Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta

DRAFT REPORT

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Overview of Presentation

- Legislative Mandate
- Planning Efforts
- Methodology
- Goals and Objectives
- Flow Criteria
- Next Steps

- Senate Bill 1
  - Delta Reform Act
    - Delta Stewardship Council (DSC)
      - Delta Plan
      - Bay Delta Conservation Plan
    - Water Code section 85084.5
      - The Department of Fish and Game in consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service and based on the best available science, shall develop and recommend to the board Delta flow criteria and quantifiable biological objectives for aquatic and terrestrial species of concern dependent on the Delta. The recommendations shall be developed no later than 12 months after the date of enactment of this division. – **Due November 2010**
    - Water Code section 85086(c) (1)
      - For the purpose of informing planning decisions for the Delta Plan and the Bay Delta Conservation Plan, the board shall pursuant to its public trust obligations, develop new flow criteria for the Delta ecosystem necessary to protect public trust resources. In carrying out this section, the board shall review existing water quality objectives and use the best available scientific information. The flow criteria for the Delta ecosystem shall include volume, quality, and timing of water necessary for the Delta ecosystem under different conditions. The flow criteria shall be developed in a public process by the board within nine months of the enactment of this division. - **Due August 2010**

Planning Efforts

- Review programs, plans, and processes
  - State of Bay-Delta Science report
  - **Ecosystem Restoration Program**
  - Bay-Delta Conservation Plan (BDCP)
  - Public Policy Institute of California (PPIC) reports
  - Pelagic Organism Decline (POD) studies
  - **Delta Vision**
  - State Water Resources Control Board's Bay-Delta Strategic Workplan
  - Suisun Marsh Plan
  - Central Valley Project Improvement Act (CVPIA) programs
  - Federal Biological Opinions and Recovery Plans
  - U.S. Fish and Wildlife Service (USFWS) Delta Native Fishes Recovery Plan
  - NOAA Fisheries Central Valley Recovery Plan
  - California Wildlife Action Plan
  - Central Valley Joint Venture (CVJV) 2006 Implementation Plan
  - Regional Habitat Conservation Plans (HCPs)
  - **SWRCB Informational Proceeding**
  - **SWRCB Flow Criteria Report**

- Develop Goals and Objectives
- Develop Flow Criteria

Relationship to the SWRCB Delta Flow Report

- The SWRCB report was developed using information on unimpaired flows, historical impaired inflows that supported more desirable ecological conditions, statistical relationships between flow and native species abundance, and an ecological functions-based analysis for desirable species and ecosystem attributes.

- While the summary recommendations found in the SWRCB report focus on a percentage of unimpaired flow, the report contains a comprehensive summary of the specific flow needs for the species identified.

- DFG's report uses the data and information submitted as part of the SWRCB's informational proceeding and the SWRCB's report.

- DFG's report represents the current understanding of the needs of the individual species identified in light of current conditions and the objectives described.

Methodology

- Principles to Guide Development of Biological Objectives and Flow Criteria
  - Use best available data and information contained in existing recovery plans, publications, reports, journal articles, etc.
  - Follow guidance in Water Code sections 85084.5 and 85086(c)(1).
  - Species to be covered by the biological objectives and flow criteria may include federal and State listed species in the Delta (e.g., delta smelt, longfin smelt, etc.), salmon, other commercial/recreational fish species, and other species or habitats known to be influenced by both Delta inflow and outflow and which contribute to the heterogeneity and sustainability of the Delta ecosystem.

Methodology cont...

- Data and Information Used (Line of Evidence approach)
  - Life history information.
  - Season or time period when flow characteristics are most important to sensitive or important species life stages.
  - Relationships of species abundance or habitat to Delta outflow, Delta inflow, water quality parameters linked to water flow, etc.
  - Species environmental requirements (e.g., dissolved oxygen, temperature tolerances, salinity, X2 location, turbidity, etc.)
  - Relationship of species survival dependent upon Delta inflow, interior Delta flow, and Delta outflow.
  - Factors influencing and limiting population trends.
  - Ecological standards (e.g. measures of population viability).

