Appendix 2A

Attachment 6: Drought Toolkit

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BUREAU OF RECLAMATION

Drought Toolkit

Central Valley Project, California
California-Great Basin Region

U.S. Department of the Interior October 2023

Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

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

Drought Toolkit

Central Valley Project, California
California-Great Basin Region

prepared by

Bay-Delta Office
801 "I" Street, Suite 140 3
Sacramento, CA 95814

In Coordination with CDFW, DWR, NMFS, USFWS, SWRCB

Cover Photo: Lupine bloom at Folsom Lake 2021 (Reclamation/Cindy Meyer)

Contents

Purpose

This voluntary Drought Toolkit provides a coordination process to implement drought relief actions and identifies potential measures to be taken under Shasta Cold Water Pool Management Dry Years, Drought Years, and Successive Dry Years.

The coordination process starts with Water Operations Management Team (WOMT) activating the Drought Relief Year (DRY) team to assess the potential application of available actions and to plan for future actions if drought conditions persist. The DRY team is also responsible for disclosing the evaluations conducted during any implemented action for the current water year. The DRY team will, at a minimum, convene when Shasta Cold Water Pool Management is in critical condition (i.e., Tier 3 years where there may be a high risk of exceeding 56°F before October 1st) and Tier 4 years. However, WOMT may activate the DRY team at its discretion based on real-time conditions.

To support an efficient and organized drought response, this drought toolkit contains summaries of potential Drought Relief Actions (DRAs). Individual action summaries provide DRY team members with a quick reference that includes both the seasonal timing and implementation times for rapid evaluation. This Drought Toolkit is not meant to be comprehensive for any single water year, but rather is intended to act as a repository of the institutional knowledge gained when a DRA is implemented. The Drought Toolkit leverages planning and communication channels to implement actions that can be taken year-round to support operational flexibility and ongoing habitat and restoration actions that may bolster the species' resilience, especially during drought and successive dry year conditions. As new DRAs are identified and developed, those DRAs will be evaluated through the Long-Term Operation (LTO) coordination process and be added to this Toolkit as appropriate. At a minimum, the entire Toolkit will be revisited at a frequency of not more than 5 years after the Record of Decision.

This Drought Toolkit is consistent with Alternative 1 (Preferred Alternative) as described in the Bureau of Reclamation's (Reclamation) Record of Decision for the Coordinated Long-Term Operation (LTO) of the Central Valley Project (CVP) and State Water Project (SWP), dated February 2020, and analyzed in the National Marine Fisheries Service (NMFS) Biological Opinion, dated October 2019. The Drought Toolkit was analyzed as a Programmatic Action in the NMFS Biological Opinion and does not have separate incidental take coverage. The DRY team understands that any potential action may require additional environmental review.

Background

The Drought and Dry Year Planning Toolkit Charter served as the origin document, establishing the focus of this Drought Toolkit on actions implemented as intervention measures during hydrologic years with drought conditions. This Drought Toolkit includes actions that can either mitigate or avoid drought impacts throughout the Central Valley. Through the development of a technical team and this toolkit via the LTO implementation process, the toolkit evolved to serve as a mechanism to support long term planning, and acting as a broad repository for challenges and solutions associated with of operating under difficult drought conditions.

As a primary tool of the DRY team, this Drought Toolkit serves as a roadmap by which the DRY team will operate and coordinate with WOMT and any necessary parties to coordinate and evaluate the implementation of DRAs. Each DRA within the toolkit is summarized and paired with a timeline of critical events to achieve its implementation to aid the DRY team's recommendations. Additionally, each DRA is categorized as an avoidance or mitigation action. An avoidance action is one that can be taken to bring about more permanent changes that limit drought impacts when droughts occur whereas a mitigation action can be taken immediately during a drought to directly limit the impacts in that specific drought. This characterization allows the DRY team to evaluate both long term actions to avoid drought conditions (e.g., infrastructure improvements) while providing the flexibility to identify rapid response action to mitigate drought within context of seasonal changes in operations or the biology of endangered and threatened species. DRAs within the toolkit are meant to act as starting points and guides. Managing natural resources during drought conditions will require collaborative relationships and communication between the DRY team, state and federal agencies, technical experts, public water agencies, and stakeholders to ensure all actions taken meet regulatory standards.

Drought Relief Action Coordination

The coordination process component of the Drought Toolkit was developed through the LTO Implementation process as a Team Charter: Drought Relief Year Team (V7 April 21, 2021).

The DRY Team will be activated at the request of the WOMT, and will function as a drought-planning hub to serve both technical and policy roles and ultimately make recommendations in coordination with the Project Manager (PM) and with WOMT for the implementation of DRAs.

Background

The Project Charter for the Drought Toolkit established the goals and objectives and empowers the PM to develop a Project Management Plan.

The PM for the Drought Toolkit will lead the development of the Drought Toolkit and develop potential actions and plans to implement intervention measures during critical hydrologic year types and drought conditions. WOMT identified the DRY Team as necessary to select and plan for the implementation of DRAs from the Drought Toolkit. The DRY team will coordinate with DWR on the development of the Drought Contingency Plan, to collate and advance DRAs from the Drought Toolkit that, when implemented, would avoid, minimize, or mitigate the impacts of contemporaneous drought conditions. Considerations for regulatory compliance such as needed for incidental take coverage would be described for each DRA within the Drought Toolkit.

Membership

The DRY team shall be comprised of technical and/or policy makers from each of the six WOMT agencies: the U.S. Bureau of Reclamation (Reclamation), the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), the California Department of Water Resources (DWR), the California Department of Fish and Wildlife (CDFW), and the State Water Resources Control Board (SWRCB). The designated PM will coordinate the DRY team efforts and communication with WOMT. Each agency shall retain the ability to contribute one team member and two alternates. For 2022, the team membership will include:

Table 1 The membership of the DRY Team for each participating agency. Membership will be evaluated at each activation of the DRY Team by WOMT. Last updated 10/14/2022.

Agency	Representative
Reclamation	Adam Nickels
USFWS	Jana Affonso, Jim Earley, Kim Squires

NMFS	Evan Sawyer
DWR	Kevin Clark, Chris Wilkinson
CDFW	Crystal Rigby, Erica Meyers
SWRCB	Craig Williams, Erin Foresman

Drought Contingency Plan

If WOMT determines that conditions are dry, or are forecasted to be dry, such that additional actions could be implemented to minimize or mitigate the impacts of those conditions, WOMT may activate the DRY Team. The DRY Team may provide recommendations during the development of the Drought Contingency Plan. Once activated, the DRY Team will continue to facilitate DRA implementation for the duration of the water year. If drought conditions persist, WOMT may direct the DRY Team continue into the following water year.

WOMT's determination to convene the DRY Team in a given water year may be based on any of the following conditions:

1. Forecasted End-of-September Storage: Any reservoir <25% capacity (based on 90% exceedance)
2. Shasta Critical determination: B-120 Water Supply Forecast, Shasta inflow <3.2 MAF
3. Shasta Tier 3 or 4 year: May 1st cold water pool (CWP) < 2.3 MAF (or forecasted May 1st storage <3.5 MAF according to historical relationship between CWP volume and total storage)
4. Emergency Drought Declaration: Declaration of a drought emergency by the California State Governor
5. Subsequent Year: The water year follows a Dry or Critically Dry water year type (WYT)

Drought Contingency Plans typically include:

1. Hydrologic conditions and forecasts;
2. Operations forecasts;
3. Fishery status
4. A list of Drought actions being taken;
5. Monitoring being conducted to detect biological/physical responses.

Once DWR has compiled the Drought Contingency Plan, the DRY Team may further coordinate with WOMT, who will consider the plan for implementation, directing member agencies to seek authorization, as appropriate, for the discrete DRAs contained therein. The DRY Team will commit to keeping WOMT apprised of plan implementation and of any additional action needed to address drought conditions.

Coordination with Resource Management Advisory Groups

A key element for executing the DRAs is coordination with existing resource management advisory groups. This coordination will be developed to accommodate annual schedules and to leverage existing authorities and technical expertise to implement DRAs. Depending on the specific DRAs being proposed, the DRY Team would coordinate with the following groups (Table 2) according to their involvement in the specific DRA.

Table 2 A List of groups the DRY Team could coordinate with and the meeting frequency of each group.

Group	Acronym	Meeting Frequency
Sacramento River Temperature Task Group	SRTTG	Monthly
Upper Sacramento Scheduling	USST	Biweekly
American River Group	ARG	Monthly
Stanislaus Watershed Team	SWT	Monthly
Salmon Monitoring Team	SaMT	Weekly (during OMR Season)
Smelt Monitoring Team	SMT	Weekly (during OMR Season)

Coordination with Public Water Agencies

Another important consideration will be the coordination with various Public Water Agencies (PWAs), as relevant and appropriate. Certain DRAs require close coordination with various PWAs. Where that coordination is necessary, representatives of the PWAs will be invited to participate in discussions with the DRY Team regarding the implementation of a particular DRA. Furthermore, all DRAs discussed in the Drought Contingency Plan will have evaluation criteria and processes to assess the efficacy of a DRA, which will be discussed at one or more technical

team forums of which the PWAs are members. Additional coordination with Agencies, PWAs, and stakeholders will be determined by the DRY team, as needed.

Reclamation shall meet and confer with USFWS, NMFS, DWR, CDFW, and Sacramento River Settlement Contractors on voluntary measures to be considered if drought conditions continue into the following year, including measures that may be beyond Reclamation and DWR's discretion. If dry conditions continue, Reclamation will continue to meet and confer with this group (and potentially other agencies and organizations) to evaluate current hydrologic conditions and the potential for continued dry conditions that may necessitate the need for development of a drought contingency plan (that may include actions from the Drought Toolkit) for the water year.

Milestones

Milestones describe the specific points for management review and approval. Given the nature of the DRY Team Charter, events in the schedule will occur during the given water year the DRY Team is convened.

Milestone (s)
WOMT 1. Provided weekly updates on conditions. 2. WOMT determination to activate the DRY Team based on conditions.
DRY Team 1. Meets to identify DRAs from Drought Toolkit (key elements drawn from details in toolkit) including consideration of any additional DRAs provided. 2. Convenes meetings with existing resource management advisory groups, as needed, to provide recommendations for the development of the Drought Contingency Plan. 3. Communicate with technical experts, PWAs, and stakeholders on DRAs, as necessary.
WOMT 1. Considers DRAs for implementation, directing member agencies to seek authorization
DRY Team 1. Coordination and communication for the Drought Contingency Plan, with tasks delegated to members to begin implementation (including invitations to technical experts, and PWAs to participate as necessary). 2. Drought Contingency Plan focused meetings to coordinate among partners involved in the specific DRAs. 3. Updated WOMT on progress or any conflicts during implementation of each DRA.

DRA Implementation 1. Partners listed in the Drought Toolkit implement action and provide updates to DRY Team. 2. Partners will implement monitoring that will be used to detect biological/physical effects and provide updates to the DRY Team.
DRA Evaluation 1. Partners provide any reporting or outcome analysis of the action to the DRY team. 2. DRY team, in coordination with technical teams, will implement evaluation criteria/process, that will be used to assess an action's effectiveness. 3. DRY team incorporates any relevant evaluation information into the Drought Toolkit annually.
WOMT 1. WOMT will suspend the DRY team and any ongoing work on DRAs no longer deemed necessary based on improved conditions. 2. DRY team completes any remaining evaluations.

Milestones may require an iterative process whereby information learned from subsequent analysis may inform updates to a prior activity.

Avoidance & Mitigation Actions

Action 1: Water Transfers by Sacramento River Settlement Contractors (SRSC)

Point of Contact: Anne Williams (SRSC)

Impact:

_X_ Avoid **_X_ Mitigate**

Category: (check all that apply)

_X_ Fish **_X_ Water** **_X_ System**

Description of Action:
SRSC voluntarily participate in water transfers by making water available through groundwater substitution and cropland idling/crop shifting. SRSC pump groundwater in-lieu of diverting surface water, thereby making the surface water available for transfer. SRSC may also idle lands that otherwise would be planted absent the transfer, or by planting a crop with a lesser water demand than what otherwise would have been planted, to make surface water available for transfer.

Intended Effect:

Absent the actions (groundwater substitution, cropland idling, crop shifting) to make water available for transfer, Reclamation would release water from Keswick Dam to be diverted by the SRSC consistent with the contracted schedule. Water made available in April, May, and June under a water transfer from a SRSC may be retained in storage in these months, and released for conveyance through the Delta in July, August, and September. In this way, transfers may increase storage in upstream reservoirs, as compared to conditions without the transfer, in the months of April, May, and June.

Process for Implementing:
Environmental documentation is needed to meet NEPA requirements (and CEQA depending on participants and facilities in use). Depending on the circumstances, Reclamation may facilitate water transfers through Forbearance Agreements. If Forbearance Agreements are executed and there is capacity at Reclamation facilities, then Petitions for Change are not needed to be submitted to the Division of Water Rights. If a Petition is needed, then the Seller must receive approval from the Division for transfer of water under its water right(s) for use by the Buyer. In addition, the Seller must submit a Water Transfer Proposal for review and approval by Department of Water Resources and Reclamation.

SRSC process involves identifying the potential for transfers and an initial volume, soliciting and compiling interest in participation from landowners, negotiating with buyers, and developing final agreements with landowners and buyers. These negotiations are subject to change based on

changes in hydrology, allocations, crop prices, and other factors. This process takes considerable effort and can involve multiple iterations to arrive at final agreements. SRSC compile extensive data and information for submittal to the agencies and must begin associated monitoring efforts ahead of the transfer start.

