199	4,108	2,312	1,021	246	94	10	0	36	712	12,549	3,047
29	1997	10,957	2,145	879	667	257	124	14	0	0	0	257	1,098	1,366
30	1998	11,775	2,678	2,196	4,343	972	313	350	60	23	37	266	496	1,959
31	1999	1,835	7,351	2,176	2,676	626	203	69	43	77	246	155	127	1,299
32	2000	1,786	12,556	3,571	754	326	167	80	240	215	117	24	131	1,664
33	2001	444	4,089	4,872	661	148	238	61	277	72	0	112	2,857	1,153
34	2002	2,211	665	1,091	324	-1,186	-82	123	55	244	216	167	11,852	1,307
35	2003	1,067	817	962	-382	910	78	130	80	167	68	36	638	381
36	2004	2,919	7,706	1,525	-961	-281	0	0	80	268	292	45	2,238	1,153
37	2005	9,590	4,764	3,279	1,991	809	141	48	31	172	289	84	2,851	2,004
38	2006	6,830	1,802	6,725	5,229	999	200	27	0	0	0	59	294	1,847
39	2007	123	1,532	797	110	-1,410	0	0	0	172	133	0	12	122

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
40	2008	11,330	4,505	1,221	329	116	13	252	19	71	6	77	275	1,518
41	2009	142	4,109	6,064	337	346	31	0	31	54	646	178	49	999
42	2010	10,798	1,804	290	894	414	18	2	43	0	0	67	2,852	1,432
43	2011	1,444	6,730	5,380	2,062	600	341	43	84	357	357	4	844	1,520
44	2012	138	59	476	1,341	287	303	264	554	465	71	755	6,894	967
45	2013	715	335	262	43	-129	658	0	0	0	595	173	43	225
46	2014	0	29	140	-1,517	-14	0	0	0	351	6	54	4,961	334
47	2015	214	1,583	255	238	46	0	0	0	0	-	-	-	-
48	*Minimum*	0	29	51	-2,109	-4,208	-1,201	-984	-1,303	-88	0	0	0	-204
49	*Maximum*	19,233	16,353	8,228	6,558	4,178	943	529	554	465	646	5,025	15,568	4,372
50	*Mean*	4,482	3,350	2,655	1,085	164	56	51	29	129	150	455	2,212	1,257

Table 31. Baseline operations: average monthly storage (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	13,198	13,206	-	-
2	1970	18,810	28,126	33,818	35,920	39,035	39,620	39,154	38,505	37,430	33,518	29,054	29,651	34,742	31,380
3	1971	33,882	34,214	34,747	38,133	39,654	39,683	39,680	39,685	38,519	32,741	28,335	29,013	35,288	30,045
4	1972	30,098	30,968	32,698	37,768	39,685	39,625	37,738	35,655	34,607	29,529	28,310	29,761	35,165	27,429
5	1973	35,083	38,997	39,004	39,280	39,547	39,292	38,727	38,108	35,839	30,639	28,063	31,379	39,071	28,037
6	1974	38,287	38,341	38,700	39,646	39,683	39,500	39,063	36,092	29,718	24,556	21,999	21,405	38,953	22,413
7	1975	21,730	29,128	38,039	38,838	39,651	39,447	39,029	38,456	37,236	31,657	26,140	24,928	38,964	28,413
8	1976	24,951	25,512	30,876	33,911	33,554	33,093	32,517	31,829	31,357	29,702	24,778	24,212	33,461	26,611
9	1977	24,274	25,259	31,524	35,685	37,712	38,388	37,795	37,059	32,967	28,651	25,792	25,312	35,002	26,932
10	1978	32,154	38,085	38,869	39,476	38,855	38,358	37,766	37,091	35,178	28,330	23,906	23,474	39,183	25,505
11	1979	24,007	26,392	32,312	35,251	38,397	37,958	37,342	36,549	33,090	27,542	23,159	22,924	33,276	24,830
12	1980	29,088	35,610	38,844	39,077	38,920	38,754	37,852	36,336	33,858	27,948	24,414	24,237	38,900	25,058
13	1981	24,407	27,100	34,063	39,004	38,733	37,503	35,775	33,550	31,417	30,241	30,401	30,996	38,904	30,185
14	1982	38,203	38,936	38,924	39,759	39,023	38,355	37,419	36,918	34,980	28,257	22,213	28,657	41,712	24,799
15	1983	35,427	39,120	40,141	39,515	39,034	38,969	38,583	38,111	36,610	30,649	25,591	29,822	39,326	27,537
16	1984	34,116	33,999	36,148	37,032	38,627	38,606	37,212	35,285	32,329	26,722	24,833	24,748	36,759	26,296
17	1985	25,408	26,729	31,717	37,580	39,428	38,993	38,343	36,520	33,787	28,673	26,146	22,564	35,448	28,405
18	1986	22,448	33,239	39,006	39,639	39,169	38,867	38,163	37,705	35,567	30,090	25,950	22,629	39,200	28,459
19	1987	22,637	23,425	26,907	33,607	37,703	37,779	37,290	36,423	31,789	24,550	21,247	21,263	30,748	21,600
20	1988	21,707	22,146	24,685	30,428	35,473	38,055	37,542	36,791	32,387	26,206	23,741	21,972	27,502	24,624
21	1989	22,035	22,774	27,615	31,380	33,597	33,540	32,976	32,444	30,096	25,860	24,888	24,845	30,333	25,169
22	1990	24,824	27,713	31,846	32,706	33,561	35,186	34,778	34,240	33,117	30,464	27,849	25,829	32,421	29,185
23	1991	26,048	29,708	35,434	38,614	38,755	38,212	36,027	34,238	31,787	28,298	24,778	24,045	39,166	26,619
24	1992	24,351	29,074	33,231	36,513	39,399	39,155	38,372	36,282	34,162	27,490	23,622	23,452	34,691	24,808

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
25	1993	32,745	38,950	38,801	39,633	39,291	39,036	38,491	37,947	35,545	29,993	26,745	26,714	39,408	27,882
26	1994	26,805	27,504	30,918	32,817	38,242	39,685	39,232	38,415	36,775	32,870	28,330	26,705	31,147	30,151
27	1995	35,047	38,301	38,971	39,646	39,359	38,933	38,673	38,130	36,154	31,439	27,915	26,076	39,325	29,189
28	1996	28,288	39,598	38,996	39,335	39,351	38,846	38,346	37,735	34,692	28,096	21,870	22,696	38,951	24,626
29	1997	38,991	39,002	39,002	39,201	39,444	38,832	39,333	38,826	36,066	29,950	26,121	26,751	39,022	27,500
30	1998	31,961	41,517	39,005	39,583	39,560	39,634	39,179	36,512	32,407	28,387	25,519	24,888	39,245	26,566
31	1999	24,810	31,691	35,924	38,400	39,490	39,090	37,782	36,802	35,641	32,817	28,377	27,602	37,111	31,224
32	2000	28,317	34,144	38,815	38,779	39,243	39,007	38,050	36,272	34,042	29,431	24,551	24,455	38,550	26,991
33	2001	24,862	26,867	33,696	36,330	38,507	36,407	34,763	37,771	37,345	36,972	37,135	36,971	34,462	37,514
34	2002	38,359	36,509	35,301	36,268	38,648	39,393	38,297	36,602	34,189	32,042	28,045	32,044	35,727	30,281
35	2003	38,048	34,420	35,017	38,859	39,457	38,757	37,623	36,623	33,414	29,382	26,863	26,179	37,428	29,053
36	2004	29,164	31,050	37,706	39,602	39,032	38,282	37,450	34,987	31,612	26,903	25,011	24,962	38,872	25,497
37	2005	33,710	37,173	38,984	39,532	39,413	38,899	37,905	37,168	35,308	30,261	25,709	25,280	39,072	27,568
38	2006	33,598	34,577	38,498	39,632	39,579	39,121	38,403	37,345	36,053	32,658	27,891	26,152	39,076	29,952
39	2007	26,214	26,454	29,620	35,150	39,371	36,244	34,960	34,443	33,218	29,252	28,424	28,272	32,127	28,738
40	2008	32,164	38,476	38,601	38,091	38,316	37,792	38,043	37,376	36,162	36,305	35,533	30,554	38,191	36,694
41	2009	27,744	29,084	36,480	36,930	37,121	36,622	36,173	35,131	34,643	34,491	33,657	28,171	36,896	34,569
42	2010	29,973	38,311	39,004	39,566	39,184	38,154	37,264	36,427	35,792	35,493	36,282	31,878	39,083	36,511
43	2011	31,251	32,206	38,508	39,364	39,507	39,536	39,059	38,097	37,463	37,250	36,105	31,208	39,063	37,141
44	2012	28,436	28,442	28,368	29,682	33,715	35,276	34,957	35,702	37,694	34,396	29,382	30,721	28,488	31,466
45	2013	35,535	35,901	35,514	37,480	39,295	39,608	39,287	37,988	34,795	30,716	30,061	30,039	35,774	30,063
46	2014	29,890	31,699	36,621	39,629	38,983	39,046	38,603	37,978	35,006	29,151	27,346	29,533	39,323	27,389
47	2015	32,305	33,244	33,823	35,826	37,020	36,280	35,492	33,476	32,044	-	-	-	33,776	-
48	*Minimum*	*18,810*	*22,146*	*24,685*	*29,682*	*33,554*	*33,093*	*32,517*	*31,829*	*29,718*	*24,550*	*13,198*	*13,206*	*27,502*	*21,600*
49	*Maximum*	*38,991*	*41,517*	*40,141*	*39,759*	*39,685*	*39,685*	*39,680*	*39,685*	*38,519*	*37,250*	*37,135*	*36,971*	*41,712*	*37,514*
50	*Mean*	*29,395*	*32,385*	*35,333*	*37,350*	*38,442*	*38,248*	*37,533*	*36,557*	*34,432*	*30,235*	*26,854*	*26,482*	*36,485*	*28,465*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 32. Baseline operations: peak monthly elevation (ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	648.00	648.44
2	1970	682.56	685.69	695.35	699.76	703.10	703.10	703.05	701.45	700.57	696.61	689.87	691.49
3	1971	696.24	694.81	696.14	703.10	703.10	703.10	703.10	703.10	703.10	696.93	687.45	687.15
4	1972	688.34	689.78	695.95	703.10	703.10	703.10	703.04	697.20	696.27	691.53	686.31	688.01
5	1973	701.70	701.70	701.78	703.04	703.07	703.06	701.72	700.89	699.97	693.16	684.91	696.37
6	1974	701.70	701.42	701.70	703.10	703.10	703.09	702.90	701.40	692.15	682.02	672.74	670.73
7	1975	671.55	695.10	701.73	703.03	703.10	703.09	702.35	701.34	700.53	695.53	684.47	678.32
8	1976	678.35	683.21	693.22	694.24	693.88	693.09	692.25	691.36	690.28	689.70	681.25	676.95

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
9	1977	677.05	683.90	695.58	697.37	701.42	701.20	700.41	699.63	696.58	688.73	681.96	679.35
10	1978	700.86	701.76	701.86	703.10	701.86	701.19	700.40	699.44	698.41	690.71	679.28	675.28
11	1979	677.69	690.03	692.98	699.54	701.13	700.71	699.69	698.88	696.68	688.05	677.91	674.73
12	1980	693.48	712.50	701.70	703.01	701.70	701.47	701.11	698.53	696.69	689.29	678.35	676.91
13	1981	680.72	686.56	701.54	701.75	701.68	700.72	698.70	695.12	691.91	688.11	688.78	692.40
14	1982	705.42	701.70	706.32	706.30	703.10	701.19	699.61	699.01	698.24	691.04	677.87	694.04
15	1983	711.36	705.44	715.00	703.10	703.10	702.27	701.62	700.63	700.24	693.69	682.95	696.57
16	1984	696.58	696.39	698.38	699.78	701.85	701.41	700.77	697.27	695.76	685.24	680.92	678.85
17	1985	679.63	684.99	696.39	701.34	703.10	701.98	701.27	700.31	697.20	688.20	684.68	676.92
18	1986	673.51	723.67	701.90	703.10	703.10	701.78	700.84	700.14	699.50	691.91	684.64	675.64
19	1987	673.58	676.41	688.66	697.83	700.71	700.28	699.56	698.85	695.46	683.99	670.75	670.33
20	1988	672.02	672.29	682.93	693.30	699.62	700.76	700.05	699.09	696.46	685.72	677.61	674.05
21	1989	672.15	677.57	688.02	691.95	694.22	693.81	693.03	692.07	691.34	681.91	678.72	678.19
22	1990	678.92	687.82	691.71	692.97	695.09	696.37	695.85	694.97	694.19	689.77	686.08	681.28
23	1991	681.80	692.03	701.88	702.94	703.03	702.66	699.03	696.15	693.26	687.60	681.41	676.68
24	1992	677.30	693.68	695.13	700.79	703.10	703.03	701.51	698.17	697.26	689.12	677.88	677.01
25	1993	701.70	703.00	703.00	703.10	703.04	701.90	701.40	700.55	699.79	691.63	683.60	681.75
26	1994	682.02	686.68	689.60	696.50	703.10	703.10	703.10	701.35	700.38	695.79	687.62	682.18
27	1995	701.92	701.70	711.71	703.10	703.10	701.69	701.51	700.86	700.03	694.02	685.96	682.57
28	1996	698.57	710.49	701.70	703.10	703.08	701.84	701.14	700.30	699.41	690.66	677.49	686.34
29	1997	707.46	701.70	701.71	702.99	703.10	703.08	703.07	701.82	701.11	692.64	682.93	682.31
30	1998	699.80	717.82	701.91	703.10	703.10	703.10	703.06	700.64	694.94	688.19	681.30	679.16
31	1999	680.95	695.87	698.89	703.04	703.10	702.04	700.79	699.14	697.32	695.62	689.53	684.21
32	2000	686.94	701.70	701.70	703.01	703.03	703.00	701.01	699.22	696.32	691.43	682.11	677.84
33	2001	678.61	688.06	694.90	699.58	701.90	700.31	698.99	700.23	700.12	699.54	699.53	700.28
34	2002	701.70	699.38	696.86	699.14	703.10	703.10	701.68	699.39	696.95	691.83	687.82	701.70
35	2003	701.70	697.03	699.41	703.10	703.10	701.77	700.87	698.94	697.28	688.71	685.81	681.62
36	2004	686.74	698.99	701.36	703.10	703.10	701.06	700.27	698.67	694.08	685.09	679.35	682.30
37	2005	697.67	701.70	701.79	703.10	703.10	702.64	700.62	699.58	698.58	692.59	683.02	683.88
38	2006	695.27	696.79	701.72	703.26	703.10	703.02	701.39	700.12	698.80	695.66	687.28	681.31
39	2007	680.79	683.38	691.01	700.10	703.10	703.04	695.98	695.32	694.43	689.31	685.27	684.57
40	2008	701.47	701.70	701.70	701.31	701.50	700.82	700.82	699.92	698.61	698.48	698.30	692.63
41	2009	684.86	690.51	699.44	698.87	699.46	698.61	698.75	696.39	695.53	695.23	695.08	689.66
42	2010	699.20	701.70	701.79	703.10	703.10	700.89	699.93	698.52	697.32	698.11	699.27	694.33
43	2011	690.11	699.03	704.85	703.10	703.10	703.08	703.02	701.05	699.83	699.28	698.97	694.06
44	2012	684.93	684.80	684.81	690.49	695.70	696.38	696.03	698.61	700.32	699.13	689.92	696.08
45	2013	696.94	697.23	697.29	702.09	703.10	703.10	703.09	701.64	698.19	691.42	687.67	687.67
46	2014	687.53	693.76	702.03	703.10	703.10	703.01	701.62	700.65	699.51	691.17	682.86	691.34
47	2015	691.53	693.83	693.92	700.05	700.03	698.12	697.22	695.41	691.11	-	-	-
48	*Minimum*	*671.55*	*672.29*	*682.93*	*690.49*	*693.88*	*693.09*	*692.25*	*691.36*	*690.28*	*681.91*	*648.00*	*648.44*

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
49	*Maximum*	*711.36*	*723.67*	*715.00*	*706.30*	*703.10*	*703.10*	*703.10*	*703.10*	*703.10*	*699.54*	*699.53*	*701.70*
50	*Mean*	*689.37*	*695.33*	*698.46*	*700.85*	*701.84*	*701.33*	*700.37*	*698.99*	*697.22*	*691.42*	*683.81*	*683.34*

Table 33. Baseline operations: number of days Lake Del Valle elevation thresholds are exceeded by year

		Days threshold is exceeded																	
ID (1)	Year (2)	703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	5.4	5.0	4.7	4.5	4.4	4.0	3.7	3.4	2.9	1.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1982	3.5	2.5	1.7	0.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1983	14.5	12.5	11.1	10.1	9.3	7.8	6.6	5.6	4.4	3.1	2.3	1.8	1.3	0.0	0.0	0.0	0.0	0.0	0.0
16	1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1986	7.3	6.9	6.6	6.5	6.3	6.0	5.7	5.3	5.0	4.3	3.8	3.4	3.0	2.7	0.0	0.0	0.0	0.0	0.0
19	1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1995	6.3	5.6	5.0	4.7	4.4	3.7	2.7	1.7	1.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	1996	4.6	4.2	3.9	3.7	3.5	2.9	1.9	1.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1997	5.5	3.8	3.0	2.5	2.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1998	10.8	9.5	9.3	9.1	9.0	8.7	7.8	6.8	6.1	5.3	4.6	3.9	3.1	1.6	0.0	0.0	0.0	0.0	0.0
31	1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
34	2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	2006	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2011	2.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0
50	*Mean*	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Table 34. Baseline operations: annual event results

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	648.46	682.10	0	47	66	2,937	5,133
2	1971	682.71	696.24	113	19	40	853	982
3	1972	685.60	687.68	0	2	20	251	272
4	1973	701.62	701.70	1,701	1,635	1,707	2,482	2,887
5	1974	689.17	701.70	223	183	224	1,102	3,420
6	1975	695.13	701.72	1,037	954	954	1,737	2,539
7	1976	678.29	689.33	0	3	3	101	108
8	1977	676.69	676.98	9	10	10	138	172
9	1978	679.32	700.86	131	6	28	1,511	2,291
10	1979	677.87	690.02	0	11	22	1,179	1,437
11	1980	689.70	712.50	2,085	2,055	2,905	3,643	9,072
12	1981	676.92	680.72	0	17	33	677	713
13	1982	688.89	705.42	2,083	2,026	2,200	5,926	7,256
14	1983	690.36	711.36	2,118	2,061	2,654	5,135	7,784
15	1984	687.67	696.57	106	6	199	1,313	1,858
16	1985	691.64	698.16	0	3	31	167	352
17	1986	676.04	723.67	3,028	3,061	3,606	6,907	10,030
18	1987	673.70	676.18	0	3	250	940	2,103
19	1988	670.71	671.93	0	17	163	359	1,344
20	1989	677.60	686.59	0	8	22	293	901
21	1990	681.58	687.81	0	13	64	844	2,344
22	1991	685.38	695.54	0	2	33	477	1,238
23	1992	677.30	693.68	97	9	185	1,088	3,279
24	1993	675.08	701.70	588	501	673	4,373	10,049
25	1994	682.02	688.67	0	8	109	476	1,287
26	1995	697.08	711.71	2,152	2,056	2,618	3,890	14,794

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	701.70	710.49	2,047	2,056	2,553	3,789	8,933
28	1997	701.70	707.46	2,038	2,056	2,724	5,063	10,239
29	1998	698.10	717.82	3,019	3,062	4,289	6,228	17,676
30	1999	680.99	692.54	0	10	216	1,788	4,380
31	2000	687.05	699.07	121	8	243	2,373	6,208
32	2001	681.94	694.83	0	3	56	442	754
33	2002	698.37	701.70	89	45	97	955	2,392
34	2003	682.56	700.73	0	8	1,031	3,450	9,906
35	2004	689.02	698.99	0	6	117	3,465	3,510
36	2005	696.70	701.70	1,117	1,073	1,066	1,391	1,964
37	2006	679.18	692.94	0	3	337	8,827	10,102
38	2007	681.23	684.07	0	5	92	2,817	2,621
39	2008	690.36	701.47	107	5	45	989	972
40	2009	690.15	699.31	10	9	88	2,214	3,384
41	2010	681.49	697.79	0	7	153	4,644	4,970
42	2011	700.49	704.85	2,129	2,115	2,658	5,156	10,726
43	2012	685.10	687.27	0	10	32	2,272	2,310
44	2013	686.77	696.08	10	4	67	2,311	6,448
45	2014	691.17	698.70	0	6	19	1,585	1,464
46	2015	682.75	691.34	0	7	75	5,165	8,647

Appendix IV. Results for FIRO alone

This appendix details FIRO-alone simulation results in the following tables:

- Table 35. FIRO alone: average monthly runoff capture (ac-ft) by year
- Table 36. FIRO alone: differences in average monthly runoff capture (ac-ft) by year
- Table 38. FIRO alone: differences in average monthly storage (ac-ft) results from baseline operations by year (positive values are an increase from baseline)
- Table 39. FIRO alone: peak monthly elevation (ft) by year
- Table 40. FIRO alone: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)
- Table 41. FIRO alone: number of days in which Lake Del Valle elevation thresholds are exceeded by year
- Table 42. FIRO alone: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)
- Table 43. FIRO alone: annual event results
- Table 44. FIRO alone: differences in annual event results from baseline operations (positive values are an increase from baseline)

Table 35. FIRO alone: average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	12	224	-
2	1970	10,375	1,860	6,039	334	-44	-1,168	1	0	202	615	907	6,875	2,166
3	1971	3,370	569	1,037	-2,109	-3,166	-1,201	-984	-1,303	-88	400	357	672	-204
4	1972	391	667	138	-569	-4,208	-1,181	49	31	41	363	2,029	997	-104
5	1973	11,436	3,149	2,827	1,333	452	119	50	6	6	343	969	6,905	2,300
6	1974	6,049	1,398	3,490	2,395	411	178	48	157	298	9	32	307	1,231
7	1975	425	8,594	8,757	3,081	434	125	53	2	131	5	64	96	1,814
8	1976	90	186	83	46	7	0	0	0	0	0	0	1	35
9	1977	207	59	51	2	0	0	0	0	173	0	18	282	66
10	1978	14,793	6,889	4,481	1,650	465	99	15	0	0	67	48	25	2,378
11	1979	1,264	5,859	1,970	541	218	48	68	0	18	0	98	470	880
12	1980	10,553	10,862	3,824	1,147	672	226	244	12	184	197	0	66	2,332
13	1981	1,993	636	2,724	437	138	68	80	105	18	80	615	2,250	762
14	1982	11,216	2,153	6,020	2,737	1,311	458	200	81	257	105	5,025	11,226	3,399
15	1983	10,920	3,200	5,441	6,108	4,178	943	529	263	274	192	4,843	15,568	4,372
16	1984	2,684	2,737	1,572	733	64	131	182	86	153	86	1,265	1,022	893
17	1985	525	1,682	2,722	810	-831	113	21	92	89	59	420	344	504
18	1986	611	17,037	209	293	994	353	107	70	55	118	129	157	1,678
19	1987	309	1,357	1,082	328	99	10	0	67	137	0	38	148	298
20	1988	799	228	175	40	63	0	0	6	71	123	84	293	157
21	1989	319	340	984	143	32	0	0	12	202	0	79	0	176
22	1990	97	483	148	62	6	3	0	0	0	98	220	203	110
23	1991	0	211	8,784	575	-49	14	0	0	154	389	114	207	867
24	1992	337	10,004	2,089	66	-616	11	0	0	374	14	0	990	1,106
25	1993	19,917	3,213	4,756	1,662	646	283	6	55	178	314	112	149	2,608
26	1994	226	1,619	406	210	-1,020	-708	0	0	146	0	236	155	106
27	1995	15,377	1,043	6,205	2,005	1,689	658	115	2	154	74	5	1,069	2,366
28	1996	11,282	4,883	4,111	1,629	1,021	246	94	10	0	36	712	12,549	3,048
29	1997	11,641	2,147	875	368	-114	124	14	0	0	0	257	1,098	1,367
30	1998	11,775	3,361	2,052	3,806	972	313	350	60	23	37	266	496	1,959
31	1999	1,835	7,351	2,176	2,676	626	203	69	43	77	246	155	127	1,299
32	2000	1,786	13,240	3,571	411	250	167	80	240	215	117	24	131	1,686
33	2001	444	4,089	4,872	661	148	238	61	277	72	0	112	2,857	1,153
34	2002	2,283	665	1,091	324	-1,476	-82	123	55	244	216	167	12,535	1,346
35	2003	1,067	817	962	-1,059	910	78	130	80	167	68	36	638	324
36	2004	2,919	7,706	1,525	-961	-281	0	0	80	268	292	45	2,238	1,153
37	2005	9,590	5,448	3,217	1,373	809	141	48	31	172	289	84	2,851	2,004
38	2006	6,830	1,802	7,394	4,562	999	200	27	0	0	0	59	294	1,847
39	2007	123	1,532	797	110	-1,410	0	0	0	172	133	0	12	122

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
40	2008	11,330	5,190	1,222	329	116	13	252	19	71	6	77	275	1,575
41	2009	142	4,109	6,064	337	346	31	0	31	54	646	178	49	999
42	2010	10,798	1,893	230	275	414	18	2	43	0	0	67	2,852	1,383
43	2011	1,444	6,730	6,006	1,438	600	341	43	84	357	357	4	844	1,521
44	2012	138	59	476	1,341	287	303	264	554	465	71	755	6,894	967
45	2013	715	335	262	43	-129	658	0	0	0	595	173	43	225
46	2014	0	29	156	-1,532	-14	0	0	0	351	6	54	4,961	334
47	2015	214	1,583	255	238	46	0	0	0	0	-	-	-	-
48	*Minimum*	0	29	51	-2,109	-4,208	-1,201	-984	-1,303	-88	0	0	0	-204
49	*Maximum*	19,917	17,037	8,784	6,108	4,178	943	529	554	465	646	5,025	15,568	4,372
50	*Mean*	4,579	3,457	2,681	879	132	56	51	29	129	150	455	2,227	1,258

Table 36. FIRO alone: differences in average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-
2	1970	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1971	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1972	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1973	684	1	-54	-400	-119	0	0	0	0	0	0	0	9
6	1974	584	0	2	-682	0	0	0	0	0	0	0	0	-8
7	1975	0	0	667	-406	-256	0	0	0	0	0	0	0	0
8	1976	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1977	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1978	0	684	-108	-573	0	0	0	0	0	0	0	0	0
11	1979	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1980	0	684	1	-346	0	0	0	0	0	0	0	0	28
13	1981	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1982	396	1	-681	0	0	0	0	0	0	0	0	0	-24
15	1983	683	-683	451	-450	0	0	0	0	0	0	0	0	0
16	1984	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1985	0	0	0	0	0	0	0	0	0	0	0	0	0
18	1986	0	684	-138	-543	0	0	0	0	0	0	0	0	0
19	1987	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1988	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1989	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1990	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1991	0	0	556	-178	-106	0	0	0	0	0	0	0	23
24	1992	0	0	0	0	-250	0	0	0	0	0	0	0	-21
25	1993	684	1	-322	-359	0	0	0	0	0	0	0	0	0

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
26	1994	0	0	0	0	0	0	0	0	0	0	0	0	0
27	1995	684	0	-229	-452	0	0	0	0	0	0	0	0	0
28	1996	0	684	3	-682	0	0	0	0	0	0	0	0	0
29	1997	684	2	-4	-299	-371	0	0	0	0	0	0	0	1
30	1998	0	684	-144	-537	0	0	0	0	0	0	0	0	0
31	1999	0	0	0	0	0	0	0	0	0	0	0	0	0
32	2000	0	684	0	-343	-76	0	0	0	0	0	0	0	22
33	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2002	72	0	0	0	-290	0	0	0	0	0	0	683	39
35	2003	0	0	0	-677	0	0	0	0	0	0	0	0	-56
36	2004	0	0	0	0	0	0	0	0	0	0	0	0	0
37	2005	0	684	-61	-618	0	0	0	0	0	0	0	0	0
38	2006	0	0	669	-667	0	0	0	0	0	0	0	0	0
39	2007	0	0	0	0	0	0	0	0	0	0	0	0	0
40	2008	0	685	1	0	0	0	0	0	0	0	0	0	57
41	2009	0	0	0	0	0	0	0	0	0	0	0	0	0
42	2010	0	89	-60	-620	0	0	0	0	0	0	0	0	-49
43	2011	0	0	626	-624	0	0	0	0	0	0	0	0	0
44	2012	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2013	0	0	0	0	0	0	0	0	0	0	0	0	0
46	2014	0	0	16	-16	0	0	0	0	0	0	0	0	0
47	2015	0	0	0	0	0	0	0	0	0	-	-	-	-
48	*Minimum*	0	-683	-681	-682	-371	0	0	0	0	0	0	0	-56
49	*Maximum*	684	685	669	0	0	0	0	0	0	0	0	683	57
50	*Mean*	97	106	26	-206	-32	0	0	0	0	0	0	15	1

Table 37. FIRO alone: average monthly storage (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	13,198	13,206	-	-
2	1970	18,810	28,126	33,818	35,920	39,035	39,620	39,154	38,505	37,430	33,518	29,053	29,651	34,742	31,380
3	1971	33,882	34,214	34,747	38,133	39,653	39,683	39,680	39,685	38,519	32,741	28,335	29,013	35,288	30,045
4	1972	30,097	30,968	32,698	37,768	39,685	39,625	37,738	35,655	34,607	29,529	28,310	29,761	35,165	27,429
5	1973	35,310	39,424	39,685	39,673	39,667	39,397	38,830	38,210	35,940	30,739	28,162	31,478	39,685	28,137
6	1974	38,777	39,024	39,383	39,666	39,683	39,500	39,063	36,092	29,717	24,556	21,999	21,405	39,537	22,413
7	1975	21,730	29,128	38,499	39,444	39,678	39,447	39,029	38,456	37,236	31,657	26,140	24,928	39,629	28,413
8	1976	24,951	25,512	30,876	33,911	33,553	33,093	32,517	31,829	31,357	29,702	24,778	24,212	33,461	26,611
9	1977	24,274	25,259	31,524	35,685	37,712	38,388	37,795	37,059	32,967	28,651	25,792	25,311	35,002	26,932
10	1978	32,154	38,557	39,535	39,529	38,855	38,358	37,766	37,091	35,178	28,330	23,906	23,474	39,685	25,505
11	1979	24,007	26,392	32,311	35,251	38,397	37,958	37,342	36,549	33,090	27,541	23,159	22,924	33,276	24,830
12	1980	29,088	35,746	39,526	39,474	39,251	39,082	38,177	36,658	34,178	28,265	24,729	24,551	39,581	25,374
13	1981	24,720	27,412	34,374	39,312	39,038	37,805	36,073	33,845	31,709	30,531	30,690	31,284	39,214	30,474
14	1982	38,813	39,588	39,494	39,759	39,023	38,355	37,419	36,918	34,980	28,257	22,213	28,657	41,712	24,799
15	1983	35,450	39,500	40,540	39,537	39,034	38,969	38,583	38,111	36,610	30,649	25,591	29,821	39,685	27,537
16	1984	34,116	33,999	36,148	37,031	38,627	38,605	37,212	35,285	32,328	26,722	24,833	24,747	36,759	26,296
17	1985	25,408	26,729	31,717	37,580	39,428	38,993	38,343	36,520	33,787	28,673	26,146	22,564	35,448	28,405
18	1986	22,448	33,345	39,456	39,685	39,169	38,867	38,163	37,705	35,567	30,090	25,950	22,629	39,685	28,459
19	1987	22,637	23,425	26,907	33,607	37,703	37,778	37,290	36,423	31,789	24,550	21,247	21,263	30,748	21,600
20	1988	21,707	22,145	24,685	30,428	35,473	38,055	37,542	36,791	32,387	26,206	23,741	21,972	27,502	24,624
21	1989	22,035	22,774	27,615	31,380	33,597	33,540	32,976	32,444	30,096	25,860	24,888	24,845	30,333	25,169
22	1990	24,824	27,713	31,846	32,706	33,561	35,186	34,778	34,240	33,117	30,464	27,849	25,829	32,421	29,185
23	1991	26,048	29,708	35,514	38,999	39,093	38,478	36,291	34,499	32,046	28,554	25,033	24,299	39,685	26,875
24	1992	24,605	29,327	33,484	36,764	39,474	39,155	38,372	36,282	34,162	27,490	23,622	23,452	34,943	24,808
25	1993	32,951	39,530	39,478	39,652	39,291	39,036	38,491	37,947	35,545	29,993	26,744	26,714	39,685	27,882
26	1994	26,805	27,504	30,918	32,817	38,242	39,685	39,232	38,415	36,775	32,870	28,330	26,705	31,147	30,151
27	1995	35,299	38,983	39,468	39,670	39,359	38,933	38,673	38,130	36,154	31,439	27,915	26,076	39,685	29,189
28	1996	28,287	39,979	39,679	39,424	39,352	38,847	38,347	37,735	34,692	28,097	21,870	22,696	39,633	24,627
29	1997	39,383	39,685	39,685	39,685	39,650	38,832	39,332	38,826	36,066	29,950	26,121	26,751	39,685	27,500
30	1998	31,961	41,662	39,685	39,611	39,560	39,634	39,179	36,512	32,407	28,387	25,519	24,888	39,685	26,566
31	1999	24,809	31,691	35,923	38,399	39,490	39,090	37,782	36,802	35,640	32,817	28,377	27,602	37,111	31,224
32	2000	28,317	34,217	39,497	39,425	39,501	39,259	38,299	36,518	34,287	29,674	24,793	24,696	39,230	27,233
33	2001	25,103	27,107	33,935	36,568	38,743	36,640	34,993	38,000	37,571	37,197	37,359	37,195	34,701	37,738
34	2002	38,643	36,803	35,594	36,560	38,815	39,393	38,297	36,602	34,188	32,042	28,045	32,091	36,019	30,281
35	2003	38,731	35,102	35,697	39,176	39,457	38,757	37,623	36,622	33,414	29,382	26,863	26,179	38,107	29,053
36	2004	29,164	31,050	37,706	39,602	39,032	38,282	37,450	34,987	31,612	26,903	25,011	24,962	38,872	25,497
37	2005	33,710	37,380	39,665	39,685	39,413	38,899	37,905	37,168	35,308	30,260	25,709	25,280	39,685	27,568
38	2006	33,598	34,577	38,903	39,684	39,579	39,121	38,402	37,345	36,053	32,658	27,891	26,152	39,685	29,952

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
39	2007	26,214	26,454	29,620	35,150	39,370	36,244	34,960	34,443	33,218	29,252	28,424	28,272	32,127	28,738
40	2008	32,164	39,113	39,283	38,770	38,989	38,459	38,703	38,029	36,810	36,949	36,174	31,193	38,872	37,336
41	2009	28,382	29,721	37,115	37,562	37,749	37,245	36,790	35,743	35,249	35,091	34,255	28,768	37,530	35,168
42	2010	30,569	38,920	39,685	39,685	39,184	38,154	37,264	36,427	35,792	35,493	36,282	31,877	39,685	36,511
43	2011	31,251	32,206	38,636	39,666	39,507	39,535	39,059	38,097	37,463	37,250	36,105	31,208	39,685	37,141
44	2012	28,436	28,442	28,367	29,682	33,715	35,276	34,957	35,702	37,694	34,396	29,382	30,721	28,488	31,466
45	2013	35,534	35,901	35,514	37,480	39,295	39,608	39,287	37,988	34,795	30,716	30,061	30,039	35,774	30,063
46	2014	29,889	31,699	36,622	39,630	38,983	39,046	38,603	37,978	35,005	29,151	27,346	29,533	39,339	27,389
47	2015	32,305	33,244	33,823	35,826	37,020	36,280	35,492	33,476	32,044	-	-	-	33,776	-
48	*Minimum*	*18,810*	*22,145*	*24,685*	*29,682*	*33,553*	*33,093*	*32,517*	*31,829*	*29,717*	*24,550*	*13,198*	*13,206*	*27,502*	*21,600*
49	*Maximum*	*39,383*	*41,662*	*40,540*	*39,759*	*39,685*	*39,685*	*39,680*	*39,685*	*38,519*	*37,250*	*37,359*	*37,195*	*41,712*	*37,738*
50	*Mean*	*29,509*	*32,587*	*35,628*	*37,492*	*38,515*	*38,308*	*37,592*	*36,616*	*34,491*	*30,294*	*26,912*	*26,541*	*36,769*	*28,524*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 38. FIRO alone: differences in average monthly storage (ac-ft) results from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-	-
2	1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1973	226	426	681	393	121	104	103	102	101	100	100	100	614	100
6	1974	490	682	683	20	0	0	0	0	0	0	0	0	585	0
7	1975	0	0	460	606	27	0	0	0	0	0	0	0	665	0
8	1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1978	0	471	666	52	0	0	0	0	0	0	0	0	502	0
11	1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1980	0	136	683	398	331	328	325	322	320	317	315	313	681	316
13	1981	313	312	311	309	305	302	299	295	292	290	289	288	310	289
14	1982	610	651	570	0	0	0	0	0	0	0	0	0	0	0
15	1983	22	380	398	22	0	0	0	0	0	0	0	0	359	0
16	1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	1986	0	106	450	46	0	0	0	0	0	0	0	0	485	0
19	1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
22	1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1991	0	0	80	385	338	266	264	262	259	257	255	254	519	256
24	1992	254	253	253	251	75	0	0	0	0	0	0	0	252	0
25	1993	206	580	677	19	0	0	0	0	0	0	0	0	277	0
26	1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	1995	253	683	496	24	0	0	0	0	0	0	0	0	360	0
28	1996	0	381	683	89	0	0	0	0	0	0	0	0	682	0
29	1997	392	683	683	484	206	0	0	0	0	0	0	0	663	0
30	1998	0	145	680	28	0	0	0	0	0	0	0	0	440	0
31	1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	2000	0	73	682	646	258	251	249	246	244	243	242	241	680	242
33	2001	241	240	239	238	236	233	230	228	226	225	224	223	238	224
34	2002	284	294	293	292	167	0	0	0	0	0	0	47	293	0
35	2003	683	682	680	317	0	0	0	0	0	0	0	0	678	0
36	2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	2005	0	208	681	153	0	0	0	0	0	0	0	0	613	0
38	2006	0	0	405	52	0	0	0	0	0	0	0	0	608	0
39	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	2008	0	637	682	679	673	667	660	654	648	644	641	640	681	642
41	2009	638	637	635	632	628	623	617	611	605	601	598	597	634	599
42	2010	596	609	681	119	0	0	0	0	0	0	0	0	602	0
43	2011	0	0	127	302	0	0	0	0	0	0	0	0	622	0
44	2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	2014	0	0	0	1	0	0	0	0	0	0	0	0	16	0
47	2015	0	0	0	0	0	0	0	0	0	-	-	-	0	-
48	*Minimum*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
49	*Maximum*	*683*	*683*	*683*	*679*	*673*	*667*	*660*	*654*	*648*	*644*	*641*	*640*	*682*	*642*
50	*Mean*	*113*	*202*	*295*	*142*	*73*	*60*	*60*	*59*	*59*	*59*	*58*	*59*	*284*	*59*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 39. FIRO alone: peak monthly elevation (ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	648.00	648.44
2	1970	682.56	685.69	695.35	699.76	703.10	703.10	703.05	701.45	700.57	696.61	689.87	691.49
3	1971	696.24	694.81	696.14	703.10	703.10	703.10	703.10	703.10	703.10	696.93	687.45	687.15
4	1972	688.34	689.78	695.95	703.10	703.10	703.10	703.04	697.20	696.27	691.53	686.31	688.01
5	1973	703.10	703.10	703.10	703.10	703.10	703.08	701.87	701.04	700.12	693.32	685.09	696.52

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
6	1974	703.10	703.05	703.10	703.10	703.10	703.09	702.89	701.40	692.15	682.02	672.74	670.73
7	1975	671.55	695.10	703.10	703.10	703.10	703.09	702.35	701.34	700.53	695.53	684.47	678.32
8	1976	678.35	683.21	693.22	694.24	693.88	693.09	692.25	691.36	690.28	689.70	681.25	676.95
9	1977	677.05	683.90	695.58	697.37	701.42	701.20	700.41	699.63	696.58	688.73	681.96	679.35
10	1978	700.86	703.11	703.15	703.10	701.86	701.19	700.40	699.44	698.41	690.71	679.28	675.28
11	1979	677.69	690.03	692.98	699.54	701.13	700.71	699.69	698.88	696.68	688.05	677.91	674.73
12	1980	693.48	712.57	703.10	703.10	703.00	701.94	701.58	699.01	697.17	689.85	678.98	677.55
13	1981	681.28	687.11	701.99	703.01	702.84	701.16	699.15	695.60	692.37	688.63	689.29	692.86
14	1982	705.82	703.10	706.32	706.30	703.10	701.19	699.61	699.01	698.24	691.04	677.87	694.04
15	1983	711.36	705.49	715.00	703.10	703.10	702.27	701.62	700.63	700.24	693.69	682.95	696.57
16	1984	696.58	696.39	698.38	699.78	701.85	701.41	700.77	697.27	695.76	685.24	680.92	678.85
17	1985	679.63	684.99	696.39	701.34	703.10	701.98	701.27	700.31	697.20	688.20	684.68	676.92
18	1986	673.51	723.67	703.11	703.10	703.10	701.78	700.84	700.14	699.50	691.91	684.64	675.64
19	1987	673.58	676.40	688.66	697.83	700.71	700.28	699.56	698.85	695.46	683.99	670.75	670.33
20	1988	672.02	672.29	682.93	693.30	699.62	700.76	700.05	699.09	696.46	685.72	677.61	674.05
21	1989	672.15	677.57	688.02	691.95	694.22	693.81	693.03	692.07	691.34	681.91	678.72	678.19
22	1990	678.92	687.82	691.71	692.97	695.09	696.37	695.85	694.97	694.19	689.77	686.08	681.28
23	1991	681.80	692.03	703.10	703.10	703.10	703.06	699.43	696.54	693.67	688.06	681.86	677.22
24	1992	677.81	694.08	695.53	701.15	703.10	703.03	701.51	698.17	697.26	689.12	677.88	677.01
25	1993	703.10	703.10	703.10	703.10	703.04	701.90	701.40	700.55	699.79	691.63	683.60	681.75
26	1994	682.02	686.68	689.60	696.50	703.10	703.10	703.10	701.35	700.38	695.79	687.62	682.18
27	1995	703.10	703.10	711.71	703.10	703.10	701.69	701.51	700.86	700.03	694.02	685.96	682.57
28	1996	698.57	710.49	703.10	703.10	703.08	701.84	701.14	700.30	699.41	690.66	677.49	686.34
29	1997	707.46	703.10	703.10	703.10	703.10	703.08	703.07	701.82	701.11	692.64	682.93	682.31
30	1998	699.80	717.96	703.10	703.10	703.10	703.10	703.06	700.64	694.94	688.19	681.30	679.16
31	1999	680.94	695.87	698.89	703.04	703.10	702.04	700.79	699.14	697.32	695.62	689.53	684.21
32	2000	686.94	703.10	703.10	703.10	703.10	703.07	701.37	699.59	696.69	691.82	682.54	678.33
33	2001	679.10	688.49	695.28	699.93	703.02	700.65	699.33	700.56	700.45	699.87	699.86	700.61
34	2002	702.83	699.82	697.29	699.57	703.10	703.10	701.68	699.39	696.95	691.83	687.82	703.10
35	2003	703.10	698.05	700.41	703.10	703.10	701.77	700.87	698.94	697.28	688.71	685.81	681.62
36	2004	686.74	698.99	701.36	703.10	703.10	701.06	700.27	698.67	694.08	685.09	679.35	682.30
37	2005	697.67	703.10	703.10	703.10	703.10	702.64	700.62	699.58	698.58	692.59	683.02	683.88
38	2006	695.27	696.79	703.10	703.41	703.10	703.02	701.39	700.12	698.80	695.66	687.28	681.31
39	2007	680.79	683.38	691.01	700.10	703.10	703.04	695.98	695.32	694.43	689.31	685.27	684.57
40	2008	701.47	703.10	703.10	703.02	703.06	701.77	701.77	700.88	699.58	699.44	699.26	693.65
41	2009	686.00	691.52	700.38	699.81	700.39	699.55	699.67	697.31	696.47	696.17	696.03	690.64
42	2010	700.09	703.10	703.10	703.10	703.10	700.89	699.93	698.52	697.32	698.11	699.27	694.33
43	2011	690.11	699.03	704.85	703.10	703.10	703.08	703.02	701.05	699.83	699.28	698.97	694.06
44	2012	684.93	684.80	684.81	690.49	695.70	696.38	696.03	698.61	700.32	699.13	689.92	696.08
45	2013	696.94	697.23	697.29	702.09	703.10	703.10	703.09	701.64	698.19	691.42	687.67	687.67