Goals

- Terrestrial
- Aquatic
- Management

As used in this report, “goals” are defined as a future desired outcome or state. Goals provide direction and focus on ends rather than means.

Terrestrial Species Biological Goals

- Achieve, first, recovery and then self-sustaining populations of the following at-risk native species dependent on the Delta, Suisun Bay and Suisun Marsh, with emphasis on valley elderberry longhorn beetle, Suisun ornate shrew, Suisun song sparrow, soft bird's-beak, Suisun thistle, Mason's lilaeopsis, Lange's metalmark butterfly, Antioch Dunes evening primrose, Contra Costa wallflower, and Suisun marsh aster.

- Contribute to the recovery of the following at-risk native species in the Bay-Delta estuary and its watershed: delta green ground beetle, giant garter snake, riparian brush rabbit, least Bell's vireo, California black rail, California clapper rail, bank swallow, western yellow-billed cuckoo, greater sandhill crane, Swainson's hawk, California yellow warbler, delta tule pea, delta mudwort, and delta coyote thistle.

- Protect and/or restore natural communities in the Bay-Delta Estuary and its watershed for ecological values such as supporting species and functional habitat types, and ecological processes.

Aquatic Species Biological Goals

- Halt species population declines and increase populations of ecologically important native species, as well as species of commercial and recreational importance, by providing sufficient water flow and water quality at appropriate times to propagate species life stages that use the Delta.

- Establish water flows through the Delta that will likely benefit particular species or ecosystem functions in a manner that is: (1) comprehensive, (2) not overly complex, and (3) encourages production. Functional flow criteria shall be established for at least:
  - Yolo Bypass
  - Sacramento River and its basin
  - San Joaquin River and its basin
  - Eastside streams and their basins
  - Interior Delta including Old and Middle rivers
  - Delta outflow

- Establish an adaptive management process to review and modify flow criteria in the Delta that is: (1) responsive to scientific advances, changing environmental conditions including a warming climate and change in sea level, and changes in conveyance and water operations, and (2) implemented on a time scale needed to realistically manage desirable species.

Management Goals

- Integrate all flow measures needed to protect species and ecosystem functions in a manner that is comprehensive, does not double count flows, uses a justified time step, and is documented in peer reviewed or otherwise vetted literature.

- Establish an adaptive management process to evaluate Delta environmental conditions, periodically review the scientific underpinnings of the biological objectives and flow criteria, and change biological objectives and flow criteria when warranted.

Objectives

- Terrestrial
- Aquatic
- Other Factors

"Objectives" are statements of action that are clear, realistic, specific, and measurable.

Terrestrial Species Biological Objectives

- Mason's Lilaeopsis
- Suisun Marsh Aster
- Suisun Thistle
- Soft-Bird's Beak
- Antioch Dunes Evening-Primrose and Contra Costa Wallflower
- Lange's Metalmark Butterfly
- Valley Elderberry Longhorn Beetle
- Salt Marsh Harvest Mouse
- Suisun Ornate Shrew
- San Joaquin Valley Woodrat
- Suisun Song Sparrow
- California Black Rail
- California Clapper Rail
- Swainson's Hawk
- Riparian-Brush Rabbit
- Greater Sandhill Crane
- California Yellow Warbler
- Least Bell's Vireo
- Western Yellow-Billed Cuckoo
- Bank Swallow
- Giant Garter Snake
- Delta Green Ground Beetle
- Delta Mudwort and Delta Tule Pea
- Delta Coyote-Thistle
- Waterfowl
- Intertidal Habitat

Aquatic Species Biological Objectives and Flow Criteria

- Selection of Priority Species
- Species Status, Life History, and Relationship to Flow