Agency Participation:
SWRCB Division of Water Rights – approval of Petition; DWR and Reclamation – review and approval of Water Transfer Proposal; Reclamation – execution of Forbearance Agreement; DWR – execution of Conveyance Agreement (as needed, depending on water transfer method). Participation by landowners within the SRSC.

Communication Plan:
DWR and Reclamation need to be in communication throughout review and approval of the Water Transfer Proposal.

Timeframe for Initiation:
The Seller is to inform DWR and Reclamation of their intent to transfer (via Intent to Transfer Checklist) as early as possible (January or February). If actions to make water available for transfer are to begin in April, then the Petition needs to be submitted to the SWRCB Division of Water Rights in February; or if the transfer is to begin in July, then the Petition needs to be submitted no later than May. SRSC interactions between landowners, buyers, and agencies begins in January and continues through the transfer, and even into the following year.

Advanced Timing Requirements or options for expediting timing:
Early submittal of the Intent to Transfer Checklist is intended to expedite review and timing of approval of Water Transfer Proposal. A Drought Declaration by the Governor could help facilitate expedited processing of water transfer reviews by state agencies.

Pros/Cons:
Supplies are made available to Water Service Contractors with substantially reduced water supply allocations. Depending on conditions, water made available during April – June can be retained in storage and Reclamation may release it from Shasta to meet multiple beneficial uses, including fishery benefits.

Evaluation Criteria:
Reclamation may quantify the volume of water made available for transfer to evaluate potential for benefits to fishery and other project purposes.

Other Considerations:
Allocations to other contractors (Buyers) and available capacity to move water through Delta.

_ Flow – Amount of Water Needed

_ Non – Flow

Action 2: Increasing Seasonal Food Availability for Juvenile Chinook Salmon

Point of Contact: Rodney Wittler (rjwittler@usbr.gov; 530-262-3670)

Impact:

_X_ Avoid **_X_ Mitigate**

Category: (check all that apply)

_X_ Fish **_X_ Water** **___ System**

Description of Action:
Apply practices expanding from the 2019 Food for Fish (FFF) research project of rice fields in fall and winter months. This action is a drought contingency plan item that can directly impact winter-run Chinook salmon in years with poor hydrological conditions by increasing in-river prey availability that may accelerate somatic growth rates of juvenile salmon. The SRSC seek to implement their FFF practices on flooded fields after the growing season between December and March.

Intended Effect:
Rice decomposition from wetted rice fields produces abundant prey (e.g. zooplankton) for juvenile foraging and rearing Chinook salmon. The prey dense rice-field water will be pumped back into the mainstem Sacramento River to increase prey available for juvenile salmon rearing in the mainstem. If implemented during fall and winter, consumption of this prey subsidy may accelerate somatic growth rates of juvenile winter-run Chinook salmon in this reach of the Sacramento River. Larger fish are predicted to have greater subsequent survival rates assuming larger fish have a higher average survival probability than smaller fish in the same life stage.

Process for Implementing:
This program will be based on practices currently in development by the CVPIA-Cal Trout 2019-2021 science project. Water from the Sacramento River will be pumped from the mainstem onto the rice fields to facilitate decomposition of residual plant matter from the prior growing season. Water on the rice fields will grow zooplankton over a period of weeks that accumulate to high densities. Zooplankton-dense water from flooded rice fields will be pumped back into the mainstem Sacramento River augmenting the available food supply for winter-run Chinook salmon rearing and/or migrating between Meridian at Highway 20 (RM132) and Knights Landing (RM90).

A management team consisting of U.S. Bureau of Reclamation (Reclamation), SRSC, U.S. Fish and Wildlife Service (USFWS), and California Trout (CalTrout) will conduct technical evaluations to plan and implement this action. These technical evaluations will generally focus on: 1) pump capacity at participating rice fields, 2) hydrodynamic and transport analysis to optimize release of rice field effluent based on drought year conditions and presence of juveniles, and 3) bioenergetic analysis to estimate salmonid growth potential based on prey availability, water temperature, and initial fish size. The timing of rice-field water releases will be

coordinated with SRSC beginning December and running through March during years with dry conditions to benefit outmigrating juvenile winter-run Chinook Salmon.

Agency Participation:
This action will require coordination and planning from a diverse set of agency and stakeholder members. Participants will include members from Reclamation, the SRSC, the USFWS, CalTrout, RD108, the National Marine Fisheries Service (NMFS), the California Department of Water Resources (DWR), and the California Department of Fish and Wildlife (CDFW).

Communication Plan:

Timeframe for Initiation:
Successful action implementation relies on the timing of two primary action components:

1) rice decomposition and subsequent rice-field water releases, and

2) presence of outmigrating juvenile winter-run Chinook salmon.

The optimal timeframe for initiation will maximize the overlap between rice-field water releases and the presence of outmigrating winter-run Chinook salmon. As such, rice fields must be flooded several weeks prior to the peak outmigration date of juvenile winter-run Chinook salmon. Flooding rice fields prior to peak outmigration will provide to time to grow and accumulate zooplankton to high densities, that can be returned to the mainstem Sacramento River during peak outmigration.

Advanced Timing Requirements or options for expediting timing:
Prior to implementation, the management team will perform a hydrodynamic and transport analysis to establish a water release strategy and provide historic and current outmigrating winter-run Chinook salmon patterns.

Pros/Cons:

Pros:

- Expected to increase the availability of food for out-migrating juvenile winter-run Chinook salmon

Cons:

- Requires unknown amount of water to complete action and may impact water quality and outmigrating juvenile winter-run Chinook salmon

Evaluation Criteria:

- Zooplankton sampling
- Fish samping
- Resource availability, hydrodynamics and transport, and release timing analyses

Other Considerations:

This action becomes less viable as the available water (less in dry years) decreases.

x_ Flow – Amount of Water Needed: To be determined

_ Non – Flow

Action 3: SRSC Diversion and Operation Communication

Point of Contact: Anne Williams (MBK Engineers)

Impact:
_X_ Avoid **___ Mitigate**

Category: (check all that apply)
_X_ Fish **_X_ Water** **_X_ System**

Description of Action:
SRSC voluntarily compile and provide diversion estimates to Reclamation and participate in calls or meetings to discuss SRSC diversions, operations, and river conditions. The SRSC Diversion Portal has been developed to aggregate, display, and share daily SRSC diversion data and other resources in real time to further improve these communication efforts.

Intended Effect:
Increased sharing of information on SRSC diversions and operations allows Reclamation to better anticipate depletions in the Sacramento River and inform its release schedule from Keswick Reservoir. Particularly during the spring and fall months, the daily timestep of SRSC diversion data can be helpful for Reclamation's planning purposes as it schedules releases from Shasta and Keswick dams for multiple beneficial purposes. Regular updates and discussions with Reclamation allow the SRSC to keep landowners and operators informed of upcoming changes in river conditions and operations.

Process for Implementing:
The SRSC Corporation funds the maintenance of the online SRSC Diversion Portal by MBK Engineers and schedules regular meetings with Reclamation Central Valley Office (CVO) staff. Participating SRSC enter anticipated daily diversion schedules and actual daily diversions into the online Portal.

Agency Participation:
Reclamation has access to view the aggregated data sets in the online Portal and participates in regularly scheduled meetings with SRSC to discuss. SRSC participate in the Upper Sac Scheduling Team to communicate diversion information to other agencies. SRSC communicate and coordinate through the SRSC Corporation and with individual boards and landowners at regularly scheduled board meetings.

Communication Plan:
None – Reclamation shares relevant updates/information in other agency forums as needed.

Timeframe for Initiation:
Initial diversion estimates for the contract season (April-October) are provided by SRSC in late March through the online SRSC Diversion Portal and updated as needed and as the season progresses. Regular meetings between SRSC and Reclamation typically begin in early April and continue through the irrigation season and into the fall months as needed.

Advanced Timing Requirements or options for expediting timing:
Uncertain and changing spring hydrology limits the ability of SRSC to provide initial diversion estimates any earlier in the season. For more general preliminary estimates of SRSC diversions during drought years, data in the SRSC Diversion Portal from prior years can be used until current year estimates become available.

Pros/Cons:
Reclamation decisions relative to Keswick releases are better informed and Reclamation staff gain a better understanding of SRSC diversions and operations. SRSC are updated regularly on CVP operations and have a venue to ask questions.

Evaluation Criteria: None

Other Considerations:
The SRSC fund the ongoing maintenance and upkeep cost of the online Portal, as well as the staffing costs to participate in discussions with Reclamation and investigate questions/additional data needs as they arise.

_ Flow – Amount of Water Needed
_ Non – Flow

Action 4: Request Modified Fall Diversion Schedule by SRSC

Point of Contact: Anne Williams (MBK Engineers)

Impact:
_X_ Avoid **___ Mitigate**

Category: (check all that apply)
_X_ Fish **_X_ Water** **_X_ System**

Description of Action:
Upon Reclamation request, the SRSC may voluntarily consider modified diversion schedules to reschedule fall (October) diversions to later weeks in October and November.

Intended Effect:
Reschedule diversion patterns to better align with the timing of Reclamation's release reductions from Keswick for multiple beneficial uses, including fishery needs and storage conservation.

Process for Implementing:
Reclamation requests that SRSCs voluntarily reschedule water in October to later weeks in October and subsequent months. Reclamation treats the voluntarily deferred water as if it had been diverted in October pursuant to the SRSC's Settlement Contract. SRSCs compile and provide modified diversion schedules that Reclamation CVO and contracting approve.

Agency Participation:
Reclamation communicates with SRSCs and internally coordinates between CVO and contracting for accounting and payment approvals. Decisions from the boards of individual SRSC. SRSC participate in the Upper Sac Scheduling Team to communicate diversion information to other agencies. SRSC communicate and coordinate through the SRSC Corporation and with individual boards and landowners at regularly scheduled board meetings.

Communication Plan: None – Reclamation shares relevant updates/information in other agency forums as needed.

Timeframe for Initiation:
Initial monthly diversion estimates for October may be provided by SRSC after planting has occurred, approximately by mid-June, based on anticipated remaining quantities under individual Contracts. More refined diversion estimates for October are provided by SRSC in late August and September through the online SRSC Diversion Portal and updated as needed and as the season progresses.

SRSC actions begin in August and continue through the end of the extended Contract season. SRSC communicate and coordinate with individual boards and landowners to address challenges with a delayed and/or extended fall season (equipment, supplies, conveyance, and system maintenance limitations) and the risk to rice straw decomposition, Pacific Flyway habitat lands, and fish food production programs. Decisions on delayed diversions require action of individual

SRSC boards of directors at either regularly scheduled meetings or special board meetings that require a minimum notice of three days.

Advanced Timing Requirements or options for expediting timing:
Uncertain and changing conditions during the crop growing season (e.g. planting dates, smoke, air temperatures) limit the ability of SRSC to provide refined diversion estimates any earlier in the season. For more general preliminary estimates of SRSC diversions during October of drought years, data in the SRSC Diversion Portal from prior years can be used until current year estimates become available.

Pros/Cons:

Pro:

- Rescheduling fall diversions creates risk and operational challenges for SRSC.

Con:

- Rescheduling fall diversions into later weeks adds risk to successful rice straw decomposition, fish food production programs, and adequate Pacific Flyway habitat lands. SRSC operational challenges include the capacity to divert and convey water to numerous landowners who request water for decomposition and habitat lands at similar times. Due to lower river flows during the release reduction period, SRSC experience increases in energy costs to obtain water and potential damage to pumps and impellers. Later in the fall there is a higher likelihood of precipitation events for natural runoff and tributary flows to support SRSC diversions.
- Potential redd dewatering in the upper stretches of the Sacramento River due to reduction in Keswick release

Evaluation Criteria:
Reclamation may quantify the volume of water rescheduled to evaluate potential for benefits to fishery and other project purposes.

Other Considerations:
Potential redd dewatering in the upper stretches of the Sacramento River due to reduction in Keswick release

_ Flow – Amount of Water Needed
_ Non – Flow

Action 5: Request Modified Spring Diversion Schedule by SRSC

Point of Contact: Anne Williams (MBK Engineers)

Impact:
_X_ Avoid **___ Mitigate**

Category: (check all that apply)
_X_ Fish **_X_ Water** **_X_ System**

Description of Action:
Upon Reclamation request, the SRSC may voluntarily consider modified diversion schedules to reschedule early spring (April-May) diversions to later weeks in April and May.

Intended Effect:
Rescheduled diversion patterns to better align with the timing of Reclamation's releases from Keswick Dam for multiple beneficial uses, including fishery needs during the temperature management season.

Process for Implementing:
Reclamation requests that SRSCs voluntarily reschedule water in April and May to later weeks in those months without charging a rescheduling fee under Contracts (e.g. allowing the rescheduling of Base Supply later into the season, waiver of rescheduling fees, and only charging for Project Water actually diverted). SRSCs compile and provide modified diversion schedules that Reclamation CVO and contracting approve.

Agency Participation:
Reclamation communicates with SRSCs and internally coordinates between CVO and contracting for accounting and payment approvals. Decisions from the boards of individual SRSC. SRSC participate in the Upper Sac Scheduling Team to communicate diversion information to other agencies. SRSC communicate and coordinate through the SRSC Corporation and with individual boards and landowners at regularly scheduled board meetings.

Communication Plan:
None – Reclamation shares relevant updates/information in other agency forums as needed.