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
46	2014	687.53	693.76	702.18	703.10	703.10	703.01	701.62	700.65	699.51	691.17	682.86	691.34
47	2015	691.53	693.83	693.92	700.05	700.03	698.12	697.22	695.41	691.11	-	-	-
48	*Minimum*	*671.55*	*672.29*	*682.93*	*690.49*	*693.88*	*693.09*	*692.25*	*691.36*	*690.28*	*681.91*	*648.00*	*648.44*
49	*Maximum*	*711.36*	*723.67*	*715.00*	*706.30*	*703.10*	*703.10*	*703.10*	*703.10*	*703.10*	*699.87*	*699.86*	*703.10*
50	*Mean*	*689.63*	*695.73*	*698.97*	*700.97*	*701.97*	*701.41*	*700.46*	*699.07*	*697.31*	*691.52*	*683.91*	*683.47*

Table 40. FIRO alone: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	0.00	0.00
2	1970	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	1971	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	1972	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	1973	1.40	1.40	1.32	0.06	0.03	0.02	0.15	0.15	0.15	0.16	0.18	0.15
6	1974	1.40	1.63	1.40	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
7	1975	0.00	0.00	1.37	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1978	0.00	1.35	1.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1979	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	1980	0.00	0.07	1.40	0.09	1.30	0.47	0.47	0.48	0.48	0.56	0.63	0.64
13	1981	0.56	0.55	0.45	1.26	1.16	0.44	0.45	0.48	0.46	0.52	0.51	0.46
14	1982	0.40	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1983	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	1984	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	1986	0.00	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	1987	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	1991	0.00	0.00	1.22	0.16	0.07	0.40	0.40	0.39	0.41	0.46	0.45	0.54
24	1992	0.51	0.40	0.40	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	1993	1.40	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	1995	1.18	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	1996	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	1997	0.00	1.40	1.39	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	1998	0.00	0.14	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	1999	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
32	2000	0.00	1.40	1.40	0.09	0.07	0.07	0.36	0.37	0.37	0.39	0.43	0.49
33	2001	0.49	0.43	0.38	0.35	1.12	0.34	0.34	0.33	0.33	0.33	0.33	0.33
34	2002	1.13	0.44	0.43	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40
35	2003	1.40	1.02	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	2005	0.00	1.40	1.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	2006	0.00	0.00	1.38	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	2008	0.00	1.40	1.40	1.71	1.56	0.95	0.95	0.96	0.97	0.96	0.96	1.02
41	2009	1.14	1.01	0.94	0.94	0.93	0.94	0.92	0.92	0.94	0.94	0.95	0.98
42	2010	0.89	1.40	1.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	2011	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	2012	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	2014	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-
48	*Minimum*	*-0.01*	*-0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*-0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
49	*Maximum*	*1.40*	*1.63*	*1.40*	*1.71*	*1.56*	*0.95*	*0.95*	*0.96*	*0.97*	*0.96*	*0.96*	*1.40*
50	*Mean*	*0.26*	*0.40*	*0.52*	*0.13*	*0.14*	*0.08*	*0.09*	*0.09*	*0.09*	*0.10*	*0.10*	*0.13*

Table 41. FIRO alone: number of days in which Lake Del Valle elevation thresholds are exceeded by year

		Days threshold is exceeded																	
ID (1)	Year (2)	703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	5.4	5.0	4.7	4.5	4.4	4.1	3.7	3.4	3.0	1.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1982	3.6	2.7	1.9	1.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1983	14.5	12.5	11.2	10.1	9.3	7.8	6.6	5.6	4.4	3.1	2.3	1.8	1.3	0.0	0.0	0.0	0.0	0.0	0.0
16	1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
17	1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1986	7.3	6.9	6.6	6.5	6.3	6.0	5.7	5.3	4.9	4.3	3.8	3.4	3.0	2.7	0.0	0.0	0.0	0.0	0.0
19	1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1995	6.6	5.9	5.3	5.0	4.7	4.0	3.3	2.2	1.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	1996	4.6	4.2	3.9	3.7	3.5	2.9	1.9	1.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1997	5.5	3.8	3.0	2.5	2.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1998	10.8	9.6	9.3	9.2	9.0	8.8	7.8	6.9	6.1	5.4	4.7	4.0	3.1	1.6	0.0	0.0	0.0	0.0	0.0
31	1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	2006	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2011	2.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0
50	*Mean*	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Table 42. FIRO alone: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1982	0.1	0.1	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1995	0.3	0.3	0.3	0.3	0.3	0.4	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	2006	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
39	2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	*Mean*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 43. FIRO alone: annual event results

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	648.46	682.10	0	47	66	2,937	5,133
2	1971	682.71	696.24	113	19	40	853	982
3	1972	685.60	687.68	0	2	20	251	272
4	1973	701.67	703.10	2,068	2,056	2,226	2,482	2,887
5	1974	689.34	703.10	223	178	210	1,102	3,420
6	1975	695.13	703.10	2,094	2,053	2,025	1,937	2,079
7	1976	678.29	689.33	0	3	3	101	108
8	1977	676.69	676.98	9	10	10	138	172
9	1978	679.32	700.86	131	6	28	1,511	2,291
10	1979	677.87	690.02	0	11	22	1,179	1,437
11	1980	689.70	712.57	2,085	2,055	2,913	3,643	9,072
12	1981	677.56	681.27	0	17	33	677	713
13	1982	689.41	705.82	2,083	2,026	2,440	5,926	7,256
14	1983	690.36	711.36	2,118	2,061	2,654	5,135	7,784
15	1984	687.67	696.57	106	6	199	1,313	1,858
16	1985	691.64	698.16	0	3	31	167	352
17	1986	676.04	723.67	3,028	3,061	3,502	6,910	10,034
18	1987	673.70	676.18	0	3	250	940	2,103
19	1988	670.71	671.92	0	17	163	359	1,344
20	1989	677.60	686.59	0	8	22	293	901
21	1990	681.58	687.81	0	13	64	844	2,344
22	1991	685.38	695.54	0	2	33	477	1,238
23	1992	677.81	694.08	97	9	185	1,088	3,279
24	1993	675.08	703.10	399	317	424	4,373	10,049
25	1994	682.02	688.67	0	8	109	476	1,287
26	1995	698.10	711.71	2,152	2,056	2,607	3,889	14,794

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	701.70	710.49	2,045	2,056	2,591	3,794	8,923
28	1997	701.70	707.46	2,038	2,056	2,684	5,041	10,239
29	1998	698.10	717.96	3,019	3,062	4,429	6,228	17,676
30	1999	680.99	692.54	0	10	216	1,788	4,380
31	2000	687.05	699.07	121	8	243	2,373	6,208
32	2001	682.37	695.21	0	3	56	442	754
33	2002	698.70	702.83	49	2	97	955	2,392
34	2003	682.56	700.73	0	8	1,031	3,450	9,906
35	2004	689.02	698.99	0	6	117	3,465	3,510
36	2005	696.70	703.10	1,117	1,073	1,071	1,390	1,965
37	2006	679.18	692.94	0	3	337	8,827	10,102
38	2007	681.23	684.07	0	5	92	2,817	2,621
39	2008	690.36	701.47	107	5	45	989	972
40	2009	691.16	700.25	10	9	88	2,214	3,384
41	2010	682.55	698.68	0	7	153	4,644	4,970
42	2011	700.49	704.85	2,129	2,116	2,665	5,156	10,726
43	2012	685.09	687.27	0	10	32	2,272	2,310
44	2013	686.77	696.08	10	4	67	2,311	6,448
45	2014	691.17	698.70	0	6	19	1,585	1,464
46	2015	682.75	691.34	0	7	75	5,165	8,647

Table 44. FIRO alone: differences in annual event results from baseline operations (positive values are an increase from baseline)

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	0.00	0.00	0	0	0	0	0
2	1971	0.00	0.00	0	0	0	0	0
3	1972	0.00	0.00	0	0	0	0	0
4	1973	0.05	1.40	367	422	519	0	0
5	1974	0.17	1.40	0	-5	-14	0	0
6	1975	0.00	1.38	1,057	1,099	1,071	200	-460
7	1976	0.00	0.00	0	0	0	0	0
8	1977	0.00	0.00	0	0	0	0	0
9	1978	0.00	0.00	0	0	0	0	0
10	1979	0.00	0.00	0	0	0	0	0
11	1980	0.00	0.07	0	0	9	0	0
12	1981	0.64	0.55	0	0	0	0	0
13	1982	0.52	0.40	0	0	240	0	0
14	1983	0.00	0.00	0	0	0	0	0
15	1984	0.00	0.00	0	0	0	0	0
16	1985	0.00	0.00	0	0	0	0	0
17	1986	0.00	0.00	0	0	-104	4	4
18	1987	0.00	0.00	0	0	0	0	0
19	1988	0.00	-0.01	0	0	0	0	0
20	1989	0.00	0.00	0	0	0	0	0
21	1990	0.00	0.00	0	0	0	0	0
22	1991	0.00	0.00	0	0	0	0	0
23	1992	0.51	0.40	0	0	0	0	0
24	1993	0.00	1.40	-188	-183	-250	0	0
25	1994	0.00	0.00	0	0	0	0	0

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
26	1995	1.02	0.00	0	0	-12	0	0
27	1996	0.00	0.00	-2	0	38	5	-10
28	1997	0.00	0.00	0	0	-40	-22	0
29	1998	0.00	0.14	0	0	139	0	0
30	1999	0.00	0.00	0	0	0	0	0
31	2000	0.00	0.00	0	0	0	0	0
32	2001	0.43	0.38	0	0	0	0	0
33	2002	0.33	1.13	-40	-43	0	0	0
34	2003	0.00	0.00	0	0	0	0	0
35	2004	0.00	0.00	0	0	0	0	0
36	2005	0.00	1.40	0	0	6	-1	1
37	2006	0.00	0.00	0	0	0	0	0
38	2007	0.00	0.00	0	0	0	0	0
39	2008	0.00	0.00	0	0	0	0	0
40	2009	1.01	0.94	0	0	0	0	0
41	2010	1.06	0.89	0	0	0	0	0
42	2011	0.00	0.00	0	0	7	0	0
43	2012	-0.01	0.00	0	0	0	0	0
44	2013	0.00	0.00	0	0	0	0	0
45	2014	0.00	0.00	0	0	0	0	0
46	2015	0.00	0.00	0	0	0	0	0

Appendix V. Results for 5,000 ac-ft reallocation with FIRO

This appendix details 5,000 ac-ft reallocation-with-FIRO simulation results. The information in this appendix includes the following:

- Table 45. 5,000 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year
- Table 46. 5,000 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year
- Table 48. 5,000 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)
- Table 49. 5,000 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year
- Table 50. 5,000 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from the baseline)
- Table 51. 5,000 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year
- Table 52. 5,000 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)
- Table 53. 5,000 ac-ft reallocation with FIRO: annual event results
- Table 54. 5,000 ac-ft reallocation with FIRO: differences in annual event results from baseline

Table 45. 5,000 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	12	224	-
2	1970	10,375	1,860	6,039	334	260	51	1	0	202	615	907	6,875	2,293
3	1971	3,370	569	1,037	363	-1,755	-1,141	-933	-1,254	-78	400	357	672	134
4	1972	391	667	138	-398	-4,167	-1,166	49	31	41	363	2,029	997	-85
5	1973	11,450	3,353	2,841	1,362	462	119	50	6	6	343	969	6,905	2,322
6	1974	6,313	1,398	3,503	2,423	437	178	48	157	298	9	32	307	1,259
7	1975	425	8,594	9,053	3,099	460	125	53	2	131	5	64	96	1,842
8	1976	90	186	83	46	7	0	0	0	0	0	0	1	35
9	1977	207	59	51	2	0	0	0	0	173	0	18	282	66
10	1978	14,793	7,706	4,578	1,653	465	99	15	0	0	67	48	25	2,454
11	1979	1,264	5,859	1,970	541	218	48	68	0	18	0	98	470	880
12	1980	10,553	11,503	3,830	1,164	672	226	244	12	184	197	0	66	2,388
13	1981	1,993	636	2,724	437	138	68	80	105	18	80	615	2,250	762
14	1982	11,836	2,161	4,725	4,064	1,311	458	200	81	257	105	5,025	11,226	3,454
15	1983	11,183	249	8,409	6,127	4,180	943	529	263	274	192	4,843	15,568	4,397
16	1984	2,684	2,737	1,572	733	64	131	182	86	153	86	1,265	1,022	893
17	1985	525	1,682	2,722	810	-167	113	21	92	89	59	420	344	559
18	1986	611	17,313	225	316	994	353	107	70	55	118	129	157	1,704
19	1987	309	1,357	1,082	328	99	10	0	67	137	0	38	148	298
20	1988	799	228	175	40	63	0	0	6	71	123	84	293	157
21	1989	319	340	984	143	32	0	0	12	202	0	79	0	176
22	1990	97	483	148	62	6	3	0	0	0	98	220	203	110
23	1991	0	211	9,313	753	57	14	0	0	154	389	114	207	934
24	1992	337	10,004	2,089	66	118	11	0	0	374	14	0	990	1,167
25	1993	20,492	3,220	4,769	1,676	646	283	6	55	178	314	112	149	2,658
26	1994	226	1,619	406	210	-640	-708	0	0	146	0	236	155	138
27	1995	15,555	1,045	6,221	2,018	1,706	658	115	2	154	74	5	1,069	2,385
28	1996	11,282	5,140	4,124	1,639	1,021	246	94	10	0	36	712	12,549	3,071
29	1997	11,945	2,158	897	394	-83	124	14	0	0	0	257	1,098	1,400
30	1998	10,625	4,756	2,065	3,815	1,001	323	350	60	23	37	266	496	1,985
31	1999	1,835	7,351	2,176	2,676	645	203	69	43	77	246	155	127	1,300
32	2000	1,786	13,756	3,575	451	252	167	80	240	215	117	24	131	1,733
33	2001	444	4,089	4,872	661	148	238	61	277	72	0	112	2,857	1,153
34	2002	2,283	665	1,091	324	-794	-79	123	55	244	216	167	12,786	1,423
35	2003	1,069	817	962	-1,004	913	78	130	80	167	68	36	638	329
36	2004	2,919	7,706	1,525	-597	-277	0	0	80	268	292	45	2,238	1,183
37	2005	9,590	5,749	3,232	1,396	810	141	48	31	172	289	84	2,851	2,033
38	2006	6,830	1,802	7,705	4,580	1,008	200	27	0	0	0	59	294	1,875
39	2007	123	1,532	797	110	-1,027	0	0	0	172	133	0	12	154

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
40	2008	11,330	5,463	1,226	329	116	13	252	19	71	6	77	275	1,598
41	2009	142	4,109	6,064	337	346	31	0	31	54	646	178	49	999
42	2010	10,798	2,559	248	296	425	18	2	43	0	0	67	2,852	1,442
43	2011	1,444	6,730	6,278	1,463	600	341	43	84	357	357	4	844	1,545
44	2012	138	59	476	1,341	287	303	264	554	465	71	755	6,894	967
45	2013	715	335	262	43	7	722	0	0	0	595	173	43	241
46	2014	0	29	156	-699	-13	0	0	0	351	6	54	4,961	404
47	2015	214	1,583	255	238	46	0	0	0	0	-	-	-	-
48	*Minimum*	0	29	51	-1,004	-4,167	-1,166	-933	-1,254	-78	0	0	0	-85
49	*Maximum*	20,492	17,313	9,313	6,127	4,180	943	529	554	465	646	5,025	15,568	4,397
50	*Mean*	4,602	3,509	2,754	1,004	241	86	52	30	129	150	455	2,232	1,294

Table 46. 5,000 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-
2	1970	0	0	0	0	305	1,219	0	0	0	0	0	0	127
3	1971	0	0	0	2,472	1,411	60	51	48	10	0	0	0	338
4	1972	0	0	0	171	41	15	0	0	0	0	0	0	19
5	1973	698	205	-41	-370	-110	0	0	0	0	0	0	0	32
6	1974	848	0	15	-654	26	0	0	0	0	0	0	0	20
7	1975	0	0	963	-389	-230	0	0	0	0	0	0	0	29
8	1976	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1977	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1978	0	1,501	-11	-569	0	0	0	0	0	0	0	0	77
11	1979	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1980	0	1,325	7	-329	0	0	0	0	0	0	0	0	84
13	1981	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1982	1,016	10	-1,976	1,327	0	0	0	0	0	0	0	0	31
15	1983	946	-3,634	3,418	-431	2	0	0	0	0	0	0	0	25
16	1984	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1985	0	0	0	0	664	0	0	0	0	0	0	0	55
18	1986	0	961	-122	-520	0	0	0	0	0	0	0	0	27
19	1987	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1988	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1989	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1990	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1991	0	0	1,085	0	0	0	0	0	0	0	0	0	90
24	1992	0	0	0	0	484	0	0	0	0	0	0	0	40
25	1993	1,259	9	-309	-345	0	0	0	0	0	0	0	0	51

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
26	1994	0	0	0	0	380	0	0	0	0	0	0	0	32
27	1995	862	2	-213	-438	17	0	0	0	0	0	0	0	19
28	1996	0	941	16	-673	0	0	0	0	0	0	0	0	24
29	1997	987	14	18	-272	-340	0	0	0	0	0	0	0	34
30	1998	-1,149	2,079	-131	-528	29	10	0	0	0	0	0	0	26
31	1999	0	0	0	0	19	0	0	0	0	0	0	0	2
32	2000	0	1,200	4	-303	-73	0	0	0	0	0	0	0	69
33	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2002	72	0	0	0	392	3	0	0	0	0	0	934	117
35	2003	2	0	0	-622	3	0	0	0	0	0	0	0	-51
36	2004	0	0	0	364	4	0	0	0	0	0	0	0	31
37	2005	0	985	-46	-595	0	0	0	0	0	0	0	0	29
38	2006	0	0	980	-649	8	0	0	0	0	0	0	0	28
39	2007	0	0	0	0	383	0	0	0	0	0	0	0	32
40	2008	0	958	5	0	0	0	0	0	0	0	0	0	80
41	2009	0	0	0	0	0	0	0	0	0	0	0	0	0
42	2010	0	755	-42	-598	11	0	0	0	0	0	0	0	11
43	2011	0	0	898	-599	0	0	0	0	0	0	0	0	25
44	2012	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2013	0	0	0	0	136	64	0	0	0	0	0	0	17
46	2014	0	0	16	818	1	0	0	0	0	0	0	0	70
47	2015	0	0	0	0	0	0	0	0	0	-	-	-	-
48	*Minimum*	-1,149	-3,634	-1,976	-673	-340	0	0	0	0	0	0	0	-51
49	*Maximum*	1,259	2,079	3,418	2,472	1,411	1,219	51	48	10	0	0	934	338
50	*Mean*	120	159	99	-81	77	30	1	1	0	0	0	20	36

Table 47. 5,000 ac-ft reallocation with FIRO: average monthly storage (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	13,198	13,206	-	-
2	1970	18,810	28,126	33,818	35,920	39,050	40,579	40,666	40,002	38,913	34,989	30,519	31,114	34,742	32,848
3	1971	35,343	35,672	36,201	40,019	44,831	44,996	44,994	45,000	43,819	38,005	33,573	34,238	36,740	35,295
4	1972	35,313	36,175	37,886	42,949	45,000	44,930	42,995	40,858	39,768	34,662	33,429	34,873	40,339	32,551
5	1973	40,415	44,442	45,000	44,985	44,971	44,657	44,039	43,368	41,057	35,825	33,227	36,536	45,000	33,210
6	1974	43,994	44,332	44,694	44,980	44,997	44,786	44,306	41,287	34,863	29,657	27,075	26,469	44,847	27,497
7	1975	26,781	34,168	43,710	44,754	44,992	44,730	44,271	43,649	42,390	36,782	31,249	30,023	44,942	33,529
8	1976	30,032	30,576	35,924	38,936	38,542	38,039	37,411	36,682	36,169	34,486	29,538	28,954	38,496	31,382
9	1977	29,005	29,979	36,227	40,363	42,364	43,007	42,371	41,592	37,464	33,117	30,237	29,742	39,694	31,386
10	1978	36,576	43,585	44,789	44,839	44,136	43,594	42,957	42,230	40,277	33,388	28,937	28,492	45,000	30,547
11	1979	29,018	31,393	37,303	40,224	43,343	42,855	42,193	41,355	37,854	32,268	27,868	27,618	38,261	29,546
12	1980	33,774	40,219	44,838	44,781	44,535	44,333	43,387	41,819	39,301	33,349	29,785	29,588	44,884	30,443
13	1981	29,748	32,430	39,376	44,296	43,990	42,712	40,928	38,650	36,468	35,260	35,400	35,987	44,209	35,192
14	1982	44,016	44,888	44,623	44,852	44,319	43,612	42,637	42,083	40,101	33,347	27,285	33,720	45,758	29,878
15	1983	39,757	44,474	45,048	44,848	44,337	44,234	43,801	43,281	41,738	35,749	30,670	34,891	45,000	32,624
16	1984	39,180	39,054	41,189	42,051	43,615	43,549	42,102	40,128	37,126	31,483	29,576	29,482	41,789	31,045
17	1985	30,134	31,444	36,414	42,257	44,529	44,263	43,555	41,685	38,915	33,766	31,215	27,624	40,137	33,485
18	1986	27,500	37,399	44,617	45,000	44,468	44,126	43,375	42,871	40,696	35,189	31,024	27,688	45,000	33,548
19	1987	27,688	28,463	31,928	38,601	42,661	42,700	42,172	41,264	36,594	29,316	25,995	25,999	35,756	26,354
20	1988	26,435	26,859	29,373	35,079	40,096	42,646	42,088	41,296	36,852	30,637	28,153	26,372	32,170	29,043
21	1989	26,427	27,157	31,986	35,727	37,914	37,822	37,213	36,637	34,251	29,987	28,993	28,937	34,694	29,284
22	1990	28,907	31,786	35,908	36,746	37,571	39,166	38,720	38,146	36,992	34,310	31,670	29,637	36,473	33,016
23	1991	29,848	33,497	39,323	43,460	43,577	42,998	40,773	38,943	36,455	32,926	29,380	28,630	44,024	31,232
24	1992	28,928	33,643	37,788	41,051	44,210	44,108	43,285	41,146	38,985	32,275	28,384	28,200	39,240	29,581
25	1993	37,848	44,779	44,791	44,965	44,582	44,292	43,695	43,102	40,657	35,072	31,795	31,751	45,000	32,947
26	1994	31,833	32,522	35,921	37,793	43,299	45,000	44,523	43,657	41,974	38,039	33,481	31,848	36,138	35,308
27	1995	40,442	44,296	44,176	44,984	44,664	44,216	43,914	43,322	41,304	36,554	33,004	31,152	45,000	34,287
28	1996	33,357	44,750	44,993	44,733	44,629	44,083	43,535	42,869	39,782	33,150	26,900	27,716	44,944	29,664
29	1997	44,382	45,000	45,000	44,999	44,959	44,115	44,570	44,018	41,220	35,067	31,215	31,836	45,000	32,602
30	1998	36,992	44,767	45,000	44,924	44,870	44,943	44,450	41,732	37,580	33,528	30,641	29,999	45,000	31,694
31	1999	29,910	36,784	41,005	43,464	44,534	44,111	42,757	41,738	40,539	37,680	33,217	32,427	42,185	36,073
32	2000	33,128	39,050	44,807	44,718	44,803	44,523	43,518	41,689	39,416	34,770	29,873	29,765	44,530	32,321
33	2001	30,159	32,151	38,963	41,574	43,715	41,563	39,870	42,833	42,364	41,958	42,100	41,928	39,717	42,487
34	2002	43,370	41,521	40,296	41,241	43,730	44,687	43,540	41,795	39,336	37,150	33,129	37,170	40,710	35,377
35	2003	44,045	40,406	40,987	44,474	44,761	44,017	42,829	41,777	38,525	34,450	31,904	31,210	43,385	34,100
36	2004	34,188	36,064	42,702	44,714	44,330	43,536	42,658	40,146	36,720	31,972	30,057	29,994	43,856	30,551
37	2005	38,734	42,484	44,979	44,999	44,715	44,165	43,121	42,330	40,428	35,346	30,769	30,322	45,000	32,641
38	2006	38,633	39,602	44,078	44,892	44,881	44,383	43,611	42,500	41,165	37,739	32,950	31,197	44,665	35,017

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
39	2007	31,245	31,473	34,621	40,123	44,532	41,525	40,193	39,626	38,353	34,356	33,505	33,337	37,114	33,829
40	2008	37,220	44,401	44,591	44,052	44,233	43,658	43,850	43,128	41,862	41,968	41,173	36,183	44,168	42,341
41	2009	33,363	34,689	42,071	42,494	42,648	42,104	41,602	40,509	39,973	39,785	38,932	33,434	42,474	39,852
42	2010	35,228	43,671	45,000	45,000	44,493	43,427	42,488	41,605	40,929	40,597	41,370	36,957	45,000	41,606
43	2011	36,325	37,267	43,594	44,980	44,802	44,799	44,278	43,269	42,590	42,348	41,184	36,273	45,000	42,226
44	2012	33,485	33,477	33,379	34,669	38,663	40,180	39,811	40,506	42,456	39,127	34,095	35,422	33,490	36,188
45	2013	40,228	40,586	40,183	42,124	43,919	44,322	44,008	42,666	39,435	35,324	34,643	34,606	40,432	34,656
46	2014	34,440	36,235	41,142	44,829	44,275	44,286	43,791	43,116	40,101	34,209	32,378	34,554	43,848	32,431
47	2015	37,318	38,246	38,807	40,782	41,943	41,166	40,330	38,266	36,809	-	-	-	38,746	-
48	*Minimum*	*18,810*	*26,859*	*29,373*	*34,669*	*37,571*	*37,822*	*37,213*	*36,637*	*34,251*	*29,316*	*13,198*	*13,206*	*32,170*	*26,354*
49	*Maximum*	*44,382*	*45,000*	*45,048*	*45,000*	*45,000*	*45,000*	*44,994*	*45,000*	*43,819*	*42,348*	*42,100*	*41,928*	*45,758*	*42,487*
50	*Mean*	*34,207*	*37,260*	*40,414*	*42,353*	*43,479*	*43,294*	*42,547*	*41,525*	*39,360*	*35,133*	*31,624*	*31,241*	*41,578*	*33,349*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 48. 5,000 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-	-
2	1970	0	0	0	0	15	959	1,512	1,497	1,483	1,471	1,466	1,463	0	1,468
3	1971	1,461	1,458	1,454	1,886	5,178	5,313	5,314	5,315	5,300	5,264	5,238	5,225	1,452	5,251
4	1972	5,216	5,207	5,188	5,181	5,315	5,305	5,257	5,203	5,161	5,133	5,118	5,111	5,174	5,123
5	1973	5,331	5,445	5,996	5,705	5,425	5,365	5,312	5,260	5,217	5,186	5,164	5,157	5,929	5,173
6	1974	5,707	5,991	5,994	5,334	5,314	5,286	5,243	5,195	5,146	5,101	5,076	5,064	5,895	5,084
7	1975	5,051	5,040	5,671	5,916	5,341	5,283	5,242	5,194	5,153	5,125	5,108	5,094	5,979	5,116
8	1976	5,081	5,064	5,047	5,025	4,988	4,946	4,894	4,852	4,812	4,785	4,760	4,742	5,035	4,770
9	1977	4,731	4,720	4,702	4,678	4,651	4,619	4,576	4,533	4,497	4,467	4,445	4,431	4,692	4,455
10	1978	4,422	5,500	5,921	5,362	5,281	5,236	5,190	5,139	5,098	5,058	5,031	5,018	5,817	5,042
11	1979	5,010	5,001	4,991	4,973	4,945	4,897	4,851	4,806	4,764	4,727	4,709	4,694	4,985	4,716
12	1980	4,686	4,609	5,994	5,704	5,614	5,579	5,535	5,483	5,443	5,401	5,371	5,351	5,984	5,385
13	1981	5,340	5,330	5,313	5,292	5,257	5,210	5,153	5,100	5,052	5,018	5,000	4,991	5,305	5,007
14	1982	5,813	5,951	5,698	5,093	5,296	5,258	5,218	5,164	5,121	5,091	5,072	5,064	4,046	5,079
15	1983	4,330	5,354	4,907	5,333	5,303	5,265	5,219	5,170	5,128	5,100	5,079	5,070	5,674	5,087
16	1984	5,064	5,055	5,041	5,020	4,988	4,943	4,890	4,842	4,798	4,761	4,743	4,734	5,030	4,749
17	1985	4,726	4,716	4,698	4,677	5,101	5,270	5,213	5,165	5,127	5,093	5,069	5,060	4,689	5,079
18	1986	5,052	4,160	5,611	5,361	5,299	5,259	5,212	5,166	5,129	5,100	5,074	5,059	5,800	5,088
19	1987	5,051	5,038	5,021	4,994	4,958	4,921	4,882	4,842	4,805	4,766	4,748	4,736	5,009	4,754
20	1988	4,728	4,714	4,688	4,651	4,624	4,590	4,546	4,504	4,465	4,432	4,412	4,400	4,667	4,419
21	1989	4,392	4,383	4,371	4,347	4,317	4,282	4,237	4,192	4,155	4,127	4,105	4,092	4,361	4,115

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
22	1990	4,083	4,073	4,062	4,041	4,009	3,979	3,942	3,905	3,875	3,845	3,822	3,809	4,052	3,831
23	1991	3,800	3,789	3,890	4,846	4,822	4,786	4,746	4,706	4,669	4,628	4,602	4,586	4,858	4,612
24	1992	4,577	4,568	4,557	4,538	4,810	4,953	4,913	4,864	4,823	4,785	4,762	4,749	4,549	4,773
25	1993	5,103	5,829	5,990	5,332	5,291	5,256	5,203	5,155	5,112	5,079	5,050	5,038	5,592	5,064
26	1994	5,029	5,019	5,003	4,977	5,056	5,315	5,291	5,242	5,199	5,169	5,150	5,143	4,990	5,157
27	1995	5,396	5,996	5,205	5,337	5,306	5,284	5,241	5,192	5,150	5,115	5,089	5,077	5,675	5,099
28	1996	5,069	5,152	5,998	5,398	5,278	5,237	5,189	5,134	5,090	5,054	5,030	5,020	5,993	5,038
29	1997	5,391	5,998	5,998	5,798	5,515	5,283	5,237	5,192	5,154	5,117	5,093	5,085	5,978	5,102
30	1998	5,031	3,250	5,995	5,341	5,309	5,309	5,270	5,220	5,173	5,141	5,122	5,111	5,755	5,128
31	1999	5,101	5,093	5,082	5,064	5,045	5,021	4,975	4,936	4,899	4,863	4,840	4,825	5,074	4,849
32	2000	4,811	4,906	5,993	5,939	5,560	5,516	5,468	5,417	5,374	5,339	5,322	5,310	5,980	5,330
33	2001	5,297	5,285	5,267	5,244	5,207	5,156	5,107	5,061	5,019	4,986	4,965	4,957	5,255	4,973
34	2002	5,011	5,012	4,995	4,972	5,082	5,294	5,243	5,193	5,147	5,108	5,084	5,126	4,984	5,096
35	2003	5,997	5,987	5,970	5,614	5,303	5,261	5,206	5,155	5,111	5,068	5,041	5,031	5,957	5,047
36	2004	5,024	5,014	4,996	5,112	5,298	5,255	5,208	5,159	5,109	5,069	5,046	5,033	4,984	5,054
37	2005	5,024	5,311	5,995	5,468	5,302	5,266	5,215	5,162	5,120	5,085	5,060	5,042	5,928	5,073
38	2006	5,034	5,024	5,580	5,260	5,302	5,262	5,209	5,154	5,112	5,081	5,059	5,046	5,588	5,065
39	2007	5,032	5,019	5,001	4,973	5,161	5,282	5,233	5,183	5,135	5,104	5,081	5,065	4,987	5,092
40	2008	5,056	5,925	5,990	5,960	5,918	5,865	5,808	5,752	5,700	5,663	5,640	5,630	5,977	5,647
41	2009	5,619	5,604	5,591	5,563	5,527	5,483	5,429	5,377	5,330	5,294	5,275	5,262	5,578	5,283
42	2010	5,255	5,360	5,996	5,434	5,309	5,274	5,224	5,178	5,137	5,104	5,088	5,080	5,917	5,095
43	2011	5,074	5,060	5,086	5,616	5,295	5,263	5,218	5,172	5,127	5,097	5,078	5,065	5,937	5,085
44	2012	5,050	5,034	5,012	4,987	4,948	4,903	4,854	4,803	4,762	4,731	4,713	4,700	5,002	4,721
45	2013	4,693	4,685	4,669	4,644	4,624	4,714	4,721	4,678	4,640	4,607	4,582	4,567	4,658	4,593
46	2014	4,551	4,536	4,521	5,201	5,292	5,240	5,188	5,138	5,096	5,058	5,032	5,021	4,525	5,042
47	2015	5,013	5,002	4,984	4,956	4,923	4,886	4,838	4,790	4,764	-	-	-	4,970	-
48	*Minimum*	*0*	*0*	*0*	*0*	*15*	*959*	*1,512*	*1,497*	*1,483*	*1,471*	*0*	*0*	*0*	*1,468*
49	*Maximum*	*5,997*	*5,998*	*5,998*	*5,960*	*5,918*	*5,865*	*5,808*	*5,752*	*5,700*	*5,663*	*5,640*	*5,630*	*5,993*	*5,647*
50	*Mean*	*4,811*	*4,875*	*5,081*	*5,003*	*5,037*	*5,046*	*5,015*	*4,968*	*4,928*	*4,898*	*4,770*	*4,759*	*5,093*	*4,885*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 49. 5,000 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	648.00	648.44
2	1970	682.56	685.69	695.35	699.76	703.18	704.81	704.56	703.59	703.11	698.82	692.22	693.82
3	1971	698.42	697.06	698.31	708.04	709.91	709.91	709.91	709.91	709.91	704.60	696.08	695.77
4	1972	696.77	697.95	703.54	709.91	709.91	709.91	709.59	704.78	703.83	699.49	694.85	696.34
5	1973	709.65	709.91	709.91	709.91	709.91	709.79	709.05	708.21	707.30	701.07	693.68	703.89

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
6	1974	709.91	709.65	709.91	709.91	709.91	709.88	709.34	708.59	700.11	691.04	683.03	681.38
7	1975	682.01	703.08	709.91	709.91	709.91	709.82	709.26	708.53	707.72	703.18	693.22	687.60
8	1976	687.62	692.00	700.89	701.80	701.45	700.67	699.83	698.92	697.85	697.29	689.77	685.78
9	1977	685.82	692.07	703.07	704.18	707.85	707.63	706.85	706.06	703.20	696.00	689.92	687.32
10	1978	707.03	709.91	710.04	709.91	709.13	708.45	707.67	706.73	705.74	698.62	688.37	684.94
11	1979	686.89	697.86	700.59	706.55	707.99	707.56	706.57	705.77	703.67	695.81	686.57	683.90
12	1980	700.62	716.10	709.91	709.91	709.38	709.16	708.78	706.37	704.62	697.87	688.15	686.83
13	1981	690.23	695.40	708.84	709.01	708.94	707.99	706.09	703.11	699.74	696.30	696.81	700.07
14	1982	712.00	710.26	711.59	711.59	709.90	708.45	706.98	706.38	705.62	698.98	687.16	701.67
15	1983	713.26	713.54	715.63	709.91	709.91	709.27	708.82	707.85	707.43	701.42	691.81	703.96
16	1984	703.97	703.77	705.60	706.82	708.69	708.26	707.61	704.34	703.14	693.35	689.40	687.43
17	1985	688.11	693.02	703.26	707.80	709.91	709.23	708.51	707.55	704.66	696.50	693.35	686.32
18	1986	683.57	725.03	710.68	709.91	709.91	709.01	708.10	707.39	706.76	699.80	693.32	685.30
19	1987	683.62	685.84	696.73	705.01	707.60	707.19	706.48	705.79	703.09	692.26	680.86	680.48
20	1988	681.81	681.99	691.13	700.39	706.14	707.17	706.48	705.54	703.17	693.27	685.77	682.86
21	1989	681.31	685.66	695.18	698.68	700.75	700.36	699.58	698.61	697.86	689.31	686.21	685.71
22	1990	686.32	694.54	698.03	699.17	701.08	703.02	701.72	700.88	700.11	695.94	692.60	688.09
23	1991	688.58	697.93	708.56	708.80	708.89	708.69	705.83	703.18	700.42	695.27	689.64	685.26
24	1992	685.77	700.63	701.92	707.10	709.48	709.13	708.32	705.20	704.29	696.81	686.64	685.82
25	1993	709.91	709.95	709.91	709.91	709.60	709.13	708.60	707.76	707.00	699.50	692.36	690.66
26	1994	690.88	695.02	697.50	703.75	709.91	709.91	709.91	708.61	707.65	703.40	696.08	691.22
27	1995	709.91	709.91	715.29	709.91	709.91	708.94	708.75	708.09	707.26	701.75	694.52	691.47
28	1996	705.81	714.99	709.91	709.91	709.76	709.06	708.35	707.50	706.62	698.56	686.76	694.72
29	1997	713.76	709.91	709.91	709.91	709.91	709.80	709.68	708.98	708.26	700.50	691.82	691.24
30	1998	706.10	717.87	709.91	709.91	709.91	709.91	709.68	707.93	703.10	696.56	690.41	688.39
31	1999	690.04	703.34	706.11	709.25	709.56	708.92	707.74	706.18	704.45	703.13	697.22	692.51
32	2000	694.92	709.91	709.91	709.91	709.91	709.71	708.60	706.91	704.19	699.71	691.45	687.56
33	2001	688.22	696.63	703.11	706.96	709.05	707.52	706.22	707.29	707.17	706.56	706.55	707.21
34	2002	708.61	706.48	704.11	706.20	709.91	709.91	708.92	706.76	704.47	699.74	696.16	709.91
35	2003	709.91	705.68	707.76	709.91	709.91	709.02	708.12	706.30	704.72	696.89	694.30	690.53
36	2004	695.09	706.12	708.24	709.91	709.91	708.35	707.56	706.06	701.80	693.72	688.45	691.14
37	2005	704.92	709.91	709.91	709.91	709.91	709.33	707.91	706.88	705.92	700.41	691.86	692.57
38	2006	703.11	704.10	709.91	709.91	709.91	709.47	708.61	707.36	706.11	703.19	695.64	690.30
39	2007	689.77	692.08	698.77	707.04	709.91	709.62	703.67	703.17	703.00	697.44	693.89	693.23
40	2008	708.44	709.91	709.91	709.47	709.65	708.88	708.88	707.98	706.74	706.53	706.36	701.22
41	2009	694.38	699.21	707.29	706.73	707.25	706.44	706.46	704.26	703.41	703.17	703.15	697.95
42	2010	706.63	709.91	709.91	709.91	709.91	708.23	707.28	705.95	704.79	705.43	706.48	701.96
43	2011	698.06	706.22	710.63	709.91	709.89	709.76	709.44	708.24	707.05	706.50	706.20	701.71
44	2012	693.53	693.39	693.35	698.26	703.16	703.57	703.20	705.46	706.98	705.89	697.36	703.16
45	2013	703.78	704.04	704.08	708.37	709.13	709.16	709.11	708.12	704.90	698.61	695.23	695.21

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
46	2014	695.05	700.64	708.23	709.91	709.91	709.35	708.80	707.82	706.72	699.06	691.67	699.12
47	2015	699.29	701.39	701.45	706.98	706.96	705.18	704.28	703.08	698.53	-	-	-
48	*Minimum*	*681.31*	*681.99*	*691.13*	*698.26*	*700.75*	*700.36*	*699.58*	*698.61*	*697.85*	*689.31*	*648.00*	*648.44*
49	*Maximum*	*713.76*	*725.03*	*715.63*	*711.59*	*709.91*	*709.91*	*709.91*	*709.91*	*709.91*	*706.56*	*706.55*	*709.91*
50	*Mean*	*697.09*	*702.51*	*705.52*	*707.52*	*708.53*	*708.14*	*707.30*	*706.09*	*704.44*	*699.09*	*691.99*	*691.56*

Table 50. 5,000 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from the baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	0.00	0.00
2	1970	0.00	0.00	0.00	0.00	0.08	1.71	1.51	2.14	2.54	2.21	2.35	2.33
3	1971	2.18	2.25	2.17	4.94	6.81	6.81	6.81	6.81	6.81	7.67	8.63	8.62
4	1972	8.43	8.17	7.59	6.81	6.81	6.81	6.55	7.58	7.56	7.96	8.54	8.33
5	1973	7.95	8.21	8.13	6.87	6.84	6.73	7.33	7.32	7.33	7.91	8.77	7.52
6	1974	8.21	8.23	8.21	6.81	6.81	6.79	6.44	7.19	7.96	9.02	10.29	10.65
7	1975	10.46	7.98	8.18	6.88	6.81	6.73	6.91	7.19	7.19	7.65	8.75	9.28
8	1976	9.27	8.79	7.67	7.56	7.57	7.58	7.58	7.56	7.57	7.59	8.52	8.83
9	1977	8.77	8.17	7.49	6.81	6.43	6.43	6.44	6.43	6.62	7.27	7.96	7.97
10	1978	6.17	8.15	8.18	6.81	7.27	7.26	7.27	7.29	7.33	7.91	9.09	9.66
11	1979	9.20	7.83	7.61	7.01	6.86	6.85	6.88	6.89	6.99	7.76	8.66	9.17
12	1980	7.14	3.60	8.21	6.90	7.68	7.69	7.67	7.84	7.93	8.58	9.80	9.92
13	1981	9.51	8.84	7.30	7.26	7.26	7.27	7.39	7.99	7.83	8.19	8.03	7.67
14	1982	6.58	8.56	5.27	5.29	6.80	7.26	7.37	7.37	7.38	7.94	9.29	7.63
15	1983	1.90	8.10	0.63	6.81	6.81	7.00	7.20	7.22	7.19	7.73	8.86	7.39
16	1984	7.39	7.38	7.22	7.04	6.84	6.85	6.84	7.07	7.38	8.11	8.48	8.58
17	1985	8.48	8.03	6.87	6.46	6.81	7.25	7.24	7.24	7.46	8.30	8.67	9.40
18	1986	10.06	1.36	8.78	6.81	6.81	7.23	7.26	7.25	7.26	7.89	8.68	9.66
19	1987	10.04	9.43	8.07	7.18	6.89	6.91	6.92	6.94	7.63	8.27	10.11	10.15
20	1988	9.79	9.70	8.20	7.09	6.52	6.41	6.43	6.45	6.71	7.55	8.16	8.81
21	1989	9.16	8.09	7.16	6.73	6.53	6.55	6.55	6.54	6.52	7.40	7.49	7.52
22	1990	7.40	6.72	6.32	6.20	5.99	6.65	5.87	5.91	5.92	6.17	6.52	6.81
23	1991	6.78	5.90	6.68	5.86	5.86	6.03	6.80	7.03	7.16	7.67	8.23	8.58
24	1992	8.47	6.95	6.79	6.31	6.38	6.10	6.81	7.03	7.03	7.69	8.76	8.81
25	1993	8.21	6.95	6.91	6.81	6.56	7.23	7.20	7.21	7.21	7.87	8.76	8.91
26	1994	8.86	8.34	7.90	7.25	6.81	6.81	6.81	7.26	7.27	7.61	8.46	9.04
27	1995	7.99	8.21	3.58	6.81	6.81	7.25	7.24	7.23	7.23	7.73	8.56	8.90
28	1996	7.24	4.50	8.21	6.81	6.68	7.22	7.21	7.20	7.21	7.90	9.27	8.38
29	1997	6.30	8.21	8.20	6.92	6.81	6.72	6.61	7.16	7.15	7.86	8.89	8.93
30	1998	6.30	0.05	8.00	6.81	6.81	6.81	6.62	7.29	8.16	8.37	9.11	9.23
31	1999	9.09	7.47	7.22	6.21	6.46	6.88	6.95	7.04	7.13	7.51	7.69	8.30