Priority Species	Life Stage(s)	Mechanism	Time When Water Flows are Most Important
Chinook salmon (San Joaquin River basin)	Smolt	Outmigration	March – June
Chinook salmon (San Joaquin River basin)	Adult	Immigration & Egg Viability	Sept – December
Chinook salmon (Sacramento River basin)	Juvenile	Outmigration	November – June
Chinook salmon (San Joaquin River tributaries)	Adults (Egg)/fry	Temperature, dissolved oxygen	September – March
Steelhead Rainbow Trout (San Joaquin River basin)	Smolt	Outmigration	March – May
Steehead Rainbow Trout (San Joaquin River basin)	Adult	Immigration & Egg Viability	Sept – April
Longfin smelt	Egg	Freshwater-brackish habitat	December – April
Longfin smelt	Larvae	Freshwater-brackish habitat; transport; turbidity	December – May
Splittail	Adults	Floodplain inundating flows	January – April
Splittail	Eggs and larvae	Floodplain habitat persistence	January – May
Delta smelt	Larvae, juvenile, and pre-adult	Transport; low salinity zone habitat suitability	March – November September – November
Starry flounder	Settled juvenile; Juvenile-2 yr old	Estuary attraction; habitat	February – May
Bay shrimp	Late-stage larvae and small juveniles	Transport	February – June
Bay shrimp	Juveniles	Nursery habitat	April – June
Mysid shrimp (zooplankton)	All	Habitat	March – November
Eurytemora affinis (zooplankton)	All	Habitat	March – May
American shad	Egg/larvae	Transport; dispersal; habitat	April – June

Aquatic Species Biological Objectives and Flow Criteria cont...

- Species Selected
  - Chinook Salmon
  - Longfin Smelt
  - Delta Smelt
  - Starry Flounder
  - American Shad
  - Bay Shrimp
  - Zooplankton
  - Sacramento Splittail

Chinook Salmon Biological Objectives

- For the San Joaquin River basin, provide sufficient water flow depending on year type to transport salmon smolts through the Delta during spring in order to contribute to attainment of the salmon protection water quality objective[1].

- For the Sacramento River basin, provide sufficient water flow to transport salmon smolts through the Delta during the spring in order to contribute to the attainment of the salmon protection water quality objective[1].

- For eastside streams that flow to the Delta including the Mokelumne and Consumes River basins, provide sufficient water flow to transport salmon smolts through the Delta during the spring in order to contribute to the attainment of the salmon protection water quality objective[1].

1 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Water Board Resolution No. 2006-0098. Table 3. Page 14.

Chinook Salmon Biological Objectives cont..

- To favor salmon smolts rearing in the Delta, during above normal and wet years, provide floodplain inundation flows for at least a 10 consecutive day period between January and May, maintain continuous inundation for at least 30 days in the Yolo Bypass and at suitable locations in the Sacramento River or in the San Joaquin River.

- For mainstem rivers that flow into the Delta and their tributaries, maintain water temperatures and dissolved oxygen at levels that will support adult migration, egg incubation, smolting, and early-year and late-year juvenile rearing at levels that facilitate attainment of specified life-history stage production goals.

Longfin Smelt Biological Objectives

- Provide low salinity habitat for longfin smelt in Suisun Bay (and farther downstream) by maintaining X2 between 64 km and 75 km between January and June.
- Depending on year type, provide sufficient water flow to increase abundance of longfin smelt to pre-1987 abundance levels.
- At no time should Old and Middle River flows be more negative than -5,000 cfs during the period between December and March.
- During critical and dry years and when longfin FMWT index is more than 500, Old and Middle River flows should be more positive than -1500 cfs during the period between April and May.
- During critical and dry years and when longfin FMWT index is less than 500, Old and Middle River flows should be positive during the period between April and May.

Delta Smelt
Biological Objectives

- Provide low salinity habitat for delta smelt in Suisun Bay by maintaining X2 between 74 km and 81 km between September and November in wet and above normal years.
- At no time should Old and Middle River flows be more negative than -5,000 cfs between December and February.
- For critical and dry years, at no time should Old and Middle River flows be more negative than -1,500 cfs between March and June.
- Develop a comprehensive life-cycle model for delta smelt that would allow for assessment of population level impacts associated with entrainment.