Timeframe for Initiation:
Pursuant to the Contracts, initial diversion estimates for the contract season (April-October) are provided by SRSC in late March through the online SRSC Diversion Portal and updated as needed and as the season progresses.

SRSC actions begin in February and continue into the spring. SRSC communicate and coordinate with individual boards and landowners to address challenges with a compressed planting/flood-up season (equipment, supplies, and conveyance limitations) and the risk of later harvest. Decisions on delayed diversions require action of individual SRSC boards of directors at

either regularly scheduled meetings or special board meetings. Special board meetings require a minimum notice of three days.

Advanced Timing Requirements or options for expediting timing:
Uncertain and changing spring hydrology limits the ability of SRSC to provide initial diversion estimates any earlier in the season. For more general preliminary estimates of SRSC diversions during drought years, data in the SRSC Diversion Portal from prior years can be used until current year estimates become available.

Pros/Cons:

Pros:

- Rescheduled diversion patterns to better align with the timing of Reclamation's releases from Keswick Dam for multiple beneficial uses, including fishery needs during the temperature management season.
- Reclamation retains flexibility to utilize water in spring months that is rescheduled for diversion by SRSCs during later weeks in those months.
- Lower river flows potentially reduce the transport time of emigrating juvenile salmon from upstream areas to downstream areas.

Cons:

- Rescheduling spring diversions creates risk and operational challenges for SRSC. Successful fall harvest of the regions' crops begins with the early spring irrigation of lands to ensure the plants have adequate time to grow, mature and be harvested before winter rains. Rescheduling spring diversions into later weeks adds risk to successful harvest and crop yields. SRSC operational challenges include the capacity to divert and convey water to numerous landowners who, due to a compressed irrigation season with spring diversions rescheduled into later weeks, request water for irrigation at similar times. Due to lower river flows during the spring, SRSC experience increases in energy costs to obtain water, potential damage to pumps and impellers, and in some cases, complete inability to access the Sacramento River water.

Evaluation Criteria:
Reclamation may quantify the volume of water rescheduled to evaluate potential for benefits to fishery and other project purposes.

Other Considerations:
Lower river flows potentially reduce the transport time of emigrating juvenile salmon from upstream areas to downstream areas. See NCWA report titled "Why Spring Diversions on the Sacramento River are Important to Serve Multiple Benefits".

_ Flow – Amount of Water Needed
_ Non – Flow

Action 6: Release Water through River Outlets

Point of Contact: Lee Bergfeld (MBK Engineers) and Mike Deas (Watercourse Engineering)

Impact:
_X_ Avoid **__ Mitigate**

Category: (check all that apply)
___ Fish **_X_ Water** **___ System**

Description of Action:
Use of river outlets at various times for the release of water from Shasta Lake to provide flexibility in meeting temperature targets and preserve cold-water pool. The river outlets were used in April and May of 2015 to release water from the upper elevations of the water column when water surface elevations were below the upper gates of the TCD.

Intended Effect:
Provide added flexibility in meeting tail bay temperature targets and preserve cold-water pool.

Process for Implementing:
Coordination between Reclamation and Western Area Power Administration (WAPA)

Agency Participation: Reclamation, WAPA

Communication Plan:

Timeframe for Initiation:
Investigation of the potential for power bypass to improve temperature management should begin in early March when current storage and hydrologic conditions indicate water levels in Shasta Lake will not allow for access to the upper gates of the temperature control device (TCD). Early implementation of power bypass will increase the benefits to temperature management. (Describe the timing for the action)

Advanced Timing Requirements or options for expediting timing:

Pros/Cons:

Pro:
- Provides flexibility in temperature management and preserves cold-water pool

Con:
- Bypasses hydropower

Evaluation Criteria:
Temperature modeling analysis can be performed prior to initiating power bypass to estimate the potential benefits to temperature management. A similar post-bypass analysis can also be

performed to assess the actual bypass operations. (Criteria used to measure success of the action to be used in further refinement)

Other Considerations:

_ Flow – Amount of Water Needed
_ Non – Flow

Action 7: Salmon eDNA Early Warning

Point of Contact: Brett Harvey

Impact:
_X_ Avoid **__ Mitigate**

Category: (check all that apply)
X Fish **X Water** **___ System**

Description of Action:
Long-term monitoring of Chinook Salmon that relies on physical capture and enumeration to determine spatial distribution has proven particularly unreliable during drought conditions due to low capture efficiency. This has forced management of water operations to minimize impact on salmon populations to rely on historical patterns of salmon migration to infer population distributions and risk. This proposed management action for the Drought Toolkit is to monitor salmon environmental DNA (eDNA) found in water samples, and to use this as an indicator of the arrival and duration of presence of migrating juvenile salmon at critical monitoring locations including the point of Delta Entry on the Sacramento River, and distributary routes to the south Delta along the Delta Cross Channel, and Georgiana Slough.

Intended Effect:
Improve information used by Salmon Management Team and Water Operations Management Team for developing salmon risk assessments and water operations recommendations. In particular, improve ability of these teams to track presence of migrating juvenile salmon at the point of Delta Entry, and along distributary junction leading to south Delta, especially the initial arrival of salmon which triggers Delta Cross Channel Gate closures, and the end of salmon presence signaling the end of the migration season.

Process for implementing:
During early summer of 2021, eDNA monitoring was conducted to calibrate the approach for three locations expected to be useful for management: Knights Landing and Kiesel on the Sacramento River, and the Delta Cross Channel. A report on the calibration study, and draft implementation plan for Salmon eDNA Monitoring were completed in the Fall of 2021, but monitoring was not implemented during the WY 2022 migration season because large numbers of winter-run entered the Delta in the early fall, eliminating the need for an early warning approach.

Agency Participation:
Calibration study was funded by DWR. Other agency participation in implementation during a subsequent drought year has not been discussed.

Communication Plan:
The study report and eDNA Early-Warning Monitoring Plan will be shared with SaMT and lead permitted and permitting agencies for comments and further discussion regarding whether, who, and how the Plan should be implemented in a subsequent drought year.

Timeframe for Initiation:
Implementation would occur prior to late December and if monitoring were continued through June, comparison of traditional monitoring and eDNA detections would improve interpretability of eDNA detections in future years monitoring.

Advanced Timing Requirements or options for expediting timing:
Shared funding of implementation of the expected Salmon eDNA Early Warning Monitoring should be discussed among permitted agencies (Reclamation and DWR).

Pros/Cons:
This action does not require any permits and sampling protocol can be easily adjusted throughout the monitoring period to respond to conditions. Currently, only species-specific eDNA assays are available, not run-specific assays. If only winter-run juveniles were expected for a given location and time of year, this assay would work. However, if mixed juvenile stock or adults were expected in the vicinity, an eDNA detection would not distinguish among these possibilities. It would be possible in fairly short order to develop an eDNA assay specific to the early migration genotypes (winter-run and spring-run). Detection of an early migration genotype would not be able to distinguish between early migration types, or juveniles that are hybrid early/late migration types.

Evaluation Criteria:
Monitoring information proves useful for SaMT and WOMT management recommendations and decisions.

Other Considerations:
If successful, Salmon eDNA Early Warning Monitoring may be extended to non-drought years, and possibly expanded to other locations for tracking juvenile salmon spatio-temporal distributions in areas where traditional monitoring is not very effective, such as along the Old and Middle River corridors. UCSC/NOAA submitted a Prop 1 funding proposal (not rewarded) to develop a reactive transport model to map eDNA detections into probabilistic salmon distributions; this proposal could be funded to enhance the use of eDNA survey data for real-time management decisions.

_ Flow – Amount of Water Needed
_ Non – Flow

Action 8: Nimbus Hatchery Drought Preparations

Point of Contact: Erica Meyers, CDFW and Crystal Rigby, CDFW

Impact:
_X__ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish _X__ Water ___ System

Description of Action:
CDFW will assess potential alternatives to help reduce steelhead mortality through the summer when temperature modeling results indicate that elevated temperatures will occur at the Nimbus Fish Hatchery. Drought conditions leading to increased water temperatures on the Lower American River can create concerns within hatchery management over the survival of steelhead juveniles that are held over summer at the Nimbus Fish Hatchery. Steelhead mortality at the Nimbus Fish Hatchery can increase in the summer months during drought years when the cold-water pool volume is low. Higher than optimal water temperatures increase disease risk and the amount of medicated feed that is necessary to treat steelhead. Ensuring that temperatures stay at or below 68° F throughout the summer reduces the likelihood of disease outbreaks and mortality of steelhead. If temperatures increase above 70° F, ensuring the survival of the cohort may include decreasing in-river temperatures or relocating steelhead. In emergency situations and when all other resources have been exhausted, a decision may be made to temporarily relocate Nimbus Fish Hatchery steelhead to another hatchery where water temperatures are expected to remain within the acceptable temperature range for rearing.

Intended Effect:
The intended effect of this action is to minimize mortality, decrease the impact of diseases, and meet mitigation goals for production at Nimbus Fish Hatchery during periods of elevated water temperatures. If water reaches lethal temperatures at Nimbus Fish Hatchery, relocating steelhead would avoid complete loss to the cohort. Since an adequate amount of time is needed to prepare for drought preparations and relocation of steelhead, coordinating early in the season would allow the process to operate more smoothly.

Process for Implementing:
Reclamation and CDFW will coordinate on these efforts throughout the water year to determine if water temperatures will be elevated and if additional actions need to be done to prepare for elevated temperatures at the Nimbus Fish Hatchery. If necessary, USFWS, EBMUD and NMFS staff will be involved for coordination and consultation of transporting steelhead out of the Nimbus Fish Hatchery and into a more suitable hatchery.

Agency Participation: CDFW, USFWS, EBMUD, USBR

Communication Plan:

Reclamation will communicate to CDFW, NMFS, USFWS, and EBMUD in April and May to determine a Temperature Management Plan for the Lower American River. If the temperatures on the Lower American River are projected to exceed 68° F, discussions will occur amongst agencies to ensure adequate survival of steelhead at Nimbus Fish Hatchery. If temperatures exceed 70° F, USBR, EBMUD, CDFW and NMFS will coordinate the next steps to temporarily relocate the steelhead to another hatchery over summer. A translocation evaluation document will be prepared and signed by the agencies involved before the action is approved. Coordination will be ongoing throughout the summer to determine when conditions are appropriate to transfer fish back to Nimbus Fish Hatchery where they will be held until release in the winter.

Timeframe and Milestones:
Drought preparations will occur in the late spring and early summer months and is dependent on the Lower American River Temperature Management Plan. If temperature modeling results show elevated temperatures during the summer months, Nimbus Fish Hatchery staff will start preparations for elevated summer temperatures in April and May. If lethal temperatures (>70° F) occur any time during the summer, emergency evacuation of steelhead at the Nimbus Hatchery may occur which is also dependent on staff and truck availability.

Evaluation Criteria and Reporting Requirements:
Since the purpose of this action is to ensure survival of steelhead during drought periods at the Nimbus Fish Hatchery, evaluation and success of this action will be determined by in river temperatures being maintained throughout the summer and diseases being successfully treated before large mortalities occur. If large mortalities occur in the hatchery due to disease outbreaks or stress related mortality due to increased water temperatures, documentation will occur. Steelhead counts and mortalities will also be documented if fish are relocated to another hatchery.

Other Considerations:

_ Flow – Amount of Water Needed
X_ Non – Flow

Action 9: Temporary Urgency Change Petition (TUCP)

Point of Contact: Ryan Reeves, DWR

Impact:
__X_ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish __X_ Water _X__ System

Description of Action:
Reclamation and DWR could jointly submit a Temporary Urgency Change Petition to request the SWRCB consider modifying requirements of Reclamation's and DWR' s water right permits to enable changes in operations of the CVP and SWP (collectively Projects) that will allow for delivery of water with conservation for later instream uses and water quality requirements. The Water Board would issue an order conditionally approving a petition for temporary urgency changes to license and permit terms of the central valley project (CVP) and state water project (SWP) and conditions requiring compliance with Delta water quality objectives in response to drought conditions.

Intended Effect:
The combination of factors, including the inflow forecast deficit being far less than predictable with available forecasting methods, parched watershed soils and extremely low rainfall, continued dry and warm conditions, and limited available water supplies in the Sacramento – San Joaquin Bay-Delta (Delta) create an urgent need to act. The TUCP modification to some D-1641 requirements y will be preserve Delta water quality while preserving some carryover storage in upstream reservoirs including Shasta and Oroville.

Process for Implementing:
DWR and Reclamation would coordinate with USFWS, NMFS, SWRCB, and CDFW staff to develop the supporting petition materials and analysis.

Agency Participation: DWR, CDFW, SWRCB, NMFS, USFWS

Communication Plan: None

Timeframe and Milestones:

Pros/Cons

Pros:
- Reduce impact on the SWP and CVP operations.
- Conserve cold-water pools in upstream reservoirs.
- Protect future cold-water needs for natural resources.

Con:

- Many entities are not in favor of the TUCP and have submitted protests.

Evaluation Criteria and Reporting Requirements:
A monitoring and reporting plan is identified in the Order.