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
32	2000	7.98	8.21	8.21	6.90	6.88	6.71	7.59	7.69	7.87	8.28	9.34	9.72
33	2001	9.61	8.57	8.21	7.38	7.15	7.21	7.23	7.06	7.05	7.02	7.02	6.93
34	2002	6.91	7.10	7.25	7.06	6.81	6.81	7.24	7.37	7.52	7.91	8.34	8.21
35	2003	8.21	8.65	8.35	6.81	6.81	7.25	7.25	7.36	7.44	8.18	8.49	8.91
36	2004	8.35	7.13	6.88	6.81	6.81	7.29	7.29	7.39	7.72	8.63	9.10	8.84
37	2005	7.25	8.21	8.12	6.81	6.81	6.69	7.29	7.30	7.34	7.82	8.84	8.69
38	2006	7.84	7.31	8.19	6.65	6.81	6.45	7.22	7.24	7.31	7.53	8.36	8.99
39	2007	8.98	8.70	7.76	6.94	6.81	6.58	7.69	7.85	8.57	8.13	8.62	8.66
40	2008	6.97	8.21	8.21	8.16	8.15	8.06	8.06	8.06	8.13	8.05	8.06	8.59
41	2009	9.52	8.70	7.85	7.86	7.79	7.83	7.71	7.87	7.88	7.94	8.07	8.29
42	2010	7.43	8.21	8.12	6.81	6.81	7.34	7.35	7.43	7.47	7.32	7.21	7.63
43	2011	7.95	7.19	5.78	6.81	6.79	6.68	6.42	7.19	7.22	7.22	7.23	7.65
44	2012	8.60	8.59	8.54	7.77	7.46	7.19	7.17	6.85	6.66	6.76	7.44	7.08
45	2013	6.84	6.81	6.79	6.28	6.03	6.06	6.02	6.48	6.71	7.19	7.56	7.54
46	2014	7.52	6.88	6.20	6.81	6.81	6.34	7.18	7.17	7.21	7.89	8.81	7.78
47	2015	7.76	7.56	7.53	6.93	6.93	7.06	7.06	7.67	7.42	-	-	-
48	*Minimum*	*0.00*	*0.00*	*0.00*	*0.00*	*0.08*	*1.71*	*1.51*	*2.14*	*2.54*	*2.21*	*0.00*	*0.00*
49	*Maximum*	*10.46*	*9.70*	*8.78*	*8.16*	*8.15*	*8.06*	*8.06*	*8.06*	*8.57*	*9.02*	*10.29*	*10.65*
50	*Mean*	*7.72*	*7.18*	*7.06*	*6.67*	*6.70*	*6.81*	*6.92*	*7.10*	*7.22*	*7.67*	*8.17*	*8.23*

Table 51. 5,000 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year

		Days threshold is exceeded																	
ID (1)	Year (2)	703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	175.5	167.6	161.2	158.0	154.9	148.3	141.7	135.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1972	178.4	146.6	108.8	105.0	101.5	93.5	85.5	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1973	254.1	244.8	239.8	237.3	234.7	229.8	194.1	152.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1974	234.5	230.2	222.9	220.3	218.0	213.9	210.1	168.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1975	215.3	204.2	200.3	198.4	196.4	192.3	165.5	124.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	155.0	118.1	106.8	102.4	81.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	246.3	238.3	230.9	223.9	204.0	164.0	126.6	75.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1979	146.6	132.8	117.7	104.7	86.2	44.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	209.9	205.1	189.8	184.8	176.6	156.3	147.3	121.3	4.3	3.9	3.5	3.2	2.2	0.9	0.0	0.0	0.0	0.0	0.0
13	1981	135.5	120.4	111.4	106.7	100.5	77.5	64.3	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1982	257.9	254.0	248.8	242.8	224.9	172.5	164.3	117.0	3.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1983	252.0	243.0	237.7	235.7	233.8	230.2	165.3	103.4	8.9	6.8	5.0	3.1	1.7	0.8	0.0	0.0	0.0	0.0	0.0
16	1984	210.4	152.4	129.7	115.6	88.4	66.7	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
17	1985	168.6	156.9	126.9	122.2	118.1	109.4	73.4	36.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1986	216.3	211.9	208.4	206.8	205.1	183.4	134.1	86.3	6.3	5.1	4.6	4.0	3.4	3.0	0.0	0.0	0.0	0.0	0.0
19	1987	131.6	120.6	111.4	100.6	76.5	23.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	111.7	98.7	88.5	65.8	47.3	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	132.0	112.3	104.0	99.4	94.1	82.0	34.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	162.4	152.2	109.2	98.5	94.6	86.9	67.7	24.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	247.2	241.6	238.1	236.3	234.4	223.3	180.2	138.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1994	159.8	148.4	138.5	134.1	129.6	119.4	94.0	61.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1995	258.0	251.8	247.6	245.2	236.6	221.9	180.4	104.9	5.1	4.5	3.9	3.0	2.0	0.2	0.0	0.0	0.0	0.0	0.0
28	1996	230.1	224.3	221.3	219.8	218.3	195.2	159.3	117.2	3.8	3.4	2.8	1.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1997	264.3	259.3	255.5	253.6	251.7	246.0	235.1	183.0	4.3	3.3	2.5	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1998	224.5	216.8	208.6	201.1	192.9	185.8	172.9	154.3	6.4	5.7	5.0	4.3	3.5	2.5	0.0	0.0	0.0	0.0	0.0
31	1999	219.3	188.0	156.8	146.2	126.5	94.3	76.5	28.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2000	214.9	201.1	188.6	181.5	169.5	157.7	144.0	116.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2001	259.5	239.6	226.5	202.1	133.4	60.7	19.8	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	2002	265.6	224.5	187.5	165.6	147.0	115.3	80.6	43.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2003	247.0	211.0	194.7	180.5	170.2	135.2	108.2	67.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2004	171.6	165.8	161.8	159.5	150.4	114.1	75.1	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	2005	250.9	241.6	206.7	204.4	193.4	160.7	128.9	114.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	2006	229.8	203.9	196.5	192.0	185.0	151.5	130.5	96.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	2007	121.1	60.2	54.1	51.0	46.4	38.9	32.2	22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2008	303.9	298.7	294.5	270.5	250.9	208.7	169.5	56.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	2009	245.5	159.4	139.9	129.8	110.2	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	309.6	286.6	232.8	212.7	192.5	151.8	116.2	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2011	275.1	268.2	263.3	261.2	258.0	182.1	135.3	116.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2012	130.7	47.0	36.5	31.3	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	247.4	181.7	145.4	135.7	128.7	115.5	95.3	21.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2014	194.4	185.1	177.8	173.6	166.5	155.1	116.7	56.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2015	110.0	86.1	49.9	23.9	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	309.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0
50	*Mean*	188.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0

Table 52. 5,000 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	175.5	167.6	161.2	158.0	154.9	148.3	141.7	135.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1972	178.4	146.6	108.8	105.0	101.5	93.5	85.5	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1973	254.1	244.8	239.8	237.3	234.7	229.8	194.1	152.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1974	234.5	230.2	222.9	220.3	218.0	213.9	210.1	168.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1975	215.3	204.2	200.3	198.4	196.4	192.3	165.5	124.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	155.0	118.1	106.8	102.4	81.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	246.3	238.3	230.9	223.9	204.0	164.0	126.6	75.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1979	146.6	132.8	117.7	104.7	86.2	44.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	204.5	200.1	185.1	180.3	172.3	152.2	143.6	117.9	1.4	2.3	3.0	3.2	2.2	0.9	0.0	0.0	0.0	0.0	0.0
13	1981	135.5	120.4	111.4	106.7	100.5	77.5	64.3	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1982	254.4	251.4	247.1	242.0	224.5	172.5	164.3	117.0	3.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1983	237.5	230.5	226.5	225.6	224.6	222.4	158.7	97.8	4.5	3.8	2.8	1.3	0.4	0.8	0.0	0.0	0.0	0.0	0.0
16	1984	210.4	152.4	129.7	115.6	88.4	66.7	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1985	168.6	156.9	126.9	122.2	118.1	109.4	73.4	36.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1986	209.0	205.0	201.8	200.3	198.8	177.3	128.4	81.0	1.3	0.8	0.8	0.6	0.4	0.3	0.0	0.0	0.0	0.0	0.0
19	1987	131.6	120.6	111.4	100.6	76.5	23.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	111.7	98.7	88.5	65.8	47.3	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	132.0	112.3	104.0	99.4	94.1	82.0	34.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	162.4	152.2	109.2	98.5	94.6	86.9	67.7	24.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	247.2	241.6	238.1	236.3	234.4	223.3	180.2	138.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1994	159.8	148.4	138.5	134.1	129.6	119.4	94.0	61.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1995	251.7	246.2	242.5	240.5	232.3	218.3	177.7	103.2	3.9	3.8	3.9	3.0	2.0	0.2	0.0	0.0	0.0	0.0	0.0
28	1996	225.5	220.2	217.4	216.1	214.7	192.3	157.4	115.9	3.0	3.4	2.8	1.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1997	258.8	255.5	252.5	251.1	249.7	245.4	235.1	183.0	4.3	3.3	2.5	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1998	213.7	207.3	199.3	192.0	183.9	177.0	165.2	147.5	0.3	0.3	0.4	0.4	0.4	0.9	0.0	0.0	0.0	0.0	0.0
31	1999	219.3	188.0	156.8	146.2	126.5	94.3	76.5	28.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2000	214.9	201.1	188.6	181.5	169.5	157.7	144.0	116.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2001	259.5	239.6	226.5	202.1	133.4	60.7	19.8	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	2002	265.6	224.5	187.5	165.6	147.0	115.3	80.6	43.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2003	247.0	211.0	194.7	180.5	170.2	135.2	108.2	67.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2004	171.6	165.8	161.8	159.5	150.4	114.1	75.1	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	2005	250.9	241.6	206.7	204.4	193.4	160.7	128.9	114.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Difference in days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
38	2006	229.3	203.9	196.5	192.0	185.0	151.5	130.5	96.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	2007	121.1	60.2	54.1	51.0	46.4	38.9	32.2	22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2008	303.9	298.7	294.5	270.5	250.9	208.7	169.5	56.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	2009	245.5	159.4	139.9	129.8	110.2	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	309.6	286.6	232.8	212.7	192.5	151.8	116.2	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2011	273.0	267.5	263.3	261.2	258.0	182.1	135.3	116.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2012	130.7	47.0	36.5	31.3	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	247.4	181.7	145.4	135.7	128.7	115.5	95.3	21.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2014	194.4	185.1	177.8	173.6	166.5	155.1	116.7	56.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2015	110.0	86.1	49.9	23.9	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	309.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
50	*Mean*	187.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Table 53. 5,000 ac-ft reallocation with FIRO: annual event results

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	648.46	682.10	0	47	66	2,937	5,133
2	1971	685.33	698.42	113	19	40	853	982
3	1972	694.40	696.22	0	2	20	251	272
4	1973	707.56	709.91	2,068	2,056	2,423	2,912	3,050
5	1974	697.38	709.91	201	154	160	1,102	3,420
6	1975	703.09	709.91	2,099	2,053	2,400	2,444	2,486
7	1976	687.53	697.35	0	3	3	101	108
8	1977	685.55	685.77	9	10	10	138	172
9	1978	687.29	707.03	131	6	28	1,511	2,291
10	1979	687.04	697.85	0	11	22	1,179	1,437
11	1980	697.11	716.10	3,083	3,061	3,866	4,196	9,608
12	1981	686.81	690.22	0	17	33	677	713
13	1982	696.90	712.00	2,083	2,026	2,186	5,926	7,256
14	1983	698.26	713.26	2,118	2,061	2,642	6,005	7,992
15	1984	695.99	703.96	106	6	199	1,313	1,858
16	1985	698.92	704.90	0	3	31	167	352
17	1986	685.58	725.03	3,028	3,061	3,365	7,184	10,275
18	1987	683.72	685.68	0	3	250	940	2,103
19	1988	680.78	681.74	0	17	163	359	1,344
20	1989	685.69	693.91	0	8	22	293	901
21	1990	688.86	694.52	0	13	64	844	2,344
22	1991	691.92	701.18	0	2	33	477	1,238
23	1992	685.77	700.63	97	9	185	1,088	3,279
24	1993	684.28	709.91	264	175	325	4,373	10,049
25	1994	690.88	696.75	0	8	109	476	1,287
26	1995	705.72	715.29	3,093	2,876	2,925	3,888	14,721

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	706.01	714.99	2,040	2,056	2,548	3,785	8,933
28	1997	706.73	713.76	2,038	2,056	2,692	5,280	9,628
29	1998	704.04	717.87	3,030	3,061	4,235	7,346	18,145
30	1999	690.08	700.35	0	10	216	1,788	4,380
31	2000	695.02	705.91	121	8	243	2,373	6,208
32	2001	691.23	703.10	0	3	56	442	754
33	2002	705.47	708.61	49	2	97	955	2,392
34	2003	691.44	707.77	0	8	1,031	3,450	9,906
35	2004	697.04	706.12	0	6	117	3,465	3,510
36	2005	704.01	709.91	1,117	1,072	1,069	1,391	1,957
37	2006	688.27	700.64	0	3	337	8,827	10,102
38	2007	690.17	692.69	0	5	92	2,817	2,621
39	2008	698.26	708.44	107	5	45	989	972
40	2009	698.87	707.18	10	9	88	2,214	3,384
41	2010	690.78	705.35	0	7	153	4,644	4,970
42	2011	707.19	710.63	2,129	2,058	2,647	5,129	10,706
43	2012	693.58	695.50	0	10	32	2,272	2,310
44	2013	694.60	703.16	10	4	67	2,311	6,448
45	2014	698.25	705.18	0	6	19	1,585	1,464
46	2015	691.53	699.12	0	7	75	5,165	8,647

Table 54. 5,000 ac-ft reallocation with FIRO: differences in annual event results from baseline

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	0.00	0.00	0	0	0	0	0
2	1971	2.62	2.18	0	0	0	0	0
3	1972	8.80	8.54	0	0	0	0	0
4	1973	5.94	8.21	367	422	715	430	163
5	1974	8.21	8.21	-23	-28	-64	0	0
6	1975	7.96	8.19	1,062	1,099	1,446	708	-53
7	1976	9.24	8.02	0	0	0	0	0
8	1977	8.86	8.79	0	0	0	0	0
9	1978	7.97	6.17	0	0	0	0	0
10	1979	9.17	7.83	0	0	0	0	0
11	1980	7.41	3.60	998	1,006	962	554	536
12	1981	9.89	9.50	0	0	0	0	0
13	1982	8.01	6.58	0	0	-15	0	0
14	1983	7.90	1.90	0	0	-12	871	208
15	1984	8.32	7.39	0	0	0	0	0
16	1985	7.28	6.74	0	0	0	0	0
17	1986	9.54	1.36	0	0	-241	277	245
18	1987	10.02	9.50	0	0	0	0	0
19	1988	10.07	9.81	0	0	0	0	0
20	1989	8.09	7.32	0	0	0	0	0
21	1990	7.28	6.71	0	0	0	0	0
22	1991	6.54	5.64	0	0	0	0	0
23	1992	8.47	6.95	0	0	0	0	0
24	1993	9.20	8.21	-323	-325	-348	0	0
25	1994	8.86	8.08	0	0	0	0	0
26	1995	8.64	3.58	941	820	307	-2	-73

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	4.31	4.50	-7	0	-5	-4	0
28	1997	5.03	6.30	0	1	-32	217	-611
29	1998	5.94	0.05	12	0	-54	1,118	469
30	1999	9.09	7.81	0	0	0	0	0
31	2000	7.97	6.84	0	0	0	0	0
32	2001	9.29	8.27	0	0	0	0	0
33	2002	7.10	6.91	-40	-43	0	0	0
34	2003	8.88	7.04	0	0	0	0	0
35	2004	8.02	7.13	0	0	0	0	0
36	2005	7.31	8.21	0	-1	4	1	-7
37	2006	9.09	7.70	0	0	0	0	0
38	2007	8.94	8.62	0	0	0	0	0
39	2008	7.90	6.97	0	0	0	0	0
40	2009	8.72	7.87	0	0	0	0	0
41	2010	9.29	7.56	0	0	0	0	0
42	2011	6.70	5.78	0	-57	-11	-26	-20
43	2012	8.48	8.23	0	0	0	0	0
44	2013	7.83	7.08	0	0	0	0	0
45	2014	7.08	6.48	0	0	0	0	0
46	2015	8.78	7.78	0	0	0	0	0

Appendix VI. Results for 10,500 ac-ft reallocation with FIRO

This appendix details 10,500 ac-ft reallocation-with-FIRO simulation results in the following tables:

- Table 55. 10,500 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year
- Table 56. 10,500 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year
- Table 57. 10,500 ac-ft reallocation with FIRO: average monthly storage (ac-ft) by year
- Table 58. 10,500 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)
- Table 59. 10,500 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year
- Table 60. 10,500 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)
- Table 61. 10,500 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year
- Table 62. 10,500 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)
- Table 63. 10,500 ac-ft reallocation with FIRO: annual event results
- Table 64. 10,500 ac-ft reallocation with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

Table 55. 10,500 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	12	224	-
2	1970	10,375	1,860	6,039	334	260	51	1	0	202	615	907	6,875	2,293
3	1971	3,370	569	1,037	363	269	44	70	6	18	400	357	672	598
4	1972	391	667	138	-184	-4,123	-1,150	49	31	41	363	2,029	997	-63
5	1973	11,450	3,574	2,856	1,384	481	119	50	6	6	343	969	6,905	2,345
6	1974	6,579	1,398	3,517	2,453	463	178	48	157	298	9	32	307	1,287
7	1975	425	8,594	9,341	3,117	480	125	53	2	131	5	64	96	1,869
8	1976	90	186	83	46	7	0	0	0	0	0	0	1	35
9	1977	207	59	51	2	0	0	0	0	173	0	18	282	66
10	1978	14,793	8,580	4,594	1,657	465	99	15	0	0	67	48	25	2,528
11	1979	1,264	5,859	1,970	541	218	48	68	0	18	0	98	470	880
12	1980	10,553	12,137	3,836	1,181	672	226	244	12	184	197	0	66	2,442
13	1981	1,993	636	2,724	437	138	68	80	105	18	80	615	2,250	762
14	1982	12,444	2,169	3,971	4,852	1,311	458	200	81	257	105	5,025	11,226	3,508
15	1983	11,448	256	8,420	6,147	4,182	943	529	263	274	192	4,843	15,568	4,422
16	1984	2,684	2,737	1,572	733	64	131	182	86	153	86	1,265	1,022	893
17	1985	525	1,682	2,722	810	61	113	21	92	89	59	420	344	578
18	1986	611	17,995	242	340	995	353	107	70	55	118	129	157	1,764
19	1987	309	1,357	1,082	328	99	10	0	67	137	0	38	148	298
20	1988	799	228	175	40	63	0	0	6	71	123	84	293	157
21	1989	319	340	984	143	32	0	0	12	202	0	79	0	176
22	1990	97	483	148	62	6	3	0	0	0	98	220	203	110
23	1991	0	211	9,313	753	57	14	0	0	154	389	114	207	934
24	1992	337	10,004	2,089	66	118	11	0	0	374	14	0	990	1,167
25	1993	21,440	4,221	4,783	1,691	646	283	6	55	178	314	112	149	2,823
26	1994	226	1,619	406	210	-270	-707	0	0	146	0	236	155	168
27	1995	15,734	1,046	6,238	2,033	1,715	658	115	2	154	74	5	1,069	2,403
28	1996	11,282	5,401	4,138	1,649	1,021	246	94	10	0	36	712	12,549	3,095
29	1997	12,250	2,171	920	420	-46	124	14	0	0	0	257	1,098	1,434
30	1998	10,866	4,760	2,078	3,823	1,032	334	350	60	23	37	266	496	2,010
31	1999	1,835	7,351	2,176	2,676	645	203	69	43	77	246	155	127	1,300
32	2000	1,786	14,074	3,787	494	255	167	80	240	215	117	24	131	1,781
33	2001	444	4,089	4,872	661	148	238	61	277	72	0	112	2,857	1,153
34	2002	2,283	665	1,091	324	-101	-76	123	55	244	216	167	13,034	1,502
35	2003	1,071	817	962	-948	917	78	130	80	167	68	36	638	335
36	2004	2,919	7,706	1,525	-237	-273	0	0	80	268	292	45	2,238	1,214
37	2005	9,590	6,041	3,248	1,420	810	141	48	31	172	289	84	2,851	2,060
38	2006	6,830	1,802	8,014	4,599	1,016	200	27	0	0	0	59	294	1,904
39	2007	123	1,532	797	110	-648	0	0	0	172	133	0	12	186

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
40	2008	11,330	5,721	1,231	329	116	13	252	19	71	6	77	275	1,620
41	2009	142	4,109	6,064	337	346	31	0	31	54	646	178	49	999
42	2010	10,798	3,238	268	319	435	18	2	43	0	0	67	2,852	1,503
43	2011	1,444	6,730	6,559	1,488	600	341	43	84	357	357	4	844	1,571
44	2012	138	59	476	1,341	287	303	264	554	465	71	755	6,894	967
45	2013	715	335	262	43	7	722	0	0	0	595	173	43	241
46	2014	0	29	156	87	1	0	0	0	351	6	54	4,961	470
47	2015	214	1,583	255	238	46	0	0	0	0	-	-	-	-
48	*Minimum*	0	29	51	-948	-4,123	-1,150	0	0	0	0	0	0	-63
49	*Maximum*	21,440	17,995	9,341	6,147	4,182	943	529	554	465	646	5,025	15,568	4,422
50	*Mean*	4,664	3,624	2,765	1,059	326	112	74	58	131	150	455	2,238	1,329

Table 56. 10,500 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-
2	1970	0	0	0	0	305	1,219	0	0	0	0	0	0	127
3	1971	0	0	0	2,472	3,434	1,245	1,054	1,309	106	0	0	0	802
4	1972	0	0	0	385	85	31	0	0	0	0	0	0	42
5	1973	698	426	-26	-348	-90	0	0	0	0	0	0	0	55
6	1974	1,115	0	28	-624	52	0	0	0	0	0	0	0	48
7	1975	0	0	1,251	-370	-210	0	0	0	0	0	0	0	56
8	1976	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1977	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1978	0	2,375	4	-566	0	0	0	0	0	0	0	0	151
11	1979	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1980	0	1,959	14	-312	0	0	0	0	0	0	0	0	138
13	1981	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1982	1,624	18	-2,730	2,115	0	0	0	0	0	0	0	0	86
15	1983	1,211	-3,627	3,429	-411	4	0	0	0	0	0	0	0	51
16	1984	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1985	0	0	0	0	892	0	0	0	0	0	0	0	74
18	1986	0	1,642	-104	-495	1	0	0	0	0	0	0	0	87
19	1987	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1988	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1989	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1990	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1991	0	0	1,085	0	0	0	0	0	0	0	0	0	90
24	1992	0	0	0	0	484	0	0	0	0	0	0	0	40
25	1993	2,207	1,009	-295	-331	0	0	0	0	0	0	0	0	216

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
26	1994	0	0	0	0	749	0	0	0	0	0	0	0	62
27	1995	1,041	3	-196	-424	26	0	0	0	0	0	0	0	37
28	1996	0	1,202	30	-662	0	0	0	0	0	0	0	0	47
29	1997	1,292	26	41	-247	-303	0	0	0	0	0	0	0	67
30	1998	-909	2,082	-118	-519	60	21	0	0	0	0	0	0	51
31	1999	0	0	0	0	19	0	0	0	0	0	0	0	2
32	2000	0	1,518	216	-260	-71	0	0	0	0	0	0	0	117
33	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2002	72	0	0	0	1,085	6	0	0	0	0	0	1,182	195
35	2003	4	0	0	-566	7	0	0	0	0	0	0	0	-46
36	2004	0	0	0	724	8	0	0	0	0	0	0	0	61
37	2005	0	1,278	-31	-571	1	0	0	0	0	0	0	0	56
38	2006	0	0	1,289	-630	17	0	0	0	0	0	0	0	56
39	2007	0	0	0	0	762	0	0	0	0	0	0	0	64
40	2008	0	1,216	9	0	0	0	0	0	0	0	0	0	102
41	2009	0	0	0	0	0	0	0	0	0	0	0	0	0
42	2010	0	1,434	-22	-576	20	0	0	0	0	0	0	0	71
43	2011	0	0	1,180	-574	0	0	0	0	0	0	0	0	50
44	2012	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2013	0	0	0	0	136	64	0	0	0	0	0	0	17
46	2014	0	0	16	1,604	15	0	0	0	0	0	0	0	136
47	2015	0	0	0	0	0	0	0	0	0	-	-	-	-
48	*Minimum*	-909	-3,627	-2,730	-662	-303	0	0	0	0	0	0	0	-46
49	*Maximum*	2,207	2,375	3,429	2,472	3,434	1,245	1,054	1,309	106	0	0	1,182	802
50	*Mean*	182	273	110	-26	163	56	23	28	2	0	0	26	71

Table 57. 10,500 ac-ft reallocation with FIRO: average monthly storage (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	13,198	13,206	-	-
2	1970	18,810	28,126	33,818	35,920	39,050	40,579	40,666	40,002	38,913	34,989	30,519	31,114	34,742	32,848
3	1971	35,343	35,672	36,201	40,019	46,178	47,480	48,703	49,786	49,242	43,400	38,945	39,600	36,740	40,678
4	1972	40,667	41,521	43,216	48,270	50,500	50,419	48,431	46,239	45,105	39,973	38,727	40,166	45,657	37,854
5	1973	45,702	49,923	50,500	50,481	50,459	50,099	49,428	48,703	46,349	41,089	38,473	41,776	50,500	38,462
6	1974	49,386	49,826	50,190	50,479	50,496	50,254	49,728	46,659	40,191	34,946	32,343	31,725	50,342	32,771
7	1975	32,025	39,401	49,107	50,249	50,488	50,188	49,686	49,015	47,714	42,079	36,531	35,293	50,441	38,817
8	1976	35,291	35,820	41,154	44,144	43,714	43,171	42,494	41,725	41,177	39,470	34,500	33,901	43,715	36,354
9	1977	33,942	34,906	41,139	45,251	47,223	47,833	47,152	46,326	42,163	37,790	34,892	34,384	44,597	36,049
10	1978	41,209	48,786	50,289	50,333	49,600	49,012	48,328	47,548	45,553	38,627	34,153	33,697	50,500	35,773
11	1979	34,216	36,582	42,484	45,388	48,477	47,939	47,230	46,344	42,802	37,183	32,767	32,504	43,435	34,451
12	1980	38,652	44,930	50,335	50,271	50,001	49,765	48,778	47,158	44,601	38,615	35,027	34,814	50,371	35,696
13	1981	34,965	37,638	44,571	49,471	49,131	47,808	45,967	43,641	41,416	40,181	40,308	40,888	49,397	40,105
14	1982	49,396	50,386	50,117	50,299	49,798	49,053	48,036	47,426	45,399	38,618	32,540	38,968	49,913	35,139
15	1983	44,973	49,904	50,451	50,343	49,824	49,683	49,202	48,631	47,046	41,030	35,933	40,146	50,500	37,893
16	1984	44,430	44,295	46,416	47,256	48,786	48,674	47,173	45,148	42,103	36,428	34,505	34,403	47,005	35,980
17	1985	35,049	36,350	41,305	47,127	49,504	49,289	48,528	46,612	43,806	38,629	36,061	32,463	45,020	38,338
18	1986	32,331	41,993	50,087	50,500	49,952	49,569	48,770	48,218	46,004	40,471	36,285	32,934	50,500	38,819
19	1987	32,927	33,691	37,141	43,790	47,813	47,813	47,244	46,295	41,588	34,278	30,940	30,933	40,959	31,305
20	1988	31,361	31,771	34,261	39,936	44,927	47,442	46,837	46,001	41,519	35,274	32,772	30,979	37,040	33,669
21	1989	31,028	31,749	36,567	40,287	42,446	42,320	41,666	41,048	38,629	34,340	33,325	33,257	39,267	33,626
22	1990	33,219	36,089	40,200	41,020	41,814	43,380	42,897	42,284	41,100	38,391	35,731	33,686	40,757	37,086
23	1991	33,888	37,527	43,344	47,465	47,561	46,953	44,695	42,833	40,317	36,759	33,195	32,434	48,039	35,055
24	1992	32,725	37,433	41,570	44,818	47,950	47,819	46,965	44,790	42,599	35,864	31,957	31,765	43,016	33,162
25	1993	41,579	49,992	50,288	50,464	50,055	49,730	49,078	48,437	45,947	40,331	37,030	36,976	50,500	38,193
26	1994	37,051	37,732	41,117	42,966	48,524	50,500	49,998	49,081	47,353	43,387	38,813	37,174	41,323	40,646
27	1995	45,850	49,794	49,453	50,482	50,150	49,675	49,328	48,686	46,624	41,841	38,270	36,408	50,500	39,561
28	1996	38,606	49,890	50,493	50,226	50,088	49,501	48,903	48,180	45,048	38,383	32,112	32,919	50,440	34,884
29	1997	49,509	50,500	50,500	50,499	50,453	49,582	49,987	49,388	46,552	40,364	36,492	37,106	50,500	37,887
30	1998	42,270	49,506	50,500	50,422	50,363	50,435	49,901	47,131	42,932	38,852	35,950	35,299	50,500	37,008
31	1999	35,201	42,067	46,278	48,718	49,759	49,300	47,899	46,840	45,602	42,708	38,224	37,421	47,450	41,087
32	2000	38,112	44,032	50,300	50,194	50,290	49,968	48,916	47,036	44,721	40,045	35,134	35,016	50,013	37,588
33	2001	35,400	37,382	44,179	46,769	48,873	46,671	44,932	47,849	47,339	46,900	47,021	46,840	44,922	47,415
34	2002	48,275	46,417	45,176	46,097	48,694	50,165	48,965	47,168	44,662	42,439	38,397	42,431	45,579	40,654
35	2003	49,543	45,896	46,462	49,956	50,248	49,460	48,215	47,110	43,813	39,701	37,132	36,428	48,849	39,332
36	2004	39,401	41,269	47,890	49,937	49,811	48,973	48,046	45,485	42,011	37,229	35,294	35,221	49,030	35,796
37	2005	43,952	47,776	50,478	50,499	50,201	49,612	48,516	47,670	45,725	40,610	36,012	35,550	50,500	37,894
38	2006	43,853	44,813	49,427	50,391	50,367	49,827	49,000	47,832	46,453	42,996	38,188	36,425	50,139	40,261

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
39	2007	36,461	36,678	39,811	45,288	49,854	46,990	45,607	44,991	43,675	39,651	38,781	38,600	42,292	39,114
40	2008	42,476	49,873	50,084	49,517	49,661	49,038	49,178	48,406	47,091	47,163	46,347	41,348	49,649	47,521
41	2009	38,520	39,835	47,206	47,603	47,723	47,140	46,588	45,446	44,867	44,648	43,779	38,271	47,597	44,706
42	2010	40,060	48,565	50,500	50,500	49,984	48,882	47,892	46,961	46,241	45,876	46,631	42,211	50,500	46,874
43	2011	41,573	42,503	48,900	50,479	50,281	50,242	49,673	48,617	47,892	47,618	46,434	41,512	50,500	47,484
44	2012	38,711	38,690	38,574	39,843	43,802	45,274	44,855	45,499	47,407	44,046	38,997	40,313	38,676	41,097
45	2013	45,113	45,463	45,043	46,958	48,712	49,074	48,712	47,326	44,057	39,917	39,215	39,167	45,280	39,237
46	2014	38,988	40,771	45,663	49,705	49,533	49,492	48,946	48,221	45,165	39,239	37,388	39,555	48,359	37,449
47	2015	42,312	43,230	43,774	45,723	46,851	46,036	45,152	43,044	41,563	-	-	-	43,700	-
48	*Minimum*	*18,810*	*28,126*	*33,818*	*35,920*	*39,050*	*40,579*	*40,666*	*40,002*	*38,629*	*34,278*	*13,198*	*13,206*	34,742	31,305
49	*Maximum*	*49,543*	*50,500*	*50,500*	*50,500*	*50,500*	*50,500*	*49,998*	*49,786*	*49,242*	*47,618*	*47,021*	*46,840*	50,500	47,521
50	*Mean*	*39,008*	*42,109*	*45,360*	*47,312*	*48,478*	*48,307*	*47,541*	*46,496*	*44,306*	*40,053*	*36,419*	*36,027*	46,505	38,258

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 58. 10,500 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-	-
2	1970	0	0	0	0	15	959	1,512	1,497	1,483	1,471	1,466	1,463	0	1,468
3	1971	1,461	1,458	1,454	1,886	6,525	7,797	9,023	10,101	10,723	10,659	10,611	10,587	1,452	10,633
4	1972	10,570	10,553	10,518	10,502	10,815	10,794	10,693	10,584	10,497	10,444	10,417	10,405	10,491	10,425
5	1973	10,619	10,926	11,496	11,201	10,913	10,807	10,701	10,595	10,510	10,450	10,410	10,397	11,429	10,425
6	1974	11,099	11,484	11,490	10,833	10,813	10,754	10,665	10,567	10,473	10,391	10,343	10,320	11,389	10,359
7	1975	10,295	10,273	11,068	11,411	10,837	10,741	10,657	10,559	10,477	10,422	10,391	10,365	11,477	10,404
8	1976	10,340	10,308	10,277	10,233	10,160	10,078	9,977	9,896	9,820	9,768	9,723	9,689	10,254	9,743
9	1977	9,667	9,646	9,614	9,566	9,511	9,445	9,357	9,267	9,196	9,139	9,100	9,072	9,595	9,117
10	1978	9,055	10,700	11,420	10,857	10,745	10,654	10,562	10,456	10,374	10,297	10,248	10,223	11,317	10,268
11	1979	10,208	10,190	10,173	10,137	10,080	9,981	9,888	9,795	9,712	9,642	9,608	9,580	10,160	9,621
12	1980	9,563	9,320	11,491	11,195	11,081	11,011	10,926	10,822	10,743	10,666	10,612	10,577	11,470	10,638
13	1981	10,558	10,538	10,508	10,468	10,398	10,305	10,193	10,091	9,999	9,940	9,907	9,892	10,493	9,920
14	1982	11,193	11,449	11,192	10,540	10,775	10,698	10,617	10,508	10,419	10,362	10,327	10,311	8,202	10,340
15	1983	9,545	10,784	10,310	10,829	10,790	10,714	10,620	10,520	10,436	10,380	10,342	10,325	11,174	10,356
16	1984	10,314	10,297	10,268	10,224	10,159	10,069	9,961	9,863	9,774	9,706	9,673	9,656	10,246	9,684
17	1985	9,641	9,621	9,588	9,548	10,076	10,296	10,185	10,092	10,019	9,956	9,915	9,898	9,572	9,933
18	1986	9,883	8,754	11,081	10,861	10,783	10,702	10,607	10,513	10,437	10,381	10,335	10,306	11,300	10,360
19	1987	10,290	10,265	10,234	10,183	10,110	10,034	9,955	9,872	9,800	9,728	9,692	9,670	10,211	9,704
20	1988	9,654	9,626	9,576	9,508	9,454	9,386	9,295	9,209	9,132	9,069	9,031	9,008	9,538	9,045
21	1989	8,993	8,976	8,951	8,907	8,849	8,780	8,691	8,604	8,534	8,480	8,437	8,412	8,934	8,457

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
22	1990	8,395	8,376	8,354	8,314	8,253	8,194	8,119	8,044	7,983	7,927	7,883	7,857	8,336	7,901
23	1991	7,840	7,819	7,910	8,851	8,806	8,741	8,667	8,595	8,530	8,461	8,417	8,389	8,872	8,435
24	1992	8,374	8,359	8,339	8,305	8,551	8,664	8,594	8,508	8,437	8,374	8,336	8,313	8,325	8,354
25	1993	8,834	11,042	11,488	10,831	10,764	10,694	10,587	10,490	10,402	10,338	10,286	10,263	11,092	10,311
26	1994	10,246	10,228	10,199	10,149	10,282	10,815	10,765	10,666	10,578	10,518	10,483	10,469	10,176	10,495
27	1995	10,803	11,494	10,482	10,836	10,791	10,742	10,655	10,556	10,470	10,402	10,355	10,332	11,175	10,372
28	1996	10,319	10,292	11,497	10,891	10,737	10,654	10,556	10,445	10,356	10,287	10,242	10,223	11,489	10,258
29	1997	10,518	11,498	11,497	11,298	11,009	10,750	10,655	10,563	10,486	10,414	10,371	10,355	11,478	10,387
30	1998	10,309	7,989	11,495	10,839	10,803	10,802	10,722	10,619	10,525	10,466	10,431	10,411	11,255	10,443
31	1999	10,391	10,376	10,355	10,318	10,269	10,210	10,117	10,038	9,961	9,891	9,847	9,819	10,339	9,864
32	2000	9,795	9,889	11,486	11,415	11,047	10,961	10,866	10,764	10,679	10,614	10,583	10,561	11,463	10,597
33	2001	10,538	10,515	10,484	10,439	10,366	10,264	10,169	10,078	9,994	9,928	9,886	9,869	10,460	9,901
34	2002	9,916	9,909	9,875	9,829	10,045	10,772	10,667	10,566	10,473	10,397	10,352	10,387	9,852	10,373
35	2003	11,495	11,476	11,444	11,097	10,790	10,704	10,593	10,488	10,400	10,319	10,268	10,250	11,420	10,279
36	2004	10,237	10,219	10,184	10,335	10,779	10,692	10,596	10,498	10,399	10,326	10,283	10,259	10,158	10,299
37	2005	10,242	10,603	11,494	10,968	10,788	10,713	10,611	10,502	10,416	10,350	10,303	10,270	11,427	10,326
38	2006	10,255	10,236	10,929	10,759	10,788	10,706	10,597	10,487	10,400	10,338	10,297	10,273	11,062	10,309
39	2007	10,247	10,224	10,191	10,138	10,483	10,747	10,647	10,548	10,457	10,399	10,357	10,327	10,165	10,377
40	2008	10,312	11,397	11,483	11,426	11,345	11,245	11,136	11,030	10,929	10,858	10,814	10,795	11,458	10,827
41	2009	10,777	10,751	10,726	10,673	10,602	10,518	10,415	10,315	10,223	10,157	10,122	10,100	10,701	10,137
42	2010	10,086	10,253	11,496	10,934	10,800	10,728	10,628	10,534	10,450	10,382	10,349	10,333	11,417	10,363
43	2011	10,321	10,297	10,392	11,115	10,773	10,707	10,614	10,520	10,429	10,367	10,329	10,304	11,437	10,344
44	2012	10,275	10,247	10,207	10,161	10,086	9,997	9,898	9,797	9,713	9,650	9,616	9,592	10,188	9,631
45	2013	9,579	9,562	9,529	9,478	9,417	9,466	9,425	9,337	9,261	9,200	9,154	9,128	9,506	9,174
46	2014	9,099	9,072	9,041	10,077	10,550	10,446	10,343	10,243	10,159	10,088	10,042	10,022	9,036	10,060
47	2015	10,007	9,986	9,952	9,896	9,831	9,756	9,660	9,567	9,519	-	-	-	9,924	-
48	*Minimum*	*0*	*0*	*0*	*0*	*15*	*959*	*1,512*	*1,497*	*1,483*	*1,471*	*0*	*0*	*0*	*1,468*
49	*Maximum*	*11,495*	*11,498*	*11,497*	*11,426*	*11,345*	*11,245*	*11,136*	*11,030*	*10,929*	*10,858*	*10,814*	*10,795*	*11,489*	*10,827*
50	*Mean*	*9,612*	*9,724*	*10,027*	*9,962*	*10,036*	*10,059*	*10,008*	*9,939*	*9,874*	*9,818*	*9,565*	*9,545*	*10,020*	*9,794*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 59. 10,500 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	648.00	648.44
2	1970	682.56	685.69	695.35	699.76	703.18	704.81	704.56	703.59	703.11	698.82	692.22	693.82
3	1971	698.42	697.06	698.31	708.04	712.49	713.96	715.18	716.64	716.74	711.78	703.95	703.63
4	1972	704.54	705.62	710.70	716.81	716.81	716.81	716.48	711.94	711.02	706.98	703.11	704.05
5	1973	716.31	716.81	716.81	716.81	716.81	716.66	715.93	715.11	714.18	708.37	701.61	710.92

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
6	1974	716.81	716.57	716.81	716.81	716.81	716.76	716.22	715.50	707.58	699.28	692.18	690.68
7	1975	691.21	709.71	716.81	716.81	716.81	716.70	716.14	715.43	714.63	710.30	701.26	696.23
8	1976	696.23	700.07	708.12	708.97	708.61	707.83	707.00	706.12	705.10	704.53	697.61	694.13
9	1977	694.13	699.66	709.22	710.74	714.13	713.91	713.12	712.29	709.60	703.14	697.27	694.99
10	1978	713.06	716.81	716.92	716.81	716.08	715.42	714.64	713.69	712.68	706.12	696.81	693.79
11	1979	695.50	705.33	707.79	713.27	714.63	714.18	713.17	712.35	710.38	703.17	694.75	692.34
12	1980	707.41	719.96	716.81	716.81	716.30	716.07	715.68	713.37	711.69	705.47	696.67	695.50
13	1981	698.37	703.18	715.47	715.61	715.52	714.60	712.72	709.57	706.73	703.52	703.96	706.94
14	1982	717.72	717.13	717.78	717.36	716.79	715.43	714.02	713.39	712.60	706.47	695.83	708.87
15	1983	719.57	720.23	722.11	716.81	716.81	716.18	715.73	714.79	714.33	708.71	699.94	711.00
16	1984	711.01	710.81	712.45	713.57	715.31	714.89	714.21	711.08	709.67	700.90	697.24	695.54
17	1985	696.13	700.51	709.89	714.09	716.29	715.65	714.94	713.96	711.20	703.63	700.74	694.43
18	1986	691.96	727.07	717.53	716.81	716.81	715.94	715.08	714.35	713.69	707.23	701.32	694.17
19	1987	692.65	694.61	704.31	711.86	714.26	713.86	713.13	712.43	709.44	699.93	689.70	689.28
20	1988	690.54	690.66	698.71	707.16	712.45	713.41	712.73	711.78	709.42	700.37	693.59	690.98
21	1989	689.52	693.43	702.00	705.20	707.06	706.70	705.94	704.97	704.23	696.32	693.53	693.06
22	1990	693.58	701.02	704.24	705.26	706.98	708.05	707.53	706.69	705.93	701.99	698.89	694.75
23	1991	695.16	703.77	713.74	713.96	714.01	713.81	711.05	708.41	705.89	701.03	695.77	691.83
24	1992	692.27	705.96	707.15	712.02	714.27	713.91	713.10	710.11	709.19	702.76	692.71	691.94
25	1993	715.61	716.83	716.81	716.81	716.51	716.04	715.52	714.68	713.90	706.93	700.41	698.79
26	1994	698.99	703.11	705.00	710.69	716.81	716.81	716.81	715.58	714.63	710.63	703.89	699.48
27	1995	716.81	716.81	720.58	716.81	716.80	715.88	715.69	715.04	714.19	709.03	703.05	699.60
28	1996	712.69	717.47	716.81	716.81	716.62	715.97	715.27	714.41	713.51	706.06	695.43	703.06
29	1997	719.91	716.81	716.81	716.81	716.81	716.68	716.52	715.84	715.14	707.89	699.98	699.40
30	1998	713.10	722.07	716.81	716.81	716.81	716.81	716.56	714.93	709.99	704.33	698.69	696.95
31	1999	698.31	710.47	713.00	715.90	716.16	715.56	714.42	712.88	711.22	709.70	704.49	700.18
32	2000	703.04	716.56	716.81	716.81	716.81	716.56	715.53	713.89	711.30	707.13	699.60	696.16
33	2001	696.71	704.24	709.84	713.71	715.62	714.15	712.81	713.79	713.66	713.00	712.98	713.59
34	2002	714.92	712.89	710.65	712.57	716.81	716.81	715.86	713.78	711.58	707.19	703.87	716.81
35	2003	716.81	712.88	714.82	716.81	716.81	715.96	715.10	713.29	711.77	704.54	702.99	698.66
36	2004	703.13	712.92	714.91	716.81	716.81	715.36	714.57	713.07	709.10	701.68	696.91	699.24
37	2005	711.83	716.81	716.81	716.81	716.81	716.24	714.91	713.86	712.88	707.76	699.96	700.57
38	2006	709.83	711.07	716.81	716.81	716.81	716.36	715.54	714.30	713.05	710.30	703.35	698.47
39	2007	697.97	700.09	706.15	713.74	716.81	716.53	710.96	710.33	709.46	705.11	701.85	701.24
40	2008	715.18	716.81	716.81	716.35	716.51	715.70	715.70	714.83	713.57	713.30	713.12	708.36
41	2009	702.79	706.50	713.95	713.37	713.84	713.04	712.98	710.90	710.07	709.67	709.52	704.93
42	2010	712.93	716.81	716.81	716.81	716.81	715.26	714.32	712.99	711.86	712.36	713.34	709.16
43	2011	705.60	713.06	716.81	716.81	716.78	716.62	716.29	715.15	713.97	713.38	713.07	708.91
44	2012	701.46	701.31	701.24	705.66	709.93	710.45	710.07	712.01	713.43	712.36	704.48	709.63
45	2013	710.36	710.59	710.62	714.58	715.23	715.21	715.16	714.16	711.08	705.22	702.33	702.07