Starry Flounder
Biological Objectives

- Provide low salinity habitat for starry flounder in Suisun Bay (and farther downstream) by maintaining X2 between 64 km and 75 km between March and June.

- Depending on year type, provide sufficient water flow to increase abundance of starry flounder to pre-1987 abundance levels.

American Shad
Biological Objectives

- Provide low salinity habitat for American shad in Suisun Bay (and farther downstream) by maintaining X2 between 64 km and 75 km between April and June.

Bay Shrimp
Biological Objectives

- Provide shallow water habitat for bay shrimp in Suisun Bay (and farther downstream) by maintaining X2 between 64 km and 75 km between March and May.

Zooplankton
Biological Objectives

- Provide low salinity habitat for zooplankton in Suisun Bay (and farther downstream) by maintaining X2 between 64 km and 75 km between January and June.

Sacramento Splittail Biological Objectives

- To favor Sacramento splittail recruitment, during above normal and wet years, once floodplain inundation has been achieved based on runoff and discharge for 10 days between March and May, maintain continuous inundation for at least 30 days in the Yolo Bypass and at suitable locations in the Sacramento River or in the San Joaquin River.

Other Factors Recommended Objectives

- **Natural Hydrograph**
  - To the extent possible, flow criteria should reflect the frequency, duration, timing, and rate of change of flows, and not just volumes or magnitudes.
  - Delta inflows should generally be provided from tributaries to the Delta watershed in proportion to their contribution to unimpaired flow unless otherwise necessary.
- **Nutrients and other pollutants**
  - Prevent the discharge of pollutants at concentrations that are acutely or chronically toxic to aquatic life.
- **Cold Water Pool**
  - Balance the need for cold water storage for upstream salmon habitat protection with the need for Delta outflow in late winter through spring.

Flow Criteria

- Notwithstanding the descriptions of “flow criteria” in the Delta Reform Act, flow criteria are considered to be equivalent to performance measures. Performance measures are indicators of progress toward meeting prescribed objectives.

Flow Criteria

Category	Function	Flow (cfs)	Year Type	Months												Citation
				O	N	D	J	F	M	A	M	J	J	A	S	
Delta Outflow	Increase quantity and quality of habitat for delta smelt promotes variability of fall flows and habitat conditions in above normal and wet water year types; may result in improved conditions for delta smelt	7100 ($X_2 \leq$ 81 km) to 12400 ($X_2 \leq$ 74 km)	AN W	1	1										1	SWRCB (2010)
	Promote increased abundance for longfin smelt, starry flounder, zooplankton, American shad, Crangon franciscorum (bay shrimp), and other desirable estuarine species	11400 – 29200 (X_2 between 64 km and 75 km)	All				1	1	1	1	1	1				DFG (2010a)
San Joaquin River	Increase juvenile Chinook salmon outmigration survival and abundance and provide conditions that will generally produce positive population growth in most years and eventually achieve the doubling goal	At Vernalis: 1500 (Base) 5500 (Pulse) (4/15-5/15) (Total 7000)	C				1	1	1	1	1	½				DFG (2010a)
										½	½					
		At Vernalis: 2125 (Base) 4875 (Pulse) (4/11-5/20) (Total 7000)	D				1	1	1	1	1	½				DFG (2010a)
										½	½					
		At Vernalis: 2258 (Base) 6242 (Pulse) (4/6-5/25) (Total 8500)	BN				1	1	1	1	1	½				DFG (2010a)
										1	1					
		At Vernalis: 4339 (Base) 5661 (Pulse) (4/1-5/30) (Total 10000)	AN				1	1	1	1	1	½				DFG (2010a)
										1	1					
		At Vernalis: 6315 (Base) 8685 (Pulse) (3/27-6/4) (Total 15000)	W				1	1	1	1	1	½				DFG (2010a)
									1	1	1	1				

Flow Criteria cont...