Other Considerations:

- Relocation of the D-1641 compliance point from Threemile Slough to Emmaton allows SWP and CVP operators some flexibility in operations while minimally affecting other beneficial uses in the interior Delta.
- Coincident installation of the West False River Drought Barrier further enhances protection of interior Delta beneficial uses during drought conditions.
- DWR and Reclamation are evaluating the need for future D-1641 TUCP's

_ Flow – Amount of Water Needed
_ Non – Flow

Action 10: Emergency Drought Salinity Barrier

Point of Contact: Robert Trang, DWR

Impact:
__X_ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish __X_ Water _X__ System

Description of Action:
To install the Emergency Drought Salinity Barrier (EDSB) made of embankment rock across West False River from Jersey to Bradford Island in Contra Costa County. The project is intended to protect the beneficial uses of water in the central and south Delta during drought periods by reducing the intrusion of saltwater from the Bay which is consistent with the state's long-term strategic plan for managing water resources throughout the state. With the Temporary Urgency Change Order (TUCP) relaxing some D-1641 requirements and the EDSB in place, interior Delta salinity will be preserved with the release of less fresh water from upstream reservoirs including Shasta and Oroville.

Intended Effect:
DWR has evaluated several locations for a proposed drought salinity barrier and the effectiveness of repelling and minimizing saltwater intrusion into the Delta. The results of that analysis indicated that one barrier, particularly along West False River, would most effectively reduce the unacceptably high risk of saltwater intrusion into the Delta. Based on modeling results, in 2015 DWR constructed a drought salinity barrier at West False River. Subsequently DWR evaluated the efficacy of the barrier and concluded the barrier performed as predicted by the hydrodynamic modeling. A summary of the range of estimates for water cost savings associated with having the TUCP and the barrier in place was also analyzed. Thus, as in 2015, DWR is proposing to construct the EDSB in the same location and alignment.

Process for Implementing:
It may be necessary for an emergency drought proclamation from the Governor of California to be issued prior to implementation.

Agency Participation:
DWR, CDFW, SWRCB, U.S. Army Corps of Engineers, NMFS, USFWS

Communication Plan:
A communications plan for the EDSB has been developed by DWR's Public Affairs Office and the Division of Operations and Maintenance staff. The purpose of the plan is to provide DWR personnel with consistent messaging and answers to anticipated questions from stakeholders and the media inquiring about the project.

Timeframe and Milestones:
TBD

Pros/Cons

Pros:

- Help repel higher salinity waters from the Bay thus maintaining water quality objectives.
- Maintaining salinity objectives in the Delta reduces demand for water in upstream reservoirs.
- Reduce impact on the SWP and CVP operations.
- Conserve cold-water pools in upstream reservoirs.
- Protect future cold-water needs for natural resources.

Cons:

- Some degradation of water quality in areas of the western Delta.

Evaluation Criteria and Reporting Requirements:
An EDSB monitoring plan has been developed and provided to the permitting agencies for their review prior to the environmental permit issuance. The plan provides a detailed description of monitoring activities that will be conducted to evaluate the ecological responses (i.e. physical, chemical, and biological) to the EDSB. Preliminary draft results of the EDSB monitoring and analysis will be included in the report associated the Drought Contingency Plan. A final report on the efficacy of the EDSB and environmental effects will be completed approximately one year after removal of the barrier.

All periodic reporting requirements specified in the environmental permits for the EDSB installation are currently being addressed. Similarly reporting requirements during the EDSB removal phase will also be adhered to.

Other Considerations:
DWR is considering the idea of only partially removing the Emergency Drought Salinity Barrier (EDSB) in November this year if dry conditions continue. This will require authorization from the regulatory agencies. DWR is also currently working on the long-term planning to secure 10-year authorizations (2022-2031) for future installations of the EDSB on West False River if needed.

_ Flow – Amount of Water Needed
_ Non – Flow

Action 11: Curtailments

Point of Contact: Erin Foresman, SWRCB

Impact:
__X_ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish _X__ Water ___ System

Description of Action:

The State Water Board may adopt emergency curtailment regulations pursuant to the directives in the Governor's emergency drought proclamation. Emergency regulations may allow for curtailment orders that direct water right holders to stop diverting, including under pre-1914 appropriative or riparian claims.

Intended Effect:
Protecting lawful diversions of water, including protecting previously stored water not available for diversion, and the Delta ecosystem by prohibiting water diversions when water is not available at water right holders' or claimants' priority of right. This action is intended to reduce river flow depletions downstream of reservoirs which will leave water in river channels to support ecosystem functions and to serve downstream lawful diversions of water and avoid depleting reservoirs.

Process for Implementing:
A Governor's Proclamation of a State of Emergency could direct the State Water Board to "consider emergency regulations to curtail water diversions when water is not available at water right holders' priority of right or to protect releases of stored water." The Board is further directed to "consider emergency regulations to establish minimum drought instream flows." Emergency regulations may curtail specified priorities and classes of water rights, potentially including pre-1914 appropriative and/or riparian rights. An emergency curtailment regulation may provide exemptions for critical municipal and domestic health and safety needs.

The State Water Board would issue notices of water unavailability and notify the water right holders for approximately 9,150 post-1914 appropriative rights (some water users hold or claim more than one right).

The Board would initiate an emergency rulemaking process. If the process is initiated, the State Water Board would provide notice through the Board's email subscription lists. Any notice of the emergency rulemaking would include information about how the public can participate in the Board's review, consideration, and adoption process.

Agency Participation:

Emergency regulations are completed using the State Water Board's public process which is open to agencies and members of the public. Additional technical coordination has and will also continue with agencies and members of the public.

Communication Plan:
The drought proclamation directs DWR to provide technical assistance to the State Water Board which has been occurring through specific meetings. Reclamation has also provided similar technical assistance. It is anticipated that technical assistance would continue to be provided as needed.

Timeframe and Milestones:

Evaluation Criteria and Reporting Requirements:
Reduction in illegal diversions of water.

Other Considerations:

_Flow – Amount of Water Needed
_ Non – Flow

Action 12: Emergency Clear Creek Pulse Flow

Point of Contact: Derek Rupert, DRupert@usbr.gov

Impact:
_X_ Avoid **__ Mitigate**

Category: (check all that apply)
_X_ Fish **_X_ Water** **___ System**

Description of Action:
This action would allow Reclamation to release an emergency pulse flow with the hopes of triggering the upstream movement of spring-run Chinook Salmon (using flow and temperature as a migration cues/triggers). As there are no water allocations available for an emergency pulse during drought conditions, base flows would be reduced commensurate with the pulse volume, so that no additional water is needed beyond normal operations [i.e. Proposed Action and Biologic Opinion (BiOp) minimum flows].

Intended Effect:
The emergency pulse would encourage spring-run Chinook Salmon to migrate upstream of the Gorge Cascade (via water temperature and flow related migration cues/triggers). Preferably, these fish would make their way into the upper-most 10 miles of Clear Creek, where they could hold in the deep pools and cool water of the canyon, and also be protected from poaching and fall-run interaction impacts.

Process for implementing:
As needed, the Clear Creek Technical Team (CCTT) will meet and discuss the current conditions, distribution of fish, weather conditions, etc. The CCTT will provide a draft proposal to Reclamation's CVO. Following CVO approval, the flow changes will be implemented.

Agency Participation:
The CCTT includes representative from Reclamation, USFWS, CDFW, DWR, BLM, tribal partners, and local stakeholders, all of whom are welcome to participate in emergency pulse flow discussions and proposal creation.

Communication Plan:
Meetings and document creation will be completed within the CCTT communication process. CCTT members will be alerted of upcoming meetings and action proposals through the CCTT email list. CVO has members on the CCTT, and they will be kept apprised of Clear Creek conditions, fish migration information, and any CCTT-proposed actions.

Timeframe for Initiation:
Emergency pulse flow could occur at any point when spring-run Chinook Salmon are present in Clear Creek (i.e. March – September) and downstream of the Gorge Cascade.

Advanced Timing Requirements or options for expediting timing:

Many aspects of this action are dictated by fish data (e.g. snorkel survey results)

Pros:

- Improves conditions for migrating spring-run Chinook Salmon.
- Encourages spring-run Chinook Salmon to move to safer upstream habitats.
- Uses no additional water volume above normal base flow requirements.

Cons:

- The base flows release would be reduced, but remain within the operational contingencies of the proposed action for Critically Dry water years).
- The reduced base flows could lead to increased water temperatures in Clear Creek (although operational contingencies exist within the proposed action for Critically Dry water years).

Evaluation Criteria:
The success of this action will be determined by amount of spring-run Chinook Salmon that successfully migrate upstream of the Clear Creek Gorge versus downstream. The ultimate preference is to have 100% of Clear Creek's spring-run Chinook to pass the Gorge.

Other Considerations:
Clear Creek is continuing to grow in popularity with various user groups (e.g. swimmers, kayakers, fishermen, etc.). Providing adequate signage at popular access points will be required to inform them of the rapid increases in flow associated with the emergency pulse.

_ Flow – Amount of Water Needed
_ Non – Flow

Action 13: Infrastructure Improvements at Livingston Stone National Fish Hatchery

Point of Contact: Derek Rupert (DRupert@usbr.gov)

Impact:
___ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish ___ Water _X_ System

Description of Action:
Increase the winter-run Chinook Salmon production potential through the improvements and additions of infrastructure to Livingston Stone National Fish Hatchery (LSNFH).

Intended Effect:
Increase production potential (e.g., increase current carrying capacity) and drought resilience (e.g., utilize chillers) of LSNFH.

Process for Implementing:
1) Develop technical team (completed),
2) Evaluate and define hatchery production goal in drought years (in progress)
3) Review LSNFH infrastructure and analyze hatchery needs (in progress),
3) Prioritize infrastructure needs,
5) Work with Reclamation to implement needed improvements.

Agency Participation:
Tech Team agencies include Reclamation, USFWS, NMFS, DWR, and CDFW.

Communication Plan:
The Tech team will communicate as needed to review and evaluate the current infrastructure and requirements for increased production.

Timeframe for Initiation: Currently in progress.

Advanced Timing Requirements or options for expediting timing:
Infrastructure will need to be in place and operational prior to droughts to increase winter-run Chinook Salmon production. Once infrastructure requirements are required and funding is secured, it will likely take at least two years to have major infrastructure installed and operational.

Pros/Cons:

Pros:

- Protection of the winter-run Chinook Salmon population when river conditions are poor. Infrastructure could potentially be used for other purposes when not a drought year (e.g. Battle Creek introduction efforts).

Con:

- Infrastructure is expensive to purchase, install, and maintain.

Evaluation Criteria: Ability of hatchery to meet production goals.

Other Considerations: Below are approximate needs for LSNFH-

- 12 cfs of water (currently 6)
- Chillers to keep water cold (current water becomes too warm during drought conditions)
- 480 incubator trays (currently 240)
- 60 deep troughs (currently 30)
- 26 circular tanks (currently 26)
- General improvements to piping and water conveyance infrastructure.
- Overhead cover (i.e. barn to cover infrastructure)
- Additional hatchery gates (protection from people and bears)
- Additional feed storage
- Additional Staffing

_ Flow – Amount of Water Needed
X_ Non – Flow

Action 14: Lower Pump Intakes Near Wilkins Slough

Point of Contact: Rod Wittler

Impact:
___ Avoid _X__ Mitigate

Category: (check all that apply)
___ Fish ___ Water _X__ System

Description of Action:

Intended Effect:
Lowering irrigation pump intakes will increase operational flexibility for Reclamation to operate Shasta in a manner that meets other requirements of the BiOps, namely cold-water pool management. The Meridian Farms irrigation pump intakes will be lowered to ensure they remain screened and operational at Sacramento River flows below 5,000 cfs. This change will increase flexibility in the operation of Shasta at flows below 5,000 cfs at Wilkins Slough.

The installation of lower irrigation pump intakes at the Meridian Farms pumps will include fish screens that meet California and NMFS requirements, structural improvements, and landside improvements. It will also specifically include including relocating and merging the Drexler pump facility. Furthermore, additional facilities in the vicinity will be considered by the Small Pump Screening Program.

Process for Implementing:
A Technical Team will be formed to develop an improvement plan that identifies alternatives for lowering the pumps. Then the team will oversee and complete the design and permitting processes. This effort will identify all necessary Federal and state environmental requirements (e.g., National Environmental Policy Act, ESA, California ESA), and other applicable laws.

Agency Participation: Reclamation, DWR, NMFS, USFWS, CDFW

Communication Plan:
Reclamation, through the Project Manager, will be responsible for keeping records of the Project, including the technical team activities.

Timeframe for Initiation:
2021 Project Technical Team Formation
2022 Improvement Plan Development
2023 Design
2024 Permitting/Environmental Review
TBD Submit contracting materials for actions (if needed)
TBD Complete Plan
TBD Priority actions funded and implementation begins
TBD Annual report on effectiveness of actions implemented and recommendations for future

Advanced Timing Requirements or options for expediting timing:
No advance timing requirements exist at this time for lowering the irrigations pump intakes, but any delays in the development and implementation will delay the ability of Reclamation to gain operational flexibility.

Pros/Cons:

Pro:

- Reclamation will gain operational flexibility in managing the Sacramento River and Shasta Cold Water Pool

Evaluation Criteria:
An annual report on effectiveness of actions implemented will written include and recommendations for future improvements.

Other Considerations:
_ Flow – Amount of Water Needed
_ Non – Flow

Action 15: Installation of the Shasta TCD Middle Gate Curtain

Point of Contact: Randi Field/ Lee Bergfeld

Impact:
___ Avoid __X_ Mitigate

Category: (check all that apply)
____ Fish _X__ Water ___ System

Description of Action:
Deploy the Shasta TCD middle gate curtain. This requires divers to release a rolled up impermeable curtain over the Middle TCD gates.