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
46	2014	701.86	706.97	714.05	716.53	716.54	715.96	715.42	714.45	713.35	706.23	699.43	706.22
47	2015	706.36	708.26	708.31	713.39	713.37	711.66	710.78	709.10	705.35	-	-	-
48	*Minimum*	*682.56*	*685.69*	*695.35*	*699.76*	*703.18*	*704.81*	*704.56*	*703.59*	*703.11*	*696.32*	*648.00*	*648.44*
49	*Maximum*	*719.91*	*727.07*	*722.11*	*717.36*	*716.81*	*716.81*	*716.81*	*716.64*	*716.74*	*713.38*	*713.34*	*716.81*
50	*Mean*	*704.15*	*708.98*	*711.96*	*713.90*	*714.96*	*714.59*	*713.81*	*712.63*	*711.02*	*706.10*	*699.38*	*698.97*

Table 60. 10,500 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	0.00	0.00
2	1970	0.00	0.00	0.00	0.00	0.08	1.71	1.51	2.14	2.54	2.21	2.35	2.33
3	1971	2.18	2.25	2.17	4.94	9.39	10.86	12.08	13.54	13.64	14.85	16.50	16.48
4	1972	16.20	15.84	14.75	13.71	13.71	13.71	13.44	14.74	14.75	15.45	16.80	16.04
5	1973	14.61	15.11	15.03	13.77	13.74	13.60	14.21	14.22	14.21	15.21	16.70	14.55
6	1974	15.11	15.15	15.11	13.71	13.71	13.67	13.32	14.10	15.43	17.26	19.44	19.95
7	1975	19.66	14.61	15.08	13.78	13.71	13.61	13.79	14.09	14.10	14.77	16.79	17.91
8	1976	17.88	16.86	14.90	14.73	14.73	14.74	14.75	14.76	14.82	14.83	16.36	17.18
9	1977	17.08	15.76	13.64	13.37	12.71	12.71	12.71	12.66	13.02	14.41	15.31	15.64
10	1978	12.20	15.05	15.06	13.71	14.22	14.23	14.24	14.25	14.27	15.41	17.53	18.51
11	1979	17.81	15.30	14.81	13.73	13.50	13.47	13.48	13.47	13.70	15.12	16.84	17.61
12	1980	13.93	7.46	15.11	13.80	14.60	14.60	14.57	14.84	15.00	16.18	18.32	18.59
13	1981	17.65	16.62	13.93	13.86	13.84	13.88	14.02	14.45	14.82	15.41	15.18	14.54
14	1982	12.30	15.43	11.46	11.06	13.69	14.24	14.41	14.38	14.36	15.43	17.96	14.83
15	1983	8.21	14.79	7.11	13.71	13.71	13.91	14.11	14.16	14.09	15.02	16.99	14.43
16	1984	14.43	14.42	14.07	13.79	13.46	13.48	13.44	13.81	13.91	15.66	16.32	16.69
17	1985	16.50	15.52	13.50	12.75	13.19	13.67	13.67	13.65	14.00	15.43	16.06	17.51
18	1986	18.45	3.40	15.63	13.71	13.71	14.16	14.24	14.21	14.19	15.32	16.68	18.53
19	1987	19.07	18.20	15.65	14.03	13.55	13.58	13.57	13.58	13.98	15.94	18.95	18.95
20	1988	18.52	18.37	15.78	13.86	12.83	12.65	12.68	12.69	12.96	14.65	15.98	16.93
21	1989	17.37	15.86	13.98	13.25	12.84	12.89	12.91	12.90	12.89	14.41	14.81	14.87
22	1990	14.66	13.20	12.53	12.29	11.89	11.68	11.68	11.72	11.74	12.22	12.81	13.47
23	1991	13.36	11.74	11.86	11.02	10.98	11.15	12.02	12.26	12.63	13.43	14.36	15.15
24	1992	14.97	12.28	12.02	11.23	11.17	10.88	11.59	11.94	11.93	13.64	14.83	14.93
25	1993	13.91	13.83	13.81	13.71	13.47	14.14	14.12	14.13	14.11	15.30	16.81	17.04
26	1994	16.97	16.43	15.40	14.19	13.71	13.71	13.71	14.23	14.25	14.84	16.27	17.30
27	1995	14.89	15.11	8.87	13.71	13.70	14.19	14.18	14.18	14.16	15.01	17.09	17.03
28	1996	14.12	6.98	15.11	13.71	13.54	14.13	14.13	14.11	14.10	15.40	17.94	16.72
29	1997	12.45	15.11	15.10	13.82	13.71	13.60	13.45	14.02	14.03	15.25	17.05	17.09
30	1998	13.30	4.25	14.90	13.71	13.71	13.71	13.50	14.29	15.05	16.14	17.39	17.79
31	1999	17.36	14.60	14.11	12.86	13.06	13.52	13.63	13.74	13.90	14.08	14.96	15.97

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
32	2000	16.10	14.86	15.11	13.80	13.78	13.56	14.52	14.67	14.98	15.70	17.49	18.32
33	2001	18.10	16.18	14.94	14.13	13.72	13.84	13.82	13.56	13.54	13.46	13.45	13.31
34	2002	13.22	13.51	13.79	13.43	13.71	13.71	14.18	14.39	14.63	15.36	16.05	15.11
35	2003	15.11	15.85	15.41	13.71	13.71	14.19	14.23	14.35	14.49	15.83	17.18	17.04
36	2004	16.39	13.93	13.55	13.71	13.71	14.30	14.30	14.40	15.02	16.59	17.56	16.94
37	2005	14.16	15.11	15.02	13.71	13.71	13.60	14.29	14.28	14.30	15.17	16.94	16.69
38	2006	14.56	14.28	15.09	13.55	13.71	13.34	14.15	14.18	14.25	14.64	16.07	17.16
39	2007	17.18	16.71	15.14	13.64	13.71	13.49	14.98	15.01	15.03	15.80	16.58	16.67
40	2008	13.71	15.11	15.11	15.04	15.01	14.88	14.88	14.91	14.96	14.82	14.82	15.73
41	2009	17.93	15.99	14.51	14.50	14.38	14.43	14.23	14.51	14.54	14.44	14.44	15.27
42	2010	13.73	15.11	15.02	13.71	13.71	14.37	14.39	14.47	14.54	14.25	14.07	14.83
43	2011	15.49	14.03	11.96	13.71	13.68	13.54	13.27	14.10	14.14	14.10	14.10	14.85
44	2012	16.53	16.51	16.43	15.17	14.23	14.07	14.04	13.40	13.11	13.23	14.56	13.55
45	2013	13.42	13.36	13.33	12.49	12.13	12.11	12.07	12.52	12.89	13.80	14.66	14.40
46	2014	14.33	13.21	12.02	13.43	13.44	12.95	13.80	13.80	13.84	15.06	16.57	14.88
47	2015	14.83	14.43	14.39	13.34	13.34	13.54	13.56	13.69	14.24	-	-	-
48	*Minimum*	*0.00*	*0.00*	*0.00*	*0.00*	*0.08*	*1.71*	*1.51*	*2.14*	*2.54*	*2.21*	*0.00*	*0.00*
49	*Maximum*	*19.66*	*18.37*	*16.43*	*15.17*	*15.01*	*14.88*	*14.98*	*15.01*	*15.43*	*17.26*	*19.44*	*19.95*
50	*Mean*	*14.78*	*13.65*	*13.51*	*13.06*	*13.12*	*13.26*	*13.43*	*13.64*	*13.81*	*14.68*	*15.56*	*15.64*

Table 61. 10,500 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year

		Days threshold is exceeded																	
ID (1)	Year (2)	703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	211.1	196.2	189.2	185.6	182.0	174.5	167.1	160.3	153.6	146.5	139.0	99.6	83.2	58.5	0.0	0.0	0.0	0.0	0.0
4	1972	325.1	276.7	245.1	226.6	206.6	198.9	192.0	185.2	178.0	152.0	114.2	101.6	93.2	84.8	0.0	0.0	0.0	0.0	0.0
5	1973	326.8	319.8	292.6	285.0	279.0	274.1	267.6	259.7	253.3	245.3	239.8	234.3	229.1	192.0	0.0	0.0	0.0	0.0	0.0
6	1974	260.0	255.6	252.3	250.5	248.8	245.2	241.3	237.7	234.5	230.9	223.2	218.0	213.8	209.7	0.0	0.0	0.0	0.0	0.0
7	1975	255.7	250.1	245.2	242.5	239.8	234.0	228.0	221.3	214.4	204.6	200.4	196.2	191.9	160.8	0.0	0.0	0.0	0.0	0.0
8	1976	222.7	214.7	172.1	146.3	138.7	97.8	53.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	206.0	195.3	187.0	182.5	178.3	171.8	164.8	157.0	147.5	110.3	96.8	51.0	9.5	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	268.1	263.9	260.8	259.3	257.8	254.8	251.8	248.8	242.4	234.6	226.9	194.5	161.2	126.4	0.0	0.0	0.0	0.0	0.0
11	1979	221.1	215.3	208.8	203.9	198.4	171.8	162.0	152.7	142.1	129.0	108.9	68.0	33.8	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	270.2	265.2	248.4	244.0	239.6	228.4	217.4	213.4	209.5	205.4	190.2	176.5	156.0	146.8	0.0	0.0	0.0	0.0	0.0
13	1981	307.1	223.5	197.8	194.4	188.8	169.8	156.2	143.4	129.5	118.2	108.7	91.5	73.1	54.7	0.0	0.0	0.0	0.0	0.0
14	1982	293.2	289.3	286.2	284.6	283.1	279.3	272.6	260.9	257.5	254.2	248.9	224.5	179.8	164.4	0.0	0.0	0.0	0.0	0.0
15	1983	314.4	302.0	293.9	291.9	287.8	276.2	265.8	256.0	251.5	243.3	237.9	233.4	228.9	165.1	0.0	0.0	0.0	0.0	0.0
16	1984	269.0	265.2	262.4	261.0	259.5	256.5	235.0	220.6	189.8	151.6	126.0	76.9	59.7	13.6	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
17	1985	208.3	200.9	194.3	190.9	187.5	180.2	174.3	170.3	162.6	150.0	121.9	112.5	101.5	52.7	0.0	0.0	0.0	0.0	0.0
18	1986	247.5	239.4	235.5	233.6	231.8	227.9	224.1	220.1	216.0	212.3	208.5	204.9	180.7	134.5	0.2	0.0	0.0	0.0	0.0
19	1987	180.5	173.1	167.1	164.2	161.1	154.5	147.4	137.6	128.3	119.0	108.6	59.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	161.8	153.8	147.4	144.2	140.8	133.5	125.4	114.5	102.9	92.3	56.0	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	160.5	135.5	92.0	71.8	50.3	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	201.1	187.9	144.5	118.3	94.5	48.9	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	207.3	195.3	187.2	184.6	178.2	146.0	132.3	115.5	106.5	96.8	84.7	38.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	225.7	219.8	202.6	188.9	175.3	168.6	160.7	152.4	106.8	94.0	86.0	58.3	14.8	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	279.7	272.0	267.8	265.6	263.1	257.9	252.8	249.0	245.0	240.6	235.2	230.6	216.5	174.6	0.0	0.0	0.0	0.0	0.0
26	1994	250.5	239.9	206.0	200.5	196.4	188.3	179.7	171.4	158.9	149.3	138.4	128.8	118.1	92.3	0.0	0.0	0.0	0.0	0.0
27	1995	293.3	286.6	282.0	279.6	277.3	272.6	268.1	263.4	257.5	252.3	247.8	240.0	222.3	180.0	0.0	0.0	0.0	0.0	0.0
28	1996	261.1	256.0	252.8	251.0	249.0	243.3	238.7	234.0	229.3	224.5	221.2	217.9	192.5	156.2	0.0	0.0	0.0	0.0	0.0
29	1997	291.5	285.5	281.1	279.3	277.8	274.5	271.3	267.7	264.2	259.9	255.7	251.6	245.8	232.8	0.0	0.0	0.0	0.0	0.0
30	1998	269.5	260.4	254.7	251.9	249.1	243.1	236.2	230.2	224.5	218.0	209.4	192.3	183.9	171.2	0.0	0.0	0.0	0.0	0.0
31	1999	270.1	265.8	254.7	252.9	251.1	246.8	237.3	225.5	216.8	181.8	153.8	119.8	88.5	73.7	0.0	0.0	0.0	0.0	0.0
32	2000	249.0	242.7	238.5	236.5	234.5	230.5	223.2	219.5	213.9	202.5	188.7	169.4	157.3	141.6	0.0	0.0	0.0	0.0	0.0
33	2001	309.3	307.1	302.0	301.9	301.7	301.4	293.9	284.7	251.1	237.8	207.4	101.8	28.8	16.8	0.0	0.0	0.0	0.0	0.0
34	2002	323.5	319.0	315.4	313.5	311.5	298.9	282.6	271.7	251.6	208.5	176.0	134.4	103.7	62.4	0.0	0.0	0.0	0.0	0.0
35	2003	280.6	275.7	270.8	269.1	267.5	264.3	258.0	254.6	251.4	215.0	197.2	171.3	136.3	108.3	0.0	0.0	0.0	0.0	0.0
36	2004	246.8	217.5	209.7	204.9	203.0	199.3	195.8	189.1	171.4	166.4	162.0	147.7	108.5	74.5	0.0	0.0	0.0	0.0	0.0
37	2005	286.8	280.9	276.4	274.1	271.8	266.4	261.3	256.1	250.2	241.1	206.7	192.0	159.7	128.5	0.0	0.0	0.0	0.0	0.0
38	2006	304.9	299.5	295.3	293.2	291.1	286.6	279.2	265.8	218.4	204.8	196.2	181.8	150.2	128.0	0.0	0.0	0.0	0.0	0.0
39	2007	209.1	195.8	189.0	183.7	180.3	172.8	164.7	157.4	120.5	60.9	54.0	45.5	38.0	31.2	0.0	0.0	0.0	0.0	0.0
40	2008	358.8	349.3	343.1	338.4	321.5	315.9	311.5	307.0	302.9	298.5	291.8	245.8	204.3	162.1	0.0	0.0	0.0	0.0	0.0
41	2009	293.0	288.6	284.1	279.4	275.0	265.3	261.5	258.2	183.5	145.6	133.1	83.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	345.3	345.2	339.3	331.0	326.8	322.1	317.6	313.3	308.3	290.5	233.0	188.3	146.2	107.5	0.0	0.0	0.0	0.0	0.0
43	2011	359.6	354.5	332.3	303.1	296.9	292.6	287.0	279.5	272.4	268.3	263.0	250.1	174.8	133.0	0.0	0.0	0.0	0.0	0.0
44	2012	214.0	202.3	194.8	190.1	185.2	177.0	166.9	150.1	101.2	42.9	31.6	17.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	287.3	280.1	274.3	271.5	268.6	264.8	261.1	257.3	227.2	151.5	131.9	117.7	102.7	36.2	0.0	0.0	0.0	0.0	0.0
46	2014	263.6	252.2	236.6	231.6	224.3	210.9	203.7	196.2	188.6	180.6	169.3	160.0	138.5	91.1	0.0	0.0	0.0	0.0	0.0
47	2015	244.0	244.0	244.0	241.5	238.0	190.6	177.3	117.0	100.3	67.6	23.6	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	359.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	232.8	0.2	0.0	0.0	0.0	0.0
50	*Mean*	253.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.3	0.0	0.0	0.0	0.0	0.0

Table 62. 10,500 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	Differences in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	211.1	196.2	189.2	185.6	182.0	174.5	167.1	160.3	153.6	146.5	139.0	99.6	83.2	58.5	0.0	0.0	0.0	0.0	0.0
4	1972	325.1	276.7	245.1	226.6	206.6	198.9	192.0	185.2	178.0	152.0	114.2	101.6	93.2	84.8	0.0	0.0	0.0	0.0	0.0
5	1973	326.8	319.8	292.6	285.0	279.0	274.1	267.6	259.7	253.3	245.3	239.8	234.3	229.1	192.0	0.0	0.0	0.0	0.0	0.0
6	1974	260.0	255.6	252.3	250.5	248.8	245.2	241.3	237.7	234.5	230.9	223.2	218.0	213.8	209.7	0.0	0.0	0.0	0.0	0.0
7	1975	255.7	250.1	245.2	242.5	239.8	234.0	228.0	221.3	214.4	204.6	200.4	196.2	191.9	160.8	0.0	0.0	0.0	0.0	0.0
8	1976	222.7	214.7	172.1	146.3	138.7	97.8	53.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	206.0	195.3	187.0	182.5	178.3	171.8	164.8	157.0	147.5	110.3	96.8	51.0	9.5	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	268.1	263.9	260.8	259.3	257.8	254.8	251.8	248.8	242.4	234.6	226.9	194.5	161.2	126.4	0.0	0.0	0.0	0.0	0.0
11	1979	221.1	215.3	208.8	203.9	198.4	171.8	162.0	152.7	142.1	129.0	108.9	68.0	33.8	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	264.8	260.2	243.7	239.5	235.3	224.3	213.7	210.0	206.6	203.8	189.6	176.5	156.0	146.8	0.0	0.0	0.0	0.0	0.0
13	1981	307.1	223.5	197.8	194.4	188.8	169.8	156.2	143.4	129.5	118.2	108.7	91.5	73.1	54.7	0.0	0.0	0.0	0.0	0.0
14	1982	289.7	286.7	284.5	283.8	282.6	279.3	272.6	260.9	257.5	254.2	248.9	224.5	179.8	164.4	0.0	0.0	0.0	0.0	0.0
15	1983	299.9	289.5	282.8	281.8	278.5	268.5	259.2	250.5	247.1	240.3	235.7	231.6	227.6	165.1	0.0	0.0	0.0	0.0	0.0
16	1984	269.0	265.2	262.4	261.0	259.5	256.5	235.0	220.6	189.8	151.6	126.0	76.9	59.7	13.6	0.0	0.0	0.0	0.0	0.0
17	1985	208.3	200.9	194.3	190.9	187.5	180.2	174.3	170.3	162.6	150.0	121.9	112.5	101.5	52.7	0.0	0.0	0.0	0.0	0.0
18	1986	240.3	232.5	228.9	227.2	225.4	221.9	218.4	214.8	211.0	208.0	204.7	201.5	177.7	131.8	0.2	0.0	0.0	0.0	0.0
19	1987	180.5	173.1	167.1	164.2	161.1	154.5	147.4	137.6	128.3	119.0	108.6	59.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	161.8	153.8	147.4	144.2	140.8	133.5	125.4	114.5	102.9	92.3	56.0	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	160.5	135.5	92.0	71.8	50.3	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	201.1	187.9	144.5	118.3	94.5	48.9	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	207.3	195.3	187.2	184.6	178.2	146.0	132.3	115.5	106.5	96.8	84.7	38.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	225.7	219.8	202.6	188.9	175.3	168.6	160.7	152.4	106.8	94.0	86.0	58.3	14.8	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	279.7	272.0	267.8	265.6	263.1	257.9	252.8	249.0	245.0	240.6	235.2	230.6	216.5	174.6	0.0	0.0	0.0	0.0	0.0
26	1994	250.5	239.9	206.0	200.5	196.4	188.3	179.7	171.4	158.9	149.3	138.4	128.8	118.1	92.3	0.0	0.0	0.0	0.0	0.0
27	1995	286.9	281.0	276.9	274.9	272.9	268.9	265.5	261.7	256.3	251.6	247.8	240.0	222.3	180.0	0.0	0.0	0.0	0.0	0.0
28	1996	256.5	251.8	248.9	247.3	245.4	240.4	236.8	232.7	228.6	224.5	221.2	217.9	192.5	156.2	0.0	0.0	0.0	0.0	0.0
29	1997	285.9	281.8	278.1	276.8	275.7	273.9	271.3	267.7	264.2	259.9	255.7	251.6	245.8	232.8	0.0	0.0	0.0	0.0	0.0
30	1998	258.7	250.9	245.4	242.8	240.1	234.4	228.4	223.4	218.4	212.6	204.8	188.3	180.8	169.6	0.0	0.0	0.0	0.0	0.0
31	1999	270.1	265.8	254.7	252.9	251.1	246.8	237.3	225.5	216.8	181.8	153.8	119.8	88.5	73.7	0.0	0.0	0.0	0.0	0.0
32	2000	249.0	242.7	238.5	236.5	234.5	230.5	223.2	219.5	213.9	202.5	188.7	169.4	157.3	141.6	0.0	0.0	0.0	0.0	0.0
33	2001	309.3	307.1	302.0	301.9	301.7	301.4	293.9	284.7	251.1	237.8	207.4	101.8	28.8	16.8	0.0	0.0	0.0	0.0	0.0
34	2002	323.5	319.0	315.4	313.5	311.5	298.9	282.6	271.7	251.6	208.5	176.0	134.4	103.7	62.4	0.0	0.0	0.0	0.0	0.0
35	2003	280.6	275.7	270.8	269.1	267.5	264.3	258.0	254.6	251.4	215.0	197.2	171.3	136.3	108.3	0.0	0.0	0.0	0.0	0.0
36	2004	246.8	217.5	209.7	204.9	203.0	199.3	195.8	189.1	171.4	166.4	162.0	147.7	108.5	74.5	0.0	0.0	0.0	0.0	0.0
37	2005	286.8	280.9	276.4	274.1	271.8	266.4	261.3	256.1	250.2	241.1	206.7	192.0	159.7	128.5	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Differences in days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
38	2006	304.5	299.5	295.3	293.2	291.1	286.6	279.2	265.8	218.4	204.8	196.2	181.8	150.2	128.0	0.0	0.0	0.0	0.0	0.0
39	2007	209.1	195.8	189.0	183.7	180.3	172.8	164.7	157.4	120.5	60.9	54.0	45.5	38.0	31.2	0.0	0.0	0.0	0.0	0.0
40	2008	358.8	349.3	343.1	338.4	321.5	315.9	311.5	307.0	302.9	298.5	291.8	245.8	204.3	162.1	0.0	0.0	0.0	0.0	0.0
41	2009	293.0	288.6	284.1	279.4	275.0	265.3	261.5	258.2	183.5	145.6	133.1	83.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	345.3	345.2	339.3	331.0	326.8	322.1	317.6	313.3	308.3	290.5	233.0	188.3	146.2	107.5	0.0	0.0	0.0	0.0	0.0
43	2011	357.5	353.8	332.3	303.1	296.9	292.6	287.0	279.5	272.4	268.3	263.0	250.1	174.8	133.0	0.0	0.0	0.0	0.0	0.0
44	2012	214.0	202.3	194.8	190.1	185.2	177.0	166.9	150.1	101.2	42.9	31.6	17.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	287.3	280.1	274.3	271.5	268.6	264.8	261.1	257.3	227.2	151.5	131.9	117.7	102.7	36.2	0.0	0.0	0.0	0.0	0.0
46	2014	263.6	252.2	236.6	231.6	224.3	210.9	203.7	196.2	188.6	180.6	169.3	160.0	138.5	91.1	0.0	0.0	0.0	0.0	0.0
47	2015	244.0	244.0	244.0	241.5	238.0	190.6	177.3	117.0	100.3	67.6	23.6	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	358.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	232.8	0.2	0.0	0.0	0.0	0.0
50	*Mean*	252.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.2	0.0	0.0	0.0	0.0	0.0

Table 63. 10,500 ac-ft reallocation with FIRO: annual event results

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	648.46	682.10	0	47	66	2,937	5,133
2	1971	685.33	698.42	113	19	40	853	982
3	1972	703.05	704.04	0	2	20	251	272
4	1973	714.67	716.81	3,068	2,986	3,270	3,700	3,782
5	1974	704.95	716.81	201	154	154	1,102	3,420
6	1975	709.73	716.81	2,107	2,062	2,438	2,457	2,503
7	1976	696.14	704.92	0	3	3	101	108
8	1977	693.89	694.09	9	10	10	138	172
9	1978	694.97	713.06	131	6	28	1,511	2,291
10	1979	695.63	705.32	0	11	22	1,179	1,437
11	1980	704.19	719.96	3,085	3,064	3,879	4,643	10,019
12	1981	695.46	698.37	0	17	33	677	713
13	1982	704.04	717.72	3,081	3,060	3,552	6,140	7,256
14	1983	705.76	719.57	3,075	3,061	3,753	6,005	7,992
15	1984	703.68	711.00	106	6	199	1,313	1,858
16	1985	705.89	711.38	0	3	31	167	352
17	1986	693.74	727.07	4,500	4,541	4,725	8,286	11,446
18	1987	692.73	694.47	0	3	250	940	2,103
19	1988	689.58	690.47	0	17	163	359	1,344
20	1989	693.46	700.85	0	8	22	293	901
21	1990	695.84	701.01	0	13	64	844	2,344
22	1991	698.19	706.79	0	2	33	477	1,238
23	1992	692.27	705.96	97	9	185	1,088	3,279
24	1993	690.58	715.65	126	8	325	4,373	10,049
25	1994	698.99	704.32	0	8	109	476	1,287
26	1995	712.92	720.58	3,148	3,061	3,730	4,911	14,721

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	713.20	717.47	3,041	3,062	3,667	4,770	9,529
28	1997	713.75	719.91	3,022	3,062	3,654	5,838	9,852
29	1998	711.39	722.07	3,061	3,106	4,493	8,206	18,145
30	1999	698.34	707.71	0	10	216	1,788	4,380
31	2000	703.05	712.44	121	8	243	2,373	6,208
32	2001	699.33	709.79	0	3	56	442	754
33	2002	711.95	714.92	49	2	97	955	2,392
34	2003	699.58	714.56	0	8	1,031	3,450	9,906
35	2004	704.59	712.92	0	6	117	3,465	3,510
36	2005	710.99	716.81	1,117	1,079	1,135	1,376	1,874
37	2006	696.73	707.89	0	3	337	8,827	10,102
38	2007	698.31	700.65	0	5	92	2,817	2,621
39	2008	705.79	715.18	107	5	45	989	972
40	2009	706.19	713.84	10	9	88	2,214	3,384
41	2010	698.32	711.73	0	7	153	4,644	4,970
42	2011	714.29	716.81	3,122	3,062	3,640	5,129	10,710
43	2012	701.43	703.19	0	10	32	2,272	2,310
44	2013	701.93	709.63	10	4	67	2,311	6,448
45	2014	704.78	711.19	0	6	19	1,585	1,464
46	2015	699.28	706.22	0	7	75	5,165	8,647

Table 64. 10,500 ac-ft reallocation with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	0.00	0.00	0	0	0	0	0
2	1971	2.62	2.18	0	0	0	0	0
3	1972	17.45	16.36	0	0	0	0	0
4	1973	13.05	15.11	1,367	1,351	1,563	1,218	895
5	1974	15.78	15.11	-23	-28	-70	0	0
6	1975	14.60	15.09	1,070	1,109	1,484	721	-36
7	1976	17.85	15.59	0	0	0	0	0
8	1977	17.20	17.11	0	0	0	0	0
9	1978	15.65	12.20	0	0	0	0	0
10	1979	17.76	15.30	0	0	0	0	0
11	1980	14.49	7.46	1,000	1,009	975	1,000	947
12	1981	18.54	17.65	0	0	0	0	0
13	1982	15.15	12.30	998	1,034	1,352	214	0
14	1983	15.40	8.21	957	1,001	1,099	871	208
15	1984	16.01	14.43	0	0	0	0	0
16	1985	14.25	13.22	0	0	0	0	0
17	1986	17.70	3.40	1,472	1,479	1,119	1,379	1,416
18	1987	19.03	18.29	0	0	0	0	0
19	1988	18.87	18.54	0	0	0	0	0
20	1989	15.86	14.26	0	0	0	0	0
21	1990	14.26	13.20	0	0	0	0	0
22	1991	12.81	11.25	0	0	0	0	0
23	1992	14.97	12.28	0	0	0	0	0

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
24	1993	15.50	13.95	-462	-492	-348	0	0
25	1994	16.97	15.65	0	0	0	0	0
26	1995	15.84	8.87	996	1,006	1,112	1,021	-73
27	1996	11.50	6.98	994	1,006	1,114	982	596
28	1997	12.05	12.45	984	1,006	930	775	-387
29	1998	13.29	4.25	43	45	204	1,978	469
30	1999	17.35	15.17	0	0	0	0	0
31	2000	16.00	13.37	0	0	0	0	0
32	2001	17.39	14.96	0	0	0	0	0
33	2002	13.58	13.22	-40	-43	0	0	0
34	2003	17.02	13.83	0	0	0	0	0
35	2004	15.57	13.93	0	0	0	0	0
36	2005	14.29	15.11	0	6	69	-14	-90
37	2006	17.55	14.95	0	0	0	0	0
38	2007	17.08	16.58	0	0	0	0	0
39	2008	15.43	13.71	0	0	0	0	0
40	2009	16.04	14.53	0	0	0	0	0
41	2010	16.83	13.94	0	0	0	0	0
42	2011	13.80	11.96	993	946	982	-26	-16
43	2012	16.33	15.92	0	0	0	0	0
44	2013	15.16	13.55	0	0	0	0	0
45	2014	13.61	12.49	0	0	0	0	0
46	2015	16.53	14.88	0	0	0	0	0

Appendix VII. Results for 15,000 ac-ft reallocation with FIRO

This appendix details 15,000 ac-ft reallocation-with-FIRO simulation results in the following tables:

- Table 65. 15,000 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year
- Table 66. 15,000 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year
- Table 67. 15,000 ac-ft reallocation with FIRO: average monthly storage (ac-ft) by year
- Table 68. 15,000 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)
- Table 69. 15,000 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year
- Table 70. 15,000 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)
- Table 71. 15,000 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year
- Table 72. 15,000 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)
- Table 73. 15,000 ac-ft reallocation with FIRO: annual event results
- Table 74. 15,000 ac-ft reallocation with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

Table 65. 15,000 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	12	224	-
2	1970	10,375	1,860	6,039	334	260	51	1	0	202	615	907	6,875	2,293
3	1971	3,370	569	1,037	363	269	44	70	6	18	400	357	672	598
4	1972	391	667	138	107	9	-1,139	49	31	41	363	2,029	997	307
5	1973	11,450	3,744	2,867	1,397	500	119	50	6	6	343	969	6,905	2,363
6	1974	6,783	1,398	3,527	2,476	483	178	48	157	298	9	32	307	1,308
7	1975	425	8,594	9,554	3,132	495	125	53	2	131	5	64	96	1,890
8	1976	90	186	83	46	7	0	0	0	0	0	0	1	35
9	1977	207	59	51	2	0	0	0	0	173	0	18	282	66
10	1978	14,793	9,248	4,605	1,659	465	99	15	0	0	67	48	25	2,585
11	1979	1,264	5,859	1,970	541	218	48	68	0	18	0	98	470	880
12	1980	10,553	12,615	3,841	1,195	672	226	244	12	184	197	0	66	2,484
13	1981	1,993	636	2,724	437	138	68	80	105	18	80	615	2,250	762
14	1982	12,909	2,176	4,079	4,770	1,311	458	200	81	257	105	5,025	11,226	3,550
15	1983	11,649	360	8,331	6,163	4,184	943	529	263	274	192	4,843	15,568	4,441
16	1984	2,684	2,737	1,572	733	64	131	182	86	153	86	1,265	1,022	893
17	1985	525	1,682	2,722	810	61	113	21	92	89	59	420	344	578
18	1986	611	18,675	256	359	995	353	107	70	55	118	129	157	1,824
19	1987	309	1,357	1,082	328	99	10	0	67	137	0	38	148	298
20	1988	799	228	175	40	63	0	0	6	71	123	84	293	157
21	1989	319	340	984	143	32	0	0	12	202	0	79	0	176
22	1990	97	483	148	62	6	3	0	0	0	98	220	203	110
23	1991	0	211	9,313	753	57	14	0	0	154	389	114	207	934
24	1992	337	10,004	2,089	66	118	11	0	0	374	14	0	990	1,167
25	1993	21,440	5,713	4,794	1,702	646	283	6	55	178	314	112	149	2,949
26	1994	226	1,619	406	210	11	-707	0	0	146	0	236	155	192
27	1995	15,871	1,047	6,251	2,044	1,715	658	115	2	154	74	5	1,069	2,417
28	1996	11,282	5,607	4,149	1,657	1,021	246	94	10	0	36	712	12,549	3,114
29	1997	12,479	2,181	937	441	-18	124	14	0	0	0	257	1,098	1,459
30	1998	11,146	4,666	2,089	3,830	1,055	342	350	60	23	37	266	496	2,030
31	1999	1,835	7,351	2,176	2,676	645	203	69	43	77	246	155	127	1,300
32	2000	1,786	14,074	4,192	527	257	167	80	240	215	117	24	131	1,817
33	2001	444	4,089	4,872	661	148	238	61	277	72	0	112	2,857	1,153
34	2002	2,283	665	1,091	324	89	45	123	55	244	216	167	13,333	1,553
35	2003	1,175	817	962	-905	919	78	130	80	167	68	36	638	347
36	2004	2,919	7,706	1,525	34	-270	0	0	80	268	292	45	2,238	1,236
37	2005	9,590	6,263	3,260	1,439	810	141	48	31	172	289	84	2,851	2,082
38	2006	6,830	1,802	8,249	4,614	1,023	200	27	0	0	0	59	294	1,925
39	2007	123	1,532	797	110	-361	0	0	0	172	133	0	12	210

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
40	2008	11,330	5,924	1,234	329	116	13	252	19	71	6	77	275	1,637
41	2009	142	4,109	6,064	337	346	31	0	31	54	646	178	49	999
42	2010	10,798	3,758	283	337	436	18	2	43	0	0	67	2,852	1,549
43	2011	1,444	6,730	6,780	1,508	600	341	43	84	357	357	4	844	1,591
44	2012	138	59	476	1,341	287	303	264	554	465	71	755	6,894	967
45	2013	715	335	262	43	7	722	0	0	0	595	173	43	241
46	2014	0	29	156	87	1	0	0	0	351	6	54	4,961	470
47	2015	214	1,583	255	238	46	0	0	0	0	-	-	-	-
48	*Minimum*	0	29	51	-905	-361	-1,139	0	0	0	0	0	0	35
49	*Maximum*	21,440	18,675	9,554	6,163	4,184	943	529	554	465	646	5,025	15,568	4,441
50	*Mean*	4,699	3,725	2,792	1,076	435	115	74	58	131	150	455	2,244	1,354

Table 66. 15,000 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-
2	1970	0	0	0	0	305	1,219	0	0	0	0	0	0	127
3	1971	0	0	0	2,472	3,434	1,245	1,054	1,309	106	0	0	0	802
4	1972	0	0	0	676	4,217	42	0	0	0	0	0	0	411
5	1973	698	596	-14	-335	-71	0	0	0	0	0	0	0	73
6	1974	1,319	0	39	-601	72	0	0	0	0	0	0	0	69
7	1975	0	0	1,464	-356	-196	0	0	0	0	0	0	0	76
8	1976	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1977	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1978	0	3,042	16	-563	0	0	0	0	0	0	0	0	208
11	1979	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1980	0	2,436	19	-298	0	0	0	0	0	0	0	0	180
13	1981	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1982	2,089	25	-2,621	2,034	0	0	0	0	0	0	0	0	127
15	1983	1,412	-3,523	3,340	-395	6	0	0	0	0	0	0	0	70
16	1984	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1985	0	0	0	0	892	0	0	0	0	0	0	0	74
18	1986	0	2,322	-90	-477	1	0	0	0	0	0	0	0	146
19	1987	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1988	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1989	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1990	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1991	0	0	1,085	0	0	0	0	0	0	0	0	0	90
24	1992	0	0	0	0	484	0	0	0	0	0	0	0	40
25	1993	2,207	2,502	-284	-319	0	0	0	0	0	0	0	0	342

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
26	1994	0	0	0	0	1,031	0	0	0	0	0	0	0	86
27	1995	1,177	4	-183	-413	26	0	0	0	0	0	0	0	51
28	1996	0	1,408	41	-654	0	0	0	0	0	0	0	0	66
29	1997	1,522	36	58	-225	-275	0	0	0	0	0	0	0	93
30	1998	-628	1,988	-107	-513	83	29	0	0	0	0	0	0	71
31	1999	0	0	0	0	19	0	0	0	0	0	0	0	2
32	2000	0	1,518	621	-227	-69	0	0	0	0	0	0	0	154
33	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2002	72	0	0	0	1,275	127	0	0	0	0	0	1,481	246
35	2003	108	0	0	-523	10	0	0	0	0	0	0	0	-34
36	2004	0	0	0	995	11	0	0	0	0	0	0	0	84
37	2005	0	1,499	-19	-552	1	0	0	0	0	0	0	0	77
38	2006	0	0	1,524	-615	23	0	0	0	0	0	0	0	78
39	2007	0	0	0	0	1,049	0	0	0	0	0	0	0	87
40	2008	0	1,419	12	0	0	0	0	0	0	0	0	0	119
41	2009	0	0	0	0	0	0	0	0	0	0	0	0	0
42	2010	0	1,954	-7	-558	22	0	0	0	0	0	0	0	118
43	2011	0	0	1,400	-554	0	0	0	0	0	0	0	0	71
44	2012	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2013	0	0	0	0	136	64	0	0	0	0	0	0	17
46	2014	0	0	16	1,604	15	0	0	0	0	0	0	0	136
47	2015	0	0	0	0	0	0	0	0	0	-	-	-	-
48	*Minimum*	-628	-3,523	-2,621	-654	-275	0	0	0	0	0	0	0	-34
49	*Maximum*	2,207	3,042	3,340	2,472	4,217	1,245	1,054	1,309	106	0	0	1,481	802
50	*Mean*	217	374	137	-9	272	59	23	28	2	0	0	32	97

Table 67. 15,000 ac-ft reallocation with FIRO: average monthly storage (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	13,198	13,206	-	-
2	1970	18,810	28,126	33,818	35,920	39,050	40,579	40,666	40,002	38,913	34,989	30,519	31,114	34,742	32,848
3	1971	35,343	35,672	36,201	40,019	46,178	47,480	48,703	49,786	49,242	43,400	38,945	39,600	36,740	40,678
4	1972	40,667	41,521	43,216	48,279	53,040	54,813	52,785	50,550	49,381	44,229	42,975	44,409	45,657	42,104
5	1973	49,941	54,345	54,903	54,881	54,852	54,457	53,745	52,980	50,594	45,311	42,681	45,980	54,903	42,675
6	1974	53,699	54,223	54,590	54,882	54,898	54,632	54,071	50,964	44,460	39,189	36,571	35,945	54,740	37,004
7	1975	36,238	43,607	53,424	54,647	54,888	54,558	54,023	53,315	51,982	46,326	40,767	39,521	54,843	43,058
8	1976	39,511	40,030	45,353	48,326	47,867	47,292	46,575	45,775	45,198	43,471	38,487	37,878	47,906	40,346
9	1977	37,911	38,869	45,091	49,184	51,135	51,718	51,003	50,142	45,950	41,557	38,646	38,129	48,542	39,808
10	1978	44,949	52,913	54,701	54,731	53,976	53,353	52,634	51,812	49,785	42,831	38,342	37,878	54,903	39,968
11	1979	38,392	40,754	46,649	49,539	52,606	52,030	51,285	50,362	46,787	41,142	36,716	36,443	47,595	38,404
12	1980	42,586	49,091	54,735	54,666	54,378	54,116	53,097	51,439	48,851	42,838	39,233	39,010	54,763	39,910
13	1981	39,156	41,823	48,746	53,631	53,265	51,907	50,024	47,658	45,398	44,141	44,256	44,831	53,566	44,058
14	1982	53,724	54,788	54,533	54,714	54,185	53,410	52,362	51,710	49,649	42,847	36,758	43,180	54,391	39,360
15	1983	49,257	54,346	54,856	54,742	54,217	54,046	53,530	52,921	51,303	45,265	40,156	44,364	54,903	42,120
16	1984	48,644	48,502	50,612	51,434	52,939	52,793	51,249	49,186	46,105	40,406	38,474	38,367	51,192	39,952
17	1985	39,008	40,303	45,247	51,053	53,407	53,162	52,361	50,413	47,579	42,382	39,802	36,198	48,955	42,084
18	1986	36,062	45,929	54,517	54,903	54,342	53,928	53,092	52,505	50,261	44,707	40,506	37,147	54,903	43,048
19	1987	37,134	37,891	41,331	47,962	51,956	51,927	51,327	50,345	45,610	38,275	34,926	34,912	45,142	35,295
20	1988	35,334	35,735	38,209	43,862	48,832	51,320	50,679	49,809	45,296	39,030	36,516	34,715	40,976	37,416
21	1989	34,758	35,474	40,284	43,988	46,125	45,970	45,280	44,628	42,182	37,875	36,847	36,771	42,978	37,154
22	1990	36,727	39,591	43,695	44,498	45,268	46,809	46,295	45,651	44,442	41,711	39,036	36,983	44,244	40,397
23	1991	37,179	40,811	46,620	50,728	50,809	50,177	47,893	46,004	43,465	39,886	36,309	35,540	51,310	38,174
24	1992	35,827	40,531	44,660	47,895	51,007	50,852	49,975	47,770	45,554	38,800	34,883	34,684	46,101	36,093
25	1993	44,496	53,884	54,689	54,865	54,437	54,085	53,392	52,714	50,190	44,550	41,232	41,170	54,903	42,403
26	1994	41,240	41,915	45,290	47,120	52,699	54,903	54,381	53,425	51,664	47,675	43,088	41,445	45,487	44,925
27	1995	50,191	54,195	53,881	54,884	54,538	54,038	53,659	52,979	50,884	46,075	42,487	40,618	54,903	43,783
28	1996	42,812	54,288	54,896	54,624	54,460	53,840	53,205	52,440	49,273	42,583	36,298	37,098	54,840	39,074
29	1997	53,914	54,903	54,903	54,901	54,850	53,959	54,327	53,692	50,827	44,611	40,725	41,334	54,903	42,125
30	1998	46,506	53,944	54,903	54,823	54,761	54,833	54,266	51,456	47,221	43,119	40,206	39,549	54,903	41,268
31	1999	39,445	46,307	50,509	52,934	53,952	53,467	52,030	50,940	49,672	46,750	42,249	41,438	51,674	45,119
32	2000	42,121	48,036	54,674	54,578	54,682	54,329	53,241	51,322	48,975	44,275	39,353	39,229	54,403	41,812
33	2001	39,606	41,581	48,367	50,940	53,016	50,775	48,999	51,882	51,340	50,875	50,981	50,794	49,101	51,381
34	2002	52,223	50,358	49,104	50,008	52,588	54,328	53,092	51,259	48,718	46,466	42,409	46,437	49,498	44,673
35	2003	53,944	50,290	50,844	54,345	54,641	53,819	52,532	51,387	48,055	43,913	41,329	40,620	53,223	43,533
36	2004	43,588	45,450	52,058	54,109	54,200	53,328	52,365	49,765	46,253	41,445	39,497	39,415	53,188	40,004
37	2005	48,142	52,020	54,880	54,902	54,593	53,974	52,839	51,951	49,973	44,832	40,219	39,746	54,902	42,109
38	2006	48,044	48,997	53,695	54,799	54,759	54,186	53,318	52,107	50,695	47,213	42,390	40,619	54,556	44,467

