	NMFS Draft Solutions List - For Discussion Purposes Only, subject to revision: June 7, 2019						
#	Action	Action Description	Key Stressor Addressed by Action	Biological Rationale	Cost	Total Estimated Cost	Source of Action
1	**Shasta Operations Performance Objectives**	Reduce the potential adverse effect of operations on the survival of WR in the upper Sacramento River	Water temperatures warmer than life stage requirements during egg incubation and fry emergence.	(1) part of ongoing discussion to bound effects related to Shasta Cold Water Pool Management. (2) Winter-run Chinook salmon require conditions that prevent frequent high mortality events and support viability of the species despite demands of operations.	Not clear to NMFS	Not clear to NMFS	Ongoing consultation discussion
2	**Livinston Stone National Fish Hatchery Funding and Improvements**	(1) Securing an emergency/alternate water supply when Shasta and Keswick reservoirs reach elevations below the current penstock, (2) Acquiring water chillers to ensure that adequate water temperatures are provided during critical winter-run Chinook salmon life stages (i.e., adult holding, egg incubation, and juvenile rearing), (3) Acquiring more physical space (i.e., round tanks, juvenile rearing tanks, etc.) to adequately rear increased production to help the population withstand the drought and to successfully operate the Captive Broodstock Program, (4) Modifications/improvements to Keswick Dam Fish Trap, (5) Modifications/improvements to Anderson-Cottonwood Irrigation District (ACID) Dam Fish Trap or investigations/assessment of new adult trapping facility/location. , (6) Improvements to the water treatment facility. (7) Ongoing monitoring and research	Water temperatures warmer than life stage requirements during egg incubation and fry emergence. Injury and death during adult collection	(1) Supports Collaborative Planning Action by providing specificity to action. (2) Due to numerous stressors, including warm water temperatures and water exports, the ESU is currently dependent on LSNFH production, particularly during drought.		$6.9 million $4,200,000 (one time) Water Treatment Facility (Item 6): $2,500,000 (one time),Monitoring and research $250,000 (annually)	NMFS WIIN Act Hatchery Assessment
3	**Spawning Habitat**	Spawning Habitat Keswick to Red Bluff Diversion Dam;	Dams block gravel recruitment, low fall	(1) Supports			Supports
4	**Upper Sacramento River**	Rearing Habitat Keswick to Red Bluff Diversion Dam;	Seasonal operations resulting in low	(1) Supports			Supports
5	**Sacramento River**	Rearing Habitat Red Bluff Diversion Dam to Verona;	Seasonal operaitons that result in low	(1) Supports			Supports
6	**Sacramento River**	Science coordination and funding	Water temperatures warmer than life	Science support to		$2 million/year	
7	**Shasta Reservoir**	Development and Application of Shasta Stratification	Water temperatures warmer than life	(1) Supports 4 Tiered			
8	**DWR - Meet and Confer**	DWR (shall) meet and confer on reoperation of Oroville	Water temperatures warmer than life	Potentially savings of			Links DWR/FERC
9	**Battle Creek Actions**	Complete the Battle Creek Salmon and Steelhead	Water temperatures warmer than life	Collaborative Planning	$6 million for four	$24 million	CA Salmon
10	**Battle Creek Actions**	Implement the Battle Creek Reintroduction Plan	Water temperatures warmer than life	(1) Supports	$740,000 for five	$3.7 million one-time;	CA Salmon
11	**Battle Creek Actions**	Design and construct a fish sorting facility at Coleman	Water temperatures warmer than life	(1) Supports	Multi-phase plan in	~$13 million	
12	**Spring-run tributary Habitat Improvements**	Passage improvements on Mill Creek at Upper Dam	Sacramento River and Clear Creek water temperatures warmer than life stage requirements during egg incubation and fry emergence.	(1) Provides resiliency to spring-run populations, (2) off site-mitigation actions for temperature-related related effects downstream of Shasta and in Clear Creek		~$4 million	CA Salmon Resiliency Strategy