Intended Effect:
This action blocks water from entering the TCD at the middle gate elevation and prevents warm water leakage. The intent is to improve seasonal temperatures downstream of Keswick Dam and reduce late season temperature dependent mortality risk.

Process for Implementing: Reclamation contracting

Agency Participation: Reclamation

Communication Plan: None known

Timeframe for Initiation:
Curtain deployment depends on the dynamics of the particular year. Seasonal temperature modeling will inform the period when the middle gates are no longer needed (most likely June through July).

Advanced Timing Requirements or options for expediting timing:
Ideally, contracting should be notified in the February time frame.

Pros/Cons:

Pro:

- Benefits to cold water pool management can be estimated. This action could be useful to incrementally improve downstream temperatures in poor hydrologic conditions when winter/spring storage and cold-water pool recovery are poor. No known cons.

Evaluation Criteria:
Effectiveness can be estimated by comparing seasonal modeling results with and without the action.

Other Considerations:
This action was considered but not implemented due to safety concerns

_ Flow – Amount of Water Needed
_ Non – Flow

Action 16: Aquatic Vegetation Monitoring

Point of Contact: Rosemary Hartman – Rosemary.Hartman@water.ca.gov

Impact:
___ Avoid X_ Mitigate

Category: (check all that apply)
_X_ Fish ___ Water ___ System

Description of Action:
This action includes monitoring of the response of invasive aquatic vegetation in the Delta and Suisun Marsh to the decreased outflow and increased temperatures that occur during droughts. The action will help to assess the impact of other Drought Toolkit Actions, including changes to Delta outflow and temporary barriers, as well as helping to plan control strategies if the drought continues. Invasive floating aquatic vegetation (FAV) and submerged aquatic vegetation (SAV) cause navigation hazards in the Delta and decrease habitat for listed fish species. FAV and SAV have increased in coverage over the past 20 years, with particular increases seen in the last drought. Both types of vegetation establish more readily in slower-moving water, so low flow conditions that occur during droughts have been linked to increases in coverage of invasive vegetation. To track the impact of drought on invasive vegetation, Hyperspectral imagery was collected via aircraft in late July. Imagery will be trained and validated by conducting field surveys of vegetation species composition throughout the area. Vegetation across the Delta will be classified using machine learning techniques and accuracy will be assessed by comparing classifications to field-collected data. Final maps will be produced to visualize the cover of submerged and floating vegetation throughout the region.

Intended Effect:
Track any expansion of weeds due to decreased flow, prioritize areas for weed treatment/control, assess impacts of other drought response actions, and evaluate effectiveness of restoration sites.

Process for Implementing:
The Center for Spatial Technology and Remote Sensing (C-STARS) at the University of California, Davis (or other qualified contractor) will be contracted to collect imagery during the summer of drought years. Submerged and floating vegetation distribution and abundance will be mapped and disseminated six to nine months after collection.

Agency Participation:
Field work**,** Analysis, and data processing will be conducted by UC Davis and CDFW, with assistance from DWR. Data will also be shared with State Parks Division of Boating and Waterways (DBW). Information on the action will be shared with the larger scientific community through the Interagency Ecological Program Aquatic Vegetation Project Work Team.

Communication Plan:

DWR will contact C-STARS in February of drought years to assess feasibility of collecting imagery the following summer and begin the contracting process. DWR will also reach out to the DBW, Reclamation, and the Delta Science Program to discuss whether a cost share is feasible. Plans for the data collection will be shared with the IEP Vegetation Project Work Team during the spring to receive feedback on the monitoring plan. Once data have been collected and processed, a final report will be disseminated to all interested parties. This data will also be used in a synthesis of drought impacts.

Timeframe for Initiation:
Imagery collection occurred in late July and ground surveys were conducted during July and August.

Advanced Timing Requirements or options for expediting timing:
Contracting should begin 6 months before imagery collection, though can be expedited to 2-3 months.

Pros/Cons:

Pros:

- Does not require permitting or changes to any water operations. Collects important data on environmental impacts of drought that are useful to multiple agencies (CDFW, DWR, DBW). These data can also be used to evaluate the impacts of fall flow actions on weeds and can be used to inform Delta Plan performance measures, specifically Outcome Performance Measure 4.10, Terrestrial and Aquatic Invasive Species.

Cons**:**

- We do not have good control methods for submerged aquatic vegetation, so it will be difficult to take action if we detect a change in coverage.

Evaluation Criteria:

- Time from data collection to final report.
- Hyperspectral imagery will be ground-truthed with field surveys. Accuracy of final maps and data can also be verified with DBW's aquatic weed control program surveys.

Other Considerations:
Collection of imagery costs approximately $120K per year. Field data collection and image processing costs an additional $150K per year.

_ Flow – Amount of Water Needed
_ Non – Flow

Action 17: Delta Ecosystem Monitoring and Synthesis

Point of Contact: Rosemary Hartman – Rosemary.Hartman@water.ca.gov

Impact:
___ Avoid X_ Mitigate

Category: (check all that apply)
_X_ Fish __x_ Water ___ System

Description of Action:
DWR is leading a team of Interagency Ecological Program (IEP) scientists to develop a monitoring and synthesis plan for the environmental impacts of the drought and drought actions in the Sacramento San-Joaquin Delta and Suisun Marsh. Data collection will rely primarily on existing monitoring, with the addition of a few special studies, such as aquatic vegetation monitoring. Data will be integrated and compared to previous droughts and previous wet periods to detect ecosystem changes. These changes will be compared to actions in the Drought Toolkit to inform future dry year actions.

Intended Effect:
Improve our understanding of the environmental impacts of drought. Assess the environmental effects of actions included in the Drought Toolkit in the Delta and develop recommendations for future drought actions.

Process for implementing:
A team of IEP scientists was formed in spring of 2021 and developed a workplan for evaluating the 2020-2021 drought, assessing impacts of previous droughts, and assessing management actions. They will assemble a data set of relevant water quality, phytoplankton, zooplankton, vegetation, and fish data to identify large-scale ecosystem responses to drought. This team can be reformed during future droughts to update the synthesis with new data, as it becomes available. A preliminary study plan was included with the February Drought Contingency Plan and refined with updates to the Plan. The monitoring and synthesis work can also be used in the monitoring plan for various other Toolkit actions, including the Emergency Drought Barrier and TUCP. A synthesis team for 2021 has already been assembled, and, as of July, has begun to organize data and reporting options.

Agency Participation:
Members of the Drought Synthesis team include participants from DWR, Reclamation, CDFW, USFWS, USGS, and the Delta Science Program. This may be expanded to include other IEP member agencies, stakeholders, and universities, as needed.

Communication Plan:
The workplan for the Drought Synthesis will be presented to the DRY team, IEP Science Management Team, Flow Alteration Project Work Team, the State Water Contractors, and the Collaborative Adaptive Management Team for feedback. The final study plan will be included in the IEP workplan. Results of the synthesis will be disseminated in a final report, fact sheets, and

peer-reviewed journal articles. Presentations on the contents of the report will be given to all the collaborative groups listed above and the team developing the annual Drought Contingency Plan.

Timeframe for Initiation:
Data collection and processing will occur May-December of drought years. Preliminary findings will be presented in February of the following year, to inform the following year's Drought Contingency Plan.

Advanced Timing Requirements or options for expediting timing:
Providing additional staff time will allow the data analysis to go faster.

Pros/Cons:

Pro:

- Identifies ecosystem responses to drought.

Con:

- Not all drought impacts identified will have actionable solutions associated with them.

Evaluation Criteria:

- Identifies environmental variables that increase or decrease during drought
- Provides useful input into next year's drought contingency plan

Other Considerations:

_ Flow – Amount of Water Needed
_ Non – Flow

Action 18: Increased Production at Livingston Stone National Fish Hatchery

Point of Contact: Amanda Cranford (NMFS), Derek Rupert, Bob Clarke

Impact:
___ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish ___ Water ___ System

Description of Action:
Increase the adult collections and the juvenile production of winter-run Chinook Salmon (winter run) at LSNFH, beyond the typical goals.

Intended Effect:
Increase juvenile winter run production at LSNFH to offset poor in-river survival.

Process for implementing:
The current LSNFH Hatchery Genetic Management Plan (HGMP) can accommodate increased production such that a maximum number of adults to be collected for broodstock under expanded production is 400 (normal broodstock collection levels are 60 females and 120 males).

- This take must be shared with the Battle Creek Jumpstart Project, which is expected to collect up to 100 adults for broodstock annually, thus reducing the take available for expanded production years down to 300.
- The ESA Section 10(a)(1)(A) Permit can be modified to increase these levels if it is determined to be necessary but may take up to 6 months to process.

Critical milestones/deadlines:

- Date trapping at the Keswick Dam Fish Trap begins (mid-February)
- Date broodstock collections are typically completed (June 1)
- Date spawning begins (May 1 - 15, depending on conditions)

Agency Participation:

- USFWS: manage LSNFH operations, coordinate necessary permit amendments, coordinate juvenile release.
- CDFW: coordinate in-river monitoring, evaluate and permit any necessary changes to the HGMP.
- Reclamation: coordinate hatchery management with water operations, and assist with temporary (or long-term) LSNFH improvements
- NMFS: assists with coordination, modeling to evaluate and permit any necessary changes to the HGMP or the Section 10(a)(1)(A) Permit.

Communication Plan:

USFWS would evaluate conditions to determine whether increased collection already permitted by the HGMP is warranted (triggers met).
Expanding production beyond what is permitted in the LSNFH HGMP would be considered at the SRTTG where the potential negative impacts of expanded production would be weighed against forecasted in-river conditions.

Timeframe for Initiation:

- Keswick Dam Fish Trap begins operation mid-February,
- Spawning begins May 1 - 15, and depending on conditions,
- Broodstock collection completed by June.

Advanced Timing Requirements or options for expediting timing:
If collection of adult winter-run Chinook Salmon is needed, in excess of the already expended target of 400 adults, is needed the Section 10(a)(1)(A) Permit can be modified to increase these levels if it is determined to be necessary but may take up to 6 months to process.

Pros/Cons:

Pro:

- Avoid catastrophic population decline

Con:

- Increased hatchery influence on wild population (decreased PNI)

Evaluation Criteria:
Positive: Consider terms of "success" criteria based on a WR juvenile production estimate threshold.

Negative: Consider terms of a "negative" impact criteria on the wild population by:

- Some hatchery % of the JPE,
- Some hatchery % of escapement/adult returns.

Other Considerations:

- Trapping at Keswick commences in early-January (mostly late-fall Chinook Salmon trapped in Jan). During 2020, winter-run Chinook Salmon were trapped and retained as early as mid-February. Therefore, the earlier a decision can be made the better, but it is understood that the Forecasts are not complete (or very accurate), by then. This helps with planning for monthly broodstock collection targets, etc.
- Infrastructure improvements (hatchery capacity? chillers needed?);
- Alternative rearing locations?

_ Flow – Amount of Water Needed
_ Non – Flow

Action 19: Drought Feather River Spring Flow Redistribution

Point of Contact: Erica Meyer, CDFW and Crystal Rigby, CDFW

Impact:
__X_ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish ___ Water ___ System

Action 19: Drought Feather River Spring Flow Redistribution is separate from the actions covered by the long-term Project operations section 7 Endangered Species Act consultations and California Endangered Species Act incidental take permit (the 2019 USFWS and NMFS Biological Opinions and the 2020 Incidental Take Permit, or incidental take authorizations that may update or replace the existing authorizations). Action 19 is included in this Drought Toolkit for informational purposes.

Description of Action:
Re-allocate flow distribution from the Feather River High Flow Channel to the Feather River Low Flow Channel to attract listed spring-run Chinook salmon into the Feather River Hatchery (FRH) to facilitate marking broodstock for fall spawning. Additional benefits include increased spring-run Chinook Salmon over-summering in the Low Flow Channel which offers better over-summer holding temperatures and refuge from recreational angler harvest.

Intended Effect:
DWR has a mitigation target of two million spring-run Chinook Salmon smolts to be produced annually at the Feather River Fish Hatchery which is operated by the CDFW. This production goal has not been met in recent years. Annually, CDFW tags spring-run Chinook Salmon broodstock as they enter FRH in the spring and early summer, then releases these tagged fish to over-summer in the Feather River. This is done to ensure that during the fall spawn pairings at FRH occur between spring-run Chinook Salmon and do not include in later arriving fall-run Chinook Salmon. The annual adult tagging goal is a minimum of 3,500 adults; however, tagging as many spring-run Chinook Salmon as possible increased the likelihood that the annual smolt production goal of two million is met. This is particularly important in drought years where overall natural origin brood year production of spring-run Chinook Salmon in the Feather and Sacramento Rivers and tributaries may decline as a result of poor environmental conditions.

Under current water operations the volume of flow entering the Feather River from the Thermalito Afterbay Outlet is significantly greater than the flow entering this junction from the upstream low flow channel. This induces spring-run Chinook Salmon to hold in the Thermalito Afterbay Outlet rather than move upstream through the low flow channel into the FRH where they can be tagged and subsequently utilized as spawning broodstock. Increasing the flow distribution through the low flow channel has proven to be effective in attracting spring-run Chinook Salmon upstream into the low flow channel and, subsequently, the FRH.

