State Water Project and Central Valley Project
Drought Contingency Plan
February 1, 2022 – September 30, 2022

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This Drought Contingency Plan (Drought Plan) is prepared by the California of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation) to provide an initial outline of areas of potential concern given the current hydrology and water operation conditions in 2022. DWR and Reclamation operate the State Water Project (SWP) and the Central Valley Project (CVP), respectively, to the 2019 U.S. Fish and Wildlife Service (USFWS) Biological Opinion and 2019 National Marine Fisheries Service (NMFS) Biological Opinion (Collectively the 2019 Biological Opinions), and DWR also operates to the 2020 California Department of Fish and Wildlife Incidental Take Permit (ITP). This Drought Plan will be submitted by DWR to the California Department of Fish and Wildlife (CDFW) in response to Condition 8.21 of the ITP. This plan will also be shared with the Water Operations Management Team (WOMT) which includes representatives from DWR, Reclamation, USFWS, NMFS, CDFW, and the State Water Resources Control Board (SWRCB) (collectively referred to as Agencies).

Throughout 2021, DWR and Reclamation, in coordination with stakeholders and with the Agencies, identified and implemented drought actions during calendar year 2021 to manage California's limited water supplies. The 2021 Drought and Dry Year Actions report (which will also be released in February 2022) provides evaluations of actions implemented in 2021 based on staff observations of effectiveness, and it concludes with recommendations for how to address water supply and fish effects associated with future drought conditions.

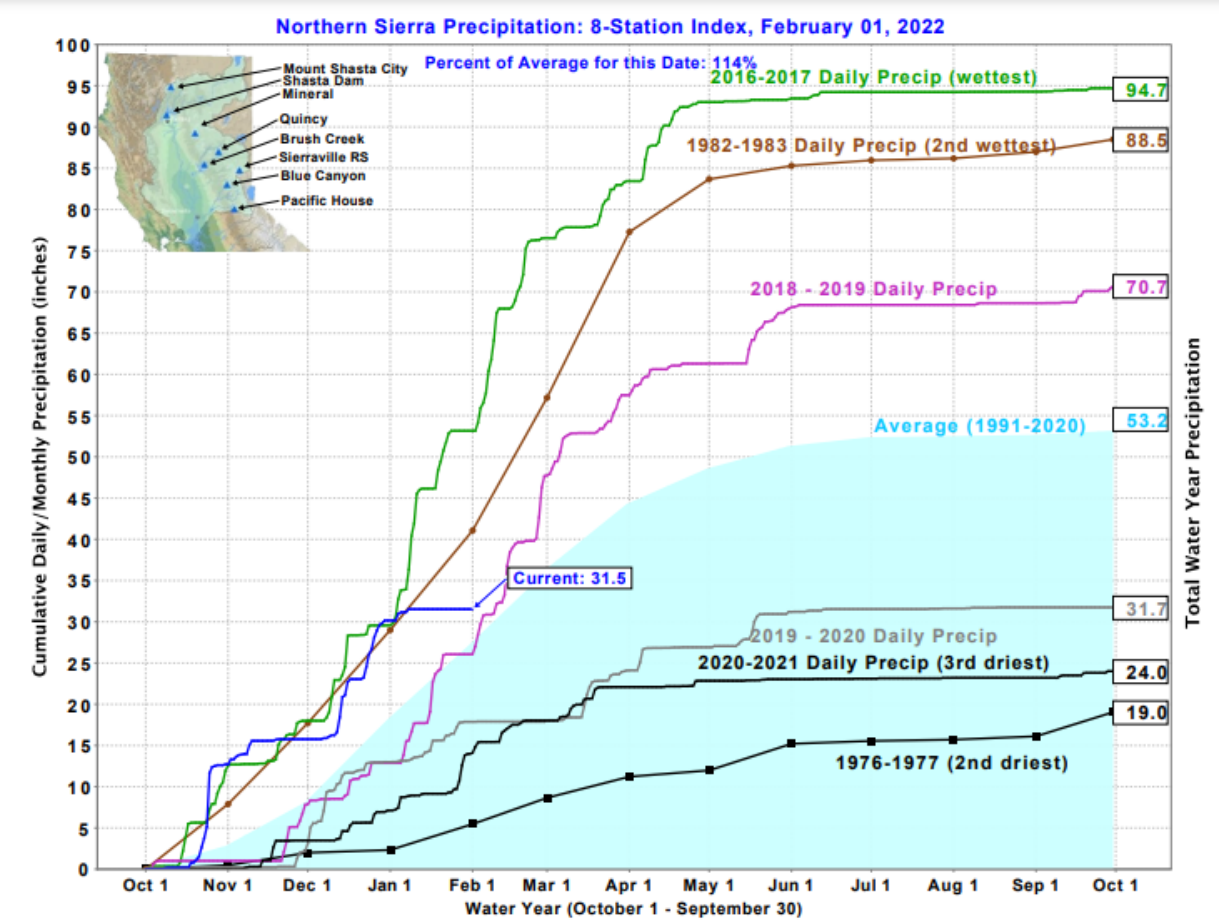
In anticipation of drought conditions continuing into 2022, DWR and Reclamation initiated early drought action activities in 2021. These actions included the approval to delay the removal of the West False River Drought Barrier to November 2022, and a submittal of a Temporary Urgency Change Petition (TUCP) to the SWRCB requesting a modification of certain water rights Decision 1641 objectives during February through April 2022. On January 18, 2022, DWR and Reclamation withdrew the TUCP because of improved storage conditions in Folsom and Oroville. However, DWR and Reclamation recognize the extreme dry January conditions may offset some of the storage gains realized in October and December 2021. Therefore, DWR and Reclamation are diligently tracking and monitoring conditions and will continue to evaluate whether a TUCP will provide benefits later in the year where needed. These drought actions are further described in this Drought Plan.

The Drought Plan also includes current hydrologic conditions, a species status update, SWP and CVP (collectively referred to as Projects) operations forecasts which utilize the January 1 hydrology forecasts, water supply forecasting improvements, and areas of potential concern. Most importantly, the Project operations forecasts included in this Drought Plan are a broad spectrum of forecasted outcomes based on the hydrologic conditions as of January 1, 2022. This Drought Plan will be updated in March, which will reflect the very dry conditions experienced in January as captured in the updated February water supply forecast. We

anticipate changes in drought response actions as the year's hydrology unfolds. DWR and Reclamation are committed to working with the Agencies through further development of drought actions, weekly WOMT coordination, and other forums as necessary.