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13	**Spring-run tributary Habitat Improvements**	Passage improvements on Deer Creek at Stanford Vina Dam	Sacramento River and Clear Creek water temperatures warmer than life stage requirements during egg incubation and fry emergence.	(1) Provides resiliency to spring-run populations, (2) off site-mitigation actions for temperature-related related effects downstream of Shasta and in Clear Creek		~$4 million	CA Salmon Resiliency Strategy
14	**Lower Sacramento River**	Restore X amount of floodplain habitat in the lower	Seasonal operations resulting in low	(1) Supports			
15	**Knights Landing Outfall Gates**	Fund the repair of KLOG	Adult straying into the agricultural ditch system	Out-of-kind mitigation to reduce loss of adult WR, SR, ST into the Colusa Basin			NCWA action plan, Supported by RD-108
16	**Yolo Bypass Actions**	Complete Yolo bypass actions (programmatic)	Seasonal operations resulting in low winter flows. Loss of natural river morphology. Adult straying into the agricultural ditch system. Loss of floodplain rearing habitat. Low flows limiting rearing habitat quantity and quality.	(1) An increase in floodplain rearing habitat in wet conditions will help offset reductions in rearing habitat quality and quantity associated with low winter flows under the PA and altered Delta hydrodynamics. (2) Out-of-kind mitigation to reduce loss of adult WR, SR, ST into the Colusa Basin			CA Salmon Resiliency Strategy; NCWA action plan
17	**Sutter Bypass Actions**	Support Sutter Bypass inundation planning and implementation	Seasonal operations resulting in low winter flows. Loss of natural river morphology Loss of floodplain rearing habitat. Low flows limiting rearing habitat quantity and quality.	An increase in floodplain rearing habitat in wet conditions will help offset reductions in rearing habitat quality and quantity associated with low winter flows and altered Delta hydrodynamics under the PA.			CA Salmon Resiliency Strategy
18	**Sutter Bypass Actions**	Nigiri North: Floodplain restoration in the lower Sutter Bypass (see CVSHP Project Information Sheet)	Loss of floodplain rearing habitat. Low flows limiting rearing habitat quantity and quality.	An increase in floodplain rearing habitat in wet conditions will help offset reductions in rearing habitat quality and quantity associated with low winter flows and altered Delta hydrodynamics under the PA.			CV Salmon Habitat Partnership

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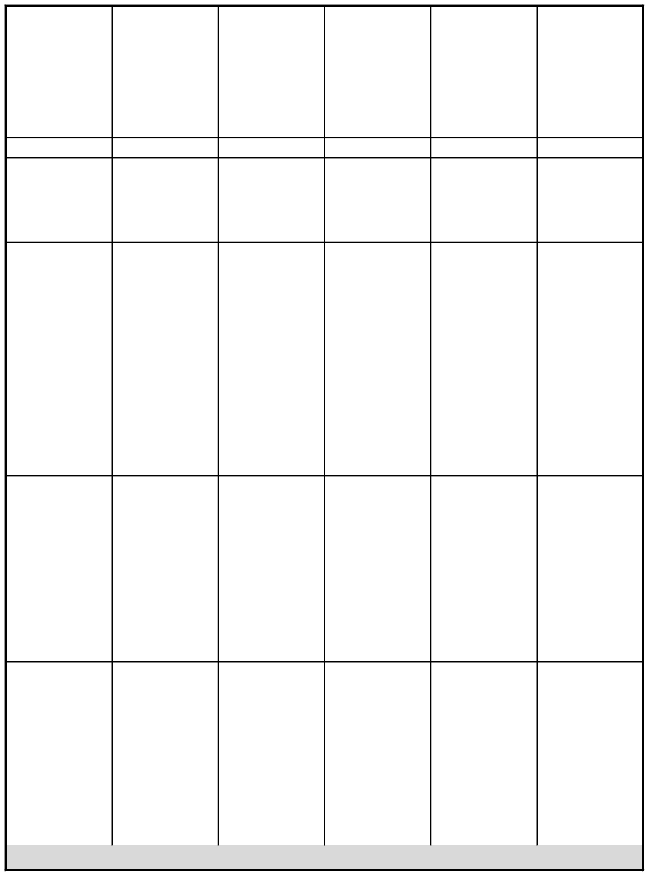