It is equally important to provide thiamine HCl injections to as many adult spring-run Chinook Salmon as possible to overcome thiamine deficiency issues which lead to poor survival of natural

origin and hatchery juvenile spring-run Chinook salmon in 2019 and natural origin juvenile spring-run Chinook Salmon in 2020. Thiamine deficiency issues may become an increasingly common occurrence due to changes in a salmon's ocean diet prey source. Attraction of spring-run adults to the low flow channel also increases the likelihood that spring-run Chinook Salmon will over-summer in the cooler temperatures of the low flow channel due to its proximity to the discharges from Lake Oroville. Recreational angling is also prohibited in the low flow channel and this action would decrease the likelihood that spring-run Chinook Salmon would be subjected to recreational angling harvest in the waters below the Thermalito Afterbay Outlet

Process for Implementing:
Action 19: Drought Feather River Spring Flow Redistribution is separate from the actions covered by the long-term Project operations section 7 Endangered Species Act consultations and California Endangered Species Act incidental take permit (the 2019 USFWS and NMFS Biological Opinions and the 2020 Incidental Take Permit, or incidental take authorizations that may update or replace the existing authorizations). Action 19 is included in this Drought Toolkit for informational purposes.

Discussion to implement the action was initiated in the Feather River Operations Group (FROG) during WY 2021 and reallocation of flow was implemented de facto due to maintenance at the Thermalito Bay Outlet which required flow to be redirected from the high flow channel to the low flow channel. Implementation in subsequent years would take place through annual discussion at bi-monthly FROG meetings.

Agency Participation: CDFW, DWR, NMFS

Communication Plan:
Technical discussion would take place in FROG meetings to plan the action in communication with the DRY Team and Water Operations Management Team. Once finalized the plan would be communicated to DWR CVO for implementation.

Timeframe and Milestones:
Planning for the action should take place prior to spring-run Chinook salmon upstream migration and would be implemented based on real time evaluation of FRH and in-river data.

Pros/Cons

Pros:
- Water cost neutral
- Increased likelihood of meeting annual spring-run Chinook salmon production goals.
- Reduction in thiamine deficiency related mortality for both in-hatchery and in-river produced juvenile spring-run Chinook salmon.
- Increased likelihood of spring-run Chinook salmon over-summering in more favorable temperature conditions.
- Reduced recreational angling harvest.

Cons:
- Reduced hydropower generation at the Thermalito Bay Outlet.

Evaluation Criteria and Reporting Requirements:
The biological response would be tracked through FRH data and reported at bi-weekly FROG meetings.

Other Considerations:
Additional communication and scheduling will be necessary to account for reduced hydropower generation.

_ Flow – Amount of Water Needed
_ Non – Flow

Action 20: Folsom Dam Power Bypass

Point of Contact: Thuy Washburn (CVO), Levi Johnson (CVO), Melissa Vignau (CCAO), Steve Melavic (CVO)

Impact:
___ Avoid _X_ Mitigate

Category: (check all that apply)
_X_ Fish ___ Water _X__ Power _X__System

Description of Action:
In drought years, Reclamation is often challenged with maintaining adequate water temperatures in the Lower American River (LAR). During these years, Reclamation often considers a power bypass at Folsom Dam in order to access Folsom Reservoir's cold water pool (CWP) that resides below the Folsom power unit intakes. The reservoir's cold water pool is a finite resource that is carefully managed across the year. A Folsom Dam power bypass reduces the amount of hydroelectric power generation because this water is not released through the powerplant. CVP power customers must then seek replacement power. This management decision is informed by modeling that helps indicate potential temperature benefits to the LAR and subsequent benefits to LAR fish species. This is weighed against Folsom Dam operational risks and economic cost of lost power generation.

Intended Effect:
Folsom power bypass is expected to improve LAR water temperatures to benefit fall run Chinook salmon (and rearing steelhead) in the October-November timeframe.

Process for Implementing:
Refer to the Framework Document – CVP Power Bypasses for Species Mitigation. Following American River Group (ARG) discussions on power bypass, which typically occur during the summer, but may begin as early as spring, the ARG submits a power bypass proposal to Reclamation's California Great-Basin Regional Director for approval. Reclamation alerts power customers of the potential bypass to provide them advance notice toward planning of replacement power and a briefing of the bypass analysis A final decision is made only after a thorough evaluation of all potential impacts that may result from implementing the power bypass proposal.

Agency Participation:
Folsom power bypass proposals typically originate within the ARG where they are collaboratively discussed amongst various governmental and non-governmental stakeholders. These proposals are then presented to CVP power customers for comment and input and then passed along to Reclamation management for a final decision.

Communication Plan:
Communication around proposal development and evaluation occurs within the existing ARG structure. Internal Reclamation communications lead to a proposal being elevated to Reclamation

management for review. As per Reclamation's CVP Power Initiative, the proposal is communicated to CVP power customers. Reclamation's is then communicated to the ARG and CVP power customers. After a power bypass is completed, Reclamation analyzes the actual impacts of the power bypass and communicates these to the ARG and CVP power customers.

Timeframe and Milestones:
For a fall Folsom power bypass, discussions typically begin late summer and the ultimate decision to perform a power bypass often does not occur until September or October when the most current temperature and forecast information becomes available. Power bypass implementation typically occurs in the October-November timeframe to coincide with the return of Chinook salmon.

Evaluation Criteria and Reporting Requirements:

- Potential impacts to fish species
- Potential impact to hydropower
- Timing of notification to hydropower for replacement power purposes.
- Consistency with the 2019 Biological Assessment and protection of species of concern in the American River
- Consistency with the 2019 NMFS BiOp on the LTO of the CVP and SWP
- Consistency with 2017 Modified FMS Exhibit C
- Consistency with Central Valley Improvement Act (CVPIA)
- Consistency with the CVP Power Initiative established by Reclamation's Commissioner in 2019 addresses powerplant bypasses for species protection under Section III Lost Production Opportunities
- Feedback and input from the ARG

Other Considerations:

_ Flow – Amount of Water Needed
_ Non – Flow
_Cold Water Pool – Amount of Cold Water Available

Action 21: Harmful Algal Bloom Monitoring

Point of Contact: Jenna Rinde – Jenna.Rinde@wildlife.ca.gov

Impact:
___ Avoid X_ **Mitigate**

Category: (check all that apply)
__ Fish **_X__ Water** **___ System**

Description of Action:
This action includes monitoring the response of harmful algal blooms (HABs) in the Delta and Suisun Bay due to decreased outflow, increased salinity, and increased water temperatures that occur in droughts. HABs are formed by photosynthetic plankton that can produce nerve, muscle, respiratory and liver toxins affecting aquatic organisms, wildlife, and humans. HABs can occur in fresh, brackish, and marine waters in an estuary. HABs have increased in the number of plankton species and types of toxins across the San Francisco Estuary for the past 20 years. Common freshwater cyanobacteria HABs in the delta are commonly dominated by *Microcystis*, *Dolichospermum* and *Aphanizomenon.* Brackish and marine dinoflagellate HABs found in the San Francisco Estuary, including Suisun Bay, include *Alexandrium, Karlodinium, Karenia, Prorocentrum, Dinophysis*, and *Akashiwo.* To track the impact of drought on HABs, existing monitoring programs will document absence or presence of HABs from a standard visual ranking colonial scale. To document spatial coverage of HABs, satellite imagery data from the Sentinel-3 mission and if possible, agency deployed drones. Imagery will be validated by fluorometric sensors, and laboratory chlorophyll *a* analyses. If additional resources are possible, then water samples may collected to determine what plankton type are present. Additionally, monitoring programs can purchase a HACH LightDeck MINI to quickly and affordably determine if certain toxins are present, like the common microcystin. Further analyses to determine photosynthetic plankton and toxins may be warranted if funding and contracts allow.

Intended Effect:
Track development and possible expansion of HABs due to decreased flow, increased water temperatures and other possible water quality changes and assess impacts of other drought actions (e.g. temporary barriers). If funds and resources allow determine what photosynthetic plankton and toxins are present. This action will help assess the impact of other Drought Toolkit Actions, including Delta outflow and temporary barriers, as well as plan mitigation strategies if the drought continues.

Process for Implementing:
Remote sensing imagery will be from the SFEI and FHAB Satellite Analysis Tool (https://fhab.sfei.org/). Field work, analysis and data processing will be completed by monitoring surveys from the Interagency Ecological Program.

Agency Participation:
Members of the Interagency Ecological Program (IEP) include participants from DWR, Reclamation, CDFW, USFWS, USGS, SWRCB, and the Delta Science Program. This may be expanded to include other IEP member agencies, stakeholders, and universities, as needed.

Communication Plan:
The workplan for HAB monitoring will be presented to the DRY team and IEP Science Management Team. Data will be made publicly available. Results will be presented in the annual Drought Contingency Plan and possibly in presentations, factsheets, technical reports, or peer reviewed journals.

Timeframe and Milestones:
HABs typically occur in summer and fall months but since drought can extend the duration of blooms, visual assessments should be made year-round. HABs typically occur in warmer months once water temperature exceeds 19 C and may last until cooler conditions when water temperatures drop below 15 C. Results and recommendations will be in the annual Drought Contingency Plan.

Other Considerations:
Sample depth and methodologies should be consistent as possible across monitoring programs based on guidance from IEP's Water Quality and Phytoplankton Project Work Team. If available, additional resources may be used for additional monitoring and laboratory analyses.

Advanced Timing Requirements or options for expediting timing:
Contracting should begin 6 months before imagery collection, though can be expedited to 2-3 months.

Pros:

- Does not require permitting or changes to any water operations. Collects important data on environmental impacts of drought that are useful to multiple agencies (CDFW, DWR, SWRCB). These data can also be used to evaluate impacts of other drought actions such as temporary barriers.
- Interagency coordination and collaboration to maximize resources

Cons:

- Additional time and effort related to planning, training, data management and analysis
- Additional funds and resources pending availability

_ Flow – Amount of Water Needed
_ Non – Flow

Action 22: Translocation of Naturally Spawning Sacramento River Chinook Salmon

Point of Contact: Mike Harris, CDFW, Dan Kratville, CDFW, and Crystal Rigby, CDFW

Impact:
_X_ Avoid **_X_ Mitigate**

Category: (check all that apply)
_X_ Fish **___ Water** **___ System**

Description of Action: This action is an emergency effort to translocate winter-run and spring-run out of the Sacramento River into cooler, suitable habitats due to elevated water temperatures. Adult winter-run and spring-run would only be translocated when hatchery capacity is maximized, lake levels are low, and drought conditions persist. Once approval of the translocation is finalized, adult winter-run and spring-run Chinook salmon would be trapped at Keswick Dam and the Coleman National Fish Hatchery (CNFH) and translocated from the upper Sacramento River into Battle Creek and Clear Creek.

Intended Effect: Translocation would be conducted only as an emergency action to provide opportunity for successful egg incubation and juvenile survival with the intended outcome to prevent near 100 percent temperature related mortality of eggs if adults spawn in the Sacramento River. Winter-run Chinook salmon have only a single population in the Sacramento River, with ongoing re-introduction into Battle Creek. This emergency action would accelerate the re-introduction of winter-run into Battle Creek while providing survival opportunity for the Sacramento River population. Only three viable and independent spring-run populations remain in the Central Valley, and those populations are under extreme threat from recent drought conditions. Translocation of Sacramento River spring-run to Clear Creek, where a small dependent population currently exists, would create opportunity for successful spawning of spring-run adults which would be a positive contribution to an ESU under increased threat due drought conditions. Habitat in Battle Creek and Clear Creek is suitable for winter-run and spring-run spawning and juvenile rearing.

Process for Implementing: Because spring-run and winter-run Chinook salmon are listed under the ESA and CESA, translocations should be discussed among CDFW, NMFS and USFWS as early as possible to coordinate efforts and determine what is necessary for approval. CDFW's Translocation Policy describes considerations and requirements for approval, and the checklist appended to the policy requests much of the information necessary for CESA and ESA approvals. Consultation with Pathology staff, the Genetics Research Lab, NMFS, and other CDFW fisheries managers is required before moving forward with implementation to determine and address any issues that may arise with the translocation process. Once the translocation process is decided, a Translocation Policy evaluation form will be written and submitted. If at any step any of this process (Need, Risk, Feasibility, Other) is considered inadequate, or the translocation presents significant risks or likelihood of failure, the translocation should be

redesigned or aborted. The goal is to design, approve, and conduct translocations with low risk and high chance of success.

Agency Participation: CDFW, NMFS, USFWS, USBR, PGE, NPS

Communication Plan: Regular and frequent communication is ongoing between CDFW, NMFS, and USFWS. CDFW will communicate and write up the translocation evaluation template describing the number of winter-run and spring-run that will be translocated, the timeframe, and other important documentation that is needed. Further actions, such as trap and hauling the Chinook salmon, will be coordinated after the process is approved.

Timeframe and Milestones: Planning for this action would take place after agency coordination and needed approvals as stated in the CDFW Translocation Policy document. This action would also need to be implemented before temperatures become lethal in the Sacramento River for holding adult spring-run and winter-run Chinook salmon.

Pros/Cons

Pros:

- Expected to provide better survival conditions for resulting juveniles than would be available if the translocated adults spawned in the Sacramento River
- There currently is no hatchery facility or existing capacity to hold and spawn Sacramento River spring-run, leaving translocation as a potential effective management action
- Translocations would potentially enhance receiving population genetics

Cons:

- Adult translocation does not produce as many juveniles as hatchery spawning of winter run
- Flows and water temperature in Battle Creek are subject to ambient weather conditions and uncontrolled outages by PG&E operations.
- Potential risks to individual fish associated with handling and transporting.