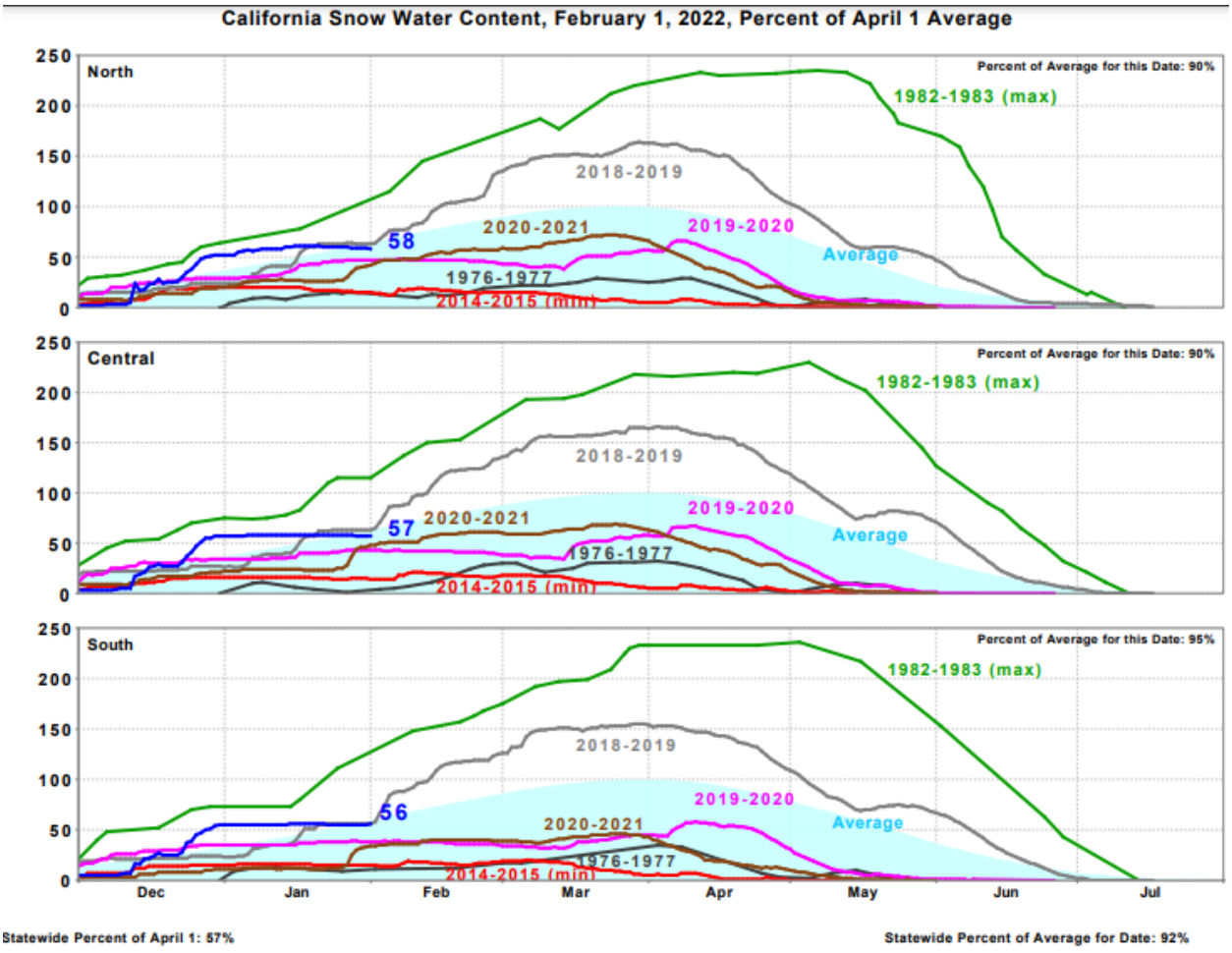
I. Current Hydrologic Conditions

California continues to see very low reservoir storage at many of the larger reservoirs; however, a series of storms in late October, including a Category 5 atmospheric river, and the recent December storms boosted precipitation totals, and WY 2022 precipitation to date has surpassed the total precipitation received in WY 2021. Since then, January precipitation totals for the Northern Sierra Basin have been well below average for what is historically one of the wettest months of the water year. Precipitation totals were 1.3 inches, which is 14% of historical average and in the top ten driest Januarys on record. In the San Joaquin and Tulare Basins, no rainfall was recorded in January. In addition, meteorological forecasts are indicating dry conditions for early February. As shown in blue on the following chart, the Northern Sierra Precipitation total as of February 1, 2022 is 31.5 inches and 114% of average to date.



In addition to the above average precipitation, the storms experienced in December were colder, and snowpack statewide across the Sierra Nevada as of February 1, 2022 is currently

92% of historical average and about 60% of the April 1 average, which is typically the seasonal peak snowpack. Considering the very dry January, snowpack accumulation across the Sierra has flatlined, and there has been a slight degradation of the overall snowpack as shown in the following chart:



A. Water Quality

Salinity and Delta outflow conditions are likely to remain manageable over the winter and spring. Should the hydrology change to a drier pattern, increased storage releases may be needed to manage salinity intrusion.

B. SWP and CVP Conditions and Releases

- Storage

Storage conservation at Shasta, Trinity, New Melones and Oroville reservoirs is a priority this winter and spring. In the Sacramento River watershed, storage in Shasta, Trinity and Oroville remains below average for this time of year.

Lake Oroville end-of-January storage was about 1.6 million acre-feet (MAF) (46% of capacity and 80% of historical average) and higher than it was at the end of January 2021. During January, Lake Oroville surpassed its 2021 peak storage of about 1.5 MAF, last seen in April 2021. However, with the extreme dry January and recent increased Feather River releases, as described below, Lake Oroville storage is projected to stabilize or decrease until additional hydrology is seen in the watershed.