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
39	2007	40,648	40,857	43,980	49,437	54,104	51,366	49,943	49,288	47,937	43,891	43,007	42,816	46,452	43,347
40	2008	46,687	54,253	54,481	53,894	54,008	53,349	53,451	52,640	51,289	51,334	50,502	45,497	54,037	51,682
41	2009	42,663	43,970	51,332	51,710	51,804	51,189	50,599	49,420	48,807	48,563	47,681	42,165	51,714	48,613
42	2010	43,949	52,483	54,903	54,903	54,376	53,245	52,216	51,249	50,497	50,104	50,846	46,420	54,903	51,095
43	2011	45,778	46,698	53,202	54,881	54,667	54,602	53,996	52,904	52,144	51,846	50,647	45,715	54,902	51,703
44	2012	42,904	42,874	42,745	43,998	47,928	49,365	48,906	49,510	51,384	47,999	42,937	44,245	42,840	45,042
45	2013	49,040	49,383	48,949	50,844	52,568	52,899	52,499	51,079	47,781	43,618	42,901	42,844	49,178	42,930
46	2014	42,655	44,429	49,308	53,334	53,135	53,061	52,482	51,725	48,641	42,693	40,829	42,990	51,996	40,895
47	2015	45,742	46,654	47,187	49,116	50,223	49,383	48,467	46,327	44,830	-	-	-	47,103	-
48	*Minimum*	*18,810*	*28,126*	*33,818*	*35,920*	*39,050*	*40,579*	*40,666*	*40,002*	*38,913*	*34,989*	*13,198*	*13,206*	*34,742*	*32,848*
49	*Maximum*	*53,944*	*54,903*	*54,903*	*54,903*	*54,898*	*54,903*	*54,381*	*53,692*	*52,144*	*51,846*	*50,981*	*50,794*	*54,903*	*51,703*
50	*Mean*	*42,765*	*45,927*	*49,234*	*51,183*	*52,396*	*52,253*	*51,453*	*50,374*	*48,153*	*43,890*	*40,160*	*39,761*	*50,383*	*42,087*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 68. 15,000 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-	-
2	1970	0	0	0	0	15	959	1,512	1,497	1,483	1,471	1,466	1,463	0	1,468
3	1971	1,461	1,458	1,454	1,886	6,525	7,797	9,023	10,101	10,723	10,659	10,611	10,587	1,452	10,633
4	1972	10,570	10,553	10,518	10,511	13,355	15,189	15,047	14,895	14,774	14,700	14,664	14,648	10,491	14,675
5	1973	14,858	15,348	15,899	15,601	15,305	15,165	15,018	14,872	14,754	14,672	14,619	14,601	15,832	14,638
6	1974	15,411	15,882	15,890	15,236	15,215	15,131	15,008	14,872	14,743	14,633	14,572	14,541	15,787	14,592
7	1975	14,508	14,479	15,385	15,810	15,236	15,110	14,994	14,859	14,746	14,669	14,627	14,593	15,879	14,645
8	1976	14,560	14,518	14,477	14,415	14,314	14,199	14,058	13,946	13,841	13,769	13,709	13,665	14,445	13,735
9	1977	13,637	13,610	13,567	13,499	13,423	13,330	13,209	13,083	12,983	12,906	12,854	12,818	13,540	12,877
10	1978	12,796	14,828	15,833	15,255	15,120	14,995	14,867	14,721	14,607	14,501	14,436	14,405	15,720	14,463
11	1979	14,385	14,362	14,338	14,288	14,209	14,072	13,942	13,813	13,697	13,601	13,556	13,520	14,320	13,574
12	1980	13,498	13,481	15,891	15,590	15,458	15,362	15,245	15,102	14,993	14,889	14,819	14,773	15,863	14,852
13	1981	14,749	14,723	14,683	14,627	14,532	14,404	14,249	14,108	13,981	13,900	13,855	13,835	14,662	13,873
14	1982	15,521	15,852	15,609	14,956	15,162	15,055	14,943	14,792	14,668	14,590	14,544	14,523	12,680	14,562
15	1983	13,830	15,226	14,715	15,228	15,183	15,078	14,947	14,810	14,694	14,616	14,566	14,543	15,577	14,583
16	1984	14,527	14,504	14,464	14,403	14,312	14,187	14,037	13,901	13,777	13,684	13,641	13,619	14,433	13,656
17	1985	13,600	13,575	13,530	13,474	13,979	14,169	14,019	13,892	13,792	13,709	13,656	13,634	13,508	13,679
18	1986	13,615	12,690	15,511	15,264	15,173	15,062	14,929	14,800	14,694	14,617	14,556	14,518	15,703	14,589
19	1987	14,497	14,465	14,424	14,355	14,253	14,148	14,037	13,923	13,821	13,725	13,678	13,649	14,394	13,695
20	1988	13,628	13,590	13,524	13,434	13,360	13,265	13,137	13,018	12,909	12,824	12,775	12,743	13,474	12,792
21	1989	12,723	12,700	12,668	12,608	12,527	12,430	12,305	12,184	12,086	12,015	11,959	11,926	12,645	11,985

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
22	1990	11,903	11,879	11,849	11,792	11,706	11,623	11,517	11,410	11,324	11,247	11,187	11,154	11,823	11,212
23	1991	11,131	11,103	11,186	12,114	12,054	11,965	11,865	11,767	11,679	11,589	11,531	11,495	12,144	11,554
24	1992	11,475	11,456	11,429	11,383	11,608	11,697	11,603	11,488	11,393	11,311	11,262	11,233	11,410	11,285
25	1993	11,750	14,934	15,889	15,232	15,147	15,049	14,901	14,767	14,645	14,557	14,488	14,457	15,495	14,521
26	1994	14,435	14,412	14,372	14,303	14,456	15,218	15,148	15,010	14,889	14,805	14,757	14,740	14,340	14,774
27	1995	15,144	15,895	14,910	15,238	15,179	15,106	14,986	14,849	14,730	14,635	14,572	14,542	15,578	14,595
28	1996	14,524	14,690	15,900	15,289	15,109	14,994	14,858	14,705	14,581	14,486	14,428	14,402	15,889	14,448
29	1997	14,923	15,901	15,900	15,700	15,407	15,127	14,995	14,867	14,761	14,661	14,603	14,583	15,881	14,625
30	1998	14,545	12,428	15,898	15,240	15,201	15,199	15,087	14,944	14,814	14,733	14,686	14,661	15,658	14,702
31	1999	14,635	14,615	14,585	14,535	14,462	14,377	14,248	14,138	14,031	13,933	13,872	13,836	14,563	13,895
32	2000	13,804	13,892	15,860	15,799	15,439	15,322	15,190	15,051	14,933	14,844	14,802	14,774	15,853	14,821
33	2001	14,744	14,714	14,672	14,610	14,509	14,368	14,236	14,110	13,995	13,903	13,846	13,822	14,639	13,866
34	2002	13,864	13,850	13,803	13,739	13,940	14,935	14,795	14,657	14,529	14,424	14,364	14,393	13,771	14,392
35	2003	15,896	15,870	15,827	15,486	15,183	15,062	14,909	14,764	14,641	14,531	14,465	14,441	15,794	14,480
36	2004	14,424	14,400	14,352	14,507	15,168	15,047	14,915	14,779	14,641	14,542	14,486	14,454	14,316	14,507
37	2005	14,431	14,847	15,896	15,370	15,179	15,075	14,934	14,784	14,664	14,572	14,510	14,467	15,830	14,540
38	2006	14,446	14,419	15,196	15,167	15,180	15,065	14,915	14,762	14,642	14,555	14,499	14,467	15,479	14,515
39	2007	14,434	14,403	14,360	14,287	14,733	15,123	14,983	14,846	14,719	14,640	14,583	14,544	14,325	14,609
40	2008	14,523	15,777	15,880	15,802	15,692	15,557	15,408	15,264	15,126	15,029	14,970	14,943	15,846	14,988
41	2009	14,919	14,886	14,852	14,780	14,683	14,568	14,427	14,289	14,163	14,072	14,023	13,993	14,817	14,044
42	2010	13,976	14,172	15,899	15,337	15,191	15,091	14,952	14,822	14,705	14,611	14,564	14,542	15,820	14,583
43	2011	14,526	14,492	14,693	15,517	15,159	15,066	14,937	14,807	14,681	14,595	14,542	14,507	15,840	14,562
44	2012	14,468	14,432	14,377	14,316	14,213	14,089	13,949	13,808	13,690	13,603	13,555	13,523	14,352	13,576
45	2013	13,505	13,481	13,435	13,364	13,272	13,290	13,212	13,091	12,985	12,902	12,840	12,805	13,404	12,867
46	2014	12,766	12,730	12,687	13,705	14,152	14,015	13,879	13,746	13,635	13,542	13,483	13,457	12,673	13,506
47	2015	13,437	13,409	13,364	13,290	13,203	13,103	12,975	12,851	12,786	-	-	-	13,327	-
48	*Minimum*	*0*	*0*	*0*	*0*	*15*	*959*	*1,512*	*1,497*	*1,483*	*1,471*	*0*	*0*	*0*	*1,468*
49	*Maximum*	*15,896*	*15,901*	*15,900*	*15,810*	*15,692*	*15,557*	*15,408*	*15,264*	*15,126*	*15,029*	*14,970*	*14,943*	*15,889*	*14,988*
50	*Mean*	*13,370*	*13,542*	*13,901*	*13,833*	*13,954*	*14,005*	*13,921*	*13,817*	*13,721*	*13,655*	*13,306*	*13,279*	*13,897*	*13,623*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 69. 15,000 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	648.00	648.44
2	1970	682.56	685.69	695.35	699.76	703.18	704.81	704.56	703.59	703.11	698.82	692.22	693.82
3	1971	698.42	697.06	698.31	708.04	712.49	713.96	715.18	716.64	716.74	711.78	703.95	703.63
4	1972	704.54	705.62	710.70	717.16	722.09	722.09	721.73	717.32	716.39	712.55	708.54	709.79
5	1973	721.40	722.09	722.09	722.09	722.09	721.91	721.14	720.27	719.35	713.83	707.43	716.20

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
6	1974	722.09	721.85	722.09	722.09	722.09	722.04	721.46	720.69	713.14	705.35	698.74	697.31
7	1975	697.80	715.06	722.09	722.09	722.09	721.97	721.37	720.62	719.80	715.67	707.15	703.06
8	1976	703.06	706.01	713.55	714.34	713.98	713.19	712.36	711.47	710.49	709.94	703.43	700.19
9	1977	700.17	705.30	714.28	715.71	718.88	718.65	717.87	717.03	714.45	708.06	703.12	700.63
10	1978	717.66	722.09	722.23	722.09	721.36	720.66	719.86	718.91	717.91	711.67	703.15	700.17
11	1979	701.71	710.87	713.19	718.34	719.62	719.17	718.17	717.35	715.44	708.48	700.71	698.44
12	1980	712.53	725.92	722.09	722.09	721.57	721.32	720.88	718.63	717.00	711.09	703.13	701.75
13	1981	704.42	708.79	720.48	720.61	720.51	719.57	717.75	714.72	711.98	708.92	709.30	712.10
14	1982	722.29	722.09	723.17	722.76	722.07	720.67	719.29	718.65	717.86	712.04	702.46	714.28
15	1983	724.96	725.62	727.00	722.09	722.09	721.44	720.95	719.98	719.50	714.17	705.92	716.29
16	1984	716.29	716.09	717.62	718.66	720.30	719.87	719.18	716.17	714.80	706.48	703.17	701.44
17	1985	701.97	706.07	714.90	718.85	720.98	720.32	719.58	718.60	715.95	708.74	706.01	700.10
18	1986	697.78	731.55	722.90	722.09	722.09	721.19	720.30	719.56	718.89	712.76	707.20	700.57
19	1987	699.14	700.93	709.95	717.03	719.27	718.88	718.16	717.46	714.60	705.61	696.08	695.69
20	1988	696.80	696.90	704.38	712.28	717.27	718.17	717.49	716.55	714.27	705.69	699.34	696.88
21	1989	695.50	699.15	707.13	710.15	711.87	711.52	710.76	709.81	709.05	701.56	698.96	698.50
22	1990	698.97	705.94	708.96	709.92	711.50	712.51	711.99	711.15	710.40	706.62	703.68	699.76
23	1991	700.12	708.24	717.74	717.94	717.96	717.76	715.13	712.54	710.11	705.46	700.43	696.72
24	1992	697.13	710.10	711.21	715.87	717.98	717.63	716.84	713.92	713.00	706.22	697.29	696.55
25	1993	719.12	722.11	722.09	722.09	721.79	721.28	720.73	719.86	719.08	712.45	706.33	704.82
26	1994	704.99	708.47	710.57	715.91	722.09	722.09	722.09	720.82	719.85	716.04	709.68	705.56
27	1995	722.09	722.09	725.97	722.09	722.06	721.14	720.91	720.22	719.37	714.48	708.20	705.59
28	1996	717.87	722.87	722.09	722.09	721.86	721.20	720.46	719.58	718.68	711.60	701.67	708.21
29	1997	725.30	722.09	722.09	722.09	722.09	721.94	721.74	721.03	720.30	713.40	705.97	705.43
30	1998	718.44	727.00	722.09	722.09	722.09	722.09	721.82	720.15	715.44	710.09	704.82	703.19
31	1999	704.44	715.81	718.18	720.95	721.19	720.58	719.44	717.94	716.34	714.88	709.93	705.86
32	2000	707.85	721.36	722.09	722.09	722.09	721.80	720.74	719.13	716.63	712.66	705.61	703.04
33	2001	703.14	709.90	715.16	718.79	720.60	719.14	717.80	718.69	718.56	717.87	717.86	718.41
34	2002	719.67	717.74	715.60	717.40	721.69	721.83	720.84	718.78	716.67	712.46	709.32	721.97
35	2003	722.09	718.29	720.09	722.09	722.09	721.22	720.31	718.54	717.06	710.22	707.93	704.69
36	2004	708.54	718.05	719.91	722.09	722.09	720.61	719.80	718.35	714.56	707.53	703.18	705.23
37	2005	717.04	722.09	722.09	722.09	722.09	721.50	720.14	719.09	718.12	713.25	705.92	706.45
38	2006	715.16	716.31	722.09	722.09	722.09	721.62	720.75	719.50	718.28	715.63	709.07	704.52
39	2007	704.05	705.99	711.62	718.78	722.09	721.80	716.40	715.78	714.92	710.77	707.70	707.11
40	2008	720.24	722.09	722.09	721.59	721.74	720.86	720.86	719.95	718.72	718.40	718.23	713.72
41	2009	707.83	711.92	718.96	718.39	718.82	718.03	717.91	715.92	715.09	714.66	714.52	710.16
42	2010	717.72	722.09	722.09	722.09	722.09	720.53	719.58	718.27	717.16	717.58	718.50	714.56
43	2011	711.17	718.20	722.16	722.09	722.06	721.87	721.50	720.32	719.16	718.55	718.25	714.32
44	2012	707.28	707.13	707.04	711.15	715.15	715.62	715.24	716.97	718.30	717.27	709.80	714.65
45	2013	715.33	715.53	715.56	719.26	719.85	719.80	719.73	718.74	715.79	710.20	707.16	707.11

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
46	2014	706.95	711.77	718.48	720.88	720.89	720.25	719.69	718.71	717.63	710.82	704.37	710.77
47	2015	710.90	712.69	712.73	717.55	717.52	715.88	715.01	713.34	709.74	-	-	-
48	*Minimum*	*682.56*	*685.69*	*695.35*	*699.76*	*703.18*	*704.81*	*704.56*	*703.59*	*703.11*	*698.82*	*648.00*	*648.44*
49	*Maximum*	*725.30*	*731.55*	*727.00*	*722.76*	*722.09*	*722.09*	*722.09*	*721.03*	*720.30*	*718.55*	*718.50*	*721.97*
50	*Mean*	*709.23*	*713.93*	*716.79*	*718.65*	*719.77*	*719.39*	*718.60*	*717.42*	*715.86*	*711.16*	*704.64*	*704.30*

Table 70. 15,000 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	0.00	0.00
2	1970	0.00	0.00	0.00	0.00	0.08	1.71	1.51	2.14	2.54	2.21	2.35	2.33
3	1971	2.18	2.25	2.17	4.94	9.39	10.86	12.08	13.54	13.64	14.85	16.50	16.48
4	1972	16.20	15.84	14.75	14.06	18.99	18.99	18.69	20.12	20.12	21.02	22.23	21.78
5	1973	19.70	20.39	20.31	19.05	19.02	18.85	19.42	19.38	19.38	20.67	22.52	19.83
6	1974	20.39	20.43	20.39	18.99	18.99	18.95	18.56	19.29	20.99	23.33	26.00	26.58
7	1975	26.25	19.96	20.36	19.06	18.99	18.88	19.02	19.28	19.27	20.14	22.68	24.74
8	1976	24.71	22.80	20.33	20.10	20.10	20.10	20.11	20.11	20.21	20.24	22.18	23.24
9	1977	23.12	21.40	18.70	18.34	17.46	17.45	17.46	17.40	17.87	19.33	21.16	21.28
10	1978	16.80	20.33	20.37	18.99	19.50	19.47	19.46	19.47	19.50	20.96	23.87	24.89
11	1979	24.02	20.84	20.21	18.80	18.49	18.46	18.48	18.47	18.76	20.43	22.80	23.71
12	1980	19.05	13.42	20.39	19.08	19.87	19.85	19.77	20.10	20.31	21.80	24.78	24.84
13	1981	23.70	22.23	18.94	18.86	18.83	18.85	19.05	19.60	20.07	20.81	20.52	19.70
14	1982	16.87	20.39	16.85	16.46	18.97	19.48	19.68	19.64	19.62	21.00	24.59	20.24
15	1983	13.60	20.18	12.00	18.99	18.99	19.17	19.33	19.35	19.26	20.48	22.97	19.72
16	1984	19.71	19.70	19.24	18.88	18.45	18.46	18.41	18.90	19.04	21.24	22.25	22.59
17	1985	22.34	21.08	18.51	17.51	17.88	18.34	18.31	18.29	18.75	20.54	21.33	23.18
18	1986	24.27	7.88	21.00	18.99	18.99	19.41	19.46	19.42	19.39	20.85	22.56	24.93
19	1987	25.56	24.52	21.29	19.20	18.56	18.60	18.60	18.61	19.14	21.62	25.33	25.36
20	1988	24.78	24.61	21.45	18.98	17.65	17.41	17.44	17.46	17.81	19.97	21.73	22.83
21	1989	23.35	21.58	19.11	18.20	17.65	17.71	17.73	17.74	17.71	19.65	20.24	20.31
22	1990	20.05	18.12	17.25	16.95	16.41	16.14	16.14	16.18	16.21	16.85	17.60	18.48
23	1991	18.32	16.21	15.86	15.00	14.93	15.10	16.10	16.39	16.85	17.86	19.02	20.04
24	1992	19.83	16.42	16.08	15.08	14.88	14.60	15.33	15.75	15.74	17.10	19.41	19.54
25	1993	17.42	19.11	19.09	18.99	18.75	19.38	19.33	19.31	19.29	20.82	22.73	23.07
26	1994	22.97	21.79	20.97	19.41	18.99	18.99	18.99	19.47	19.47	20.25	22.06	23.38
27	1995	20.17	20.39	14.26	18.99	18.96	19.45	19.40	19.36	19.34	20.46	22.24	23.02
28	1996	19.30	12.38	20.39	18.99	18.78	19.36	19.32	19.28	19.27	20.94	24.18	21.87
29	1997	17.84	20.39	20.38	19.10	18.99	18.86	18.67	19.21	19.19	20.76	23.04	23.12
30	1998	18.64	9.18	20.18	18.99	18.99	18.99	18.76	19.51	20.50	21.90	23.52	24.03
31	1999	23.49	19.94	19.29	17.91	18.09	18.54	18.65	18.80	19.02	19.26	20.40	21.65

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
32	2000	20.91	19.66	20.39	19.08	19.06	18.80	19.73	19.91	20.31	21.23	23.50	25.20
33	2001	24.53	21.84	20.26	19.21	18.70	18.83	18.81	18.46	18.44	18.33	18.33	18.13
34	2002	17.97	18.36	18.74	18.26	18.59	18.73	19.16	19.39	19.72	20.63	21.50	20.27
35	2003	20.39	21.26	20.68	18.99	18.99	19.45	19.44	19.60	19.78	21.51	22.12	23.07
36	2004	21.80	19.06	18.55	18.99	18.99	19.55	19.53	19.68	20.48	22.44	23.83	22.93
37	2005	19.37	20.39	20.30	18.99	18.99	18.86	19.52	19.51	19.54	20.66	22.90	22.57
38	2006	19.89	19.52	20.37	18.83	18.99	18.60	19.36	19.38	19.48	19.97	21.79	23.21
39	2007	23.26	22.61	20.61	18.68	18.99	18.76	20.42	20.46	20.49	21.46	22.43	22.54
40	2008	18.77	20.39	20.39	20.28	20.24	20.04	20.04	20.03	20.11	19.92	19.93	21.09
41	2009	22.97	21.41	19.52	19.52	19.36	19.42	19.16	19.53	19.56	19.43	19.44	20.50
42	2010	18.52	20.39	20.30	18.99	18.99	19.64	19.65	19.75	19.84	19.47	19.23	20.23
43	2011	21.06	19.17	17.31	18.99	18.96	18.79	18.48	19.27	19.33	19.27	19.28	20.26
44	2012	22.35	22.33	22.23	20.66	19.45	19.24	19.21	18.36	17.98	18.14	19.88	18.57
45	2013	18.39	18.30	18.27	17.17	16.75	16.70	16.64	17.10	17.60	18.78	19.49	19.44
46	2014	19.42	18.01	16.45	17.78	17.79	17.24	18.07	18.06	18.12	19.65	21.51	19.43
47	2015	19.37	18.86	18.81	17.50	17.49	17.76	17.79	17.93	18.63	-	-	-
48	*Minimum*	*0.00*	*0.00*	*0.00*	*0.00*	*0.08*	*1.71*	*1.51*	*2.14*	*2.54*	*2.21*	*0.00*	*0.00*
49	*Maximum*	*26.25*	*24.61*	*22.23*	*20.66*	*20.24*	*20.10*	*20.42*	*20.46*	*20.99*	*23.33*	*26.00*	*26.58*
50	*Mean*	*19.86*	*18.59*	*18.33*	*17.80*	*17.93*	*18.06*	*18.22*	*18.43*	*18.65*	*19.74*	*20.83*	*20.96*

Table 71. 15,000 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year

		Days threshold is exceeded																	
ID (1)	Year (2)	703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	211.1	196.2	189.2	185.6	182.0	174.5	167.1	160.3	153.6	146.5	139.0	99.6	83.2	58.5	0.0	0.0	0.0	0.0	0.0
4	1972	366.0	354.2	328.8	312.3	294.3	267.1	258.1	220.7	198.5	188.5	179.6	172.0	163.8	155.4	0.0	0.0	0.0	0.0	0.0
5	1973	365.0	365.0	365.0	365.0	365.0	346.0	329.0	323.7	308.8	285.8	276.8	271.0	263.8	255.8	0.0	0.0	0.0	0.0	0.0
6	1974	286.8	279.4	274.6	272.4	270.2	265.9	262.0	258.3	254.9	251.1	247.4	243.6	239.5	236.0	0.0	0.0	0.0	0.0	0.0
7	1975	286.9	278.9	273.2	270.3	267.5	261.6	257.7	253.5	248.8	243.2	237.1	231.0	224.3	217.1	0.0	0.0	0.0	0.0	0.0
8	1976	258.5	250.0	243.8	240.7	237.6	231.4	224.8	218.1	195.2	143.2	112.8	73.4	25.1	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	252.9	240.4	231.4	227.1	222.9	214.3	205.8	197.1	188.5	179.0	172.3	165.0	156.6	145.6	0.0	0.0	0.0	0.0	0.0
10	1978	294.9	285.9	281.5	279.3	277.3	273.2	269.5	266.1	262.8	259.5	256.3	253.0	250.0	242.5	0.0	0.0	0.0	0.0	0.0
11	1979	248.7	240.1	236.2	234.2	231.7	226.8	221.9	217.2	212.3	203.2	184.7	166.5	155.2	144.2	0.0	0.0	0.0	0.0	0.0
12	1980	293.8	288.4	284.5	282.5	280.4	276.2	272.1	268.0	252.3	242.9	232.1	219.3	215.1	211.0	0.0	0.0	0.0	0.0	0.0
13	1981	336.8	335.6	317.7	316.0	314.5	311.5	308.4	253.8	203.5	193.5	174.8	159.0	145.9	131.9	0.0	0.0	0.0	0.0	0.0
14	1982	332.7	327.2	306.5	302.7	301.0	297.9	294.7	291.5	288.4	285.0	281.6	274.9	269.5	258.9	0.0	0.0	0.0	0.0	0.0
15	1983	353.1	343.3	329.4	327.3	325.1	320.8	316.5	311.8	296.6	292.4	281.1	271.2	258.3	253.4	0.0	0.0	0.0	0.0	0.0
16	1984	306.5	281.8	278.6	277.1	275.5	272.4	269.5	266.4	263.5	260.4	257.3	246.0	224.6	197.1	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
17	1985	279.5	261.0	255.0	251.9	247.5	214.5	208.2	202.2	195.7	188.4	180.7	174.1	169.9	162.0	0.0	0.0	0.0	0.0	0.0
18	1986	280.5	271.8	267.9	266.0	264.2	259.5	254.1	242.3	238.2	234.0	230.0	226.0	222.0	217.8	1.5	0.0	0.0	0.0	0.0
19	1987	213.8	205.2	199.3	196.5	193.6	187.8	182.4	176.5	170.3	163.9	157.2	150.0	140.0	130.3	0.0	0.0	0.0	0.0	0.0
20	1988	199.5	190.1	182.2	178.8	175.3	168.4	161.7	155.2	148.5	141.6	134.0	125.5	114.1	101.9	0.0	0.0	0.0	0.0	0.0
21	1989	198.8	190.0	183.0	178.6	175.0	167.5	153.0	133.2	86.3	42.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	265.0	250.7	241.2	233.3	225.6	205.2	195.4	164.1	129.9	69.5	26.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	250.8	238.2	228.5	223.0	218.3	208.3	198.6	189.1	181.8	157.0	133.8	119.5	107.2	97.8	0.0	0.0	0.0	0.0	0.0
24	1992	239.3	235.3	232.1	230.5	228.8	225.0	220.3	205.6	179.4	168.6	160.3	143.3	102.3	93.0	0.0	0.0	0.0	0.0	0.0
25	1993	352.5	352.4	297.3	294.9	292.6	288.1	282.4	275.7	270.1	264.7	258.3	254.0	250.0	245.3	0.0	0.0	0.0	0.0	0.0
26	1994	365.0	365.0	324.4	285.5	278.9	267.3	256.4	245.6	237.7	201.3	192.4	184.0	174.6	162.5	0.0	0.0	0.0	0.0	0.0
27	1995	365.0	343.3	339.2	331.6	315.8	305.0	296.3	290.3	285.3	280.2	275.2	270.4	265.7	260.1	0.0	0.0	0.0	0.0	0.0
28	1996	310.6	290.5	286.7	284.3	280.5	273.1	264.3	258.3	255.0	251.3	246.1	241.0	236.1	231.1	0.0	0.0	0.0	0.0	0.0
29	1997	365.0	344.8	329.3	306.0	303.8	299.0	294.2	288.9	284.4	279.8	276.4	273.0	269.4	265.8	0.0	0.0	0.0	0.0	0.0
30	1998	350.4	309.3	302.8	294.8	286.5	278.9	272.9	266.3	259.0	252.9	246.9	240.1	233.3	227.3	0.0	0.0	0.0	0.0	0.0
31	1999	344.9	335.5	306.8	297.8	281.0	275.6	271.1	267.4	260.8	252.5	248.5	242.7	227.8	219.5	0.0	0.0	0.0	0.0	0.0
32	2000	317.2	311.8	307.7	305.5	277.7	272.8	251.2	246.1	241.3	237.0	232.7	225.5	221.1	217.4	0.0	0.0	0.0	0.0	0.0
33	2001	339.5	325.4	321.3	315.2	313.6	310.2	309.6	308.7	305.1	301.9	301.5	296.3	287.3	267.4	0.0	0.0	0.0	0.0	0.0
34	2002	365.0	365.0	365.0	337.7	335.2	329.1	324.2	320.5	317.0	312.8	307.5	283.9	275.7	253.2	0.0	0.0	0.0	0.0	0.0
35	2003	365.0	326.4	315.5	313.6	311.4	307.5	300.7	278.5	274.3	269.5	266.1	262.2	256.0	252.8	0.0	0.0	0.0	0.0	0.0
36	2004	311.5	298.5	293.5	286.3	278.7	274.1	263.0	231.3	215.8	205.4	201.5	197.6	193.3	173.9	0.0	0.0	0.0	0.0	0.0
37	2005	331.2	312.6	308.1	305.7	303.2	297.2	291.2	284.2	279.5	274.7	269.5	263.8	258.5	252.9	0.0	0.0	0.0	0.0	0.0
38	2006	365.0	342.2	329.3	326.1	322.6	312.8	306.8	302.6	298.2	293.6	289.1	283.3	269.7	238.4	0.0	0.0	0.0	0.0	0.0
39	2007	365.0	365.0	308.0	307.4	306.0	278.9	216.3	201.5	193.4	184.3	176.9	168.1	160.6	138.3	0.0	0.0	0.0	0.0	0.0
40	2008	366.0	366.0	366.0	366.0	366.0	362.3	361.0	353.3	346.8	339.3	318.0	313.3	308.5	304.1	0.0	0.0	0.0	0.0	0.0
41	2009	365.0	355.5	352.1	350.6	349.1	304.6	293.3	289.8	286.0	278.3	266.8	261.7	258.3	184.3	0.0	0.0	0.0	0.0	0.0
42	2010	365.0	347.3	346.3	346.2	346.1	345.5	345.3	345.3	344.1	333.0	324.4	319.6	315.0	309.8	0.0	0.0	0.0	0.0	0.0
43	2011	365.0	365.0	365.0	365.0	365.0	365.0	361.7	357.3	353.5	310.3	294.9	289.7	283.1	275.8	0.0	0.0	0.0	0.0	0.0
44	2012	366.0	366.0	366.0	366.0	358.5	312.5	217.0	205.9	198.5	189.2	179.5	169.6	158.8	108.9	0.0	0.0	0.0	0.0	0.0
45	2013	365.0	365.0	365.0	365.0	365.0	354.8	286.4	280.2	274.2	268.3	264.3	260.4	256.5	225.6	0.0	0.0	0.0	0.0	0.0
46	2014	365.0	365.0	313.5	310.7	306.4	268.5	259.8	249.9	234.0	216.5	208.4	200.7	192.8	184.9	0.0	0.0	0.0	0.0	0.0
47	2015	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	240.5	193.8	184.0	120.7	103.7	76.7	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	366.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	309.8	1.5	0.0	0.0	0.0	0.0
50	*Mean*	302.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	178.4	0.0	0.0	0.0	0.0	0.0

Table 72. 15,000 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	211.1	196.2	189.2	185.6	182.0	174.5	167.1	160.3	153.6	146.5	139.0	99.6	83.2	58.5	0.0	0.0	0.0	0.0	0.0
4	1972	366.0	354.2	328.8	312.3	294.3	267.1	258.1	220.7	198.5	188.5	179.6	172.0	163.8	155.4	0.0	0.0	0.0	0.0	0.0
5	1973	365.0	365.0	365.0	365.0	365.0	346.0	329.0	323.7	308.8	285.8	276.8	271.0	263.8	255.8	0.0	0.0	0.0	0.0	0.0
6	1974	286.8	279.4	274.6	272.4	270.2	265.9	262.0	258.3	254.9	251.1	247.4	243.6	239.5	236.0	0.0	0.0	0.0	0.0	0.0
7	1975	286.9	278.9	273.2	270.3	267.5	261.6	257.7	253.5	248.8	243.2	237.1	231.0	224.3	217.1	0.0	0.0	0.0	0.0	0.0
8	1976	258.5	250.0	243.8	240.7	237.6	231.4	224.8	218.1	195.2	143.2	112.8	73.4	25.1	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	252.9	240.4	231.4	227.1	222.9	214.3	205.8	197.1	188.5	179.0	172.3	165.0	156.6	145.6	0.0	0.0	0.0	0.0	0.0
10	1978	294.9	285.9	281.5	279.3	277.3	273.2	269.5	266.1	262.8	259.5	256.3	253.0	250.0	242.5	0.0	0.0	0.0	0.0	0.0
11	1979	248.7	240.1	236.2	234.2	231.7	226.8	221.9	217.2	212.3	203.2	184.7	166.5	155.2	144.2	0.0	0.0	0.0	0.0	0.0
12	1980	288.4	283.4	279.8	278.0	276.0	272.1	268.4	264.6	249.5	241.3	231.5	219.3	215.1	211.0	0.0	0.0	0.0	0.0	0.0
13	1981	336.8	335.6	317.7	316.0	314.5	311.5	308.4	253.8	203.5	193.5	174.8	159.0	145.9	131.9	0.0	0.0	0.0	0.0	0.0
14	1982	329.2	324.6	304.9	301.9	300.6	297.9	294.7	291.5	288.4	285.0	281.6	274.9	269.5	258.9	0.0	0.0	0.0	0.0	0.0
15	1983	338.6	330.8	318.3	317.2	315.8	313.0	309.9	306.3	292.2	289.3	278.8	269.4	257.0	253.4	0.0	0.0	0.0	0.0	0.0
16	1984	306.5	281.8	278.6	277.1	275.5	272.4	269.5	266.4	263.5	260.4	257.3	246.0	224.6	197.1	0.0	0.0	0.0	0.0	0.0
17	1985	279.5	261.0	255.0	251.9	247.5	214.5	208.2	202.2	195.7	188.4	180.7	174.1	169.9	162.0	0.0	0.0	0.0	0.0	0.0
18	1986	273.2	264.9	261.3	259.6	257.9	253.5	248.4	237.0	233.3	229.8	226.2	222.6	219.0	215.0	1.5	0.0	0.0	0.0	0.0
19	1987	213.8	205.2	199.3	196.5	193.6	187.8	182.4	176.5	170.3	163.9	157.2	150.0	140.0	130.3	0.0	0.0	0.0	0.0	0.0
20	1988	199.5	190.1	182.2	178.8	175.3	168.4	161.7	155.2	148.5	141.6	134.0	125.5	114.1	101.9	0.0	0.0	0.0	0.0	0.0
21	1989	198.8	190.0	183.0	178.6	175.0	167.5	153.0	133.2	86.3	42.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	265.0	250.7	241.2	233.3	225.6	205.2	195.4	164.1	129.9	69.5	26.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	250.8	238.2	228.5	223.0	218.3	208.3	198.6	189.1	181.8	157.0	133.8	119.5	107.2	97.8	0.0	0.0	0.0	0.0	0.0
24	1992	239.3	235.3	232.1	230.5	228.8	225.0	220.3	205.6	179.4	168.6	160.3	143.3	102.3	93.0	0.0	0.0	0.0	0.0	0.0
25	1993	352.5	352.4	297.3	294.9	292.6	288.1	282.4	275.7	270.1	264.7	258.3	254.0	250.0	245.3	0.0	0.0	0.0	0.0	0.0
26	1994	365.0	365.0	324.4	285.5	278.9	267.3	256.4	245.6	237.7	201.3	192.4	184.0	174.6	162.5	0.0	0.0	0.0	0.0	0.0
27	1995	358.7	337.6	334.1	326.9	311.4	301.3	293.6	288.7	284.1	279.5	275.2	270.4	265.7	260.1	0.0	0.0	0.0	0.0	0.0
28	1996	306.0	286.4	282.8	280.5	277.0	270.2	262.3	257.0	254.3	251.3	246.1	241.0	236.1	231.1	0.0	0.0	0.0	0.0	0.0
29	1997	359.5	341.0	326.3	303.4	301.8	298.4	294.2	288.9	284.4	279.8	276.4	273.0	269.4	265.8	0.0	0.0	0.0	0.0	0.0
30	1998	339.6	299.8	293.5	285.7	277.5	270.2	265.1	259.5	252.9	247.6	242.3	236.2	230.3	225.8	0.0	0.0	0.0	0.0	0.0
31	1999	344.9	335.5	306.8	297.8	281.0	275.6	271.1	267.4	260.8	252.5	248.5	242.7	227.8	219.5	0.0	0.0	0.0	0.0	0.0
32	2000	317.2	311.8	307.7	305.5	277.7	272.8	251.2	246.1	241.3	237.0	232.7	225.5	221.1	217.4	0.0	0.0	0.0	0.0	0.0
33	2001	339.5	325.4	321.3	315.2	313.6	310.2	309.6	308.7	305.1	301.9	301.5	296.3	287.3	267.4	0.0	0.0	0.0	0.0	0.0
34	2002	365.0	365.0	365.0	337.7	335.2	329.1	324.2	320.5	317.0	312.8	307.5	283.9	275.7	253.2	0.0	0.0	0.0	0.0	0.0
35	2003	365.0	326.4	315.5	313.6	311.4	307.5	300.7	278.5	274.3	269.5	266.1	262.2	256.0	252.8	0.0	0.0	0.0	0.0	0.0
36	2004	311.5	298.5	293.5	286.3	278.7	274.1	263.0	231.3	215.8	205.4	201.5	197.6	193.3	173.9	0.0	0.0	0.0	0.0	0.0
37	2005	331.2	312.6	308.1	305.7	303.2	297.2	291.2	284.2	279.5	274.7	269.5	263.8	258.5	252.9	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
38	2006	364.5	342.2	329.3	326.1	322.6	312.8	306.8	302.6	298.2	293.6	289.1	283.3	269.7	238.4	0.0	0.0	0.0	0.0	0.0
39	2007	365.0	365.0	308.0	307.4	306.0	278.9	216.3	201.5	193.4	184.3	176.9	168.1	160.6	138.3	0.0	0.0	0.0	0.0	0.0
40	2008	366.0	366.0	366.0	366.0	366.0	362.3	361.0	353.3	346.8	339.3	318.0	313.3	308.5	304.1	0.0	0.0	0.0	0.0	0.0
41	2009	365.0	355.5	352.1	350.6	349.1	304.6	293.3	289.8	286.0	278.3	266.8	261.7	258.3	184.3	0.0	0.0	0.0	0.0	0.0
42	2010	365.0	347.3	346.3	346.2	346.1	345.5	345.3	345.3	344.1	333.0	324.4	319.6	315.0	309.8	0.0	0.0	0.0	0.0	0.0
43	2011	362.9	364.3	365.0	365.0	365.0	365.0	361.7	357.3	353.5	310.3	294.9	289.7	283.1	275.8	0.0	0.0	0.0	0.0	0.0
44	2012	366.0	366.0	366.0	366.0	358.5	312.5	217.0	205.9	198.5	189.2	179.5	169.6	158.8	108.9	0.0	0.0	0.0	0.0	0.0
45	2013	365.0	365.0	365.0	365.0	365.0	354.8	286.4	280.2	274.2	268.3	264.3	260.4	256.5	225.6	0.0	0.0	0.0	0.0	0.0
46	2014	365.0	365.0	313.5	310.7	306.4	268.5	259.8	249.9	234.0	216.5	208.4	200.7	192.8	184.9	0.0	0.0	0.0	0.0	0.0
47	2015	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	240.5	193.8	184.0	120.7	103.7	76.7	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	366.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	309.8	1.5	0.0	0.0	0.0	0.0
50	*Mean*	301.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	178.3	0.0	0.0	0.0	0.0	0.0

Table 73. 15,000 ac-ft reallocation with FIRO: annual event results

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	648.46	682.10	0	47	66	2,937	5,133
2	1971	685.33	698.42	113	19	40	853	982
3	1972	703.05	704.04	0	2	20	251	272
4	1973	720.09	722.09	3,068	2,986	3,274	3,719	3,798
5	1974	710.57	722.09	201	154	154	1,102	3,420
6	1975	715.08	722.09	2,105	2,062	2,447	2,428	2,479
7	1976	703.04	710.54	0	3	3	101	108
8	1977	699.96	700.14	9	10	10	138	172
9	1978	700.61	717.66	131	6	28	1,511	2,291
10	1979	701.83	710.87	0	11	22	1,179	1,437
11	1980	709.50	725.92	3,093	3,064	3,888	4,602	9,350
12	1981	701.70	704.42	0	17	33	677	713
13	1982	709.37	722.29	3,079	3,023	3,404	6,460	7,256
14	1983	711.33	724.96	3,075	3,061	3,813	6,006	7,992
15	1984	709.40	716.28	106	6	199	1,313	1,858
16	1985	711.11	716.31	0	3	31	167	352
17	1986	699.45	731.55	4,500	4,541	4,718	8,258	11,362
18	1987	699.21	700.81	0	3	250	940	2,103
19	1988	695.95	696.74	0	17	163	359	1,344
20	1989	699.17	706.07	0	8	22	293	901
21	1990	701.05	705.93	0	13	64	844	2,344
22	1991	703.16	711.12	0	2	33	477	1,238
23	1992	697.13	710.10	97	9	185	1,088	3,279
24	1993	695.22	719.15	126	8	325	4,373	10,049
25	1994	704.98	709.95	0	8	109	476	1,287
26	1995	718.32	725.97	3,148	3,061	3,752	4,856	14,720

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	718.71	722.87	3,041	3,062	3,657	4,774	9,527
28	1997	719.23	725.30	3,022	3,062	3,680	5,771	9,869
29	1998	716.99	727.00	4,528	4,385	4,825	8,550	18,145
30	1999	704.47	713.21	0	10	216	1,788	4,380
31	2000	707.93	717.40	121	8	243	2,373	6,208
32	2001	705.32	715.12	0	3	56	442	754
33	2002	716.87	719.67	49	2	97	955	2,392
34	2003	705.28	719.39	0	8	1,031	3,450	9,906
35	2004	710.21	718.05	0	6	117	3,465	3,510
36	2005	716.24	722.09	1,117	1,019	1,177	1,262	1,834
37	2006	703.14	713.33	0	3	337	8,827	10,102
38	2007	704.34	706.50	0	5	92	2,817	2,621
39	2008	711.35	720.24	107	5	45	989	972
40	2009	711.63	718.86	10	9	88	2,214	3,384
41	2010	703.96	716.59	0	7	153	4,644	4,970
42	2011	719.37	722.16	3,122	3,062	3,791	5,130	10,711
43	2012	707.21	708.79	0	10	32	2,272	2,310
44	2013	707.37	714.65	10	4	67	2,311	6,448
45	2014	709.71	715.78	0	6	19	1,585	1,464
46	2015	704.22	710.77	0	7	75	5,165	8,647

Table 74. 15,000 ac-ft reallocation with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	0.00	0.00	0	0	0	0	0
2	1971	2.62	2.18	0	0	0	0	0
3	1972	17.45	16.36	0	0	0	0	0
4	1973	18.47	20.39	1,367	1,351	1,566	1,237	911
5	1974	21.40	20.39	-23	-28	-70	0	0
6	1975	19.95	20.37	1,068	1,109	1,493	691	-60
7	1976	24.75	21.21	0	0	0	0	0
8	1977	23.27	23.16	0	0	0	0	0
9	1978	21.29	16.80	0	0	0	0	0
10	1979	23.96	20.85	0	0	0	0	0
11	1980	19.80	13.42	1,008	1,009	984	960	278
12	1981	24.78	23.70	0	0	0	0	0
13	1982	20.48	16.87	995	997	1,204	534	0
14	1983	20.97	13.60	957	1,001	1,158	872	208
15	1984	21.73	19.71	0	0	0	0	0
16	1985	19.47	18.15	0	0	0	0	0
17	1986	23.41	7.88	1,472	1,479	1,112	1,351	1,332
18	1987	25.51	24.63	0	0	0	0	0
19	1988	25.24	24.81	0	0	0	0	0
20	1989	21.57	19.48	0	0	0	0	0
21	1990	19.47	18.12	0	0	0	0	0
22	1991	17.78	15.58	0	0	0	0	0
23	1992	19.83	16.42	0	0	0	0	0
24	1993	20.14	17.45	-462	-492	-348	0	0
25	1994	22.96	21.28	0	0	0	0	0