Evaluation Criteria and Reporting Requirements: Approval from CDFW, NMFS and USFWS along with a CDFW Translocation Policy evaluation template would be filled out and submitted to CDFW management for thorough review before the translocation action is implemented. Unless otherwise specified, responsible staff will submit within 30 days of the translocation action to Regional management and Fisheries Branch a post-translocation report containing procedures implemented, results of the translocation (species, number by age class, etc.) and a description of future monitoring. Success of this action will be measured in the number of adult fish transported and released alive and in good health into Battle and Clear Creeks.

Other Considerations: NA

_ Flow – Amount of Water Needed
_X_ Non – Flow

Action 23: Relocation of Spring-Run Chinook Salmon Collected Incidentally at the Keswick Trap to Clear Creek

Point of Contact: *NMFS:* Evan Sawyer

USFWS: Jim Earley

CDFW: Erica Meyers or Crystal Rigby,

Impact:

___ Avoid **_X_ Mitigate**

Category:

_X_ Fish **___ Water** **___ System**

Description of Action:

In anticipation of poor in-river conditions and the increased likelihood of egg mortality in the mainstem Sacramento River in 2022, the agencies decided to retain Central Valley spring-run Chinook adults captured at the Keswick Trap and relocate them to Clear Creek near the tailwater release of Whiskeytown Dam. Spring-run Chinook are regularly captured by USFWS at the Keswick Trap along with winter-run, and the spring-run are normally released back to the Sacramento River. Rather than release them back to the Sacramento River where summer and fall temperatures were forecast to become unfavorable due to depletion of Shasta Lake cold water pool, 373 adult spring-run were provided to DFW to translocate to the tailwater release of Whiskeytown Dam in Clear Creek where water temperatures were expected to be less detrimental than in the mainstem Sacramento River that year.

Monitoring information suggests that this action had limited success. Spring-run Chinook translocated into Clear Creek were subsequently observed through monitoring actions by the USFWS. At each stage of monitoring fewer fish were observed than would be if there was robust survival of these fish to spawning. Information about translocated fish was collected through several methods: at the Clear Creek video station, as live adults during the annual August population survey, redd number and location, and by carcass recovery. Of the 373 spring-run Chinook translocated into Clear Creek, a net of 51 translocated fish were observed leaving Clear Creek and returning to the Sacramento River. These fish were positively identified on video through marks applied in the capture/translocation effort (either a caudal punch or floy tag). These observations suggest as many as 322 translocated spring-run Chinook remained in Clear Creek. In addition, 195 spring-run were estimated to have entered Clear Creek naturally. Translocated fish were observed on snorkel surveys completed in the spring and summer months. Notably, prior to spawn timing, several fish with translocation tagging were observed exhibiting strange behavior; these "lethargic" fish were observed at the bottom of the channel in the open and did not startle when surveyors swam over. This is not a behavior normally seen pre-spawn; it’s behavior more typical of post-spawn timing. Another important anecdotal observation is that

many of the translocated fish exhibited significant fungal infection, particularly on the head. This too is unusual for pre-spawn timing.

USFWS snorkel surveys provide a metric of spring-run population and location. In combination with video station counts it is possible to detect significant changes in spawning population. Snorkel counts from May, Jun and July align well with the spawning population suggested by translocation and video station numbers. However, roughly half the expected number were observed during the survey in August, following the warmest months of the summer. This could suggest some of the spring-run Chinook recruits (translocated or native), did not survive to spawning. USFWS spawning surveys identified 42 spring-run Chinook redds. Based on ratios in previous survey years, this number of redds suggests a spawning population between 126 and 210: this suggests far fewer spawners than the total population estimate of 517 (322 translocated and 195 native recruits). The USFWS recovered the carcasses of five translocated fish. Three of these fish were collected in pre-spawn timing and two were collected in post-spawn timing and location. These two fish suggest that some of the translocated fish may have survived and produced offspring. A yet to be conducted parentage analysis of out-migrating juveniles will provide the proportional production of translocated and native spring-run Chinook populations in 2022. However, based on the monitoring observations discussed above, the fish agencies are hesitant to use this drought tool again.

Intended Effect:

The intended effect of this action is to provide access to thermal refugia in the upper reach of Clear Creek for spring-run Chinook captured in the Keswick Trap. In 2022, USFWS provided CDFW with 373 adult spring-run to translocate to Clear Creek. Based on video monitoring, another 195 fish entered Clear Creek naturally. Subsequent spawning surveys conducted by USFWS identified 42 spring-run Chinook redds which, based on ratios in previous survey years, suggests a total Clear Creek spawning population between 126 and 210.

Process for Implementing: Technical staff from the agencies developed the project conceptually and drafted a proposal for agency leadership consideration and approval.

Agency Participation:

NMFS, USFWS, CDFW and Reclamation

Communication Plan: Weekly technical team meetings and close coordination with fish agency policy leads.

Timeframe and Milestones:

- March: Forecast of Sacramento River conditions will be evaluated in the early spring to determine whether those conditions will be sufficient to support successful spawning and egg incubation in the mainstem.
- March - May: Returning spring-run adults will be collected at the Keswick Trap for possible relocation.

- May - July: Physical conditions in Clear Creek (transfer reach) will be monitored as well as periodic evaluation of signs of spawning.
- September - November: Downstream monitoring of juvenile outmigration.

Evaluation Criteria and Reporting Requirements:

No specific evaluation criteria or reporting requirements were identified in 2022.

Other Considerations:

Water temperatures and flow conditions in Clear Creek may be supported by Reclamation and mediated by in-river water operations.

_ Flow – Amount of Water Needed

_ Non – Flow

Action 24: Relocation of Adult Winter-Run Chinook Salmon Trapped at Coleman National Fish Hatchery and the Keswick Trap to Battle Creek, Upstream of Eagle Canyon Dam

Point of Contact: *NMFS:* Evan Sawyer

USFWS: Jim Earley

CDFW: Erica Meyers or Crystal Rigby,

Impact:

___ Avoid **_X_ Mitigate**

Category:

_X_ Fish **___ Water** **___ System**

Description of Action:

In 2022, in response to entering a third consecutive year of drought, NOAA Fisheries, the United States Fish and Wildlife Service (USFWS), and the California Department of Fish and Wildlife (CDFW) (fish agencies) initiated discussions in the late winter and early spring of 2022 to identify urgent actions to protect winter- and spring-run Chinook salmon in the Sacramento River. One of those actions relocated adult winter Chinook Salmon trapped at the Coleman National Fish Hatchery (Coleman NFH) and the Keswick Dam fish trap to Battle Creek, upstream of Eagle Canyon Dam (ECD) for natural spawning where water temperatures were colder and more suitable for spawning than downstream of the dam.

In 2021,191 winter-run Chinook salmon were released upstream of the Coleman barrier weir and downstream of ECD, but only one redd was observed during spawning surveys. Water temperatures downstream of ECD reached 63°F during the spawning and egg incubation period, likely limiting spawning and resulting in 100% temperature dependent egg mortality. The spawning area upstream of ECD is colder and was estimated to be potentially capable of supporting 250-300 winter-run Chinook during 2022. As such, a target of approximately 300 winter-run Chinook salmon was identified for transfer upstream of ECD.

The initial fish transfer schedule targeted 15 fish per week from the Keswick fish trap, but given low numbers of winter-run Chinook salmon being collected there, the schedule was revised to better reflect the availability of spawning adults. A proportionally based transfer rate of 1:10 was implemented for both male and female winter-run Chinook salmon collected at the Keswick Dam fish trap. That is, with implementation of the revised transfer schedule, every tenth male and every tenth female winter-run Chinook salmon collected at the Keswick Dam fish trap was relocated upstream of ECD. All Jumpstart winter-run Chinook salmon from the Coleman NFH were translocated upstream of ECD.

A small winter-run spawning run in 2022 limited the availability of fish for translocation and in total just 35 adults (34 winter-run, 1 late fall-run accidental) were moved to the upper reach of North Fork Battle Creek, with 6 winter-run adults (3 females, 3 males) from Coleman National Fish Hatchery and 28 (10 females, and 18 males) from the Keswick Dam fish trap. All translocated fish had Vemco or ATS acoustic tags implanted. The majority of the translocated fish were not detected outside of the reach where fish were translocated (25/35 fish). Of the fish that were detected on receivers, three moved upstream (2 males, 1 female) and six moved downstream (five males, 1 female).

Those translocations proved to be at least somewhat successful, as there is evidence of natural reproduction in that upper reach with observations of spawning redds and captures of outmigrating juveniles. One winter run Chinook salmon redd was found within the transfer area despite challenges surveying the upper reaches of Battle Creek related to denial of stream access due to owner permissions. As a result of this action, winter-run Chinook salmon spawning occurred upstream of Eagle Canyon Dam for the first time in over 100 years.

Intended Effect:

This action was taken to improve the reproductive success of winter-run Chinook salmon that would otherwise have spawned in potentially unsuitable water temperatures in the Sacramento River and downstream of ECD in Battle Creek. Moving a portion of adult winter-run from the Sacramento River to the upper reaches of North Fork Battle Creek contributed to the Battle Creek reintroduction effort and provided those adults with more suitable water temperatures for spawning.

Process for Implementing: Technical staff from the three fish agencies developed the project conceptually and drafted a proposal for agency leadership consideration and approval.

Agency Participation:

NMFS, USFWS, CDFW

Communication Plan: Weekly technical team meetings and close coordination with fish agency policy leads.

Timeframe and Milestones:

- March: Forecast of Sacramento River conditions will be evaluated in the early spring to determine whether those conditions will be sufficient to support successful spawning and egg incubation in the mainstem.
- March - June: Returning adults will be collected at CNFH and the Keswick trap for possible relocation.
- June - August: Physical conditions in the North Fork Battle Creek (transfer reach) will be monitored as well as periodic evaluation of signs of spawning.
- September - November: Downstream monitoring of juvenile outmigration.

Evaluation Criteria and Reporting Requirements:

Translocated fish may be implanted with Vemco or ATS acoustic tags so as to monitor adult movement and behavior after release. Transfer river reach would be monitored for evidence of spawning (e.g spawned-out carcasses, redd construction, etc.). After emergence, Battle Creek will be monitored for juvenile out migration.

Documentation of translocation, and associated monitoring would be included in the BCRP annual reporting.

Other Considerations:

Landowner permissions need to be secured to access some parts of the North Fork of Battle Creek, which can limit relocation and monitoring efforts.

_ Flow – Amount of Water Needed

_ Non – Flow

Action 25: Incubate a Portion of Winter-Run Chinook Salmon Eggs from Livingston Stone National Fish Hatchery Along the McCloud River

Point of Contact: *NMFS:* Evan Sawyer

USFWS: Jim Earley

CDFW: Erica Meyers or Crystal Rigby,

Impact:

___ Avoid **_X_ Mitigate**

Category:

_X_ Fish **___ Water** **___ System**

Description of Action:

In a 2022 pilot project developed and implemented by CDFW, the Winnemem Wintu Tribe, NMFS, and the USFWS, approximately 40,000 eggs from Livingston Stone National Fish Hatchery were incubated in remote site incubators at a site on the McCloud River. Once hatched a few weeks later, the fry were released into the river and free swimming winter-run Chinook salmon were in the McCloud River for the first time in over 80 years. Approximately 1,600 juvenile fish from those incubators were captured in the McCloud River downstream of the incubators and translocated around Shasta Reservoir to a release site in the upper Sacramento River to continue rearing and outmigration.

This action serves as a tool to spread the risk to winter-run Chinook salmon from warm water temperatures and disease outbreaks in the LSNFH and in the Sacramento River when Shasta Reservoir's cold-water supply to the hatchery and river become limited. During multi-year droughts, high levels of water temperature dependent egg mortality have been observed in the Sacramento River, whereas water temperatures in the McCloud River remain suitable for successful winter-run Chinook salmon egg incubation.

Intended Effect:

The intent of the McCloud action is to spread the risk facing winter-run in the upper Sacramento River. The purposes of this action are to: (1) provide an additional winter-run Chinook salmon egg incubation and rearing location to spread the risk of adverse impacts to early life stages caused by extreme drought; (2) collect information on the RSI system and rotary screw traps as a means to inform future winter-run Chinook salmon recovery actions on the McCloud River; and (3) study juvenile winter-run Chinook salmon growth, survival, and outmigration timing in their historical habitat to inform the long-term recovery planning.

Process for Implementing: Technical staff from the fish agencies and the Tribe developed the project conceptually and drafted a proposal for agency and tribal leadership consideration and approval.

Agency Participation:

NMFS, USFWS, CDFW and the Winnemem Wintu Tribe

Communication Plan: Technical staff from the fish agencies and Tribe met weekly to discuss implementation steps and frequently coordinated with agency and Tribe leadership for decision making.

Timeframe and Milestones:

- March: Forecast of Sacramento River conditions will be evaluated in the early spring to determine whether those conditions will be sufficient to support successful spawning and egg incubation in the mainstem.
- May-July: LSNFH spawns winter-run Chinook salmon for transfer to the McCloud.
- June-July: remote site incubators are fabricated and installed.
- July-August: Eggs are transferred from LSNFH to the McCloud River
- August: Rotary screw traps and fyke nets to collect juveniles are installed in the McCloud River
- September-December: Juveniles are collected in the McCloud River and transported to the Sacramento River for release.