19	**Delta Performance Objectives**	Develop Delta performance objectives to limits effects to post 2009 Biop loss levels at export facilities	Loss associated with state and federal pumping	(1) part of ongoing discussion to bound effects related to Shasta Cold Water Pool Management.			
21	**Delta Cross Channel Actions**	Solidify recent agreements made during Director meetings on DCC operations by incorporating details into the Proposed Action	Juvenile entrainment into central Delta through DCC	Minimize juvenile entrainment into central Delta through DCC, improve through-Delta Survival			
	Delta Cross Channel Actions	Complete DCC feasibility study and repair or replace DCC per FS findings	Juvenile entrainment into central Delta through DCC	(1) Supports DCC Channel Gate Improvement Action (2) Provide operational			
23	**Delta Habitat Restoration**	Incorporate salmon habitat restoration into Delta smelt habitat action. Restore 11,000 acres of tidal habitat for improved rearing and reduced reverse tidal flows in critical migratory channels.	Loss associated with state and federal pumping	Improve through-Delta growth and survival			Salmon Resiliency Strategy
24	**North Delta Barriers**	Non-physical exclusion Barrier at Georgiana Slough	Juvenile entrainment into central Delta through Georgiana Slough	Minimize juvenile entrainment into central Delta, improve through-Delta Survival			
25	**North Delta Barriers**	DWR Salmon Protection Technology Study proposal for Sutter and Steamboat Sloughs	Juvenile entrainment into central Delta through Georgiana Slough	Minimize juvenile entrainment into central Delta, improve through-Delta Survival			
26	**HORB**	Install when feasible	Loss associated with state and federal pumping	Minimize juvenile entrainment into South Delta, improve through-Delta Survival			
27	**VAMP-like flow action**	VAMP-like 2:1 export for April/May action for 2020/2021 water years only while study plan below is developed:	Loss associated with state and federal exports	Minimize juvenile entrainment into South Delta, improve through-Delta Survival			

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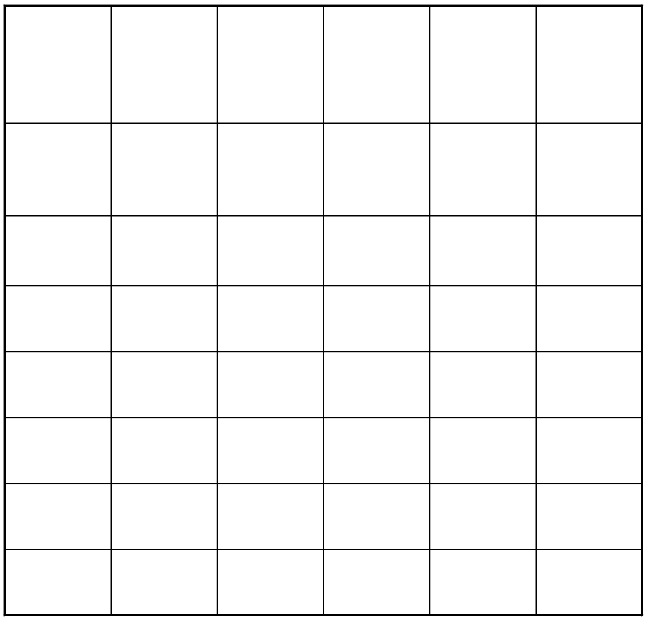