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
26	1995	21.24	14.26	996	1,006	1,134	967	-74
27	1996	17.01	12.38	994	1,006	1,105	985	594
28	1997	17.53	17.84	984	1,006	956	708	-370
29	1998	18.89	9.18	1,509	1,323	536	2,322	469
30	1999	23.48	20.67	0	0	0	0	0
31	2000	20.88	18.33	0	0	0	0	0
32	2001	23.38	20.29	0	0	0	0	0
33	2002	18.50	17.97	-40	-43	0	0	0
34	2003	22.72	18.66	0	0	0	0	0
35	2004	21.19	19.06	0	0	0	0	0
36	2005	19.54	20.39	0	-54	111	-129	-130
37	2006	23.96	20.39	0	0	0	0	0
38	2007	23.11	22.43	0	0	0	0	0
39	2008	20.99	18.77	0	0	0	0	0
40	2009	21.48	19.55	0	0	0	0	0
41	2010	22.47	18.80	0	0	0	0	0
42	2011	18.88	17.31	993	946	1,133	-25	-15
43	2012	22.11	21.52	0	0	0	0	0
44	2013	20.60	18.57	0	0	0	0	0
45	2014	18.54	17.08	0	0	0	0	0
46	2015	21.47	19.43	0	0	0	0	0

Appendix VIII. Results for 25,500 ac-ft reallocation with FIRO

This appendix details 25,500 ac-ft reallocation-with-FIRO simulation results in the following tables:

- Table 75. 25,500 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year
- Table 76. 25,500 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year
- Table 77. 25,500 ac-ft reallocation with FIRO: average monthly storage (ac-ft) by year
- Table 78. 25,500 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)
- Table 79. 25,500 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year
- Table 80. 25,500 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)
- Table 81. 25,500 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year
- Table 82. 25,500 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)
- Table 83. 25,500 ac-ft reallocation with FIRO: annual event results
- Table 84. 25,500 ac-ft reallocation with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

Table 75. 25,500 ac-ft reallocation with FIRO: average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	12	224	-
2	1970	10,375	1,860	6,039	334	260	51	1	0	202	615	907	6,875	2,293
3	1971	3,370	569	1,037	363	269	44	70	6	18	400	357	672	598
4	1972	391	667	138	107	34	1	49	31	41	363	2,029	997	404
5	1973	11,450	12,530	2,891	1,424	540	119	50	6	6	343	969	6,905	3,103
6	1974	7,220	1,398	3,549	2,525	523	178	48	157	298	9	32	307	1,354
7	1975	425	8,594	10,007	3,162	526	125	53	2	131	5	64	96	1,933
8	1976	90	186	83	46	7	0	0	0	0	0	0	1	35
9	1977	207	59	51	2	0	0	0	0	173	0	18	282	66
10	1978	14,793	10,684	4,630	1,664	465	99	15	0	0	67	48	25	2,707
11	1979	1,264	5,859	1,970	541	218	48	68	0	18	0	98	470	880
12	1980	10,553	13,643	3,852	1,224	672	226	244	12	184	197	0	66	2,573
13	1981	1,993	636	2,724	437	138	68	80	105	18	80	615	2,250	762
14	1982	13,911	2,189	3,752	5,154	1,311	458	200	81	257	105	5,025	11,226	3,639
15	1983	12,079	195	8,525	6,195	4,187	943	529	263	274	192	4,843	15,568	4,483
16	1984	2,684	2,737	1,572	733	64	131	182	86	153	86	1,265	1,022	893
17	1985	525	1,682	2,722	810	61	113	21	92	89	59	420	344	578
18	1986	611	20,151	285	399	995	353	107	70	55	118	129	157	1,953
19	1987	309	1,357	1,082	328	99	10	0	67	137	0	38	148	298
20	1988	799	228	175	40	63	0	0	6	71	123	84	293	157
21	1989	319	340	984	143	32	0	0	12	202	0	79	0	176
22	1990	97	483	148	62	6	3	0	0	0	98	220	203	110
23	1991	0	211	9,313	753	57	14	0	0	154	389	114	207	934
24	1992	337	10,004	2,089	66	118	11	0	0	374	14	0	990	1,167
25	1993	21,440	8,939	4,817	1,725	646	283	6	55	178	314	112	149	3,222
26	1994	226	1,619	406	210	297	-387	0	0	146	0	236	155	242
27	1995	16,164	1,049	6,279	2,067	1,715	658	115	2	154	74	5	1,069	2,446
28	1996	11,282	6,049	4,171	1,674	1,021	246	94	10	0	36	712	12,549	3,154
29	1997	12,971	2,201	970	487	42	124	14	0	0	0	257	1,098	1,514
30	1998	11,367	4,845	2,111	3,844	1,105	356	350	60	23	37	266	496	2,072
31	1999	1,835	7,351	2,176	2,676	645	203	69	43	77	246	155	127	1,300
32	2000	1,786	14,074	4,992	670	261	167	80	240	215	117	24	131	1,896
33	2001	444	4,089	4,872	661	148	238	61	277	72	0	112	2,857	1,153
34	2002	2,283	665	1,091	324	89	45	123	55	244	216	167	13,333	1,553
35	2003	2,552	817	962	-676	925	78	130	80	167	68	36	638	481
36	2004	2,919	7,706	1,525	255	31	0	0	80	268	292	45	2,238	1,280
37	2005	9,590	6,805	3,286	1,479	811	141	48	31	172	289	84	2,851	2,132
38	2006	6,830	1,802	8,752	4,645	1,036	200	27	0	0	0	59	294	1,971
39	2007	123	1,532	797	110	258	0	0	0	172	133	0	12	261

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
40	2008	11,330	6,360	1,241	329	116	13	252	19	71	6	77	275	1,674
41	2009	142	4,109	6,064	337	346	31	0	31	54	646	178	49	999
42	2010	10,798	4,884	314	374	439	18	2	43	0	0	67	2,852	1,649
43	2011	1,444	6,730	7,255	1,549	600	341	43	84	357	357	4	844	1,634
44	2012	138	59	476	1,341	287	303	264	554	465	71	755	6,894	967
45	2013	715	335	262	43	7	722	0	0	0	595	173	43	241
46	2014	0	29	156	87	1	0	0	0	351	6	54	4,961	470
47	2015	214	1,583	255	238	46	0	0	0	0	-	-	-	-
48	*Minimum*	0	29	51	-676	0	-387	0	0	0	0	0	0	35
49	*Maximum*	21,440	20,151	10,007	6,195	4,187	943	529	554	465	646	5,025	15,568	4,483
50	*Mean*	4,791	4,128	2,844	1,108	468	147	74	58	131	150	455	2,244	1,409

Table 76. 25,500 ac-ft reallocation with FIRO: differences in average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-
2	1970	0	0	0	0	305	1,219	0	0	0	0	0	0	127
3	1971	0	0	0	2,472	3,434	1,245	1,054	1,309	106	0	0	0	802
4	1972	0	0	0	676	4,242	1,182	0	0	0	0	0	0	508
5	1973	698	9,382	9	-308	-31	0	0	0	0	0	0	0	812
6	1974	1,756	0	61	-552	112	0	0	0	0	0	0	0	115
7	1975	0	0	1,917	-326	-165	0	0	0	0	0	0	0	119
8	1976	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1977	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1978	0	4,478	41	-558	0	0	0	0	0	0	0	0	330
11	1979	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1980	0	3,464	29	-270	0	0	0	0	0	0	0	0	269
13	1981	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1982	3,091	38	-2,949	2,417	0	0	0	0	0	0	0	0	216
15	1983	1,842	-3,688	3,534	-363	9	0	0	0	0	0	0	0	111
16	1984	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1985	0	0	0	0	892	0	0	0	0	0	0	0	74
18	1986	0	3,798	-62	-437	2	0	0	0	0	0	0	0	275
19	1987	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1988	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1989	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1990	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1991	0	0	1,085	0	0	0	0	0	0	0	0	0	90
24	1992	0	0	0	0	484	0	0	0	0	0	0	0	40
25	1993	2,207	5,728	-261	-296	0	0	0	0	0	0	0	0	615

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
26	1994	0	0	0	0	1,317	320	0	0	0	0	0	0	136
27	1995	1,470	6	-155	-389	26	0	0	0	0	0	0	0	80
28	1996	0	1,850	63	-638	0	0	0	0	0	0	0	0	106
29	1997	2,013	56	91	-179	-216	0	0	0	0	0	0	0	147
30	1998	-408	2,167	-85	-498	133	43	0	0	0	0	0	0	113
31	1999	0	0	0	0	19	0	0	0	0	0	0	0	2
32	2000	0	1,518	1,421	-84	-65	0	0	0	0	0	0	0	233
33	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2002	72	0	0	0	1,275	127	0	0	0	0	0	1,481	246
35	2003	1,485	0	0	-294	15	0	0	0	0	0	0	0	101
36	2004	0	0	0	1,216	312	0	0	0	0	0	0	0	127
37	2005	0	2,041	7	-513	1	0	0	0	0	0	0	0	128
38	2006	0	0	2,027	-584	37	0	0	0	0	0	0	0	123
39	2007	0	0	0	0	1,669	0	0	0	0	0	0	0	139
40	2008	0	1,855	19	0	0	0	0	0	0	0	0	0	156
41	2009	0	0	0	0	0	0	0	0	0	0	0	0	0
42	2010	0	3,080	24	-520	25	0	0	0	0	0	0	0	217
43	2011	0	0	1,875	-513	0	0	0	0	0	0	0	0	113
44	2012	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2013	0	0	0	0	136	64	0	0	0	0	0	0	17
46	2014	0	0	16	1,604	15	0	0	0	0	0	0	0	136
47	2015	0	0	0	0	0	0	0	0	0	-	-	-	-
48	*Minimum*	-408	-3,688	-2,949	-638	-216	0	0	0	0	0	0	0	0
49	*Maximum*	3,091	9,382	3,534	2,472	4,242	1,245	1,054	1,309	106	0	0	1,481	812
50	*Mean*	309	778	189	23	304	91	23	28	2	0	0	32	152

Table 77. 25,500 ac-ft reallocation with FIRO: average monthly storage (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	13,198	13,206	-	-
2	1970	18,810	28,126	33,818	35,920	39,050	40,579	40,666	40,002	38,913	34,989	30,519	31,114	34,742	32,848
3	1971	35,343	35,672	36,201	40,019	46,178	47,480	48,703	49,786	49,242	43,400	38,945	39,600	36,740	40,678
4	1972	40,667	41,521	43,216	48,279	53,040	55,809	53,935	51,689	50,512	45,354	44,097	45,530	45,657	43,227
5	1973	51,062	62,210	64,800	64,771	64,727	64,260	63,461	62,610	60,154	54,821	52,163	55,452	64,800	52,167
6	1974	63,369	64,109	64,481	64,777	64,792	64,476	63,840	60,653	54,072	48,743	46,095	45,455	64,628	46,538
7	1975	45,732	53,086	63,117	64,536	64,778	64,386	63,781	62,993	61,593	55,890	50,308	49,045	64,738	52,609
8	1976	49,020	49,519	54,818	57,755	57,235	56,590	55,789	54,922	54,282	52,514	47,497	46,866	57,353	49,369
9	1977	46,886	47,831	54,029	58,080	59,983	60,510	59,720	58,781	54,527	50,088	47,149	46,614	57,463	48,323
10	1978	53,422	62,153	64,584	64,619	63,815	63,118	62,323	61,414	59,318	52,302	47,778	47,299	64,800	49,418
11	1979	47,804	50,154	56,035	58,895	61,915	61,255	60,430	59,429	55,782	50,082	45,632	45,343	56,971	47,329
12	1980	51,474	58,258	64,627	64,548	64,221	63,903	62,817	61,075	58,423	52,350	48,710	48,465	64,639	49,403
13	1981	48,600	51,254	58,154	63,007	62,584	61,151	59,174	56,724	54,390	53,087	53,176	53,739	62,962	52,988
14	1982	63,474	64,681	64,405	64,583	64,049	63,211	62,095	61,353	59,217	52,369	46,256	52,667	63,860	48,868
15	1983	58,750	64,154	64,608	64,632	64,094	63,861	63,267	62,576	60,889	54,805	49,668	53,864	64,800	51,641
16	1984	58,134	57,979	60,064	60,849	62,299	62,078	60,443	58,296	55,139	49,388	47,433	47,315	60,625	48,919
17	1985	47,946	49,228	54,146	59,918	62,221	61,912	61,025	59,003	56,112	50,869	48,260	44,647	57,842	50,555
18	1986	44,502	54,633	64,365	64,800	64,213	63,733	62,819	62,154	59,847	54,247	50,012	46,634	64,800	52,572
19	1987	46,612	47,353	50,773	57,363	61,295	61,203	60,535	59,483	54,686	47,298	43,926	43,899	54,566	44,303
20	1988	44,311	44,695	47,137	52,741	57,666	60,095	59,374	58,430	53,850	47,535	44,996	43,181	49,878	45,906
21	1989	43,214	43,920	48,713	52,382	54,469	54,254	53,488	52,761	50,256	45,910	44,852	44,760	51,394	45,172
22	1990	44,705	47,557	51,642	52,410	53,127	54,615	54,034	53,322	52,059	49,280	46,571	44,499	52,175	47,945
23	1991	44,683	48,301	54,092	58,173	58,219	57,534	55,192	53,246	50,656	47,028	43,424	42,638	58,772	45,299
24	1992	42,916	47,612	51,725	54,934	57,999	57,792	56,862	54,593	52,323	45,526	41,587	41,376	53,155	42,807
25	1993	51,182	61,889	64,583	64,759	64,292	63,882	63,101	62,343	59,746	54,053	50,697	50,619	64,800	51,886
26	1994	50,677	51,340	54,691	56,481	62,036	64,788	64,236	63,199	61,366	57,326	52,711	51,058	54,870	54,557
27	1995	59,906	64,089	63,611	64,778	64,405	63,854	63,403	62,642	60,476	55,610	51,986	50,100	64,800	53,295
28	1996	52,285	64,023	64,792	64,511	64,292	63,603	62,887	62,031	58,789	52,044	45,728	46,517	64,730	48,515
29	1997	63,632	64,800	64,799	64,797	64,732	63,802	64,092	63,380	60,451	54,176	50,258	50,856	64,798	51,669
30	1998	56,025	63,440	64,800	64,717	64,648	64,717	64,083	61,188	56,874	52,726	49,787	49,118	64,800	50,858
31	1999	49,001	55,852	60,035	62,431	63,399	62,857	61,342	60,185	58,851	55,870	51,333	50,502	61,187	54,216
32	2000	51,167	57,070	64,289	64,365	64,557	64,137	62,972	60,971	58,554	53,802	48,858	48,721	64,199	51,326
33	2001	49,083	51,043	57,805	60,341	62,358	60,033	58,178	60,985	60,373	59,853	59,924	59,723	58,520	60,336
34	2002	61,141	59,260	57,978	58,843	61,373	63,047	61,734	59,825	57,214	54,906	50,818	54,828	58,352	53,096
35	2003	63,570	60,033	60,563	64,150	64,517	63,624	62,245	61,013	57,607	53,401	50,780	50,058	62,922	52,992
36	2004	53,017	54,866	61,444	63,455	63,986	63,053	62,012	59,331	55,736	50,873	48,896	48,800	62,553	49,413
37	2005	57,515	61,524	64,775	64,799	64,467	63,786	62,567	61,589	59,539	54,343	49,697	49,202	64,799	51,601
38	2006	57,489	58,425	63,243	64,688	64,634	63,993	63,034	61,733	60,248	56,713	51,858	50,070	64,431	53,944

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
39	2007	50,080	50,274	53,373	58,787	63,612	61,207	59,699	58,961	57,533	53,441	52,525	52,312	55,824	52,879
40	2008	56,171	64,095	64,367	63,736	63,788	63,052	63,069	62,176	60,745	60,734	59,868	54,847	63,903	61,057
41	2009	52,000	53,290	60,632	60,968	61,007	60,324	59,652	58,391	57,704	57,407	56,496	50,963	60,994	57,440
42	2010	52,739	61,300	64,800	64,800	64,250	63,057	61,945	60,901	60,077	59,627	60,340	55,901	64,800	60,601
43	2011	55,250	56,150	62,765	64,776	64,529	64,408	63,724	62,554	61,719	61,369	60,139	55,185	64,799	61,207
44	2012	52,353	52,302	52,143	53,362	57,231	58,592	58,047	58,564	60,365	56,926	51,837	53,126	52,224	53,953
45	2013	57,910	58,239	57,776	59,628	61,283	61,546	61,065	59,570	56,208	51,995	51,243	51,165	57,986	51,287
46	2014	50,955	52,707	57,560	61,549	61,292	61,143	60,491	59,662	56,517	50,521	48,628	50,776	60,230	48,705
47	2015	53,518	54,414	54,923	56,813	57,872	56,977	55,991	53,784	52,252	-	-	-	54,820	-
48	*Minimum*	*18,810*	*28,126*	*33,818*	*35,920*	*39,050*	*40,579*	*40,666*	*40,002*	*38,913*	*34,989*	*13,198*	*13,206*	*34,742*	*32,848*
49	*Maximum*	*63,632*	*64,800*	*64,800*	*64,800*	*64,792*	*64,788*	*64,236*	*63,380*	*61,719*	*61,369*	*60,340*	*59,723*	*64,800*	*61,207*
50	*Mean*	*51,046*	*54,444*	*57,941*	*59,903*	*61,098*	*60,941*	*60,073*	*58,919*	*56,634*	*52,346*	*48,406*	*47,993*	*59,102*	*50,527*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 78. 25,500 ac-ft reallocation with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-	-
2	1970	0	0	0	0	15	959	1,512	1,497	1,483	1,471	1,466	1,463	0	1,468
3	1971	1,461	1,458	1,454	1,886	6,525	7,797	9,023	10,101	10,723	10,659	10,611	10,587	1,452	10,633
4	1972	10,570	10,553	10,518	10,511	13,355	16,184	16,197	16,034	15,904	15,826	15,787	15,769	10,491	15,798
5	1973	15,978	23,213	25,796	25,491	25,181	24,968	24,734	24,502	24,314	24,182	24,100	24,073	25,729	24,130
6	1974	25,082	25,768	25,781	25,131	25,110	24,975	24,777	24,561	24,355	24,187	24,096	24,050	25,675	24,125
7	1975	24,003	23,959	25,078	25,698	25,127	24,938	24,753	24,537	24,356	24,233	24,167	24,117	25,774	24,196
8	1976	24,069	24,007	23,942	23,843	23,681	23,497	23,272	23,093	22,925	22,812	22,719	22,654	23,892	22,758
9	1977	22,612	22,571	22,504	22,395	22,271	22,122	21,925	21,722	21,559	21,437	21,357	21,302	22,461	21,391
10	1978	21,268	24,068	25,715	25,143	24,960	24,760	24,557	24,323	24,140	23,972	23,873	23,826	25,617	23,913
11	1979	23,797	23,761	23,724	23,644	23,517	23,297	23,088	22,880	22,693	22,540	22,473	22,419	23,695	22,499
12	1980	22,386	22,648	25,783	25,472	25,301	25,149	24,965	24,739	24,564	24,402	24,296	24,228	25,739	24,345
13	1981	24,192	24,154	24,091	24,003	23,851	23,648	23,400	23,174	22,973	22,846	22,776	22,743	24,058	22,803
14	1982	25,272	25,744	25,481	24,824	25,026	24,856	24,676	24,435	24,237	24,113	24,043	24,011	22,149	24,069
15	1983	23,323	25,034	24,467	25,117	25,060	24,892	24,684	24,465	24,280	24,155	24,077	24,042	25,474	24,104
16	1984	24,018	23,980	23,916	23,817	23,671	23,472	23,231	23,010	22,811	22,666	22,600	22,567	23,866	22,623
17	1985	22,538	22,500	22,430	22,339	22,793	22,919	22,682	22,483	22,325	22,196	22,114	22,082	22,395	22,149
18	1986	22,055	21,394	25,359	25,161	25,044	24,867	24,656	24,449	24,280	24,157	24,062	24,005	25,600	24,113
19	1987	23,974	23,928	23,866	23,756	23,592	23,424	23,245	23,061	22,897	22,748	22,679	22,636	23,818	22,703
20	1988	22,605	22,549	22,452	22,313	22,194	22,040	21,833	21,639	21,463	21,329	21,255	21,209	22,376	21,281
21	1989	21,179	21,146	21,098	21,002	20,872	20,714	20,512	20,316	20,160	20,049	19,964	19,915	21,061	20,003

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
22	1990	19,881	19,844	19,796	19,705	19,566	19,429	19,256	19,081	18,941	18,816	18,722	18,671	19,754	18,760
23	1991	18,635	18,593	18,658	19,559	19,464	19,322	19,165	19,008	18,870	18,731	18,646	18,593	19,606	18,680
24	1992	18,565	18,537	18,494	18,422	18,600	18,637	18,490	18,310	18,161	18,036	17,965	17,924	18,465	17,998
25	1993	18,436	22,939	25,782	25,127	25,001	24,846	24,610	24,396	24,201	24,061	23,953	23,905	25,392	24,004
26	1994	23,872	23,836	23,773	23,664	23,793	25,103	25,004	24,785	24,591	24,456	24,380	24,353	23,722	24,406
27	1995	24,859	25,789	24,640	25,132	25,046	24,921	24,730	24,512	24,322	24,170	24,071	24,025	25,475	24,106
28	1996	23,998	24,425	25,796	25,175	24,941	24,757	24,541	24,296	24,097	23,948	23,858	23,821	25,779	23,889
29	1997	24,641	25,798	25,797	25,596	25,288	24,970	24,759	24,554	24,385	24,226	24,137	24,105	25,776	24,169
30	1998	24,064	21,923	25,795	25,134	25,088	25,083	24,904	24,676	24,467	24,339	24,268	24,230	25,555	24,292
31	1999	24,191	24,161	24,112	24,031	23,909	23,767	23,560	23,383	23,211	23,053	22,956	22,900	24,077	22,992
32	2000	22,850	22,927	25,475	25,586	25,314	25,130	24,922	24,700	24,512	24,371	24,307	24,266	25,649	24,335
33	2001	24,221	24,177	24,110	24,011	23,850	23,626	23,415	23,213	23,028	22,881	22,789	22,752	24,057	22,822
34	2002	22,782	22,752	22,677	22,575	22,724	23,653	23,436	23,223	23,025	22,864	22,773	22,784	22,625	22,815
35	2003	25,522	25,613	25,545	25,290	25,060	24,867	24,623	24,390	24,193	24,019	23,916	23,879	25,494	23,939
36	2004	23,853	23,816	23,738	23,853	24,954	24,771	24,562	24,344	24,124	23,969	23,886	23,838	23,681	23,916
37	2005	23,804	24,351	25,792	25,267	25,053	24,887	24,662	24,421	24,230	24,083	23,987	23,922	25,727	24,033
38	2006	23,890	23,847	24,745	25,056	25,056	24,872	24,632	24,387	24,196	24,055	23,967	23,918	25,354	23,992
39	2007	23,866	23,820	23,753	23,637	24,242	24,963	24,739	24,518	24,315	24,189	24,101	24,040	23,697	24,142
40	2008	24,007	25,619	25,766	25,644	25,472	25,260	25,026	24,800	24,583	24,429	24,335	24,293	25,712	24,364
41	2009	24,257	24,206	24,152	24,038	23,886	23,703	23,479	23,260	23,060	22,916	22,839	22,792	24,098	22,871
42	2010	22,765	22,989	25,796	25,234	25,065	24,904	24,681	24,474	24,285	24,134	24,058	24,024	25,717	24,090
43	2011	23,998	23,944	24,256	25,412	25,022	24,872	24,665	24,457	24,257	24,119	24,034	23,977	25,736	24,066
44	2012	23,917	23,860	23,776	23,680	23,516	23,315	23,089	22,861	22,672	22,530	22,455	22,405	23,736	22,487
45	2013	22,376	22,337	22,262	22,148	21,988	21,937	21,778	21,582	21,412	21,279	21,182	21,126	22,212	21,224
46	2014	21,065	21,008	20,939	21,920	22,309	22,097	21,887	21,684	21,512	21,369	21,281	21,243	20,907	21,316
47	2015	21,213	21,170	21,100	20,987	20,852	20,697	20,500	20,308	20,208	-	-	-	21,044	-
48	*Minimum*	*0*	*0*	*0*	*0*	*15*	*959*	*1,512*	*1,497*	*1,483*	*1,471*	*0*	*0*	*0*	*1,468*
49	*Maximum*	*25,522*	*25,798*	*25,797*	*25,698*	*25,472*	*25,260*	*25,026*	*24,800*	*24,591*	*24,456*	*24,380*	*24,353*	*25,779*	*24,406*
50	*Mean*	*21,650*	*22,059*	*22,608*	*22,553*	*22,657*	*22,693*	*22,540*	*22,362*	*22,202*	*22,112*	*21,552*	*21,511*	*22,617*	*22,062*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 79. 25,500 ac-ft reallocation with FIRO: peak monthly elevation (ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	648.00	648.44
2	1970	682.56	685.69	695.35	699.76	703.18	704.81	704.56	703.59	703.11	698.82	692.22	693.82
3	1971	698.42	697.06	698.31	708.04	712.49	713.96	715.18	716.64	716.74	711.78	703.95	703.63
4	1972	704.54	705.62	710.70	717.16	722.12	723.49	723.12	718.69	717.76	713.98	710.03	711.22
5	1973	722.74	732.80	732.80	732.80	732.80	732.60	731.87	731.05	730.20	725.33	719.35	727.46

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
6	1974	732.80	732.59	732.80	732.80	732.80	732.74	732.18	731.46	724.83	717.62	711.85	710.59
7	1975	710.99	726.42	732.80	732.80	732.80	732.66	732.09	731.39	730.63	727.14	719.19	715.07
8	1976	715.05	718.08	724.96	725.71	725.31	724.49	723.61	722.68	721.69	721.11	715.30	712.41
9	1977	712.35	716.82	725.02	726.40	729.07	728.86	728.14	727.33	724.81	718.81	714.08	712.12
10	1978	727.68	732.80	732.89	732.80	732.16	731.51	730.77	729.90	728.98	723.26	715.41	712.94
11	1979	714.26	722.38	724.54	729.12	730.17	729.74	728.82	728.06	726.28	719.67	712.77	710.78
12	1980	723.33	735.29	732.80	732.80	732.33	732.07	731.64	729.69	728.26	722.77	715.37	714.37
13	1981	716.65	720.51	730.95	731.04	730.93	730.09	728.48	725.66	722.98	720.08	720.35	722.95
14	1982	732.96	732.80	733.56	732.88	732.78	731.53	730.34	729.72	728.98	723.66	714.71	725.70
15	1983	735.41	735.60	736.65	732.80	732.80	732.19	731.72	730.84	730.36	725.68	718.05	727.56
16	1984	727.57	727.37	728.61	729.43	730.76	730.36	729.72	727.12	725.69	717.93	714.90	713.43
17	1985	713.89	717.45	725.57	729.06	730.79	730.21	729.51	728.62	726.22	719.37	716.87	711.64
18	1986	709.61	737.68	733.36	732.80	732.80	731.98	731.17	730.47	729.85	724.37	719.20	713.36
19	1987	712.11	713.63	721.55	728.05	729.88	729.54	728.87	728.21	725.55	717.21	708.86	708.49
20	1988	709.46	709.53	715.97	723.07	727.69	728.42	727.81	726.93	724.61	716.66	711.03	708.86
21	1989	707.63	710.80	717.81	720.48	722.05	721.70	720.90	719.92	719.16	712.41	710.10	709.67
22	1990	710.05	716.19	718.88	719.69	721.11	722.04	721.49	720.62	719.83	716.36	713.66	710.16
23	1991	710.43	717.68	726.68	726.89	726.84	726.62	723.93	721.41	719.05	714.80	710.23	706.87
24	1992	707.23	718.87	719.90	724.29	726.37	725.98	725.13	722.21	721.27	714.98	706.87	706.18
25	1993	727.10	732.80	732.80	732.80	732.53	732.05	731.51	730.71	729.98	724.02	718.37	717.00
26	1994	717.13	720.22	722.11	727.09	732.48	732.80	732.80	731.66	730.77	727.53	721.55	717.85
27	1995	732.80	732.80	735.33	732.80	732.75	731.95	731.70	731.04	730.25	725.98	720.08	717.72
28	1996	728.85	732.80	732.80	732.80	732.53	731.96	731.27	730.44	729.61	723.18	714.27	719.98
29	1997	735.18	732.80	732.80	732.80	732.80	732.63	732.40	731.74	731.06	725.00	718.12	717.62
30	1998	729.49	736.17	732.80	732.80	732.80	732.80	732.53	731.06	727.05	721.92	717.17	715.74
31	1999	716.79	727.21	729.16	731.42	731.60	731.06	730.04	728.71	727.32	725.86	721.14	717.44
32	2000	719.21	731.32	732.73	732.80	732.80	732.48	731.54	730.12	727.97	724.25	717.77	714.94
33	2001	715.36	721.54	726.49	729.55	731.00	729.72	728.47	729.15	729.02	728.34	728.33	728.76
34	2002	729.81	728.19	726.22	727.83	731.32	731.43	730.54	728.75	726.90	722.76	719.78	731.19
35	2003	732.66	729.48	730.93	732.80	732.80	732.01	731.17	729.61	728.30	721.91	719.78	716.87
36	2004	720.29	728.94	730.45	732.43	732.73	731.43	730.68	729.38	726.01	719.41	715.46	717.27
37	2005	728.06	732.80	732.80	732.80	732.80	732.25	731.05	730.09	729.19	724.79	718.02	718.45
38	2006	726.48	727.50	732.80	732.80	732.80	732.35	731.55	730.40	729.31	727.04	720.83	716.76
39	2007	716.32	717.98	723.06	729.47	732.80	732.54	727.95	727.36	726.48	722.50	719.66	719.10
40	2008	730.83	732.80	732.80	732.30	732.42	731.53	731.53	730.69	729.58	729.22	729.06	725.02
41	2009	719.55	723.27	729.58	729.05	729.39	728.69	728.47	726.73	725.81	725.28	725.13	721.01
42	2010	728.04	732.80	732.80	732.80	732.80	731.44	730.58	729.41	728.41	728.65	729.41	725.97
43	2011	722.76	729.10	732.87	732.80	732.77	732.54	732.18	731.11	730.06	729.49	729.20	725.74
44	2012	719.20	719.04	718.91	722.58	726.26	726.71	726.26	727.65	728.72	727.84	720.80	725.31
45	2013	725.97	726.15	726.16	729.29	729.72	729.66	729.55	728.63	725.93	720.56	717.76	717.69

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
46	2014	717.52	721.87	728.12	730.08	730.09	729.46	728.94	728.05	727.09	720.49	714.62	720.35
47	2015	720.47	722.12	722.16	726.75	726.72	725.03	724.08	722.42	718.96	-	-	-
48	*Minimum*	*682.56*	*685.69*	*695.35*	*699.76*	*703.18*	*704.81*	*704.56*	*703.59*	*703.11*	*698.82*	*648.00*	*648.44*
49	*Maximum*	*735.41*	*737.68*	*736.65*	*732.88*	*732.80*	*732.80*	*732.80*	*731.74*	*731.06*	*729.49*	*729.41*	*731.19*
50	*Mean*	*719.51*	*723.99*	*726.72*	*728.46*	*729.49*	*729.18*	*728.43*	*727.33*	*725.88*	*721.55*	*715.19*	*714.90*

Table 80. 25,500 ac-ft reallocation with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	0.00	0.00
2	1970	0.00	0.00	0.00	0.00	0.08	1.71	1.51	2.14	2.54	2.21	2.35	2.33
3	1971	2.18	2.25	2.17	4.94	9.39	10.86	12.08	13.54	13.64	14.85	16.50	16.48
4	1972	16.20	15.84	14.75	14.06	19.02	20.39	20.08	21.49	21.49	22.45	23.72	23.21
5	1973	21.04	31.10	31.02	29.76	29.73	29.54	30.15	30.16	30.23	32.17	34.44	31.09
6	1974	31.10	31.17	31.10	29.70	29.70	29.65	29.28	30.06	32.68	35.60	39.11	39.86
7	1975	39.44	31.32	31.07	29.77	29.70	29.57	29.74	30.05	30.10	31.61	34.72	36.75
8	1976	36.70	34.87	31.74	31.47	31.43	31.40	31.36	31.32	31.41	31.41	34.05	35.46
9	1977	35.30	32.92	29.44	29.03	27.65	27.66	27.73	27.70	28.23	30.08	32.12	32.77
10	1978	26.82	31.04	31.03	29.70	30.30	30.32	30.37	30.46	30.57	32.55	36.13	37.66
11	1979	36.57	32.35	31.56	29.58	29.04	29.03	29.13	29.18	29.60	31.62	34.86	36.05
12	1980	29.85	22.79	31.10	29.79	30.63	30.60	30.53	31.16	31.57	33.48	37.02	37.46
13	1981	35.93	33.95	29.41	29.29	29.25	29.37	29.78	30.54	31.07	31.97	31.57	30.55
14	1982	27.54	31.10	27.24	26.58	29.68	30.34	30.73	30.71	30.74	32.62	36.84	31.66
15	1983	24.05	30.16	21.65	29.70	29.70	29.92	30.10	30.21	30.12	31.99	35.10	30.99
16	1984	30.99	30.98	30.23	29.65	28.91	28.95	28.95	29.85	29.93	32.69	33.98	34.58
17	1985	34.26	32.46	29.18	27.72	27.69	28.23	28.24	28.31	29.02	31.17	32.19	34.72
18	1986	36.10	14.01	31.46	29.70	29.70	30.20	30.33	30.33	30.35	32.46	34.56	37.72
19	1987	38.53	37.22	32.89	30.22	29.17	29.26	29.31	29.36	30.09	33.22	38.11	38.16
20	1988	37.44	37.24	33.04	29.77	28.07	27.66	27.76	27.84	28.15	30.94	33.42	34.81
21	1989	35.48	33.23	29.79	28.53	27.83	27.89	27.87	27.85	27.82	30.50	31.38	31.48
22	1990	31.13	28.37	27.17	26.72	26.02	25.67	25.64	25.65	25.64	26.59	27.58	28.88
23	1991	28.63	25.65	24.80	23.95	23.81	23.96	24.90	25.26	25.79	27.20	28.82	30.19
24	1992	29.93	25.19	24.77	23.50	23.27	22.95	23.62	24.04	24.01	25.86	28.99	29.17
25	1993	25.40	29.80	29.80	29.70	29.49	30.15	30.11	30.16	30.19	32.39	34.77	35.25
26	1994	35.11	33.54	32.51	30.59	29.38	29.70	29.70	30.31	30.39	31.74	33.93	35.67
27	1995	30.88	31.10	23.62	29.70	29.65	30.26	30.19	30.18	30.22	31.96	34.12	35.15
28	1996	30.28	22.31	31.10	29.70	29.45	30.12	30.13	30.14	30.20	32.52	36.78	33.64
29	1997	27.72	31.10	31.09	29.81	29.70	29.55	29.33	29.92	29.95	32.36	35.19	35.31
30	1998	29.69	18.35	30.89	29.70	29.70	29.70	29.47	30.42	32.11	33.73	35.87	36.58
31	1999	35.84	31.34	30.27	28.38	28.50	29.02	29.25	29.57	30.00	30.24	31.61	33.23

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
32	2000	32.27	29.62	31.03	29.79	29.77	29.48	30.53	30.90	31.65	32.82	35.66	37.10
33	2001	36.75	33.48	31.59	29.97	29.10	29.41	29.48	28.92	28.90	28.80	28.80	28.48
34	2002	28.11	28.81	29.36	28.69	28.22	28.33	28.86	29.36	29.95	30.93	31.96	29.49
35	2003	30.96	32.45	31.52	29.70	29.70	30.24	30.30	30.67	31.02	33.20	33.97	35.25
36	2004	33.55	29.95	29.09	29.33	29.63	30.37	30.41	30.71	31.93	34.32	36.11	34.97
37	2005	30.39	31.10	31.01	29.70	29.70	29.61	30.43	30.51	30.61	32.20	35.00	34.57
38	2006	31.21	30.71	31.08	29.54	29.70	29.33	30.16	30.28	30.51	31.38	33.55	35.45
39	2007	35.53	34.60	32.05	29.37	29.70	29.50	31.97	32.04	32.05	33.19	34.39	34.53
40	2008	29.36	31.10	31.10	30.99	30.92	30.71	30.71	30.77	30.97	30.74	30.76	32.39
41	2009	34.69	32.76	30.14	30.18	29.93	30.08	29.72	30.34	30.28	30.05	30.05	31.35
42	2010	28.84	31.10	31.01	29.70	29.70	30.55	30.65	30.89	31.09	30.54	30.14	31.64
43	2011	32.65	30.07	28.02	29.70	29.67	29.46	29.16	30.06	30.23	30.21	30.23	31.68
44	2012	34.27	34.24	34.10	32.09	30.56	30.33	30.23	29.04	28.40	28.71	30.88	29.23
45	2013	29.03	28.92	28.87	27.20	26.62	26.56	26.46	26.99	27.74	29.14	30.09	30.02
46	2014	29.99	28.11	26.09	26.98	26.99	26.45	27.32	27.40	27.58	29.32	31.76	29.01
47	2015	28.94	28.29	28.24	26.70	26.69	26.91	26.86	27.01	27.85	-	-	-
48	*Minimum*	*0.00*	*0.00*	*0.00*	*0.00*	*0.08*	*1.71*	*1.51*	*2.14*	*2.54*	*2.21*	*0.00*	*0.00*
49	*Maximum*	*39.44*	*37.24*	*34.10*	*32.09*	*31.43*	*31.40*	*31.97*	*32.04*	*32.68*	*35.60*	*39.11*	*39.86*
50	*Mean*	*30.15*	*28.65*	*28.27*	*27.62*	*27.66*	*27.85*	*28.06*	*28.34*	*28.67*	*30.13*	*31.37*	*31.57*

Table 81. 25,500 ac-ft reallocation with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year

		Days threshold is exceeded																	
ID (1)	Year (2)	703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	211.1	196.2	189.2	185.6	182.0	174.5	167.1	160.3	153.6	146.5	139.0	99.6	83.2	58.5	0.0	0.0	0.0	0.0	0.0
4	1972	366.0	354.2	328.8	312.3	294.3	291.0	266.5	257.3	240.3	203.0	186.2	178.2	168.7	160.3	0.0	0.0	0.0	0.0	0.0
5	1973	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	356.4	356.0	355.3	353.7	229.8	0.0	0.0	0.0	0.0
6	1974	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	324.2	301.5	295.4	292.0	288.6	234.6	0.0	0.0	0.0	0.0
7	1975	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	333.8	332.6	331.9	329.9	326.0	209.3	0.0	0.0	0.0	0.0
8	1976	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	316.5	310.0	285.5	0.0	0.0	0.0	0.0	0.0
9	1977	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	332.8	267.0	254.8	244.0	103.2	0.0	0.0	0.0	0.0
10	1978	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	308.4	300.5	292.6	231.4	0.0	0.0	0.0	0.0
11	1979	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	311.3	307.8	291.7	278.6	247.6	129.5	0.0	0.0	0.0	0.0
12	1980	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	356.6	355.3	354.8	354.3	294.5	208.7	0.0	0.0	0.0	0.0
13	1981	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	336.9	119.7	0.0	0.0	0.0	0.0
14	1982	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	358.8	350.4	345.9	341.7	337.8	333.8	256.8	0.0	0.0	0.0	0.0
15	1983	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	354.5	250.5	0.0	0.0	0.0	0.0
16	1984	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	359.3	334.8	308.8	288.0	169.1	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
17	1985	365.0	365.0	365.0	365.0	365.0	365.0	365.0	345.7	341.7	337.5	330.9	324.8	279.8	270.9	124.2	0.0	0.0	0.0	0.0
18	1986	365.0	365.0	365.0	365.0	365.0	365.0	365.0	360.3	332.3	327.6	297.1	291.1	286.1	281.4	215.7	0.0	0.0	0.0	0.0
19	1987	365.0	365.0	365.0	365.0	365.0	365.0	365.0	303.4	299.3	295.1	266.8	243.5	220.3	213.6	121.0	0.0	0.0	0.0	0.0
20	1988	366.0	366.0	366.0	366.0	366.0	357.8	341.7	315.8	255.5	239.5	218.4	209.2	201.6	193.8	63.3	0.0	0.0	0.0	0.0
21	1989	365.0	365.0	365.0	365.0	365.0	365.0	318.0	313.8	250.1	229.6	211.4	202.9	196.5	189.0	0.0	0.0	0.0	0.0	0.0
22	1990	365.0	365.0	365.0	365.0	365.0	365.0	365.0	360.4	304.6	291.6	278.2	264.6	252.0	241.8	0.0	0.0	0.0	0.0	0.0
23	1991	365.0	365.0	365.0	365.0	365.0	321.0	315.3	306.8	277.3	265.0	255.2	244.6	234.3	223.1	0.0	0.0	0.0	0.0	0.0
24	1992	366.0	366.0	333.9	315.8	310.8	297.9	257.9	253.2	247.9	243.9	238.5	235.1	231.7	228.2	0.0	0.0	0.0	0.0	0.0
25	1993	365.0	365.0	365.0	365.0	365.0	363.3	358.0	356.5	352.8	352.6	352.5	352.4	352.3	352.1	230.7	0.0	0.0	0.0	0.0
26	1994	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	157.2	0.0	0.0	0.0	0.0
27	1995	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	256.6	0.0	0.0	0.0	0.0
28	1996	366.0	366.0	366.0	366.0	364.2	357.0	353.3	349.4	343.4	333.3	325.0	320.6	316.0	311.2	227.6	0.0	0.0	0.0	0.0
29	1997	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	263.8	0.0	0.0	0.0	0.0
30	1998	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	352.2	224.8	0.0	0.0	0.0	0.0
31	1999	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	345.7	197.7	0.0	0.0	0.0	0.0
32	2000	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	360.1	349.6	318.5	212.1	0.0	0.0	0.0	0.0
33	2001	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	354.5	241.4	0.0	0.0	0.0	0.0
34	2002	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	191.8	0.0	0.0	0.0	0.0
35	2003	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	250.8	0.0	0.0	0.0	0.0
36	2004	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	313.6	170.6	0.0	0.0	0.0	0.0
37	2005	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	248.4	0.0	0.0	0.0	0.0
38	2006	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	215.7	0.0	0.0	0.0	0.0
39	2007	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	120.0	0.0	0.0	0.0	0.0
40	2008	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	300.8	0.0	0.0	0.0	0.0
41	2009	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	142.2	0.0	0.0	0.0	0.0
42	2010	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	304.0	0.0	0.0	0.0	0.0
43	2011	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	271.2	0.0	0.0	0.0	0.0
44	2012	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	40.5	0.0	0.0	0.0	0.0
45	2013	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	133.0	0.0	0.0	0.0	0.0
46	2014	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	314.5	159.8	0.0	0.0	0.0	0.0
47	2015	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	366.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	366.0	304.0	0.0	0.0	0.0	0.0
50	*Mean*	345.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	292.0	153.8	0.0	0.0	0.0	0.0