Lake Shasta end-of-January storage was 1.62 MAF (36% of capacity and 55% of historical average). Lake Folsom end-of-January storage was approximately 533 TAF (55% of capacity and 119% of historical average) and encroached in its flood pool space during the month of January but is currently below the flood pool space. Trinity Reservoir is well below average with an end-of-January storage of about 763 TAF (31% of capacity and 49% of historical average).

In the San Joaquin watershed, storage in New Melones Reservoir ended January with a storage of 993 TAF, which is 41% of capacity and 71% of historical average, and about 550 TAF lower than this time last year.

- Releases

Releases to the Sacramento River from Keswick reservoir are at the minimum of 3,250 cfs. Total releases to the Feather River from Lake Oroville have been at a minimum of 950 cfs throughout most of January. However, because of the extreme dry January conditions, releases from Lake Oroville were increased to 3,000 cfs at the end of January to meet increased Delta outflow required by D-1641. These releases are greater than what was projected in the operational forecasts based on the January 1 forecast, which are included as Attachment 1.

Releases from Folsom have ranged between 5,000 cfs at the beginning of January to 2,000 cfs currently. These releasees have been necessary to maintain Folsom reservoir below the flood control limit.

Releases from New Melones have been at a minimum flow of 200 cfs and were increased late January to meet the D-1641 February Vernalis base flow.

C. Biology

i. Salmonids

As of January 14, 2022, the preliminary estimate of natural juvenile winter-run Chinook salmon emigration past the Red Bluff Diversion Dam is 571,223, based on USFWS rotary screw trap monitoring. As of January 25, 2022, the Salmonid Monitoring Team (SaMT) determined the weekly risk forecast of exceeding yearly entrainment thresholds remains low due to low salvage. However, risk level for the daily entrainment threshold for natural winter-run Chinook salmon is

high and will likely be of persistent concern through March due to low loss thresholds. Low daily natural winter-run daily loss thresholds are in turn due to a relatively low winter-run Juvenile Production Estimate, and the understanding a large proportion of the natural population is in the Delta and will remain there to rear over the coming two months.

As a result of the large October storm, the proportion of natural winter-run Chinook salmon that entered the Delta on any given date since the storms began may end up as the earliest or near the earliest Delta migration on record. As of January 25, 2022, SaMT estimated as much as 85% of the population had entered the Delta (see table below). The SaMT estimates of spring-run Chinook salmon and Steelhead that have entered the Delta are higher than average observed historical migration patterns. Since spring-run are regulated using hatchery surrogate releases rather than estimates of natural production, and because hatchery winter-run were not as strongly affected by the environmental and health conditions that caused low production of the natural winter-run population, daily loss of natural winter-run Chinook Salmon will likely remain the greatest issue of concern with regard to salmon-related export management.

Location	Yet to Enter Delta (Upstream of Knights Landing)	In the Delta	Exited the Delta (Past Chipps Island)
Young-of-year (YOY) winter-run Chinook salmon	Current 15-30% Last week 20-35%	Current 69-80% Last Week 60-79%	Current 1-5% Last Week 1-5%
YOY spring-run Chinook salmon	Current 35-50% Last week 45-60%	Current 50-65% Last Week 40-55%	Current 0% Last Week 0%
Steelhead	60-70% (last week: 70-75%)	27-39% (last week:25-29%)	1-3% (last week: 0-1%)

ii. Delta Smelt

The Smelt Monitoring Team (SMT) began meeting to discuss current-year conditions at the end of November 2021. The 2021 Fall Midwater Trawl was completed in December, and the 2021 index was zero ("0") for the fourth year in a row. The only survey that has caught Delta Smelt on a quasi-regular basis in recent years is the Enhanced Delta Smelt Monitoring Program (EDSM). With the first year of Delta Smelt experimental releases, up to 45,000 hatchery-reared fish were released in the lower Sacramento River in WY 2022. The first release was conducted December 15, 2021, the second release January 11-12, 2022, and the third release is scheduled for the week of January 31. In the period since the first release, as of January 11, 2022, EDSM caught 16 Delta Smelt in the lower Sacramento River, the Sacramento Deep Water Ship Channel (DWSC), and the lower San Joaquin River. Additionally, one Delta Smelt was collected by the Chipps Island Trawl on December 29, 2021. These detections were primarily of released hatchery fish, though three Delta Smelt were untagged. An experimental released Delta Smelt was salvaged at the CVP on January 16, 2022. To minimize risk of adults spawning and rearing in the south Delta, the remaining experimental releases will be made in the DWSC.

iii. Longfin Smelt

Salvage data from WY 1994 through WY 2014 indicates that salvage of adult Longfin Smelt is generally rare and typically occurs between the months of December and February. In WY 2021, young of year (age 0) Longfin Smelt were mostly observed at the salvage facilities between April and May. The majority of Longfin Smelt salvage typically occurs after February when young of year fish rearing in the south and central Delta have grown large enough to be effectively screened by the fish collection facilities. As of January 11, 2022, no Longfin Smelt have been salvaged this water year, though larvae have been detected by the Smelt Larva Survey (SLS) in the lower San Joaquin River at stations 809 and 812, as well as in Middle River at station 914. Additionally, the pilot Larval Smelt Entrainment Monitoring Program detected a Longfin Smelt larvae in West Canal near Clifton Court Forebay in early January 2022. Catch has generally been low, but detections suggest that spawning in the Delta has occurred in both the San Joaquin River and Sacramento River corridors. The SMT tracks Longfin Smelt distribution and salvage to assess risk and make appropriate operational recommendations consistent with the Longfin Smelt ITP, and the most recent assessment showed low to moderate risk of entrainment and no recommendations have been made to date. Lastly, Barker Slough Pumping Plant (BSPP) operations can be affected under the ITP when a Longfin Smelt larvae is detected at station 716 in Lindsey Slough in Dry and Critical years. The first two SLS surveys in December detected Longfin Smelt larvae at 716, but in January, the water year was classified as Below Normal, so no BSPP restrictions are applicable at this time.