28	**Multi-species Q-west**	Multi species March-May Q-west or VAMP like action; needs an experimental design with different actions to take place in different conditions. Needs well-funded adaptive management approach. Peer review on design. NMFS consulted on design, selection of contractor, and invited to co-author annual and final reports. Reclamation to create interagency workgroup and develop science experimental alternative that provides similar protection to I:E ratio, protects multiple species in Delta during this period, and submit to NMFS for review at project specific level. Long-term investment in tagged fish studies as part of this, coupled with the spring-pulse flow actions as part of long-term study through SWFSC. NMFS SWFSC has opportunity to review and advise on experimental design.	Loss associated with state and federal exports	Minimize juvenile entrainment into South Delta, improve through-Delta Survival			
29	**Lower San Joaquin Habitat Actions**	Restoration of flood plain access and San Luis NWR	Loss associated with state and federal exports, Low flows limiting rearing habitat quantity and quality. Loss of floodplain rearing habitat.	Improve through-Delta growth and survival			
30	**Lower San Joaquin Habitat Actions**	Franks tract or other San Joaquin corridor specific restoration actions in the southern Delta	Loss associated with state and federal exports, Low flows limiting rearing habitat quantity and quality. Loss of floodplain rearing habitat.	Improve through-Delta growth and survival			
31	**Lower San Joaquin Habitat Actions**	Sturgeon Bend Floodplain Restoration	Loss associated with state and federal exports, Low flows limiting rearing habitat quantity and quality. Loss of floodplain rearing habitat.	Improve through-Delta growth and survival			
32	**Lower San Joaquin Habitat Actions**	Durham Ferry State Recreation Area floodplain restoration	Loss associated with state and federal exports, Low flows limiting rearing habitat quantity and quality. Loss of floodplain rearing habitat.	Improve through-Delta growth and survival			
33	**Lower San Joaquin Habitat Actions**	Head of Old River Scour Hole. Fill scour hole and restore adjacent floodplain habitat	Loss associated with state and federal exports, Low flows limiting rearing habitat quantity and quality. Loss of floodplain rearing habitat.	Improve through-Delta growth and survival			
34	**SRKW Prey Base Improvement**	Continue Butte City barge experiment for at least x years, and report results	Reduction in prey availability for SRKW	Increase prey base for SRKW			
35	**SRKW Prey Base Improvement**	Delta performance objectives to bound effects to 2009 Biop. (Redundant action listed here for SRKW clarity)	Reduction in prey availability for SRKW	Increase prey base for SRKW			
36	**SRKW Prey Base Improvement**	Fund/participate in CA portion of prey base evaluation being conducted by NWFSC	Reduction in prey availability for SRKW				
37	**SRKW Prey Base Improvement**	Interim Hatchery Management Action: Commitment to fund at least 25% constant fractional marking of Chinook salmon at Nimbus and Feather River Fish Hatcheries	Reduction in prey availability for SRKW				

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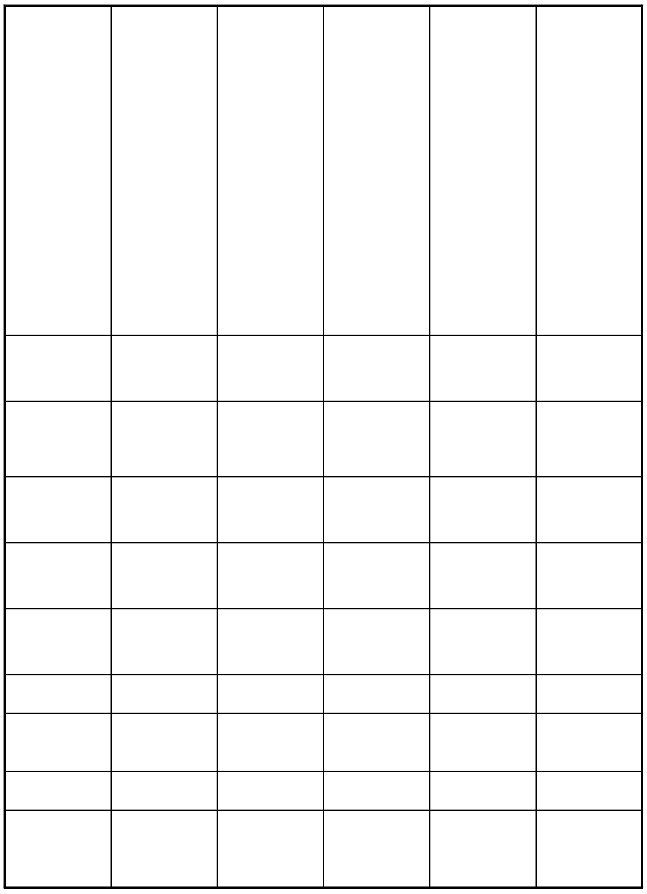