Table 82. 25,500 ac-ft reallocation with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	211.1	196.2	189.2	185.6	182.0	174.5	167.1	160.3	153.6	146.5	139.0	99.6	83.2	58.5	0.0	0.0	0.0	0.0	0.0
4	1972	366.0	354.2	328.8	312.3	294.3	291.0	266.5	257.3	240.3	203.0	186.2	178.2	168.7	160.3	0.0	0.0	0.0	0.0	0.0
5	1973	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	356.4	356.0	355.3	353.7	229.8	0.0	0.0	0.0	0.0
6	1974	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	324.2	301.5	295.4	292.0	288.6	234.6	0.0	0.0	0.0	0.0
7	1975	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	333.8	332.6	331.9	329.9	326.0	209.3	0.0	0.0	0.0	0.0
8	1976	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	316.5	310.0	285.5	0.0	0.0	0.0	0.0	0.0
9	1977	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	332.8	267.0	254.8	244.0	103.2	0.0	0.0	0.0	0.0
10	1978	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	308.4	300.5	292.6	231.4	0.0	0.0	0.0	0.0
11	1979	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	311.3	307.8	291.7	278.6	247.6	129.5	0.0	0.0	0.0	0.0
12	1980	360.6	361.0	361.3	361.5	361.6	362.0	362.3	362.6	363.1	355.0	354.7	354.8	354.3	294.5	208.7	0.0	0.0	0.0	0.0
13	1981	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	336.9	119.7	0.0	0.0	0.0	0.0
14	1982	361.5	362.5	363.3	364.2	364.5	365.0	365.0	365.0	358.8	350.4	345.9	341.7	337.8	333.8	256.8	0.0	0.0	0.0	0.0
15	1983	350.5	352.5	353.9	354.9	355.8	357.3	358.4	359.4	360.6	361.9	362.8	363.2	363.7	354.5	250.5	0.0	0.0	0.0	0.0
16	1984	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	359.3	334.8	308.8	288.0	169.1	0.0	0.0	0.0	0.0
17	1985	365.0	365.0	365.0	365.0	365.0	365.0	365.0	345.7	341.7	337.5	330.9	324.8	279.8	270.9	124.2	0.0	0.0	0.0	0.0
18	1986	357.8	358.1	358.4	358.5	358.7	359.0	359.3	355.0	327.3	323.3	293.3	287.7	283.0	278.7	215.7	0.0	0.0	0.0	0.0
19	1987	365.0	365.0	365.0	365.0	365.0	365.0	365.0	303.4	299.3	295.1	266.8	243.5	220.3	213.6	121.0	0.0	0.0	0.0	0.0
20	1988	366.0	366.0	366.0	366.0	366.0	357.8	341.7	315.8	255.5	239.5	218.4	209.2	201.6	193.8	63.3	0.0	0.0	0.0	0.0
21	1989	365.0	365.0	365.0	365.0	365.0	365.0	318.0	313.8	250.1	229.6	211.4	202.9	196.5	189.0	0.0	0.0	0.0	0.0	0.0
22	1990	365.0	365.0	365.0	365.0	365.0	365.0	365.0	360.4	304.6	291.6	278.2	264.6	252.0	241.8	0.0	0.0	0.0	0.0	0.0
23	1991	365.0	365.0	365.0	365.0	365.0	321.0	315.3	306.8	277.3	265.0	255.2	244.6	234.3	223.1	0.0	0.0	0.0	0.0	0.0
24	1992	366.0	366.0	333.9	315.8	310.8	297.9	257.9	253.2	247.9	243.9	238.5	235.1	231.7	228.2	0.0	0.0	0.0	0.0	0.0
25	1993	365.0	365.0	365.0	365.0	365.0	363.3	358.0	356.5	352.8	352.6	352.5	352.4	352.3	352.1	230.7	0.0	0.0	0.0	0.0
26	1994	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	157.2	0.0	0.0	0.0	0.0
27	1995	358.7	359.4	360.0	360.3	360.6	361.3	362.3	363.3	363.8	364.3	365.0	365.0	365.0	365.0	256.6	0.0	0.0	0.0	0.0
28	1996	361.4	361.8	362.1	362.3	360.7	354.0	351.4	348.1	342.7	333.3	325.0	320.6	316.0	311.2	227.6	0.0	0.0	0.0	0.0
29	1997	359.5	361.3	362.0	362.5	363.0	364.4	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	263.8	0.0	0.0	0.0	0.0
30	1998	354.2	355.5	355.8	355.9	356.0	356.3	357.3	358.2	358.9	359.7	360.4	361.1	361.9	350.6	224.8	0.0	0.0	0.0	0.0
31	1999	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	345.7	197.7	0.0	0.0	0.0	0.0
32	2000	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	360.1	349.6	318.5	212.1	0.0	0.0	0.0	0.0
33	2001	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	354.5	241.4	0.0	0.0	0.0	0.0
34	2002	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	191.8	0.0	0.0	0.0	0.0
35	2003	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	250.8	0.0	0.0	0.0	0.0
36	2004	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	313.6	170.6	0.0	0.0	0.0	0.0
37	2005	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	248.4	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
38	2006	364.5	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	215.7	0.0	0.0	0.0	0.0
39	2007	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	120.0	0.0	0.0	0.0	0.0
40	2008	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	300.8	0.0	0.0	0.0	0.0
41	2009	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	142.2	0.0	0.0	0.0	0.0
42	2010	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	304.0	0.0	0.0	0.0	0.0
43	2011	362.9	364.3	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	271.2	0.0	0.0	0.0	0.0
44	2012	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	366.0	40.5	0.0	0.0	0.0	0.0
45	2013	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	133.0	0.0	0.0	0.0	0.0
46	2014	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	314.5	159.8	0.0	0.0	0.0	0.0
47	2015	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	244.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	366.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	366.0	304.0	0.0	0.0	0.0	0.0
50	*Mean*	344.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	291.9	153.8	0.0	0.0	0.0	0.0

Table 83. 25,500 ac-ft reallocation with FIRO: annual event results

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	648.46	682.10	0	47	66	2,937	5,133
2	1971	685.33	698.42	113	19	40	853	982
3	1972	703.05	704.04	0	2	20	251	272
4	1973	722.74	732.80	1,141	1,078	1,115	1,735	2,255
5	1974	722.19	732.80	184	153	140	1,102	3,420
6	1975	726.44	732.80	2,107	2,062	2,435	2,444	2,486
7	1976	714.94	722.15	0	3	3	101	108
8	1977	712.18	712.33	9	10	10	138	172
9	1978	712.11	727.68	131	6	28	1,511	2,291
10	1979	714.36	722.38	0	11	22	1,179	1,437
11	1980	720.49	735.29	4,583	4,544	4,790	5,906	9,313
12	1981	714.30	716.64	0	17	33	677	713
13	1982	720.42	732.96	3,369	3,146	3,591	5,926	7,256
14	1983	722.91	735.41	4,574	4,541	4,926	6,005	7,987
15	1984	721.15	727.56	106	6	199	1,313	1,858
16	1985	722.01	726.95	0	3	31	167	352
17	1986	711.05	737.68	4,520	4,541	4,819	9,653	12,778
18	1987	712.16	713.54	0	3	250	940	2,103
19	1988	708.71	709.41	0	17	163	359	1,344
20	1989	710.82	716.87	0	8	22	293	901
21	1990	711.85	716.18	0	13	64	844	2,344
22	1991	712.97	720.31	0	2	33	477	1,238
23	1992	707.23	718.87	97	9	185	1,088	3,279
24	1993	705.01	727.13	126	8	325	4,373	10,049
25	1994	717.12	721.54	0	8	109	476	1,287
26	1995	729.64	735.33	4,641	4,541	4,988	6,372	14,720

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	729.82	732.80	4,541	4,541	4,890	5,744	8,916
28	1997	730.20	735.18	4,520	4,541	4,894	7,166	9,847
29	1998	728.36	736.17	4,533	4,541	5,519	9,497	18,149
30	1999	716.82	724.77	0	10	216	1,788	4,380
31	2000	719.28	728.02	121	8	243	2,373	6,208
32	2001	717.46	726.45	0	3	56	442	754
33	2002	727.47	729.81	49	2	97	955	2,392
34	2003	716.14	729.04	0	8	1,031	3,450	9,906
35	2004	721.78	728.94	0	6	117	3,465	3,510
36	2005	727.39	732.80	887	880	975	1,262	1,834
37	2006	715.35	724.76	0	3	337	8,827	10,102
38	2007	716.55	718.44	0	5	92	2,817	2,621
39	2008	722.94	730.83	107	5	45	989	972
40	2009	723.00	729.50	10	9	88	2,214	3,384
41	2010	715.47	727.10	0	7	153	4,644	4,970
42	2011	730.06	732.87	4,622	4,607	4,971	5,138	10,709
43	2012	719.03	720.44	0	10	32	2,272	2,310
44	2013	718.58	725.31	10	4	67	2,311	6,448
45	2014	719.96	725.68	0	6	19	1,585	1,464
46	2015	714.46	720.35	0	7	75	5,165	8,647

Table 84. 25,500 ac-ft reallocation with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	0.00	0.00	0	0	0	0	0
2	1971	2.62	2.18	0	0	0	0	0
3	1972	17.45	16.36	0	0	0	0	0
4	1973	21.12	31.10	-560	-557	-592	-747	-632
5	1974	33.02	31.10	-39	-30	-84	0	0
6	1975	31.31	31.08	1,070	1,109	1,480	708	-53
7	1976	36.65	32.82	0	0	0	0	0
8	1977	35.49	35.35	0	0	0	0	0
9	1978	32.79	26.82	0	0	0	0	0
10	1979	36.49	32.36	0	0	0	0	0
11	1980	30.79	22.79	2,498	2,489	1,886	2,263	241
12	1981	37.38	35.92	0	0	0	0	0
13	1982	31.53	27.54	1,286	1,121	1,391	0	0
14	1983	32.55	24.05	2,456	2,480	2,271	871	203
15	1984	33.48	30.99	0	0	0	0	0
16	1985	30.37	28.79	0	0	0	0	0
17	1986	35.01	14.01	1,492	1,479	1,213	2,746	2,748
18	1987	38.46	37.36	0	0	0	0	0
19	1988	38.00	37.48	0	0	0	0	0
20	1989	33.22	30.28	0	0	0	0	0
21	1990	30.27	28.37	0	0	0	0	0
22	1991	27.59	24.77	0	0	0	0	0
23	1992	29.93	25.19	0	0	0	0	0
24	1993	29.93	25.43	-462	-492	-348	0	0
25	1994	35.10	32.87	0	0	0	0	0

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
26	1995	32.56	23.62	2,489	2,485	2,370	2,482	-74
27	1996	28.12	22.31	2,494	2,484	2,337	1,955	-17
28	1997	28.50	27.72	2,482	2,485	2,170	2,103	-392
29	1998	30.26	18.35	1,514	1,479	1,230	3,269	473
30	1999	35.83	32.23	0	0	0	0	0
31	2000	32.23	28.95	0	0	0	0	0
32	2001	35.52	31.62	0	0	0	0	0
33	2002	29.10	28.11	-40	-43	0	0	0
34	2003	33.58	28.31	0	0	0	0	0
35	2004	32.76	29.95	0	0	0	0	0
36	2005	30.69	31.10	-230	-193	-91	-129	-130
37	2006	36.17	31.82	0	0	0	0	0
38	2007	35.32	34.37	0	0	0	0	0
39	2008	32.58	29.36	0	0	0	0	0
40	2009	32.85	30.19	0	0	0	0	0
41	2010	33.98	29.31	0	0	0	0	0
42	2011	29.57	28.02	2,493	2,492	2,313	-17	-17
43	2012	33.93	33.17	0	0	0	0	0
44	2013	31.81	29.23	0	0	0	0	0
45	2014	28.79	26.98	0	0	0	0	0
46	2015	31.71	29.01	0	0	0	0	0

Appendix IX. Results for structural changes with FIRO

This appendix details structural changes-with-FIRO simulation results in the following tables:

- Table 85. Structural changes with FIRO: average monthly runoff capture (ac-ft) by year
- Table 86. Structural changes with FIRO: differences in average monthly runoff capture (ac-ft) by year
- Table 87. Structural changes with FIRO: average monthly storage (ac-ft) by year
- Table 88. Structural changes with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)
- Table 89. Structural changes with FIRO: peak monthly elevation (ft) by year
- Table 90. Structural changes with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)
- Table 91. Structural changes with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year
- Table 92. Structural changes with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)
- Table 93. Structural changes with FIRO: annual event results
- Table 94. Structural changes with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

Table 85. Structural changes with FIRO: average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	12	224	-
2	1970	10,375	1,860	6,039	334	260	51	1	0	202	615	907	6,875	2,293
3	1971	3,370	569	1,037	363	-1,758	-1,141	-933	-1,254	-78	400	357	672	134
4	1972	391	667	138	-398	-4,167	-1,166	49	31	41	363	2,029	997	-85
5	1973	11,450	3,353	2,841	1,362	462	119	50	6	6	343	969	6,905	2,322
6	1974	6,312	1,398	3,503	2,423	437	178	48	157	298	9	32	307	1,259
7	1975	425	8,594	9,053	3,099	460	125	53	2	131	5	64	96	1,842
8	1976	90	186	83	46	7	0	0	0	0	0	0	1	35
9	1977	207	59	51	2	0	0	0	0	173	0	18	282	66
10	1978	14,793	7,706	4,578	1,653	465	99	15	0	0	67	48	25	2,454
11	1979	1,264	5,859	1,970	541	218	48	68	0	18	0	98	470	880
12	1980	10,553	11,503	3,830	1,164	672	226	244	12	184	197	0	66	2,388
13	1981	1,993	636	2,724	437	138	68	80	105	18	80	615	2,250	762
14	1982	11,836	2,161	5,783	3,006	1,311	458	200	81	257	105	5,025	11,226	3,454
15	1983	11,185	2,894	5,766	6,127	4,180	943	529	263	274	192	4,843	15,568	4,397
16	1984	2,684	2,737	1,572	733	64	131	182	86	153	86	1,265	1,022	893
17	1985	525	1,682	2,722	810	-167	113	21	92	89	59	420	344	559
18	1986	611	17,314	225	316	994	353	107	70	55	118	129	157	1,704
19	1987	309	1,357	1,082	328	99	10	0	67	137	0	38	148	298
20	1988	799	228	175	40	63	0	0	6	71	123	84	293	157
21	1989	319	340	984	143	32	0	0	12	202	0	79	0	176
22	1990	97	483	148	62	6	3	0	0	0	98	220	203	110
23	1991	0	211	9,313	753	57	14	0	0	154	389	114	207	934
24	1992	337	10,004	2,089	66	118	11	0	0	374	14	0	990	1,167
25	1993	20,491	3,220	4,769	1,676	646	283	6	55	178	314	112	149	2,658
26	1994	226	1,619	406	210	-640	-708	0	0	146	0	236	155	138
27	1995	15,555	1,045	6,221	2,018	1,706	658	115	2	154	74	5	1,069	2,385
28	1996	11,282	5,140	4,124	1,639	1,021	246	94	10	0	36	712	12,549	3,071
29	1997	11,944	2,158	897	394	-83	124	14	0	0	0	257	1,098	1,400
30	1998	11,775	3,608	2,065	3,815	1,001	323	350	60	23	37	266	496	1,985
31	1999	1,835	7,351	2,176	2,676	645	203	69	43	77	246	155	127	1,300
32	2000	1,786	13,755	3,575	451	252	167	80	240	215	117	24	131	1,733
33	2001	444	4,089	4,872	661	148	238	61	277	72	0	112	2,857	1,153
34	2002	2,283	665	1,091	324	-794	-79	123	55	244	216	167	12,785	1,423
35	2003	1,069	817	962	-1,004	913	78	130	80	167	68	36	638	329
36	2004	2,919	7,706	1,525	-597	-277	0	0	80	268	292	45	2,238	1,183
37	2005	9,590	5,749	3,232	1,396	810	141	48	31	172	289	84	2,851	2,033
38	2006	6,830	1,802	7,705	4,580	1,008	200	27	0	0	0	59	294	1,876
39	2007	123	1,532	797	110	-1,027	0	0	0	172	133	0	12	154

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
40	2008	11,330	5,463	1,226	329	116	13	252	19	71	6	77	275	1,598
41	2009	142	4,109	6,064	337	346	31	0	31	54	646	178	49	999
42	2010	10,798	2,559	248	296	425	18	2	43	0	0	67	2,852	1,442
43	2011	1,444	6,730	6,278	1,463	600	341	43	84	357	357	4	844	1,545
44	2012	138	59	476	1,341	287	303	264	554	465	71	755	6,894	967
45	2013	715	335	262	43	7	722	0	0	0	595	173	43	241
46	2014	0	29	156	-699	-13	0	0	0	351	6	54	4,961	404
47	2015	214	1,583	255	238	46	0	0	0	0	-	-	-	-
48	*Minimum*	0	29	51	-1,004	-4,167	-1,166	-933	-1,254	-78	0	0	0	-85
49	*Maximum*	20,491	17,314	9,313	6,127	4,180	943	529	554	465	646	5,025	15,568	4,397
50	*Mean*	4,627	3,542	2,719	981	241	86	52	30	129	150	455	2,232	1,294

Table 86. Structural changes with FIRO: differences in average monthly runoff capture (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-
2	1970	0	0	0	0	305	1,219	0	0	0	0	0	0	127
3	1971	0	0	0	2,472	1,408	60	51	48	10	0	0	0	337
4	1972	0	0	0	171	41	15	0	0	0	0	0	0	19
5	1973	698	205	-41	-370	-110	0	0	0	0	0	0	0	32
6	1974	848	0	15	-654	26	0	0	0	0	0	0	0	20
7	1975	0	0	963	-389	-230	0	0	0	0	0	0	0	29
8	1976	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1977	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1978	0	1,500	-11	-569	0	0	0	0	0	0	0	0	77
11	1979	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1980	0	1,324	7	-329	0	0	0	0	0	0	0	0	84
13	1981	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1982	1,016	9	-917	269	0	0	0	0	0	0	0	0	31
15	1983	948	-989	775	-431	2	0	0	0	0	0	0	0	25
16	1984	0	0	0	0	0	0	0	0	0	0	0	0	0
17	1985	0	0	0	0	664	0	0	0	0	0	0	0	55
18	1986	0	962	-121	-520	0	0	0	0	0	0	0	0	27
19	1987	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1988	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1989	0	0	0	0	0	0	0	0	0	0	0	0	0
22	1990	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1991	0	0	1,085	0	0	0	0	0	0	0	0	0	90
24	1992	0	0	0	0	484	0	0	0	0	0	0	0	40
25	1993	1,258	9	-309	-345	0	0	0	0	0	0	0	0	51

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Average (15)
26	1994	0	0	0	0	380	0	0	0	0	0	0	0	32
27	1995	862	2	-213	-438	17	0	0	0	0	0	0	0	19
28	1996	0	941	16	-673	0	0	0	0	0	0	0	0	24
29	1997	987	14	18	-272	-340	0	0	0	0	0	0	0	34
30	1998	0	930	-131	-528	29	10	0	0	0	0	0	0	26
31	1999	0	0	0	0	19	0	0	0	0	0	0	0	2
32	2000	0	1,199	4	-303	-73	0	0	0	0	0	0	0	69
33	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2002	72	0	0	0	392	3	0	0	0	0	0	934	117
35	2003	2	0	0	-622	3	0	0	0	0	0	0	0	-51
36	2004	0	0	0	364	4	0	0	0	0	0	0	0	31
37	2005	0	985	-46	-595	0	0	0	0	0	0	0	0	29
38	2006	0	0	980	-649	8	0	0	0	0	0	0	0	28
39	2007	0	0	0	0	383	0	0	0	0	0	0	0	32
40	2008	0	957	5	0	0	0	0	0	0	0	0	0	80
41	2009	0	0	0	0	0	0	0	0	0	0	0	0	0
42	2010	0	755	-42	-598	11	0	0	0	0	0	0	0	10
43	2011	0	0	898	-600	0	0	0	0	0	0	0	0	25
44	2012	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2013	0	0	0	0	136	64	0	0	0	0	0	0	17
46	2014	0	0	16	818	1	0	0	0	0	0	0	0	70
47	2015	0	0	0	0	0	0	0	0	0	-	-	-	-
48	*Minimum*	0	-989	-917	-673	-340	0	0	0	0	0	0	0	-51
49	*Maximum*	1,258	1,500	1,085	2,472	1,408	1,219	51	48	10	0	0	934	337
50	*Mean*	145	191	64	-104	77	30	1	1	0	0	0	20	36

Table 87. Structural changes with FIRO: average monthly storage (ac-ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	13,198	13,206	-	-
2	1970	18,810	28,126	33,818	35,920	39,050	40,579	40,666	40,002	38,913	34,989	30,519	31,114	34,742	32,848
3	1971	35,343	35,672	36,201	40,019	44,829	44,993	44,991	44,997	43,816	38,002	33,570	34,235	36,740	35,292
4	1972	35,310	36,171	37,883	42,946	44,997	44,927	42,991	40,855	39,765	34,659	33,425	34,869	40,336	32,548
5	1973	40,412	44,607	44,997	44,982	44,968	44,654	44,036	43,364	41,053	35,822	33,224	36,533	44,997	33,207
6	1974	43,991	44,329	44,691	44,977	44,994	44,783	44,303	41,284	34,860	29,653	27,072	26,466	44,844	27,493
7	1975	26,778	34,164	43,708	44,751	44,989	44,727	44,267	43,646	42,386	36,779	31,245	30,019	44,939	33,526
8	1976	30,029	30,573	35,921	38,933	38,538	38,036	37,408	36,678	36,166	34,483	29,535	28,951	38,493	31,379
9	1977	29,002	29,976	36,224	40,360	42,361	43,004	42,368	41,589	37,461	33,115	30,235	29,740	39,692	31,384
10	1978	36,573	43,582	44,819	44,835	44,133	43,591	42,954	42,227	40,273	33,385	28,934	28,489	44,997	30,544
11	1979	29,014	31,390	37,300	40,221	43,339	42,852	42,190	41,352	37,851	32,265	27,865	27,615	38,257	29,543
12	1980	33,771	40,551	44,835	44,778	44,531	44,330	43,384	41,816	39,298	33,346	29,782	29,585	44,881	30,440
13	1981	29,745	32,426	39,373	44,293	43,987	42,709	40,925	38,647	36,465	35,257	35,398	35,984	44,206	35,189
14	1982	44,013	44,884	44,755	45,062	44,316	43,609	42,634	42,079	40,098	33,344	27,282	33,717	46,823	29,875
15	1983	40,484	44,677	45,727	44,845	44,334	44,231	43,798	43,277	41,735	35,746	30,667	34,888	44,997	32,621
16	1984	39,177	39,051	41,186	42,048	43,612	43,546	42,099	40,125	37,123	31,480	29,573	29,479	41,786	31,042
17	1985	30,131	31,442	36,412	42,254	44,526	44,260	43,552	41,682	38,911	33,763	31,212	27,621	40,134	33,482
18	1986	27,496	38,429	44,664	44,997	44,465	44,123	43,372	42,868	40,692	35,186	31,021	27,684	44,997	33,544
19	1987	27,685	28,460	31,925	38,598	42,658	42,696	42,169	41,261	36,591	29,313	25,992	25,996	35,753	26,351
20	1988	26,432	26,856	29,370	35,076	40,094	42,643	42,085	41,293	36,849	30,634	28,150	26,369	32,167	29,040
21	1989	26,424	27,155	31,983	35,724	37,912	37,819	37,210	36,634	34,248	29,985	28,990	28,934	34,691	29,282
22	1990	28,904	31,783	35,905	36,744	37,568	39,163	38,718	38,143	36,990	34,307	31,668	29,635	36,470	33,014
23	1991	29,845	33,495	39,321	43,457	43,574	42,996	40,771	38,941	36,453	32,923	29,377	28,628	44,021	31,229
24	1992	28,926	33,640	37,786	41,048	44,207	44,106	43,282	41,144	38,983	32,273	28,382	28,198	39,238	29,579
25	1993	37,846	44,797	44,787	44,962	44,578	44,289	43,691	43,099	40,654	35,069	31,792	31,748	44,997	32,944
26	1994	31,830	32,519	35,918	37,790	43,296	44,997	44,520	43,654	41,971	38,035	33,477	31,845	36,135	35,305
27	1995	40,478	44,293	44,696	44,980	44,661	44,213	43,911	43,319	41,301	36,551	33,001	31,149	44,997	34,284
28	1996	33,354	45,160	44,990	44,730	44,625	44,080	43,532	42,866	39,779	33,147	26,897	27,713	44,941	29,661
29	1997	44,563	44,997	44,997	44,996	44,956	44,112	44,566	44,014	41,217	35,064	31,212	31,833	44,997	32,599
30	1998	37,033	46,710	44,997	44,921	44,866	44,939	44,447	41,729	37,576	33,524	30,638	29,996	44,997	31,691
31	1999	29,907	36,780	41,002	43,460	44,531	44,108	42,754	41,735	40,536	37,677	33,214	32,424	42,182	36,070
32	2000	33,125	39,047	44,804	44,714	44,800	44,520	43,515	41,685	39,413	34,767	29,870	29,762	44,526	32,318
33	2001	30,156	32,148	38,960	41,571	43,711	41,560	39,867	42,830	42,361	41,955	42,097	41,925	39,714	42,484
34	2002	43,367	41,518	40,293	41,238	43,727	44,684	43,537	41,792	39,332	37,147	33,126	37,167	40,708	35,373
35	2003	44,041	40,403	40,983	44,471	44,757	44,014	42,826	41,774	38,521	34,447	31,901	31,206	43,382	34,097
36	2004	34,185	36,061	42,699	44,711	44,327	43,533	42,654	40,143	36,717	31,969	30,053	29,991	43,853	30,548
37	2005	38,731	42,481	44,975	44,996	44,712	44,161	43,117	42,327	40,425	35,343	30,766	30,319	44,997	32,638
38	2006	38,629	39,598	44,075	44,996	44,878	44,380	43,608	42,496	41,162	37,736	32,947	31,194	44,997	35,014

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
39	2007	31,242	31,469	34,618	40,120	44,529	41,522	40,190	39,622	38,350	34,353	33,501	33,334	37,111	33,826
40	2008	37,217	44,398	44,588	44,048	44,230	43,655	43,847	43,125	41,859	41,965	41,170	36,180	44,165	42,338
41	2009	33,360	34,685	42,068	42,491	42,644	42,101	41,599	40,506	39,970	39,782	38,929	33,431	42,471	39,849
42	2010	35,225	43,668	44,997	44,997	44,490	43,424	42,485	41,602	40,926	40,594	41,366	36,954	44,997	41,603
43	2011	36,322	37,263	43,719	44,977	44,799	44,795	44,274	43,266	42,587	42,344	41,181	36,270	44,996	42,223
44	2012	33,482	33,473	33,376	34,666	38,660	40,177	39,808	40,503	42,453	39,124	34,092	35,419	33,487	36,185
45	2013	40,225	40,583	40,180	42,121	43,916	44,319	44,005	42,663	39,432	35,321	34,640	34,603	40,429	34,653
46	2014	34,438	36,232	41,139	44,826	44,272	44,283	43,788	43,113	40,098	34,206	32,375	34,550	43,846	32,428
47	2015	37,314	38,243	38,804	40,779	41,940	41,163	40,327	38,263	36,806	-	-	-	38,743	-
48	*Minimum*	*18,810*	*26,856*	*29,370*	*34,666*	*37,568*	*37,819*	*37,210*	*36,634*	*34,248*	*29,313*	*13,198*	*13,206*	32,167	26,351
49	*Maximum*	*44,563*	*46,710*	*45,727*	*45,062*	*44,997*	*44,997*	*44,991*	*44,997*	*43,816*	*42,344*	*42,097*	*41,925*	46,823	42,484
50	*Mean*	*34,225*	*37,347*	*40,445*	*42,357*	*43,476*	*43,291*	*42,544*	*41,522*	*39,357*	*35,130*	*31,621*	*31,238*	41,606	33,346

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 88. Structural changes with FIRO: differences in average monthly storage (ac-ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
1	1969	-	-	-	-	-	-	-	-	-	-	0	0	-	-
2	1970	0	0	0	0	15	959	1,512	1,497	1,483	1,471	1,466	1,463	0	1,468
3	1971	1,461	1,458	1,454	1,886	5,175	5,310	5,311	5,312	5,297	5,261	5,235	5,222	1,452	5,247
4	1972	5,212	5,203	5,185	5,178	5,312	5,302	5,253	5,200	5,157	5,130	5,115	5,108	5,171	5,119
5	1973	5,328	5,610	5,993	5,702	5,421	5,362	5,309	5,256	5,214	5,183	5,161	5,154	5,926	5,169
6	1974	5,704	5,988	5,991	5,331	5,311	5,283	5,240	5,191	5,143	5,098	5,073	5,061	5,892	5,081
7	1975	5,048	5,037	5,669	5,913	5,338	5,279	5,239	5,190	5,150	5,122	5,105	5,091	5,975	5,113
8	1976	5,078	5,061	5,044	5,021	4,985	4,943	4,891	4,849	4,809	4,782	4,757	4,739	5,032	4,767
9	1977	4,728	4,717	4,699	4,675	4,648	4,616	4,574	4,530	4,494	4,464	4,443	4,428	4,689	4,452
10	1978	4,419	5,497	5,950	5,359	5,277	5,233	5,187	5,135	5,095	5,055	5,028	5,015	5,814	5,039
11	1979	5,007	4,998	4,988	4,970	4,942	4,894	4,848	4,803	4,761	4,724	4,706	4,691	4,982	4,713
12	1980	4,683	4,941	5,991	5,701	5,611	5,575	5,532	5,480	5,439	5,398	5,367	5,348	5,980	5,381
13	1981	5,337	5,326	5,310	5,289	5,254	5,207	5,150	5,097	5,049	5,015	4,997	4,988	5,302	5,004
14	1982	5,810	5,947	5,830	5,303	5,292	5,254	5,214	5,161	5,118	5,088	5,069	5,060	5,111	5,076
15	1983	5,057	5,558	5,586	5,330	5,300	5,262	5,215	5,166	5,125	5,097	5,076	5,066	5,671	5,083
16	1984	5,061	5,052	5,038	5,017	4,984	4,940	4,887	4,839	4,794	4,758	4,740	4,731	5,027	4,746
17	1985	4,723	4,713	4,695	4,674	5,098	5,266	5,209	5,162	5,124	5,089	5,066	5,057	4,686	5,076
18	1986	5,049	5,190	5,658	5,358	5,296	5,256	5,209	5,163	5,126	5,096	5,071	5,056	5,797	5,085
19	1987	5,047	5,035	5,018	4,991	4,955	4,918	4,879	4,839	4,802	4,763	4,745	4,734	5,005	4,751
20	1988	4,725	4,711	4,685	4,648	4,621	4,587	4,543	4,501	4,463	4,429	4,409	4,397	4,664	4,416
21	1989	4,389	4,381	4,368	4,344	4,314	4,279	4,234	4,190	4,153	4,124	4,102	4,089	4,358	4,113

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)	Start of season[1] (15)	End of season[2] (16)
22	1990	4,080	4,071	4,059	4,038	4,007	3,977	3,940	3,903	3,873	3,843	3,819	3,806	4,049	3,829
23	1991	3,797	3,786	3,887	4,843	4,819	4,784	4,744	4,704	4,667	4,626	4,600	4,583	4,855	4,610
24	1992	4,575	4,566	4,555	4,536	4,808	4,951	4,911	4,862	4,821	4,783	4,760	4,746	4,547	4,771
25	1993	5,101	5,847	5,987	5,329	5,287	5,253	5,200	5,152	5,109	5,076	5,047	5,034	5,589	5,061
26	1994	5,025	5,016	5,000	4,973	5,053	5,312	5,288	5,239	5,196	5,166	5,147	5,140	4,987	5,154
27	1995	5,431	5,993	5,725	5,334	5,302	5,280	5,237	5,189	5,146	5,112	5,086	5,074	5,672	5,096
28	1996	5,066	5,562	5,995	5,394	5,274	5,234	5,186	5,131	5,087	5,051	5,026	5,017	5,990	5,035
29	1997	5,572	5,995	5,995	5,795	5,512	5,280	5,234	5,189	5,151	5,114	5,090	5,081	5,975	5,099
30	1998	5,072	5,194	5,992	5,338	5,306	5,306	5,267	5,217	5,170	5,138	5,118	5,108	5,752	5,125
31	1999	5,097	5,089	5,079	5,061	5,042	5,018	4,972	4,933	4,896	4,860	4,837	4,822	5,071	4,846
32	2000	4,808	4,903	5,990	5,935	5,557	5,513	5,465	5,414	5,371	5,336	5,318	5,307	5,977	5,327
33	2001	5,294	5,281	5,264	5,241	5,204	5,153	5,104	5,058	5,016	4,983	4,962	4,954	5,251	4,970
34	2002	5,008	5,009	4,992	4,969	5,079	5,291	5,240	5,190	5,144	5,105	5,081	5,123	4,981	5,092
35	2003	5,993	5,983	5,966	5,611	5,300	5,257	5,203	5,152	5,108	5,065	5,038	5,028	5,954	5,044
36	2004	5,021	5,011	4,993	5,109	5,294	5,251	5,204	5,156	5,105	5,065	5,043	5,030	4,981	5,051
37	2005	5,021	5,308	5,992	5,465	5,299	5,262	5,212	5,159	5,117	5,082	5,057	5,039	5,924	5,070
38	2006	5,031	5,021	5,577	5,364	5,299	5,259	5,205	5,151	5,109	5,078	5,056	5,042	5,920	5,062
39	2007	5,028	5,016	4,998	4,970	5,158	5,278	5,229	5,179	5,132	5,101	5,078	5,061	4,984	5,089
40	2008	5,053	5,921	5,987	5,957	5,914	5,862	5,805	5,749	5,697	5,660	5,637	5,627	5,974	5,644
41	2009	5,616	5,601	5,588	5,560	5,524	5,480	5,426	5,374	5,327	5,291	5,272	5,259	5,575	5,280
42	2010	5,252	5,357	5,993	5,431	5,305	5,270	5,221	5,175	5,134	5,101	5,084	5,077	5,914	5,091
43	2011	5,070	5,057	5,211	5,613	5,292	5,260	5,215	5,169	5,124	5,094	5,075	5,062	5,934	5,082
44	2012	5,047	5,031	5,009	4,984	4,945	4,900	4,851	4,800	4,759	4,728	4,710	4,697	4,998	4,718
45	2013	4,690	4,682	4,666	4,641	4,621	4,711	4,719	4,675	4,637	4,604	4,579	4,564	4,655	4,590
46	2014	4,548	4,533	4,518	5,197	5,289	5,237	5,185	5,135	5,093	5,055	5,029	5,018	4,523	5,039
47	2015	5,010	4,999	4,981	4,953	4,920	4,883	4,835	4,787	4,761	-	-	-	4,967	-
48	*Minimum*	*0*	*0*	*0*	*0*	*15*	*959*	*1,512*	*1,497*	*1,483*	*1,471*	*0*	*0*	*0*	*1,468*
49	*Maximum*	*5,993*	*5,995*	*5,995*	*5,957*	*5,914*	*5,862*	*5,805*	*5,749*	*5,697*	*5,660*	*5,637*	*5,627*	*5,990*	*5,644*
50	*Mean*	*4,830*	*4,962*	*5,112*	*5,007*	*5,034*	*5,043*	*5,012*	*4,965*	*4,925*	*4,895*	*4,767*	*4,756*	*5,120*	*4,882*

1. Start-of-season storage is defined as the average storage on April 1 of each year.
2. End-of-season storage is defined as the average storage on October 31 of each year.

Table 89. Structural changes with FIRO: peak monthly elevation (ft) by year

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	648.00	648.44
2	1970	682.56	685.69	695.35	699.76	703.18	704.81	704.56	703.59	703.11	698.82	692.22	693.82
3	1971	698.42	697.06	698.31	708.04	709.91	709.91	709.91	709.91	709.91	704.59	696.08	695.76
4	1972	696.76	697.95	703.53	709.91	709.91	709.91	709.59	704.77	703.83	699.48	694.85	696.33
5	1973	709.64	709.91	709.91	709.91	709.91	709.79	709.05	708.20	707.29	701.07	693.68	703.89

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
6	1974	709.91	709.64	709.91	709.91	709.91	709.87	709.33	708.59	700.10	691.04	683.02	681.38
7	1975	682.00	703.08	709.91	709.91	709.91	709.82	709.26	708.53	707.72	703.18	693.22	687.59
8	1976	687.61	691.99	700.89	701.80	701.45	700.66	699.82	698.91	697.85	697.29	689.77	685.78
9	1977	685.82	692.06	703.07	704.17	707.84	707.62	706.85	706.06	703.20	696.00	689.92	687.32
10	1978	707.02	709.91	710.09	709.91	709.12	708.45	707.66	706.73	705.73	698.61	688.36	684.93
11	1979	686.89	697.86	700.59	706.55	707.99	707.56	706.56	705.76	703.67	695.81	686.56	683.90
12	1980	700.61	718.36	709.91	709.91	709.37	709.16	708.77	706.37	704.62	697.87	688.15	686.82
13	1981	690.22	695.40	708.84	709.01	708.93	707.98	706.09	703.11	699.74	696.30	696.80	700.07
14	1982	712.00	709.91	712.94	712.93	709.89	708.45	706.97	706.38	705.61	698.97	687.15	701.66
15	1983	717.48	712.08	721.01	709.91	709.91	709.27	708.82	707.85	707.42	701.42	691.81	703.96
16	1984	703.97	703.77	705.59	706.81	708.69	708.25	707.61	704.33	703.14	693.35	689.39	687.42
17	1985	688.10	693.02	703.26	707.80	709.91	709.23	708.50	707.54	704.66	696.49	693.34	686.31
18	1986	683.57	729.26	709.91	709.91	709.91	709.01	708.09	707.39	706.75	699.80	693.32	685.29
19	1987	683.62	685.84	696.73	705.00	707.59	707.18	706.48	705.78	703.09	692.26	680.85	680.47
20	1988	681.80	681.98	691.12	700.38	706.14	707.17	706.48	705.54	703.17	693.26	685.76	682.85
21	1989	681.30	685.65	695.18	698.67	700.74	700.36	699.58	698.60	697.86	689.31	686.20	685.71
22	1990	686.32	694.53	698.03	699.17	701.08	703.02	701.72	700.87	700.10	695.94	692.60	688.09
23	1991	688.57	697.92	708.56	708.79	708.89	708.69	705.83	703.18	700.41	695.26	689.64	685.26
24	1992	685.76	700.62	701.92	707.10	709.48	709.13	708.31	705.20	704.28	696.80	686.64	685.81
25	1993	709.91	709.93	709.91	709.91	709.59	709.12	708.60	707.75	707.00	699.50	692.35	690.66
26	1994	690.88	695.01	697.49	703.75	709.91	709.91	709.91	708.61	707.65	703.40	696.08	691.22
27	1995	709.91	709.91	717.90	709.91	709.91	708.93	708.75	708.09	707.26	701.75	694.51	691.46
28	1996	705.80	716.74	709.91	709.91	709.76	709.05	708.34	707.49	706.62	698.56	686.76	694.72
29	1997	713.95	709.91	709.91	709.91	709.91	709.80	709.68	708.98	708.26	700.50	691.82	691.23
30	1998	706.92	723.85	709.91	709.91	709.91	709.91	709.68	707.92	703.10	696.55	690.40	688.39
31	1999	690.04	703.34	706.11	709.25	709.56	708.91	707.73	706.18	704.44	703.13	697.21	692.51
32	2000	694.92	709.91	709.91	709.91	709.91	709.70	708.59	706.90	704.18	699.71	691.45	687.55
33	2001	688.22	696.63	703.11	706.95	709.04	707.51	706.21	707.29	707.17	706.56	706.54	707.20
34	2002	708.61	706.48	704.11	706.20	709.91	709.91	708.92	706.75	704.46	699.74	696.15	709.91
35	2003	709.91	705.67	707.76	709.91	709.91	709.02	708.12	706.29	704.72	696.88	694.29	690.53
36	2004	695.09	706.12	708.24	709.91	709.91	708.35	707.56	706.06	701.80	693.72	688.45	691.14
37	2005	704.92	709.91	709.91	709.91	709.91	709.33	707.90	706.88	705.91	700.41	691.85	692.56
38	2006	703.11	704.10	709.91	710.57	709.91	709.46	708.61	707.36	706.11	703.19	695.63	690.29
39	2007	689.77	692.08	698.76	707.04	709.91	709.62	703.66	703.17	703.00	697.44	693.88	693.23
40	2008	708.43	709.91	709.91	709.47	709.65	708.88	708.88	707.98	706.73	706.52	706.35	701.21
41	2009	694.37	699.21	707.29	706.73	707.24	706.44	706.46	704.26	703.41	703.17	703.14	697.95
42	2010	706.62	709.91	709.91	709.91	709.91	708.22	707.28	705.94	704.79	705.42	706.47	701.95
43	2011	698.05	706.21	711.49	709.91	709.88	709.76	709.44	708.24	707.05	706.49	706.20	701.70
44	2012	693.53	693.39	693.35	698.25	703.15	703.56	703.20	705.45	706.98	705.88	697.35	703.16
45	2013	703.78	704.04	704.08	708.37	709.13	709.16	709.10	708.12	704.90	698.61	695.22	695.20

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
46	2014	695.05	700.64	708.23	709.91	709.91	709.35	708.79	707.82	706.72	699.05	691.66	699.12
47	2015	699.29	701.38	701.45	706.98	706.95	705.18	704.28	703.07	698.53	-	-	-
48	*Minimum*	*681.30*	*681.98*	*691.12*	*698.25*	*700.74*	*700.36*	*699.58*	*698.60*	*697.85*	*689.31*	*648.00*	*648.44*
49	*Maximum*	*717.48*	*729.26*	*721.01*	*712.93*	*709.91*	*709.91*	*709.91*	*709.91*	*709.91*	*706.56*	*706.54*	*709.91*
50	*Mean*	*697.20*	*702.78*	*705.72*	*707.56*	*708.53*	*708.14*	*707.29*	*706.08*	*704.44*	*699.09*	*691.98*	*691.56*

Table 90. Structural changes with FIRO: differences in peak monthly elevation (ft) from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
1	1969	-	-	-	-	-	-	-	-	-	-	0.00	0.00
2	1970	0.00	0.00	0.00	0.00	0.08	1.71	1.51	2.14	2.54	2.21	2.35	2.33
3	1971	2.18	2.25	2.17	4.94	6.81	6.81	6.81	6.81	6.81	7.66	8.63	8.61
4	1972	8.42	8.17	7.58	6.81	6.81	6.81	6.55	7.57	7.56	7.95	8.54	8.32
5	1973	7.94	8.21	8.13	6.87	6.84	6.73	7.33	7.31	7.32	7.91	8.77	7.52
6	1974	8.21	8.22	8.21	6.81	6.81	6.78	6.43	7.19	7.95	9.02	10.28	10.65
7	1975	10.45	7.98	8.18	6.88	6.81	6.73	6.91	7.19	7.19	7.65	8.75	9.27
8	1976	9.26	8.78	7.67	7.56	7.57	7.57	7.57	7.55	7.57	7.59	8.52	8.83
9	1977	8.77	8.16	7.49	6.80	6.42	6.42	6.44	6.43	6.62	7.27	7.96	7.97
10	1978	6.16	8.15	8.23	6.81	7.26	7.26	7.26	7.29	7.32	7.90	9.08	9.65
11	1979	9.20	7.83	7.61	7.01	6.86	6.85	6.87	6.88	6.99	7.76	8.65	9.17
12	1980	7.13	5.86	8.21	6.90	7.67	7.69	7.66	7.84	7.93	8.58	9.80	9.91
13	1981	9.50	8.84	7.30	7.26	7.25	7.26	7.39	7.99	7.83	8.19	8.02	7.67
14	1982	6.58	8.21	6.62	6.63	6.79	7.26	7.36	7.37	7.37	7.93	9.28	7.62
15	1983	6.12	6.64	6.01	6.81	6.81	7.00	7.20	7.22	7.18	7.73	8.86	7.39
16	1984	7.39	7.38	7.21	7.03	6.84	6.84	6.84	7.06	7.38	8.11	8.47	8.57
17	1985	8.47	8.03	6.87	6.46	6.81	7.25	7.23	7.23	7.46	8.29	8.66	9.39
18	1986	10.06	5.59	8.01	6.81	6.81	7.23	7.25	7.25	7.25	7.89	8.68	9.65
19	1987	10.04	9.43	8.07	7.17	6.88	6.90	6.92	6.93	7.63	8.27	10.10	10.14
20	1988	9.78	9.69	8.19	7.08	6.52	6.41	6.43	6.45	6.71	7.54	8.15	8.80
21	1989	9.15	8.08	7.16	6.72	6.52	6.55	6.55	6.53	6.52	7.40	7.48	7.52
22	1990	7.40	6.71	6.32	6.20	5.99	6.65	5.87	5.90	5.91	6.17	6.52	6.81
23	1991	6.77	5.89	6.68	5.85	5.86	6.03	6.80	7.03	7.15	7.66	8.23	8.58
24	1992	8.46	6.94	6.79	6.31	6.38	6.10	6.80	7.03	7.02	7.68	8.76	8.80
25	1993	8.21	6.93	6.91	6.81	6.55	7.22	7.20	7.20	7.21	7.87	8.75	8.91
26	1994	8.86	8.33	7.89	7.25	6.81	6.81	6.81	7.26	7.27	7.61	8.46	9.04
27	1995	7.99	8.21	6.19	6.81	6.81	7.24	7.24	7.23	7.23	7.73	8.55	8.89
28	1996	7.23	6.25	8.21	6.81	6.68	7.21	7.20	7.19	7.21	7.90	9.27	8.38
29	1997	6.49	8.21	8.20	6.92	6.81	6.72	6.61	7.16	7.15	7.86	8.89	8.92
30	1998	7.12	6.03	8.00	6.81	6.81	6.81	6.62	7.28	8.16	8.36	9.10	9.23
31	1999	9.09	7.47	7.22	6.21	6.46	6.87	6.94	7.04	7.12	7.51	7.68	8.30