II. SWP and CVP Operational Considerations

DWR and Reclamation have developed preliminary operational forecasts through September 30, 2022, using the 50%, 90%, and 99% exceedance forecasts from the January 1, 2022, forecast developed by DWR's Hydrology and Flood Operations Branch within the Division of Flood Management. The operational forecasts included in this Drought Plan are designed to make the most efficient use of the limited water resources in 2022 for multiple beneficial uses while meeting regulatory requirements and managing the potential risks of continued drought conditions into next year. There are four main goals of Project operations within the forecasts: 1) Meet health and safety requirements throughout the SWP and CVP service areas, including those that rely on Project exports; 2) Preserve upstream storage to the extent possible for temperature management, instream uses in the water year, and carry-over storage for future drought protection; 3) Meet regulatory and senior/riparian water right obligations throughout the basins; and 4) deliver available project water not needed to meet the previous three goals.

The operational forecasts provided reflect potential outcomes given the hydrologic forecast on January 1 and assumptions on initial regulatory and policy decisions regarding prioritization of a limited water supply. However, the actual operation is still uncertain at this time because of both changing hydrology and future decision-making of how to achieve the goals enumerated above. The hydrologic scenarios used in this Drought Plan are discussed in the Projected Hydrology and Runoff section later in the document, as are improvements to hydrologic forecasting methods.

The following are the Projects' critical operational considerations and objectives under the potential continued drought conditions, reflected in the operational forecasts.

A. Health and Safety Requirements

Operations of the SWP and CVP must provide for, at a minimum, essential human health and safety needs throughout the SWP and CVP service areas and retain the capability to provide for such minimum needs throughout WY 2022 and possibly into WY 2023, should extremely dry conditions persist. For clarity, DWR and Reclamation's consideration of these essential human health and safety needs includes adequate water supplies and water quality for drinking water, sanitation, and fire suppression, but does not extend to other urban water demands, an example of which is outdoor landscape irrigation. While most California communities may have reserve water supplies, some communities will require continued delivery of limited amounts of water through the CVP and SWP facilities to meet these basic needs.

Reclamation uses its Municipal and Industrial (M&I) Water Shortage Policy to determine the amount of water to be provided to its M&I contractors in those years where human health and safety needs govern CVP allocations to these contractors. Under these conditions, M&I contractors are required to update population estimates and non-CVP water source information to determine how much water will be needed from the CVP to meet their overall human health and safety demand for that year. The vast majority of CVP contractors throughout the entire service area that receive M&I water from the CVP have other available supplies to help meet their demand, although many alternate supplies relied upon in WY 2021 may not be available in the same capacity for WY 2022.

B. Preservation of Upstream Storage for Fish and Wildlife and Future Drought Year Protection

The SWP and CVP operation forecasts are consistent with the requirements set forth in the 2019 Biological Opinions to address impacts to endangered species. They also address SWP obligations under the California ESA (CESA). As noted above, this Drought Plan does not set forth specific operations due to the uncertain hydrology. Future revisions to this Drought Plan, including identifying potential actions, will follow applicable requirements set forth in the 2019 Biological Opinions, 2020 ITP, and/or additional court-ordered processes.

The operations forecast included in this Drought Plan covers February 1 to September 30. A primary consideration involves the need to conserve enough cold water in Project reservoirs early in the year to maintain cool water temperatures in the Sacramento River and tributaries to support the various runs of Chinook salmon and steelhead. If conditions remain dry, these same water supplies may be needed to provide for other critical operational considerations throughout 2022. The timing, flow rate, and rate of any flow changes for fishery needs will also

vary with storage and hydrologic conditions as currently reflected in the combination of increased releases from Lake Oroville and low Project exports. These operations are necessary to meet the D-1641 Habitat Protection Outflow requirement (Spring X2) because of the dry January hydrology. This dry hydrology is forecasted to continue through at least mid-February.

C. Regulatory and Senior Water Right Requirements

Both DWR and Reclamation have commitments to deliver water for Delta salinity and outflow, to senior water rights holders, and to wildlife refuges. These commitments are made through D-1641, various contracts, and through the Central Valley Project Improvement Act (CVPIA). D-1641 includes reduced requirements in dry and critically dry conditions to recognize the limited water supply in those years. The various senior water right contracts and wildlife refuge deliveries also include provisions for reduced demands in critically dry years.

III. Improvements to Hydrologic Forecasting

DWR has been forecasting runoff for the State of California since 1930. Within that time, DWR has built an extensive database of data and methods for estimating runoff volumes based on current conditions, statistical trends, and historical distributions. Although adjustments have been made to these methods based on changing hydrologic patterns, California has experienced more and more climate extremes over the past ten years. WY 2021 highlighted the challenge with relying solely on these past approaches with a rapidly changing climate that results in hydrologic patterns that exist outside of historical distributions.

Climate change has impacted precipitation patterns and snow water content, affecting the Projects' ability to forecast water supply. Increased seasonal and sub-seasonal variability in how precipitation accumulates in the watersheds is not reliably captured by lumped-sum parameters covering multiple months. Factors such as warmer and drier summer and fall months have decreased the amount of runoff following precipitation events.

Impacts to precipitation, snow water content, and runoff responses have reduced baseflow in streams. Furthermore, a loss of correlation between lower elevation snowpack and higher elevation snowpack has been observed; it is no longer true that there is more snow as a percent of average the higher the elevation.

There are a number of data enhancements being implemented this year by DWR's Division of Flood Management (DFM) to help improve water supply forecasts.

DFM is using a new period of record, 30 years (1991-2020) for the averages used in its forecasts. This change places an emphasis on more recent and relevant hydrologic patterns, and the new period includes the two most recent droughts, the most recent years with the warmest temperature records, the lowest historic snowpack (2015), and the wettest 8-station

year (2017). Also, DFM is updating the averages for precipitation, snow, and full natural flow, all variables in the current forecast equations, and this update is foundational for all other forecast improvements.

In addition, DFM is experimenting this year with two tasks to help address greater sub-season variability in our climate: 1) breaking the precipitation and Full Natural Flow (FNF) variables into monthly values rather than using seasonal values; and 2) including May 1 snow water content in forecasts to capture depletion rate of snow as compared to runoff. Disaggregating the lumped seasonal precipitation or FNF values into monthly timesteps allows for better analysis of how these two variables accumulate and removes biases from larger storms that may dominate seasonal precipitation.

Finally, DFM is assessing the use of better spatially explicit data in the forecasts through the collection of Airborne Snow Observatory (ASO) data in the Feather, Truckee, Carson, and Yuba River watersheds, in addition to the Tuolumne, Merced, San Joaquin, Kings, and Kaweah basins, where data has traditionally been collected. DFM will also be utilizing the U.S. Geological Survey's Basin Characterization Model (BCM) to provide modeled, gridded statewide climate water deficit and soil moisture data.