Evaluation Criteria and Reporting Requirements:

Other Considerations:

_ Flow – Amount of Water Needed

_ Non – Flow

Drought Relief Actions Removed from the Toolkit

A few DRAs, previously included in the toolkit, were removed in 2023. Reasoning included that the removed DRAs (1) were an action that would never be implemented under any conditions (*Water Transfers from Oakdale or South San Joaquin Irrigation District ("the Districts") diverted in the Delta*), (2) were actions that were taken as a part of water accounting and were not a response to avoid nor mitigate the impacts of drought conditions (*Feather River Settlement Contractor Reduction to Diversions; CVP/SWP Operational Exchange at San Luis Reservoir*), or (3) were an action that was a scientific study and was not a response to avoid nor mitigate the impacts of drought conditions (*Salmon Snow Globe: late-winter pulse flows to distribute pre-smolt (aka fry-migrant) salmon into estuarine tidal marsh rearing habitat*). Information on the removed DRAs is included below.

Water Transfers from Oakdale or South San Joaquin Irrigation District ("the Districts") diverted in the Delta

Point of Contact: Barbara Byrne (NMFS)

Impact:
__ Avoid X_ Mitigate

Category: (check all that apply)
_X_ Fish _X_ Water _X_ System

Description of Action:

Intended Effect:
Provide Stepped Release Plan flows in the Stanislaus River,
Provide flows in the San Joaquin River to meet (or at least contribute to) Vernalis flow requirements in D-1641
Preserve storage in New Melones

Process for implementing:
San Joaquin Basin transfers are not covered by the July-November transfer window proposed in the 2019 LTO Proposed Action (p. 4-60 of BA). Unless Reclamation makes a "no effect" determination, ESA consultation would be needed for SWP/CVP to divert the water in the Delta. The Districts should follow necessary water transfer steps with the SWRCB to change, for example, the point of diversion and place and purpose of use associated with their water rights.

Agency Participation:
Oakdale and SSJID, Reclamation, DWR, NMFS, CDFW, SWRCB, Stanislaus Watershed Team

Communication Plan:

Timeframe for Initiation:
ESA consultation (if needed):60 days (for a letter or concurrence) or 135 days (for a Biological Opinion) plus additional time needed by Reclamation/DWR to prepare a Biological Assessment for additional transfer diversions at the CVP/SWP export facilities in the Delta

Water Transfer process with SWRCB: TBD

Advanced Timing Requirements or options for expediting timing:
If applicable, a programmatic consultation for water transfers could be completed for expedited implementation in future water years.

Pros/Cons:

Pros:

- Gets water in the Stanislaus River and mainstem San Joaquin without using (or using less of) CVP water in New Melones Reservoir.
- Facilitates transfers between willing sellers and buyers

Cons:

- Reclamation and DWR may not have the capacity to move the transfer water and may get pressure from buyers to use limited export capacity for the transfer volume rather than for CVP/SWP water.
- Authorizations/Approvals (by the SWRCB and ESA consultations with NMFS and USFWS) could be lengthy. ESA burden could be mitigated with a programmatic consultation on San Joaquin Basin transfers for export in the Delta.

Evaluation Criteria:

Other Considerations:
Suggest that the Stanislaus Watershed Team be allowed to provide input into the timing and shaping of the release of any flow augmentation due to a transfer. Coordination would be easier than ever now that the Districts are part of the Stanislaus Watershed Team.

_ Flow – Amount of Water Needed
_ Non – Flow

Feather River Settlement Contractor Reduction to Diversions

Point of Contact: Noel Oberth, DWR

Impact:
___ Avoid _X_ Mitigate

Category: (check all that apply)
__ Fish __X_ Water ___ System

Description of Action:
Implement 50% reductions to maximum allowed diversions for the Feather River Settlement Contractors as a result of Drought conditions defined in the respective contracts.

Intended Effect:
In any year in which a temporary shortage due to drought occurs, the quantity of water which the Contractor shall be entitled to divert shall be reduced by a percentage not to exceed 50% in any one year, or a total of 100% in any series of seven consecutive years.

The portion of water diverted by the Contractor for use on riparian areas, as defined in the Contract, shall not be subject to this reduction.

Process for Implementing:
The contracts provide a mechanism by which the contractor is informed the contractual criteria for Drought conditions have been met and are therefore subject to 50% reductions in maximum diversions. DWR monitors diversions and sends the contractors monthly updates on the quantity of water they have diverted.

Agency Participation:
DWR, Garden Highway Mutual Water Company, Joint Water Districts Board, Oswald Water District, Plumas Mutual Water Company, Tudor Mutual Water Company, Western Canal Water Districts

Communication Plan:
Forecast letters sent, with an official forecast and diversion reduction sent later.. Informational letters containing cumulative diversions sent monthly thereafter.

Timeframe and Milestones:
Official forecast and diversion reduction notification by April 15.

Evaluation Criteria and Reporting Requirements:
DWR O&M reports quantities of water deliveries made for each Contractor. The quantities are evaluated monthly with respect to each contractual obligation for cumulative maximum diversion allowance.

Other Considerations:

_X Flow – Amount of Water Needed – Reduction is not in exceedance of 100% in any series of seven consecutive years.
_ Non – Flow

CVP/SWP Operational Exchange at San Luis Reservoir

Point of Contact: Tracy Pettit (DWR) and Elizabeth Kiteck (Reclamation)

Impact:
___ Avoid _X Mitigate

Category: (check all that apply)
__ Fish __X Water ___ System

Description of Action:

During a drought year, the Central Valley Project (CVP) or the State Water Project may agree to exchange project water stored in San Luis Reservoir to enhance the overall joint water management of the projects, and to avoid adverse effects of dry conditions. The water exchanged will be "repaid" on a mutually agreeable schedule to be developed and specified. Formal approval of the exchange would require signed agreements between DWR and Reclamation. Approval of the exchange could also require approval by the State Water Resources Control Board, if a change in the authorized place of use (service area) of the water is needed.

Intended Effect: To enhance the overall joint water management of the projects, and to avoid adverse effects of dry conditions.

Process for Implementing: The timing, amounts and repayment schedule of water exchanged between the projects would vary according to the specific hydrology and operational constraints that are applicable in any given year.

Agency Participation: DWR and Reclamation.

Communication Plan: To be developed in the specific drought year.

Timeframe and Milestones: To be developed in the specific drought year.

Evaluation Criteria and Reporting Requirements: To be developed in the specific drought year.

Other Considerations: N.A.

Salmon Snow Globe: late-winter pulse flows to distribute pre-smolt (aka fry-migrant) salmon into estuarine tidal marsh rearing habitat.

Point of Contact: Brett Harvey and Ted Sommer

Impact:
_X_ Avoid **__ Mitigate**

Category: (check all that apply)
_X_ Fish **_X_ Water** **___ System**

Description of Action:
Background – Pre-smolt salmon (those not physiologically ready to enter the ocean) are typically observed using tidal marsh habitat for rearing in wet years, but not in dry years. Pre-smolt salmon using tidal marsh rearing habitats are known variously as "fry-migrants" or "tidal parr". Ongoing research for the Tidal Parr Studies increasingly supports the conclusion that rearing conditions are good in tidal-marsh habitat during dry years, but pre-smolt salmon are seldom detected using tidal-marsh habitat because they cannot access it in the absence of adequate winter flows early in the juvenile rearing period (Brett Harvey, personal communication). As a result, the majority of juvenile salmon remain in the Sacramento River for the extent of rearing season (January through May). Pre-smolt salmon that do trickle out of the Sacramento River and into the Delta over the rearing season have a low probability of surviving and reaching estuarine rearing habitat due to poor rearing conditions in the narrow, deep, rip-rap-lined and low turbidity conditions of the lower Sacramento River, and slow movement rates (i.e. high residence time) in that poor habitat – the result of low transport flows in the lotic reach and tidal influence occurring far upstream. At the same time, salmon that remain in the river (most of the cohort in dry years) exhibit poor in-river survival. Suggested causes of poor in-river survival include elevated pathogen loads, limited habitat, and limited food supply. River-rearing salmon also exhibit slower growth rates (a predictor of future survival) compared to salmon rearing in tidal marsh (Brett Harvey & Carson Jeffries, personal communication). By the time the surviving river-reared salmon migrate into the Delta in May and June, water temperature along the lower river migration corridor and through the Delta has frequently reached thresholds associated with an extremely high mortality rates, presumably an outcome of elevated predator activity, and heat-related impairment of predator avoidance ability (Nobriga et al., in press). Such dry-year conditions are expected to increase in duration and magnitude in future years, and current management strategies are not addressing this problem.

Action – An experimental winter flow pulse could be implemented to determine to the ability to mobilize recently emerged pre-smolt salmon, like shaking a "salmon snow globe", so that young salmon distribute and settle out into habitat throughout the Bay-Delta prior to onset of warmer tempertures and increased pathogen and predator activity in the spring. Some of these mobilized juveniles will likely settle in poor habitat, like the south Delta, but many will settle into good habitat, including the North Delta Cache Slough Complex and tidal marsh habitat downstream of the Delta in Suisun Bay and Suisun Marsh. These tidal fry/parr will experience conditions supporting high growth rate relative to river habitat, may avoid infection from the high in-river pathogen loads that occur in dry years, and will avoid late-season, temperature-related, high

mortality rates experienced by late-emigrating juvenile salmon in the lower Sacramento River and Delta.

Intended Effect:
Improve dry-year cohort replacement rates by diversifying rearing habitat used by juvenile salmon (spreading the risk), by reducing population level exposure to pathogens, poor river rearing conditions, and high-temperature migration routes, and by capitalizing on unused estuarine habitat that has demonstrated high growth rates.

Process for implementing:
DWR funded a study to analyze historical data to establish the lowest observed late-winter flows on the Sacramento River associated with observations of pre-smolt salmon mobilization, and with distribution into rearing habitat in various downstream regions including tidal marsh habitat in the Yolo Bypass and in the Upper San Francisco Estuary. A report was produced including possible strategies for producing required flows for a trial action on the Feather River. If stakeholders are interested in pursuing this trial action, a technical team will be assembledto plan an implementation schedule and monitoring to track fish response.

Agency Participation:
DWR funded the planning of this potential action. If implementation of the trial action on the Feather River is pursued, DWR will form a technical team with, at a minimum, CDFW to discuss possible relaxation of flow requirement to allow water banking for the action.

Communication Plan:
If a trial action is to be implemented, stakeholders will be engaged early in forums such as CAMT to ensure consideration of stakeholder concerns. An interagency technical team will be established to further develop the plan and initiate implementation (if feasible) as an adaptively managed experimental action, and to develop appropriate monitoring to determine the actions success.

Timeframe for Initiation:
DWR would initiate stakeholder engagement and formation of an interagency team prior to December, targeting October, to discuss possible scenarios for implementing the action. Implementation would occur in mid to late February when a large size range of juveniles are present in the Feather River, allowing monitoring of potentially differential effects on different sized juveniles. This timeframe would also mobilize juveniles to leave locations of high pathogen activity prior to onset of that activity in early spring.

Advanced Timing Requirements or options for expediting timing:
DWR will share the results of the feasibility analysis to various stakeholders (as described above) and will keep stakeholders updated in various forums if there is interest in and action toward implementation.

Pros/Cons:
In contrast to most fish-related drought actions, which monitor the deleterious effects of dry-year conditions on salmon, this proposed action capitalizes on that information to try and avoid fish exposure to such conditions while at the same time making use of unused tidal marsh habitat in

the upper estuary, including restored habitat. However, success is not guaranteed, and a threshold cost in water and/or money will likely be required (but yet unidentified) for the action to move forward (i.e. expected returns may not have a linear relationship with investment). For the Feather River trial action, multiple water-neutral strategies were developed that had zero water cost, but some loss in power generation revenue, or a slight reduction in minimum flows to allow water banking..

Evaluation Criteria:
This action would require sufficient monitoring of juvenile salmon at appropriate locations to determine whether and to what spatial extent the action was successful in distributing salmon. Use of CWT-tagged hatchery fry releases or other targeted study approaches could be used both to track salmon distributions using existing monitoring surveys, and also to gauge success of these downstream distributed salmon in ocean fisheries relative to CWT-tagged smolt releases (the typical release strategy).

Other Considerations:
This action may lead to a rethinking of how pulse flows are timed across the migration season during dry years.

_ Flow – Amount of Water Needed
_ Non – Flow

Drought Toolkit: New Additions and Evaluation

Drought Toolkit – New Action Template

Action: Title of Action

Point of Contact: (for drafting purposes only)

Impact:
___ Avoid __ Mitigate

Category: (check all that apply)
__ Fish ___ Water ___ System

Description of Action:

Intended Effect: {# of fish, Water Quality}

Process for Implementing: (Describe WY Implementation)

Agency Participation:

Communication Plan: (Description of the communication between agencies needed to enact the action)

Timeframe and Milestones: (Describe the timing for the action)

Evaluation Criteria and Reporting Requirements: (Criteria used to measure success of the action)

Other Considerations:

_ Flow – Amount of Water Needed
_ Non – Flow

Drought Action – Evaluation Template

Point of Contact:

Dates Implemented:

Water Year: (description of conditions)
Action implemented during WY.

Timeframe and Milestones: (Describe the timing for the action in WY)

Intended Effect: (For example: number of fish, resulting water quality)
- Rationale for Implementation:

Effects/Outcomes:

Relation to other Drought Actions:

Data Used for Evaluation: (Cite to other final reports that are ready or upcoming as needed**)**

Other Considerations:

Resources Needed/Used:
- **Amount of Water:**
- **Funding:**

Recommendations for Modifications:

Lessons Learned:

Figures/Tables (if applicable):