38	**Collaborative Planning Implementation Strategy**	Develop Collaborative Planning Implementation Strategy with 1,5, 10 year priorities, objectives and actions, and funding and implementation strategy. Needs to address the full scope of Collaborative Planning Actions from the PA (restoration, fish screens, Tier 4 intervention, etc…	Habitat Restoration Offsets				Ongoing consultation discussion
39	**Collaborative Planning Implementation Strategy**	NMFS/Reclamation, FWS annual meeting on CVPIA funded actions and cross-walk to effects in this opinion; discuss how to address gaps, and sponsor projects as needed.	Habitat Restoration Offsets				
40	**Drought Plan**	Complete Drought Plan purusant to ongoing discussions at Tiger Team and Director meetings	Egg, fry and smolt mortality				
41	**Feather River and SWP/CVP Integrations**	DWR shall form and lead FROG to integrate Feather River Operations with other operations in this biop	Effects of seasonal operations				Links DWR/FERC BiOp to CVP BiOp
42	**Science Support**	Fund science actions such as marking and tagging/survival studies for Battle Creek Reintroduction and Spring pulse flow actions	Uncertainty	Science support to test spring pulse flow hypotheses and track emgration timing and survival of fish. Validate actions			
43	**Science Support**	Fund science, model development and monitoring; experimental design (with validation monitoring) for spring pulse flows and Anderson approach prior to operations	Uncertainty	Validate actions	$2 million/year		
44	**Science Support and Monitoring**	Need to identify and reach agreement on necessary science and monitoring needs for operations	Implementation and validation monitoring to support multiple action components				
45	**Technical assistance and Corodination**	Clarify NMFS role in technical assistance/coordination and participation on tech teams. Coordination cannot be used ambigously so we need to define and clarify	Uncertainty				
46	**Reclamation-proposed Terms and Conditions**	Solidify terms and conditions offered by Reclamation in last 2 weeks. Need to parse out what are changes to the PA vs T&Cs	Multiple stressors addressed				

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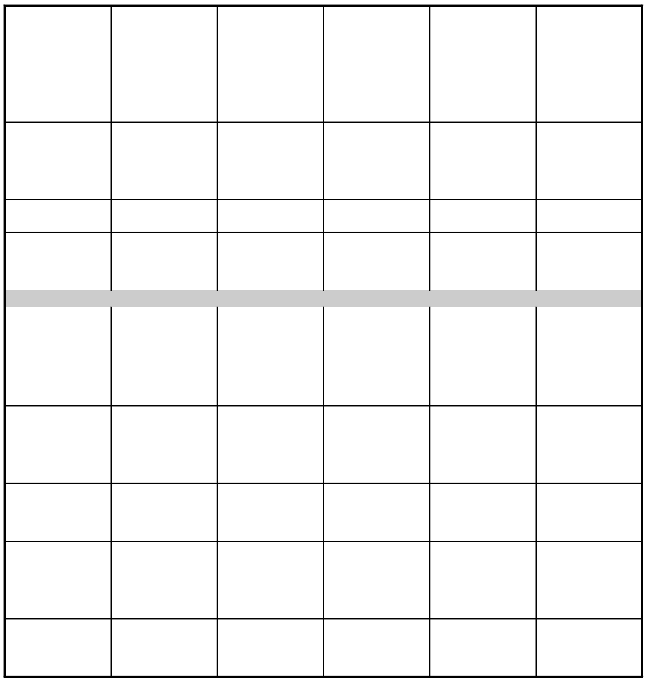

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Comment: This seems to be covered in row 8. Remove 7? +howard.brown@noaa.gov
-Brian Ellrott - NOAA Federal
Marked as resolved
-Brian Ellrott - NOAA Federal
Re-opened
You there Howard?
-Brian Ellrott - NOAA Federal