There are also some runoff forecast improvements being assessed this year. For example, DFM staff have expanded the use of machine learning tools, enabling greater flexibility in utilizing existing or newer hydroclimate variables in runoff forecasting. These staff are working with Scripps/CW3E to make use of their experience and expertise in using machine learning and applying it to hydroclimate analyses such as runoff forecasts. DFM is also assessing forecast models in the Feather and San Joaquin watersheds as part of a pilot program which uses ASO data, coupled with the WRF-Hydro physically based and climate informed model. WRF-Hydro has been developed by the National Center for Atmospheric Research (NCAR) and is used by the National Oceanic and Atmospheric Administration (NOAA) in its National Water Model. Additionally, DFM staff have worked cooperatively with the USDA to develop an entire suite of the USDA's iSnoBal models where ASO data is collected. This enables a better understanding of what is physically happening in the snowpack, which in turn provides better guidance as to how much snowmelt runoff is reaching the soils.

DWR is also coordinating with Reclamation in the longer-term work they are doing to improve forecasting across the western United States. New approaches and/or data arising from these processes will also be incorporated into DWR's forecast process as appropriate.

IV. Operations Forecasts - Projected Hydrology and Runoff, Releases and Storage

A. January 1, 2022 – Projected Hydrology and Runoff

The DWR's Hydrology and Flood Operations Branch within the Division of Flood Management produces estimates of water year runoff, or the water supply index (WSI), for the major watersheds of the Sacramento and San Joaquin River basins. The WSI forecast is a statistically based forecast of Water Year runoff for each major river basin in the Sacramento and San Joaquin valleys (Sacramento, Feather, Yuba, American, Stanislaus, Tuolumne, Merced, and San Joaquin). The runoff forecasts are produced for six exceedance levels: 99%, 90%, 75%, 50%, 25%, and 10% and are done at the beginning of the month for December through May. The statistical data now used behind the forecasts include precipitation and prior year runoff from the most recent 51 Water Years (1971-2021).

To assess an even drier scenario than the traditional 90% operations forecast, DWR and Reclamation also have included an operations forecast that is informed by the 99% runoff forecast. The driest year of the past 51 years is 1977 for all eight basins. The total Water Year precipitation used for the 99% case is exactly or slightly less than the 1977 actual total Water Year precipitation but statistically distributed throughout the months. The 99% exceedance is considered an extreme dry case from the date of the forecast moving forward.

The Water Supply Index (WSI) forecasts that are utilized for this February 1 Drought Plan are unique to this water year and informed by precipitation, runoff, and other antecedent hydrologic conditions as they existed on January 1, 2022.

These forecasts combine the runoff associated with antecedent conditions with the anticipated runoff resulting from precipitation predicted to occur through September 30 under the 50%, 90%, and 99% hydrologic exceedance scenarios. For example, the 90% exceedance hydrology assumes inflows from rainfall and snowmelt at levels that are likely to be exceeded with a 90% probability, or in other words, there is a 10% or less chance of actual conditions turning out to be this dry or drier from this point forward. The 50% probability assumes there is even chance that it will be drier or wetter from this point forward.

The January 1, WSI forecast water year classifications and runoff for the Sacramento Valley and San Joaquin Valley are summarized as follows:

Sacramento River Unimpaired Runoff (50% Exceedance)	19.9 MAF (113% of average)
Sacramento Valley Index (SVI) (50% Exceedance)	7.5 MAF (Below Normal) Oct-Dec Runoff: 128% of historical average
San Joaquin Valley Index (SJI) (75% Exceedance)	2.5 MAF (Below Normal) Oct-Dec Runoff: 205% of historical average

The forecasting process adjusts in February with the issuance of the Bulletin 120 (B120) April-July and Water Year runoff volumes which are then incorporated into the WSI forecasting process. Because the B120 forecasting procedure differs from the WSI, the forecasts do not always align on February 1. One of the main differences in methods between the B120 and the WSI is that the B120 forecasting process incorporates mountain snowpack (where the WSI does not). For this reason, the B120 is taken as the more hydrometeorological informed forecast. As such, beginning with the February 1 forecasts the WSI forecasts are adjusted up or down to match the B120 forecast volumes.

B. SWP and CVP Operations Forecasts

The January 1, 2022 SWP and CVP operations forecasts are included in Attachment 1 and include storage and flows under 50%, 90%, and 99% hydrologic scenarios. This range of exceedance scenarios was selected to show standard ranges of hydrology for potential future conditions. The operations forecasts use the runoff forecasts as model inputs to simulate Project operations under various regulatory requirements and produce forecasted reservoir storages, releases, and flows under the same set of hydrologic exceedances. These operations forecasts give general guidance for annual water delivery, storage management, and power planning purposes for each exceedance assumption. Actual hydrologic events act in time steps shorter than a month and are often unpredictable more than a few days to a week out. Day-to-day operations are driven by operating criteria such as those found in U.S. Army Corps of Engineers flood control manuals, SWRCB D-1641 Bay-Delta Standards, the NMFS and USFWS Biological Opinions, and the ITP for the SWP. Output from forecast models, as provided in this Drought Plan, represent system responses to the overlay of very specific operating criteria on each of the discrete hydrologic scenarios provided in the January 1 water supply forecasts.

The base forecast assumptions utilize existing storage conditions, actual precipitation through December 2021, forecasted runoff based on the hydrology, projected water supply deliveries, and meeting existing flow and water quality standards, and fish and wildlife protections. Each forecast includes monthly storage levels, reservoir releases, Delta export rates, and Delta outflow through September 30, 2022. Much is still unknown about the hydrology for this year, and hydrology will likely continue to fluctuate between the scenarios making the need for specific actions difficult to predict this early in the water year. Therefore, DWR and Reclamation will be planning for several potential scenarios based on the current dry trend and the significant unknowns about this year's hydrology. In addition, DWR and Reclamation will continue to update the operations forecasts with each new monthly water supply forecast, and expect that with each updated operations forecast, SWP and CVP conditions will change.