ID (1)	Year (2)	January (3)	February (4)	March (5)	April (6)	May (7)	June (8)	July (9)	August (10)	September (11)	October (12)	November (13)	December (14)
32	2000	7.98	8.21	8.21	6.90	6.88	6.70	7.58	7.68	7.86	8.28	9.34	9.71
33	2001	9.61	8.57	8.21	7.37	7.14	7.20	7.22	7.06	7.05	7.02	7.01	6.92
34	2002	6.91	7.10	7.25	7.06	6.81	6.81	7.24	7.36	7.51	7.91	8.33	8.21
35	2003	8.21	8.64	8.35	6.81	6.81	7.25	7.25	7.35	7.44	8.17	8.48	8.91
36	2004	8.35	7.13	6.88	6.81	6.81	7.29	7.29	7.39	7.72	8.63	9.10	8.84
37	2005	7.25	8.21	8.12	6.81	6.81	6.69	7.28	7.30	7.33	7.82	8.83	8.68
38	2006	7.84	7.31	8.19	7.31	6.81	6.44	7.22	7.24	7.31	7.53	8.35	8.98
39	2007	8.98	8.70	7.75	6.94	6.81	6.58	7.68	7.85	8.57	8.13	8.61	8.66
40	2008	6.96	8.21	8.21	8.16	8.15	8.06	8.06	8.06	8.12	8.04	8.05	8.58
41	2009	9.51	8.70	7.85	7.86	7.78	7.83	7.71	7.87	7.88	7.94	8.06	8.29
42	2010	7.42	8.21	8.12	6.81	6.81	7.33	7.35	7.42	7.47	7.31	7.20	7.62
43	2011	7.94	7.18	6.64	6.81	6.78	6.68	6.42	7.19	7.22	7.21	7.23	7.64
44	2012	8.60	8.59	8.54	7.76	7.45	7.18	7.17	6.84	6.66	6.75	7.43	7.08
45	2013	6.84	6.81	6.79	6.28	6.03	6.06	6.01	6.48	6.71	7.19	7.55	7.53
46	2014	7.52	6.88	6.20	6.81	6.81	6.34	7.17	7.17	7.21	7.88	8.80	7.78
47	2015	7.76	7.55	7.53	6.93	6.92	7.06	7.06	7.66	7.42	-	-	-
48	*Minimum*	*0.00*	*0.00*	*0.00*	*0.00*	*0.08*	*1.71*	*1.51*	*2.14*	*2.54*	*2.21*	*0.00*	*0.00*
49	*Maximum*	*10.45*	*9.69*	*8.54*	*8.16*	*8.15*	*8.06*	*8.06*	*8.06*	*8.57*	*9.02*	*10.28*	*10.65*
50	*Mean*	*7.83*	*7.44*	*7.26*	*6.71*	*6.69*	*6.81*	*6.92*	*7.10*	*7.22*	*7.67*	*8.17*	*8.22*

Table 91. Structural changes with FIRO: number of days Lake Del Valle elevation thresholds are exceeded by year

		Days threshold is exceeded																	
ID (1)	Year (2)	703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	175.5	167.6	161.2	158.0	154.8	148.3	141.6	135.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1972	178.4	146.5	108.6	105.0	101.4	93.5	85.5	77.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1973	254.0	244.8	239.7	237.3	234.7	229.8	199.7	152.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1974	234.5	230.1	222.9	220.2	218.0	213.9	210.0	168.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1975	215.2	204.2	200.3	198.4	196.4	192.3	165.3	124.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	155.0	118.0	106.8	102.4	80.9	40.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	246.3	238.3	230.8	223.7	203.8	163.8	127.0	75.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1979	146.6	132.8	117.7	104.5	86.0	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	209.9	205.1	189.8	184.8	176.7	156.3	147.5	121.1	5.1	4.8	4.5	4.1	3.8	3.4	0.0	0.0	0.0	0.0	0.0
13	1981	135.5	120.4	111.4	106.7	100.4	77.4	64.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1982	257.9	253.9	248.7	242.8	224.8	172.4	168.1	121.5	3.2	2.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1983	252.0	243.0	239.7	238.0	236.3	232.6	173.4	105.0	13.6	12.1	10.2	8.4	7.0	6.0	0.0	0.0	0.0	0.0	0.0
16	1984	210.3	152.3	129.6	115.4	88.3	66.6	32.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Days threshold is exceeded 703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
17	1985	168.5	156.9	126.6	122.1	118.0	109.3	73.3	36.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1986	217.1	212.5	209.0	207.3	205.5	183.6	137.7	83.4	7.1	6.8	6.5	6.2	5.9	5.5	1.2	0.0	0.0	0.0	0.0
19	1987	131.6	120.6	111.3	100.3	76.3	23.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	111.6	98.6	88.4	65.6	47.3	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	131.9	112.2	104.0	99.4	94.0	81.9	34.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	162.4	152.2	109.0	98.5	94.6	86.8	67.5	24.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	247.2	241.6	238.1	236.3	234.4	223.0	181.1	137.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1994	159.7	148.4	138.5	134.0	129.5	119.3	93.9	61.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1995	258.0	251.8	247.6	245.2	236.8	225.7	185.6	105.0	6.4	5.8	5.2	4.5	3.8	3.0	0.0	0.0	0.0	0.0	0.0
28	1996	230.0	224.3	221.3	219.8	218.3	197.8	163.2	117.2	4.5	4.0	3.7	3.3	2.7	1.5	0.0	0.0	0.0	0.0	0.0
29	1997	264.3	259.3	255.4	253.5	251.7	247.9	239.3	182.9	4.6	3.5	2.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1998	224.5	216.8	209.5	203.5	196.6	187.5	178.7	157.9	10.3	9.5	9.2	8.8	8.1	7.3	0.0	0.0	0.0	0.0	0.0
31	1999	219.2	187.9	156.7	146.1	126.5	94.3	76.4	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2000	214.8	201.1	188.6	181.4	169.4	157.6	143.9	116.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2001	259.0	239.5	226.4	202.0	133.0	60.5	19.8	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	2002	265.5	224.3	187.4	165.4	146.8	115.3	80.4	43.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2003	246.8	211.0	194.6	180.3	170.1	135.1	108.0	67.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2004	171.6	165.8	161.8	159.5	150.2	114.0	75.0	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	2005	250.9	241.5	206.7	204.4	193.3	160.5	128.8	114.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	2006	229.6	203.9	196.4	191.9	184.8	151.5	130.3	99.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	2007	120.9	60.1	54.0	51.0	46.3	38.9	32.2	22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2008	303.9	298.7	294.5	269.9	250.8	208.6	169.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	2009	245.4	159.3	139.9	129.5	110.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	309.5	286.2	232.7	212.6	192.3	151.8	115.9	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2011	275.1	268.1	263.3	261.2	258.0	181.8	139.0	116.1	1.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2012	130.3	47.0	36.4	31.2	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	247.3	181.3	145.3	135.6	128.6	115.4	94.9	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2014	194.4	185.0	177.8	173.5	166.4	155.0	116.3	56.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2015	109.8	85.9	49.8	23.8	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	309.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	1.2	0.0	0.0	0.0	0.0
50	*Mean*	188.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0

Table 92. Structural changes with FIRO: differences in number of days Lake Del Valle elevation thresholds are exceeded from baseline operations by year (positive values are an increase from baseline)

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
1	1969	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1970	95.5	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1971	175.5	167.6	161.2	158.0	154.8	148.3	141.6	135.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1972	178.4	146.5	108.6	105.0	101.4	93.5	85.5	77.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1973	254.0	244.8	239.7	237.3	234.7	229.8	199.7	152.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1974	234.5	230.1	222.9	220.2	218.0	213.9	210.0	168.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1975	215.2	204.2	200.3	198.4	196.4	192.3	165.3	124.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1977	155.0	118.0	106.8	102.4	80.9	40.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1978	246.3	238.3	230.8	223.7	203.8	163.8	127.0	75.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1979	146.6	132.8	117.7	104.5	86.0	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1980	204.5	200.1	185.1	180.3	172.3	152.3	143.8	117.7	2.3	3.2	3.9	4.1	3.8	3.4	0.0	0.0	0.0	0.0	0.0
13	1981	135.5	120.4	111.4	106.7	100.4	77.4	64.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1982	254.4	251.4	247.0	242.0	224.3	172.4	168.1	121.5	3.2	2.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	1983	237.5	230.5	228.5	227.9	227.0	224.9	166.8	99.4	9.2	9.0	8.0	6.6	5.7	6.0	0.0	0.0	0.0	0.0	0.0
16	1984	210.3	152.3	129.6	115.4	88.3	66.6	32.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1985	168.5	156.9	126.6	122.1	118.0	109.3	73.3	36.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1986	209.8	205.7	202.3	200.8	199.2	177.6	132.0	78.1	2.1	2.5	2.7	2.8	2.8	2.8	1.2	0.0	0.0	0.0	0.0
19	1987	131.6	120.6	111.3	100.3	76.3	23.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1988	111.6	98.6	88.4	65.6	47.3	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1991	131.9	112.2	104.0	99.4	94.0	81.9	34.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1992	162.4	152.2	109.0	98.5	94.6	86.8	67.5	24.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1993	247.2	241.6	238.1	236.3	234.4	223.0	181.1	137.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1994	159.7	148.4	138.5	134.0	129.5	119.3	93.9	61.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1995	251.7	246.2	242.5	240.5	232.4	222.0	182.9	103.3	5.2	5.1	5.2	4.5	3.8	3.0	0.0	0.0	0.0	0.0	0.0
28	1996	225.5	220.2	217.4	216.1	214.7	194.9	161.3	115.9	3.8	4.0	3.7	3.3	2.7	1.5	0.0	0.0	0.0	0.0	0.0
29	1997	258.8	255.5	252.4	251.0	249.6	247.3	239.3	182.9	4.6	3.5	2.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1998	213.7	207.3	200.3	194.4	187.6	178.8	171.0	151.1	4.3	4.2	4.6	4.9	5.0	5.8	0.0	0.0	0.0	0.0	0.0
31	1999	219.2	187.9	156.7	146.1	126.5	94.3	76.4	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2000	214.8	201.1	188.6	181.4	169.4	157.6	143.9	116.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	2001	259.0	239.5	226.4	202.0	133.0	60.5	19.8	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	2002	265.5	224.3	187.4	165.4	146.8	115.3	80.4	43.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	2003	246.8	211.0	194.6	180.3	170.1	135.1	108.0	67.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	2004	171.6	165.8	161.8	159.5	150.2	114.0	75.0	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	2005	250.9	241.5	206.7	204.4	193.3	160.5	128.8	114.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	2006	229.2	203.9	196.4	191.9	184.8	151.5	130.3	99.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ID (1)	Year (2)	Difference in days threshold is exceeded																		
		703.1 ft (3)	704.0 ft (4)	705.0 ft (5)	705.5 ft (6)	706.0 ft (7)	707.0 ft (8)	708.0 ft (9)	709.0 ft (10)	710.0 ft (11)	711.0 ft (12)	712.0 ft (13)	713.0 ft (14)	714.0 ft (15)	715.0 ft (16)	727.0 ft (17)	742.0 ft (18)	745.0 ft (19)	749.0 ft (20)	773.0 ft (21)
39	2007	120.9	60.1	54.0	51.0	46.3	38.9	32.2	22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	2008	303.9	298.7	294.5	269.9	250.8	208.6	169.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	2009	245.4	159.3	139.9	129.5	110.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	2010	309.5	286.2	232.7	212.6	192.3	151.8	115.9	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	2011	273.0	267.4	263.3	261.2	258.0	181.8	139.0	116.1	1.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	2012	130.3	47.0	36.4	31.2	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2013	247.3	181.3	145.3	135.6	128.6	115.4	94.9	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	2014	194.4	185.0	177.8	173.5	166.4	155.0	116.3	56.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	2015	109.8	85.9	49.8	23.8	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	*Minimum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	*Maximum*	309.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	1.2	0.0	0.0	0.0	0.0
50	*Mean*	187.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0

Table 93. Structural changes with FIRO: annual event results

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	648.46	682.10	0	47	66	2,937	5,133
2	1971	685.33	698.42	113	19	40	853	982
3	1972	694.39	696.22	0	2	20	251	272
4	1973	708.55	709.91	2,068	2,056	2,367	2,481	2,887
5	1974	697.37	709.91	201	154	163	1,102	3,420
6	1975	703.09	709.91	2,097	2,053	2,393	2,402	2,460
7	1976	687.53	697.35	0	3	3	101	108
8	1977	685.54	685.77	9	10	10	138	172
9	1978	687.29	707.02	131	6	28	1,511	2,291
10	1979	687.04	697.85	0	11	22	1,179	1,437
11	1980	697.10	718.36	2,085	2,055	2,883	3,643	9,072
12	1981	686.80	690.22	0	17	33	677	713
13	1982	696.89	712.00	2,083	2,026	2,296	5,926	7,256
14	1983	698.25	717.48	2,118	2,061	2,633	5,134	7,784
15	1984	695.99	703.95	106	6	199	1,313	1,858
16	1985	698.92	704.90	0	3	31	167	352
17	1986	685.58	729.26	3,028	3,061	3,536	6,908	10,031
18	1987	683.71	685.67	0	3	250	940	2,103
19	1988	680.77	681.73	0	17	163	359	1,344
20	1989	685.68	693.91	0	8	22	293	901
21	1990	688.85	694.52	0	13	64	844	2,344
22	1991	691.91	701.18	0	2	33	477	1,238
23	1992	685.76	700.62	97	9	185	1,088	3,279
24	1993	684.28	709.91	264	170	325	4,373	10,049
25	1994	690.88	696.74	0	8	109	476	1,287
26	1995	705.71	717.90	2,152	2,056	2,607	3,889	14,794

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
27	1996	708.58	716.74	2,041	2,056	2,571	3,795	8,927
28	1997	708.58	713.95	2,038	2,056	2,698	5,123	10,238
29	1998	705.39	723.85	3,019	3,062	4,126	6,228	17,676
30	1999	690.08	700.35	0	10	216	1,788	4,380
31	2000	695.01	705.91	121	8	243	2,373	6,208
32	2001	691.22	703.10	0	3	56	442	754
33	2002	705.47	708.61	49	2	97	955	2,392
34	2003	691.44	707.76	0	8	1,031	3,450	9,906
35	2004	697.03	706.12	0	6	117	3,465	3,510
36	2005	704.01	709.91	1,117	1,072	1,069	1,391	1,957
37	2006	688.26	700.63	0	3	337	8,827	10,102
38	2007	690.17	692.69	0	5	92	2,817	2,621
39	2008	698.25	708.43	107	5	45	989	972
40	2009	698.87	707.17	10	9	88	2,214	3,384
41	2010	690.78	705.35	0	7	153	4,644	4,970
42	2011	707.52	711.49	2,128	2,056	2,642	5,155	10,726
43	2012	693.58	695.49	0	10	32	2,272	2,310
44	2013	694.60	703.16	10	4	67	2,311	6,448
45	2014	698.24	705.18	0	6	19	1,585	1,464
46	2015	691.53	699.12	0	7	75	5,165	8,647

Table 94. Structural changes with FIRO: differences in annual event results from baseline operations (positive values are an increase from baseline)

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at: Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
1	1970	0.00	0.00	0	0	0	0	0
2	1971	2.62	2.18	0	0	0	0	0
3	1972	8.79	8.54	0	0	0	0	0
4	1973	6.93	8.21	367	422	660	0	0
5	1974	8.20	8.21	-23	-28	-62	0	0
6	1975	7.96	8.19	1,060	1,099	1,438	666	-79
7	1976	9.24	8.02	0	0	0	0	0
8	1977	8.85	8.79	0	0	0	0	0
9	1978	7.97	6.16	0	0	0	0	0
10	1979	9.17	7.83	0	0	0	0	0
11	1980	7.40	5.86	0	0	-21	0	0
12	1981	9.88	9.50	0	0	0	0	0
13	1982	8.00	6.58	0	0	96	0	0
14	1983	7.89	6.12	0	0	-21	0	0
15	1984	8.32	7.38	0	0	0	0	0
16	1985	7.28	6.74	0	0	0	0	0
17	1986	9.54	5.59	0	0	-70	1	1
18	1987	10.01	9.49	0	0	0	0	0
19	1988	10.06	9.80	0	0	0	0	0
20	1989	8.08	7.32	0	0	0	0	0
21	1990	7.27	6.71	0	0	0	0	0
22	1991	6.53	5.64	0	0	0	0	0
23	1992	8.46	6.94	0	0	0	0	0
24	1993	9.20	8.21	-323	-330	-348	0	0
25	1994	8.86	8.07	0	0	0	0	0

ID (1)	Water year (2)	Minimum pool elevation (ft) (3)	Maximum pool elevation (ft) (4)	Peak release (cfs) (5)	Maximum downstream flow (cfs) at:			
					Livermore (6)	Pleasanton (7)	Verona (8)	Niles (9)
26	1995	8.63	6.19	0	0	-12	0	0
27	1996	6.88	6.25	-6	0	18	6	-6
28	1997	6.88	6.49	0	0	-26	61	-1
29	1998	7.29	6.03	0	0	-163	0	0
30	1999	9.09	7.81	0	0	0	0	0
31	2000	7.96	6.84	0	0	0	0	0
32	2001	9.28	8.27	0	0	0	0	0
33	2002	7.10	6.91	-40	-43	0	0	0
34	2003	8.88	7.03	0	0	0	0	0
35	2004	8.01	7.13	0	0	0	0	0
36	2005	7.31	8.21	0	-1	4	1	-7
37	2006	9.08	7.69	0	0	0	0	0
38	2007	8.94	8.62	0	0	0	0	0
39	2008	7.89	6.96	0	0	0	0	0
40	2009	8.72	7.86	0	0	0	0	0
41	2010	9.29	7.56	0	0	0	0	0
42	2011	7.03	6.64	-1	-59	-16	0	0
43	2012	8.48	8.22	0	0	0	0	0
44	2013	7.83	7.08	0	0	0	0	0
45	2014	7.07	6.48	0	0	0	0	0
46	2015	8.78	7.78	0	0	0	0	0

Appendix X. USACE guidance on preparation of deviation requests

[This document will be in PDF of this report only.]

3/17/2015

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION CORPS OF ENGINEERS
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CESPD-RBT

REGULATION
No. 10-1-04

18 December 2014

Engineering and Design
GUIDANCE ON THE PREPARATION OF DEVIATIONS
FROM APPROVED WATER CONTROL PLANS

1. PURPOSE. This document establishes the protocol for reporting deviations from approved Water Control Plans for water control projects within the South Pacific Division (SPD). Each major subordinate command (MSC) is responsible for establishing guidance as outlined in ER 1110-2-1400 with respect to water control management policy including deviation. It defines coordination, review, and approval procedures between SPD and District offices. Approval from SPD must be obtained for deviations.

2. APPLICABILITY. The following is applicable to all South Pacific Division Districts and field-operating activities having civil works responsibilities.

3. REFERENCES. Authority and guidance can be found in Appendix A and B of Draft ER 1110-2-240 (enclosure):

4. OVERVIEW.

a. Water Control Manuals are prepared for USACE-owned reservoir projects. Water Control Manuals are also prepared for non-USACE projects where USACE has flood control or navigation responsibilities. The Water Control Manual provides guidance and instruction for project personnel and serves as a reference for others who may be involved with, responsible for, or affected by project water control regulation. The Water Control Manual includes the Water Control Plan and is compliant with the objectives and provisions of authorizing legislation and applicable USACE project reports. The Water Control Manual generally describes how a reservoir will be regulated, incorporates allowable flexibility for a broad variety of runoff and climatic conditions to achieve authorized project purposes and covers the regulation of the project over the entire regime of pool elevations and conditions.

b. Water Control Plans are developed to ensure that operations of reservoirs, locks and dams, re-regulation, and major control structures and interrelated systems conform to

objectives and specific provisions of authorizing legislation and applicable USACE reports, including any applicable authorities established after project completion. Water Control Plans are prepared with appropriate consideration of federal law that relates to the operation of federal facilities, as well as the requirements of Water Control Manuals. Thorough analyses are performed to establish optimal Water Control Plans within prevailing constraints. Formulation of these plans requires a comprehensive knowledge of project purposes, history, authorizing legislation, USACE policies and regulations, system effects, hydrology, meteorology, operations and physical constraints/capabilities of project features. Prior to approval and implementation, the proposed Water Control Plan is released for public review and comment. Generally, this proceeds concurrently with the NEPA public review process.

The Water Control Plan consists of coordinated regulation schedules for project/system regulation, provisions for collection and dissemination of data, guidelines for preparation of detailed operating instructions, guidelines to assure project safety, and actions to fulfill regulatory requirements.

Deviations – Water Control Manuals contain a provision authorizing the operating agency to deviate temporarily from operations prescribed in the project's approved Water Control Plan when necessary to alleviate critical situations or to realize increased benefits during an operation season without significantly affecting the fulfillment of the projects authorized purposes. These deviations are intended to address special and unique circumstances including dam safety issues. The competing goals and complex interactions of interested groups/agencies can cause even seemingly inconsequential deviations from an approved plan to lead to unforeseen life safety and environmental impacts, and legal complications. This regulation serves to assist the District in preparing their deviation requests. It outlines a minimum set of considerations that need to be addressed when making a recommendation to deviate from an approved Water Control Plan.

Deviations generally fall into three categories: emergency, unplanned, and planned deviations. Regardless of the type of deviation, the basic tenets of a deviation must adhere to safe operation to include operational/structural integrity, not endanger the dam, mitigate risk of downstream flooding, not unnecessarily store water in the pool, and not compromising the safety of persons or property downstream. Also any deviation must be consistent with project authorization and within existing authorities.

5. TYPES OF DEVIATIONS.

a. *Emergency Deviations.* An emergency deviation from an approved Water Control Plan is one that is required to mitigate an immediate threat to public health and safety, property, project, or the environment. Each Water Control Manual generally contains provisions for dealing with emergency situations. If the Water Control Manual contains provisions for emergency situations, water control action taken in accordance with those provisions would not be considered a deviation from the Water Control Plan. However, for those situations not covered in the Water Control Manual, these are considered emergency deviations and demand immediate action. Request for and approval of emergency deviation may be

transmitted to SPD by telephone or electronic media. Necessary actions may then be immediately taken under emergency conditions with the approval of the District Commander. A written confirmation describing the deviation and the conditions that required the action shall be forwarded to the SPD Commander as soon as practicable.

An emergency situation could include: drowning and other accidents, assistance to local authorities responding to an emergency (e.g. police and fire departments), failure of operations facilities, chemical spills, treatment plant failures, and other temporary pollution or water quality problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. Such deviations generally last from a few hours to a few days.

b. Unplanned Deviations. Each Water Control Manual generally contains provision for dealing with a wide range of unplanned occurrences that are not considered emergencies. The need for unplanned deviations can arise due to unforeseen conditions that do not allow sufficient time for a full analysis prior to the deviation. These types of unplanned deviations could arise due to construction, maintenance, inspection or flood control needs. Such deviations generally last from a few hours to a few days. Each request for an unplanned deviation should be analyzed on its own merits, with an evaluation of factors such as impacts to potential failure mode and consequences, upstream watershed conditions, potential flood threat, condition of the lake, possible alternative measures, and potential adverse effects on the overall regulation of the project for the authorized purposes. Requests for and approval of unplanned deviations may be transmitted by telephone or electronic media. Follow-up written documentation explaining the deviation and its cause shall be furnished as soon as practicable to the SPD Senior Regional H&H/Water Control Engineer with notification to (cc'ed) the District and SPD Dam Safety Officers. Unplanned deviation should follow the guidance and process of a planned deviation. It is recognized that unplanned deviation may require expedited review/approval due to the circumstances. Hence, early notification to SPD is of utmost importance.

c. *Planned Deviations.* Planned deviations cover other deviations not addressed by an emergency or unplanned deviation. Planned deviations for Dam Safety Action Classification (DSAC 1-3) dams shall comply with ER 1110-2-1156, chapter 24 – Dam Safety Considerations for Storage Allocation, Reallocation, and related Studies of. A major deviation that would result in increased water storage at a DSAC 1,2, or 3 requires HQ approval. Planned Deviations are categorized into two types – Planned Minor and Planned Major.

1. *Planned Minor.* Minor deviation is limited by i) flood control pool elevation will not vary more than 2 feet from what would have been the water surface elevation under the approved Water Control Plan or ii) storage difference from approved Water Control Manual will not exceed 5% of the total storage. Minor deviation should not last more than 10 days. Longer minor deviation must be coordinated with the SPD Senior Regional H&H/Water Control Engineer.

2. *Planned Major.* All other planned deviations are considered major deviations.

A risk and uncertainty (Section 8.b.3) analysis shall be performed to determine potential consequences of the deviation. Depending on the circumstances and availability of data, this could be qualitative or quantitative. Best effort should be used to attempt a qualitative analysis.

6. OFFICE OF RECORD. The originating District's water control management office will be responsible for maintaining all relevant records documenting the deviation.

7. GENERAL INFORMATION FOR PREPARING DEVIATIONS.

a. Time to Prepare Deviations. District offices should also inform potential agencies/entities that the lead time required to assemble the necessary information required to evaluate a deviation request may be on the order of months (normally due to the required environmental analysis and the public review process). Thus, the request to the District should be made well in advance of the proposed initiation date from the deviation. The requesting agency/entity should also be made aware that approval of the deviation request would depend upon such things as a review of the impacts (e.g., environmental, hydrologic, legal, etc.). The deviation request should also be coordinated with the District Dam Safety Officer.

b. Coordinating with SPD Staff. Preparation of a deviation package is a time consuming and costly undertaking. Incomplete or inadequate package impacts timing for approvals. District personnel are to coordinate any questions or concerns about potential deviations, and discuss any atypical situations with their SPD counterparts early in the process before the package submittal. The necessary technical review will be conducted at the District level with review certification provided to SPD. In an emergency situation, a formal quality certification will most likely not be required. A written confirmation describing the deviation and the conditions that required the action shall be forwarded to the division commander as soon as practicable.

c. Non-Corps Projects. Deviation requests from non-Corps (Section 7 the Flood Control Act of 1944, as amended) projects must be prepared with the approval of the project owner. This is required because project owners are responsible for assuring that the project is operated as prescribed in the Water Control Plan developed in concert with the USACE flood control requirements. The owner is also ultimately responsible for dam safety at the project and for funding of the project.

d. Environmental Requirements. Each deviation request shall include a summary of identified environmental effects of the proposed deviation, and a statement of how the proposal complies with pertinent environmental requirements, including but not limited to the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Clean Water Act (CWA), and the Clean Air Act (CAA). NEPA documentation requirements may be met by preparation of an Environmental Assessment (EA) of the proposed action, concluding with a Finding of No Significant Impact (FONSI). If the EA discloses significant impacts to the human environment that are complex, extensive

and/or that cannot be readily avoided, minimized, or mitigated; development and coordination of an Environmental Impact Statement (EIS) is required, concluding with a Record of Decision (ROD). This and related decisions will be coordinated with senior environmental staff in the District's and Division's Planning Divisions, to include senior ecologists. If an existing EIS/ROD or EA/FONSI accurately covers the action, and if there have been no environmental changes since that documentation, there may be reliance and reference to this documentation for purposes of environmental compliance. If those NEPA documents are more than five years old, such reliance is improper. Updated NEPA documentation is required to include full coordination with resource agencies and the public. The scope and type of NEPA documentation will be coordinated with Planning and Office of Counsel. Supporting environmental documents shall be included in the deviation request package when it is submitted. Subject NEPA documents will be accompanied, as applicable, by a Biological Assessment and final Biological Opinion, and a letter from U.S. Fish & Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS) concurring there is not likely to be adverse effect on listed or other significant species. A 404(b)(1) evaluation under the CWA may also be required. In the case of emergency deviations, the emergency provisions and requirements of the various environmental laws shall be followed as practicable. Deferred compliance does not mean compliance is avoided, but rather that it may be delayed or mitigated. Any significant impacts of reoperation, moreover, must be identified, managed and mitigated after the fact regardless of the urgency of such emergency activities. Foresight, planning ahead and timely coordination with resource agencies, therefore, is of utmost importance and priority.

e. *Recurring Deviation.* Recurrent or prolonged planned deviation may indicate the need for a formal change to the water control plan. Deviations that occur in three or more consecutive years, or three or more times within a five-year period, must be fully coordinated with USACE Headquarters.

8. ROLES AND RESPONSIBILITIES

a. SPD DISTRICTS

Preparation of Deviations. Processing of a deviation request as outlined in the approved Water Control Manual and in accordance with this regulation originates at the District Water Control Management office. The District Commander may delegate signature authority for requesting deviations from approved Water Control Plans to the appropriate functional division head or designated representative. Consultation with the District staffs, including engineering, planning, environmental, economics, operations, construction and legal must take place. The following information shall be submitted in written form to the SPD Commander or designee for consideration of the deviation:

(1) Description of the proposed deviation, including purpose, proposed change from the approved water control plan, duration, and other details about the deviation.

(2) The implications of adhering to the water control plan and of employing the proposed deviation.

(3) Alternative deviation plan (or plans) to include the application of risk and uncertainty in the analysis and the consequences of each.

(4) Effects of the proposed deviation on project and system operation, and on other project purposes such as flood control, hydropower, water quality, water supply, navigation, recreation, or fish and wildlife.

(5) Review of the existing Potential Failure Mode Analysis (PFMA) for the dam and an analysis of the effect of the deviation on the probability of failure and consequences associated with the deviation.

(6) The potential flood threat with and without the proposed deviation.

(7) Current and predicted maximum storage, elevation, river stage, and other pertinent information with and without the deviation.

(8) Review of the alternative (or alternatives) under provisions of pertinent laws and regulations, including, but not limited to, the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), Clean Water Act (CWA), National Historic Preservation Act (NHPA), Clean Air Act (CAA), etc., when and as applicable.

(9) A description of the coordination that has been done with affected entities, both USACE and non-USACE, and the effect on other local, regional, state, tribal, and federal agencies.

(10) Written comments from agencies, organizations, businesses, and individuals who may be impacted by, or supportive of the proposed change in flows, including federal, state, and local agencies; tribes; industries, organizations, and other stakeholders; and the public.

(11) Discussion of any other relevant issues.

(12) District Commander's, or designee's, recommendation.

In addition, requirements for submission of an exception to ER 1110-2-1156, Chapter 24, if required, shall conform to the submission requirements contained therein. Also, Appendix B.1 - District Engineer Quality Certification must be signed and submitted with the package.

b. SOUTH PACIFIC DIVISION

Approval of Deviations. Approval for deviations must be obtained from the SPD Commander or designee prior to their implementation. Approval for exceptions to Chapter 24 of ER 1110-2-1156 for deviations that increase water storage at DSAC 1, 2, or 3 dams shall be obtained from the HQUSACE Dam Safety Officer. Such request will be submitted through

command channels to the SPD USACE Regional Integration Team (RIT) in Washington, DC. As noted in paragraph 5.a, an emergency deviation situation may warrant an immediate action as outlined in the Water Control Manual. Necessary actions under emergency conditions may then be taken immediately upon telephone or electric media notification to SPD and with approval of the District Commander. A written confirmation describing the deviation and conditions that required the action shall be forwarded to the SPD Commander as soon as practicable.

Approval of all unplanned and planned deviation must be obtained prior to implementation of the deviation. Planned deviation must be approved in writing. Unplanned deviations may be approved via telephone, e-mail, fax or other appropriate communication methods with written documentation provided as soon as practicable. Unplanned and Planned major deviation must be approved by the Division Commander or designee (Deputy Commander), hence may require more time and coordination. Approval of planned minor deviation will be given by the SPD Senior Regional H&H/Water Control Engineer or his/her immediate supervisor.

9. PREPARING EMERGENCY DEVIATIONS

a. Emergency deviations are the only type of deviation that do not require prior approval from SPD, and must only be used if events warrant an immediate emergency action, such that time constraints render impractical notification to the SPD. However, even in an emergency situation, the District shall notify the SPD of the action as soon as possible, and shall comply with all applicable requirements.

b. A record of the emergency deviation shall be developed at the district office and transmitted to the SPD office within a day of the action taken.

c. Procedures for emergency deviations: (1)

(1) Take the necessary action.

(2) Contact SPD as soon as possible to describe the action taken and the cause (NOTE: The order of (l) and (2) may be reversed depending on the nature of the emergency). Continuation of the deviation will require SPD approval.

(3) The District shall provide written confirmation to the SPD office within 21 days of the deviation. The correspondence shall include the items outlined section 7.b (as applicable).

(4) The SPD shall respond within 7 days of the District's notification of the emergency deviation.

10. PREPARING PLANNED (UNPLANNED) DEVIATIONS.

a. The District shall inform SPD (Senior Regional H&H/Water Control Engineer)

within 2 days of receiving a request for a proposed deviation. If the District is requesting the deviation, notification to SPD should be made as soon as practicable.

b. At least 21 days prior to the proposed action, the District shall transmit a deviation request package to the SPD offices. The deviation request package shall include the items in section 8.a. This package may be initially transmitted electronically.

c. If the District submits a complete quality package with all required documentation, SPD will review the proposal and approve or disapprove the District's deviation request within 7 days. Early, detailed, coordination and transmittal of documents to SPD may expedite the processing time.

d. For unplanned deviation, the District will notify SPD as soon as possible of a request for a proposed deviation. SPD will make an expedited effort to review/approve the deviation based on the project's needs.

MARK TOY, P.E.
BG, USA
Commanding

APP A-District Engineer's Certification for Emergency Deviation
APP B.1 – District Approval Certification for Major Deviation
APP B.2 – Division Approval Certification for Major Deviation
APP C – Division Approval Certification for Minor Deviation

DISTRIBUTION: Electronic
Copy Available

APPENDIX A

DISTRICT ENGINEER'S CERTIFICATION
For Emergency Deviation

COMPLETION OF QUALITY CONTROL ACTIVITIES
The District has completed the review/analysis of the emergency water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in this analysis have been completed. A written confirmation describing the deviation and the conditions that required the action was forwarded to the SPD Commander on (*insert date*).

GENERAL FINDINGS

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality control certification for this deviation request.

(Signature) *(Date)*
Chief, District Engineering Division

(Signature) *(Date)*
Chief, District Asset Management (Operation) Division

(Signature) *(Date)*
Chief, District Planning (Environmental) Division

CERTIFICATION OF LEGAL REVIEW*
The request for a water control deviation from the approved Water Control Plan report for *indicate name of project*, has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

(Signature) *(Date)*
Chief, District Counsel

DISTRICT COMMANDER CERTIFICATION
All issues and concerns resulting from technical review of the water control deviation have been resolved. A written confirmation describing the deviation and the conditions that required the action shall be forward to the Division Commander as soon as practicable. **This deviation is approved.**

(Signature) *(Date)*
District Commander

APPENDIX B.1
(To be completed by District)

DISTRICT APPROVAL CERTIFICATION
For Major Planned (Unplanned) Deviation

COMPLETION OF QUALITY CONTROL ACTIVITIES

The District has completed the review/analysis of the water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in this analysis have been completed.

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality control certification for this deviation request.

(Signature) *(Date)*
Chief, District Engineering Division

(Signature) *(Date)*
Chief, District Asset Management (Operation) Division

(Signature) *(Date)*
Chief, District Planning (Environmental) Division

(Signature) *(Date)*
Chief, District Environmental Resources Branch

CERTIFICATION OF LEGAL REVIEW*

The request for a water control deviation from the approved Water Control Plan report for *indicate name of project,* has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

(Signature) *(Date)*
District Counsel

QUALITY CERTIFICATION

All issues and concerns resulting from technical review of the water control deviation have been resolved. This deviation is recommended for approval.

(Signature) *(Date)*
District Commander

APPENDIX B.2
(To be completed by Division)

DIVISION APPROVAL CERTIFICATION
For Major Planned (Unplanned) Deviation

COMPLETION OF QUALITY ASSURANCE ACTIVITIES

The Division has completed the review/analysis of the water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality assurance activities appropriate to the level of risk and complexity inherent in this analysis have been completed.

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality assurance certification for this deviation request.

(Signature) *(Date)*
Chief, SPD Business Technical Division

(Signature) *(Date)*
Chief, SPD Civil Work Integration Division

(Signature) *(Date)*
Chief, SPD Planning (Environmental) Division

CERTIFICATION OF LEGAL REVIEW*

The request for a water control deviation from the approved Water Control Plan report for *indicate name of project,* has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

(Signature) *(Date)*
Chief, SPD Office of Counsel

DIVISION COMMANDER APPROVAL

(Signature) *(Date)*
Division Commander

APPENDIX C

DIVISION APPROVAL CERTIFICATION
For Minor Planned (Unplanned) Deviation

COMPLETION OF QUALITY CONTROL ACTIVITIES

The District has completed the review/analysis of the water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in this analysis have been completed.

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality control certification for this deviation request.

_____ *(Signature)* _____ *(Date)*
Chief, District Engineering Division

_____ *(Signature)* _____ *(Date)*
Chief, District Asset Management (Operation) Division

_____ *(Signature)* _____ *(Date)*
Chief, District Planning (Environmental) Division

_____ *(Signature)* _____ *(Date)*
Chief, District Environmental Resources Branch

CERTIFICATION OF LEGAL REVIEW*

The request for a water control deviation from the approved Water Control Plan report for *indicate name of project,* has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

_____ *(Signature)* _____ *(Date)*
District Counsel

DIVISION APPROVAL

_____ *(Signature)* _____ *(Date)*
SPD Senior Regional H&H/Water Control Engineer

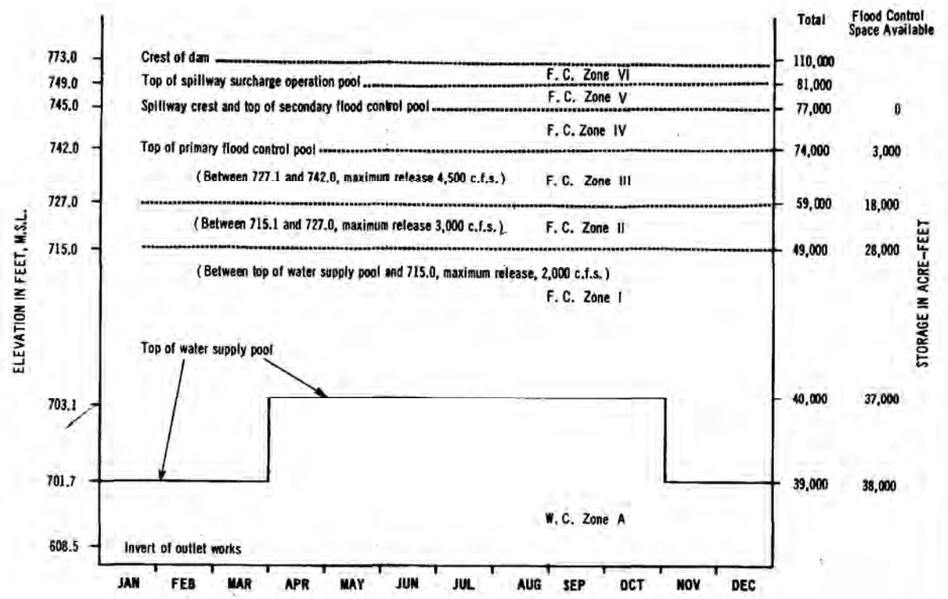
Appendix XI. Lake Del Valle water control diagram

[This page will be in PDF of this report only.]

DEL VALLE DAM AND RESERVOIR

FLOOD CONTROL REGULATION SCHEDULES

WHEN RESERVOIR WATER SURFACE ELEVATION IS: (FEET, M.S.L.)	DISCHARGE AT NILES STREAM – GAGING STATION MINUS DEL VALLE DISCHARGE AND SPILL	SCHEDULE	REQUIRED FLOOD CONTROL RELEASES
SCHEDULE 1 – DISCHARGE AT NILES GAGING STATION RISING			
Below 742.0 F. C. Zones I – III	Below 5,000 c.f.s.	1a	Maintain previous release until Niles discharge exceeds 5,000 c.f.s. or starts to recede. 2/
Below 742.0 F. C. Zones I – III	Above 5,000 c.f.s.	1b	No releases.
Above 742.0 F. C. Zones IV – VI	Above 5,000 c.f.s.	1c	When reservoir water surface reaches 742.0 feet, release 400 c.f.s. Increase release by 400 c.f.s. increments for each 0.5-foot rise in water surface until 2,400 c.f.s. is released. Maintain 2,400 c.f.s. combined F. C. release until water surface reaches 749 feet. At elevation 749 reduce F. C. release to zero.
SCHEDULE 2 – DISCHARGE AT NILES GAGING STATION RECEDING			
Water Conservation Pool Below 701.7 1/ W. C. Zone A	Below 5,000 c.f.s.	2a	Regulate for conservation.
Flood Control Pool Between 701.7 1/ and 715.0 F. C. Zone I	Below 6,000 c.f.s.	2b	Release to maintain maximum discharge of 6,000 c.f.s. at Niles gaging station 2/ except maximum Del Valle outflow equals 2,000 c.f.s.
Between 715.1 and 727.0 F. C. Zone II	Below 8,000 c.f.s.	2c	Release to maintain maximum discharge of 8,000 c.f.s. at Niles gaging station 2/ except maximum Del Valle outflow equals 3,000 c.f.s.
Between 727.1 and 742.0 F. C. Zone III	Below 9,500 c.f.s.	2d	Release to maintain maximum discharge of 9,500 c.f.s. at Niles gaging station 2/ except maximum Del Valle outflow equals 4,500 c.f.s.
Above 742.0 and rising F. C. Zone IV	Receding	2e	Regulate as in Schedule 1c.
Between 742.0 and 749.0 and receding F. C. Zones IV – V	Receding	2f	Maximum outflow (spill plus release) shall be a maximum of 7,000 c.f.s.
Above 749.0 F. C. Zone VI	Receding	2g	Spill only.



FLOOD CONTROL DIAGRAM

(NOT TO SCALE)

SCHEDULE 3 – EMERGENCY SCHEDULE

TO BE USED WHEN COMMUNICATIONS WITH THE PROJECT CONTROL CENTER ARE INTERRUPTED

WHEN RESERVOIR WATER SURFACE ELEVATION IS:	GATE OPENINGS IN FEET WHEN RESERVOIR WATER SURFACE IS RISING	GATE OPENINGS IN FEET WHEN RESERVOIR WATER SURFACE IS RECEDING
	2 GATES Release for Water Supply	2 GATES Release for Water Supply
Below 701.7 1/	Closed	3.20 (2400 c.f.s.)
701.7 – 715.0	Closed	3.05 " "
715.1 – 720.0	Closed	3.00 " "
720.1 – 725.0	Closed	2.95 " "
725.1 – 730.0	Closed	2.90 " "
730.1 – 735.0	Closed	2.80 " "
735.1 – 742.0	0.46 (400 c.f.s.)	2.75 " "
742.1 – 742.5	0.92 (800 c.f.s.)	2.75 " "
742.6 – 743.0	1.40 (1200 c.f.s.)	2.75 " "
743.1 – 743.5	1.85 (1600 c.f.s.)	2.75 " "
743.6 – 744.0	2.30 (2000 c.f.s.)	2.75 " "
744.1 – 744.5	2.75 (2400 c.f.s.)	2.75 " "
744.6 – 745.0	2.70 (2400 c.f.s.)	2.70 " "
745.1 – 749.0	Gates closed (spill only)	Gates closed (spill only)
Above 749.0		

NOTE:

For all schedules except schedule 1c, maximum increase in releases shall be 1,000 c.f.s. per hour increments and maximum decrease in releases shall be 1,000 c.f.s. per hour decrements. For Schedule 1c, increase and decrease releases to meet schedule requirements.

1/ – 701.7 – Bottom of flood control pool (703.1, 1April – 31 October)

2/ – Including outflow from Del Valle Dam.

DEL VALLE DAM AND RESERVOIR

Alameda Creek Basin, California

FLOOD CONTROL DIAGRAM

Prepared Pursuant to Flood Control Regulations for Del Valle Dam and Reservoir (_____)

APPROVED: J. D. Morris
Major General, U.S.A. Director of Civil Works

APPROVED: W. R. Gianelli
Director, Department of Water Resources, State of California

Effective Date: _____ File No. _____

ATTACHMENT 1