C. Contractual Obligations

Based upon the January 1 forecast, a reduction in Feather River Settlement Contractors (FRSC) deliveries was not included in the January operations forecasts. However, the official determination of the delivery to the FRSC is based on the April 1 Feather River runoff forecast. All exceedance forecasts assumed fulfilling the contractual obligations between DWR and North Delta Water Agency.

Deliveries to Sacramento River Settlement contractors, San Joaquin River Exchange contractors, and wildlife refuges are determined by the Shasta inflow. For 2022, an annual unimpaired inflow below 4.0 MAF indicates a "Shasta Critical" year, which triggers reduced allocations. The initial determination for the Shasta Critical year is on February 15 but may change throughout the year as forecasts and actual inflow are updated. For the purposes of the attached forecasts, the Shasta critical assumptions are listed below:

- The January 50% exceedance hydrology indicates an inflow of 5.56 MAF which is above 4.0 MAF, meaning allocations would not be reduced under the contract.

- The 90% exceedance hydrology is close to the trigger at 4.1 MAF, but the drier January hydrology combined with other forecasts (such as the California Nevada River Forecasting Center) indicates the index is likely to be below 4.0 MAF which would indicate a critical year and reduced diversions.

- The 99% exceedance hydrology is 3.55 MAF which is below the trigger of 4.0 MAF and indicates a Shasta critical year.

V. SWP and CVP Operations Forecast Summaries and Areas of Concern

Differences in snowpack distribution, variation among basin and sub-basin hydrologic circumstances, disparity among month-to-month hydrologic conditions, and other meteorological uncertainties can also affect real-time reservoir and Delta operations and the available water supply at any given time. The 50%, 90%, and 99% probability exceedance forecasts presented in this document are very general and are not the only drivers of actions that may be needed in the future. The purpose of this document is to identify generally foreseeable areas of concern in the 50%, 90%, and 99% exceedance scenarios as shown in operations forecasts based on the January 1 Water Supply forecast. As described above, hydrological conditions can vary widely, as recently seen in a very dry January. Consequently, the conditions described below are based on the January 1 water supply forecast, and the system and hydrological conditions known at the time this Drought Plan was developed. System conditions and forecasts will change with actual conditions, thus each subsequent water supply forecast and resulting areas of concern (described in Section V) will be updated in future Drought Plan updates.

WY 2022 is classified as Below Normal for the 50%, Dry in the 90%, and Critical in the 99% hydrological exceedances. However, only the 90% and 99% exceedance scenarios present significant concerns, as summarized below.

A. January 1, 2022 50% Exceedance

Both Projects anticipate being able to meet the Sacramento Valley in-basin requirements (which include senior water rights diverters and SWRCB D-1641 Bay-Delta standards), the contractual obligations of the both the Sacramento River and Feather River Settlement Contractors, and minimum health and safety needs under the 50% exceedance scenario.

B. January 1, 2022 90% and 99% Exceedance

The 90% and 99% exceedance forecasts incorporate dry conditions for WY 2022. Current system-specific operations and 90% and 99% exceedance forecast areas of potential concern are further described in detail below.

i. Trinity River

Spring flows on the Trinity River will be consistent with the annual allocation as prescribed by the Trinity River Main-stem Fishery Restoration Record of Decision. Consistent with fish health criteria, releases to augment flows in the Lower Klamath River may also be considered. The storage forecasted in the 90% exceedance forecast for the end of September is extremely low at just over 500 TAF and does not leave a storage buffer in the event 2023 is also dry. In addition, low storage of this level also typically brings temperature management concerns both in this water year and in WY 2023. Although a 99% inflow forecast was not provided for Trinity Reservoir, it is assumed that it would result in similar concerns with lower carryover storage.

ii. Sacramento River

Flow releases at Keswick are currently at the minimum of 3,250 cfs. Reclamation's goal is to maintain this flow throughout this winter and spring as much as practicable to help conserve storage in Shasta Lake; however, releases for senior water right demands may require increases before the summer releases begin.

Absent actions which would delay senior water right demands, flows are expected to begin increasing in the mid-April to May timeframe for meeting in-river temperatures, and senior water right deliveries. Should conditions remain dry throughout the remaining winter/spring, it is possible that Shasta will be relied upon to support delta conditions later in the summer. Procedures and commitments consistent with the 2019 Proposed Action under the 2019 NMFS Biological Opinion will be applied through this period in addition to any court orders in place at the time.

90% Exceedance forecast

The key areas of concern for the upper Sacramento River include temperature management, meeting in-basin demands (including senior water right deliveries) and carryover storage. Temperature management is of significant concern given that the low projected peak storage and corresponding elevation indicate that use of the temperature control device will not be possible. In particular, there will be little to no ability to blend warmer and colder water in the

spring prior to the hot summer temperatures and instead will result in the release of colder water than necessary earlier in the season, potentially depleting the cold-water resource prematurely. This presents significant concern for fishery protection in the late summer/early fall season. Preliminary estimates, based solely on the forecasted storage on April 30, indicate that 56°F may not be achievable at the Clear Creek gauge throughout the water year. The ability to manage temperatures will be heavily influenced by precipitation throughout the remainder of the precipitation season and required releases for in-basin demands including senior water right holder deliveries for the Sacramento River Settlement Contractors. The 90% exceedance forecast shows a carryover storage of approximately 1,870 TAF.

99% Exceedance Forecast

Similar concerns exist for the 99% exceedance forecast with temperature; however, the carryover storage at the end of September is much lower at 1.2 MAF. This is a similar storage to previous extreme drought years and would likely cause challenges in WY 2023 should that year also be dry.

iii. Clear Creek

Flows on Clear Creek will be consistent with the Proposed Action (PA) and the NMFS Biological Opinion. The timing of any prescribed pulse flows will be closely evaluated through technical teams to minimize effects on temperature management and/or ability to help meet other system flow needs. Concerns with Clear Creek temperature management will be similar to those of the Trinity system.

iv. Feather River – Lake Oroville

90% Exceedance

Based on this water supply forecast, the end of September carryover storage is projected to be 1.6 MAF. Feather River temperature management will be achieved through shutter removal from the Hyatt Powerplant intakes. Should there be above normal ambient temperatures during the summer and fall, flow from the Oroville Dam's low-level outlet may be needed for blending purposes. Releases from Lake Oroville are for meeting in-basin demands, which includes Delta and instream requirements and deliveries to senior water right holders, and Delta exports.

99% Exceedance

Based on this water supply forecast, the end of September carryover storage in the 99% exceedance is projected to be about 1.2 MAF. Although this storage is below the carryover storage of 1.6 MAF, it is above the historically low storage seen at the end of WY 2021. Temperature management will likely be achieved through a combination of flows from the low-level outlet of Oroville Dam and shutter removal from the Hyatt Powerplant's intakes. Releases from Lake Oroville are for meeting in-basin requirements, which includes Delta and instream requirements and deliveries to senior water rights holders, and minimum exports for municipal and industrial State Water Project Contractors not directly connected to San Luis Reservoir.

v. American River

Flows on the American River will be consistent with the provisions of action included in the 2019 NMFS Biological Opinion and the 2019 Folsom Water Control Diagram. Folsom storage is near the flood control limit, meaning that future storms in February could lead to increased releases for flood management. Based on the January 1 forecast, Folsom may be in flood control operations for some portion of the late winter and early spring period. Absent flood control operations, flows in the spring will generally follow either the minimum flows from the 2017 revised American River Flow Management plan or higher flows to meet Delta requirements. Flows in the summer and into the fall may also be adjusted for storage management, Delta needs, or to meet the temperature plan for the American River. Typically starting in June, flow releases may increase at Nimbus to facilitate temperature management along the American River, and these increased flows will then be used to meet other Project purposes in the system.

90% Exceedance

In the 90% exceedance forecasts, Folsom Reservoir reaches at or near full and is unlikely to have challenges with temperature, carryover or meeting public health and safety demands.

99% Exceedance

For the 99% exceedance forecast, the key area of concerns for the American River is temperature management. Temperature management is not expected to be as much of a concern as it was in 2021, given the given the significantly higher projected April storage of 600 TAF; however, without a full reservoir, challenges may still exist and will depend on the volume of cold-water pool available once Folsom reservoir is stratified.

vi. Stanislaus River

Flows on the Stanislaus River will be consistent with the provisions of the PA and the NMFS Biological Opinion and D1641 Vernalis base flow and water quality requirements. Flows February through June are expected to be primarily driven by the D1641 Vernalis base flow requirement which is met through releases from New Melones combined with flows in the San Joaquin River upstream of the Stanislaus River confluence. Given the San Joaquin River flows throughout January and the trend towards drier hydrology, this will require a significant volume of releases from New Melones reservoir absent any major precipitation events. Should additional runoff meet this requirement at Vernalis, spring releases on the Stanislaus River will follow the Stepped Release Plan schedules (from the PA) as modified through the interagency Stanislaus Watershed Team. The key areas of concern for the Stanislaus River basin include primarily carryover storage. New Melones has a very low refill rate, meaning it only typically fills in very wet years (such as 2017) and can go many years between filling even with non-drought hydrology. For this reason, storage within New Melones can be relied upon for meeting basin requirements for several years after the last filling. The 90% exceedance forecast shows a carryover storage of approximately 700 TAF at the end of September, leaving very little buffer

should WY2023 also be dry. The 99% exceedance forecast shows similar concerns with a carryover storage of just over 500 TAF by the end of September.

VI. Monitoring Efforts to Inform Operations

A. Delta Smelt Surveys

The current dry conditions have highlighted the need to improve information that is collected to support management decisions pertaining to the effect of winter/spring exports on the Delta Smelt population. Since the previous 2014-2016 drought, a new management-relevant survey has been developed—Enhanced Delta Smelt Monitoring Survey (EDSM), which conducts high intensity sampling year-round and provides regional population estimates for Delta Smelt across their range. This information has helped to inform export operational decisions and allowed for flexibility in maximizing export opportunities earlier this year.

The EDSM surveys are conducted in addition to several other surveys, including the Smelt Larva Survey and 20-mm Survey, which focus on early life stages, as well as the Spring Kodiak Trawl, which focuses on spawning adults. As part of the new ITP, CDFW, DWR, and partners are testing improved methods to measure larval smelt entrainment at the SWP, and pilot surveys for this effort began sampling in early January 2022.

Additionally, experimental releases of hatchery-reared Delta Smelt are occurring in February 2022. A total of approximately 45,000 fish are planned to be released during this period, and initial monitoring recaptures indicate that a portion of the releases are surviving and dispersing in the Delta.

Despite these advancements in survey methods, the Delta Smelt population was at extremely low abundance in WY 2021. Catch of wild Delta Smelt during WY 2022 is expected to be small. Consequently, as outlined in the Biological Opinions and DWR's ITP, management activities may focus more on habitat conditions including turbidity, temperature, and OMR flows when assessing the risk of entrainment. Particle tracking and life cycle models will also be considered, as appropriate, to guide management actions.

B. Salmonids Near-Term Drought Monitoring

Unlike in WY 2021, there is no need for augmented monitoring of salmon entering the Delta to inform water operation management because, in WY 2022, larger proportions of salmonid populations are already known to have entered the Delta unusually early. Instead, additional trawling and beach seining may be implemented in the Old River between the export facilities and the downstream confluence with the San Joaquin River in the event of a critical loss event or a storm flex situation to provide information that may lead to a better understanding of salmon behavior and distributions associated with such loss events. There is also consideration of implementing an eDNA survey for the same purpose. An increase in sampling duration at the salvage facilities may be considered as part of the monitoring plan to minimize inaccuracies in expanded salvage counts and loss calculations. However, in 2018, DOSS advised NMFS

against increased sampling duration because the disadvantages would outweigh the potential benefits.

Other studies on migration paths and mortality will continue in 2022 for winter-run and spring-run salmon, as well as steelhead and sturgeon, to improve scientific knowledge about the population dynamics of these species. Several new or updated models, such as the STARS model and the enhanced Particle Tracking Model, are available to simulate fish migration rate, routing, and survival in the Delta in response to flow and other variables. These models will be used to inform real-time management decisions to minimize the impact of drought actions on the survival of salmon migrating through the Delta.

As a potential additional tool, DWR's ITP requires the development of a predictive tool to improve management of winter-run Chinook Salmon salvage. One of the potential models is already in an advanced stage of development and is intended to predict continued salvage after initiation of a salvage event. Another complimentary predictive model is being developed by CDFW and is intended to predict initiation of a salvage event. These models may be available for use by SaMT to provide additional information regarding real-time operations, potentially improving our ability to reduce entrainment throughout the winter and spring.

This monitoring in 2022 and beyond was developed, partly in response to previous droughts, to improve our understanding of timing and distribution of species in the Delta, as well as inform targeted research and fill data gaps that further detail risks resulting from water operations.

C. Ecosystem Drought Monitoring

Monitoring during the previous major drought demonstrated that there can be major ecological changes in the estuary. For example, the previous drought showed increases in harmful algal blooms, aquatic weeds, and alien fishes (e.g., centrarchids). These changes are likely to occur again under drought conditions, and monitoring could focus on measuring these effects to understand the impacts of this potential drought and efficacy of different management actions taken to address these ecological stressors. As a specific example, these data can help evaluate the effects of controllable factors (e.g., diversions) versus factors that can't be managed (e.g., Delta temperature).

Our approach to drought ecosystem monitoring is expected to build on existing monitoring and synthesis efforts to examine the effects of flow management and extreme flow events (e.g., drought, flood) on critical ecological conditions. The Interagency Ecological Program (IEP) Drought Management Analysis and Synthesis Team (MAST) was originally formed in 2014 to assess the impact of the major drought of 2012-2016. This team was reformed in spring of 2021 with several of the original members as well as many new members to assess the drought of 2020-2021 and future drought impacts. The team contains members from DWR, DSP, USBR, CDFW, USFWS, NMFS, and USGS who are all committed to synthesis and monitoring of ecosystem drought impacts. The team works closely with the USBR-led effort to develop a Drought Toolkit and the joint DWR/USBR team developing the annual Drought Contingency Plan. The team is analyzing a broad suite of ecosystem parameters in the Delta to assess the impact droughts on the Delta, with particular attention to the drought of 2020-2021 and

associated drought actions. An initial report will be provided along with this Drought Plan on February 1. If 2022 is classified as Wet or Above Normal, a final report will be provided in summer of 2022. If the drought continues into 2022, a secondary report will be provided February 1, 2023, with a final report in summer of 2023.

For details, see Attachment 2, the "Drought Ecosystem Monitoring and Synthesis Plan, 2021-2023."

VII. Early Drought Actions

As noted in this Drought Plan, winter hydrological conditions are very dynamic, and there is uncertainty in the forecast. The first three months of WY 2022 have seen significant precipitation, and there have been considerable gains in snowpack, but it is uncertain how the water year will end, especially considering the very dry January. The Projects have undertaken the following early actions in response to the drought; however, future Drought Plans will likely include additional drought actions, should they be needed if dry conditions persist through the Spring.

A. Temporary Urgency Change Petition

DWR and the U.S. Bureau of Reclamation submitted a Temporary Urgency Change Petition (TUCP) on December 1, 2021, requesting modifications to specific Decision 1641 objectives between February 1 and April 30, 2022. The purpose of these requested modifications was to conserve upstream storage through operational flexibility. This modification was requested under the assumption that WY 2022 would continue with dry conditions from 2021. Because of the improved hydrology in October and December 2021 and subsequent storage improvement in Oroville and Folsom, DWR and Reclamation submitted a joint letter on January 18, 2022, requesting to withdraw the TUCP for the February through April period. However, considering the very dry conditions in January, the Projects will continue to evaluate conditions to determine whether a TUCP would be needed for later in the year.

B. Emergency Drought Salinity Barrier

Construction of this rock-filled channel closure, across West False River from Jersey Island to Bradford Island, began on June 3, 2021, and installation was completed on June 22, 2021. Removal of the barrier was originally planned to begin in October and full removal was anticipated by November 30, 2021.

However, DWR received approval from CDFW to keep the emergency drought salinity barrier in place through the winter. In January 2022, the barrier was notched by removing rock from approximately 400 feet from the center section to allow boat and fish passage. The removed rock is currently being stored on barges, and restoration of the barrier is planned for April 2022. While notched, the barrier does not provide salinity management benefits, but leaving the

majority of the embankment rock in place will allow rapid reconstruction of the barrier. The barrier will be fully removed no later than November 30, 2022.

In addition, DWR is working to get all environmental approvals, through standard non-emergency processes, to allow for up to two additional installations of the West False River barrier between 2023 and 2032.

VIII. Next Steps

DWR and Reclamation continue to provide weekly condition and Project operations updates through WOMT. In addition, DWR and Reclamation will continue to coordinate with the existing Long-term Operation Agency working groups and Drought Relief Year Team to develop a robust drought monitoring program with updates to WOMT and other forums as necessary. In addition, this Drought Plan will be updated in March to include the current hydrological conditions, SWP and CVP operational forecasts that incorporate the February 1 Bulletin 120 forecast, and additional potential drought actions, if warranted.

REFERENCES

[CDFW] California Department of Fish and Wildlife. 2020. California Endangered Species Act Incidental Take Permit No. 2081-2019-066-00. Long-term operation of the State Water Project in the Sacramento–San Joaquin Delta. March 30, 2020. 142 p. [accessed 2020 Sep 02]. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=178057&inline

Kimmerer W, Wilkerson F, Downing B, Dugdale R, Gross ES, Kayfetz K, Khanna S, Parker AE, Thompson J. 2019. Effects of drought and the emergency drought barrier on the ecosystem of the California Delta. San Franc Estuary Watershed Sci. [accessed 2020 Jul 15];17(3). https://doi.org/10.15447/sfews.2019v17iss3art2

[NMFS] National Marine Fisheries Service, Southwest Region. 2019. Biological opinion for the reinitiation of consultation on the long-term operations of the Central Valley Project and State Water Project. Long Beach (CA): Endangered Species Act Section 7 Consultation. October 21, 2019. [accessed 2020 Sep 02]. Available from: https://www.fisheries.noaa.gov/resource/document/biological-opinion-reinitiation-consultation-long-term-operation-central-valley

[USFWS] US Fish and Wildlife Service. 2019. Biological opinion of consultation on the coordinated operations of the Central Valley Project and State Water Project. Sacramento (CA): USFWS. Available from: https://www.fws.gov/sfbaydelta/cvp-swp/documents/10182019_ROC_BO_final.pdf