Category	Function	Flow (cfs)	Year Type	Months												Citation
				O	N	D	J	F	M	A	M	J	J	A	S	
Eastside Streams	Mokelumne River flows: Juvenilt salmon outmigration	1500	All						1	1						From Flennor et al. 2010
	Eastside stream minimum flows	1060	All	1	1	1	1	1	1	1	1	1	1	1	1	From Flennor et al. 2010
Sacramento River	Increase juvenile salmon outmigration survival and abundance for fall-run Chinook salmon. Increases juvenile salmon outmigration survival	At Wilkins Slough: pulse flow: 20,000 cfs for 7 days[1]	All		1	1	1									SWRCB (2010)
	Increase juvenile salmon outmigration survival by reducing diversion into Georgiana Slough and the central Delta	At Freeport: 13,000 - 17,000[2]	All		1	1	1	1	1	1	1	1				SWRCB (2010)
	Promote juvenile salmon outmigration	At Rio Vista: 20000 – 30000								1	1	1				DFG (2010a)
Floodplain	Inundation of off-channel areas improves spawning and recruitment of Sacramento splittail. Salmon smolts also benefit from increased food in floodplain habitats.	≥ 30 day floodplain inundation[3]	AN W				1	1	1	1	1					DFG (2010a)

1 = criteria recommended for the whole month

[1] Pulse flows should coincide with storm events producing unimpaired flows until monitoring indicates that majority of smolts have moved downstream

[2] Positive flows are needed downstream of confluence with Georgiana Slough while juvenile salmon are present

[3] Flows needed to inundate floodplain habitat vary substantially depending on Sacramento River, San Joaquin River, and in-Delta floodplain habitat (e.g., Fremont Weir in the Yolo Bypass flow can range from 56,000 cfs (existing crest) to 23,100 cfs (the proposed notch) (AR/NHI 1 as cited in SWRCB, 2010)).

Flow Criteria cont...

Category	Function	Flow (cfs)	Year Type	Months												Citation
				O	N	D	J	F	M	A	M	J	J	A	S	
Old and Middle Rivers	Reduces straying and improve homing fidelity for San Joaquin basin adult salmon Reduces entrainment of larval / juvenile delta smelt, longfin smelt, and provide benefits to other desirable species If FMWT index for longfin smelt is low, then OMR should be more positive than 0 or -1500 (depending on prior year population) to reduce entrainment losses when abundance is low. Needed to reduce entrainment of adult delta smelt, longfin smelt, and other species; less negative flows may be warranted during periods when significant portions of the adult smelt population migrate into the south or central Delta. Reduced risk of juvenile salmon entrainment and straying to central Delta Improve survival of San Joaquin River juvenile salmon emigrating down the San Joaquin River and improve subsequent escapement Increase survival of outmigrating smolts, decrease diversion of smolts into central Delta where survival is low	> -1,500 cfs 14-day running average	C, D						1	1	1	1				
		> 0 or -1,500 cfs, 14-day running average, when FMWT index for longfin smelt is less than 500, or greater than 500, respectively	C, D							1	1					
		> -5,000 cfs 14-day running average	All			1	1	1	1	1	1	1				
		> -2,500 cfs, 14-day running average, when salmon smolts are in the Delta	All		1	1	1	1	1	1	1	1				
		At Jersey Point: Positive flows when salmon are in the Delta	All		1	1	1	1	1	1	1	1				

1 = criteria recommended for the whole month

Limitations to DFG Report

- The recommendations in this report represent DFG's current understanding of the flow needs of the individual species identified in order to meet DFG's biological objectives.
- This report presents the effects of inflow and Delta outflow on several native, recreational, and commercial species that live in or pass through the Sacramento-San Joaquin River Delta.
- Several interrelated factors must be balanced in order to comprehensively manage water resources in the Delta, including: Delta outflows, Delta inflows, in-Delta water diversions, water quality, coldwater pool management, hydrology, hydrodynamics, tidal action, and project operations.

Summary

The flow criteria and biological objectives contained in this report provide recommendations to:

- Improve inflow to the Delta from the San Joaquin River and Sacramento River for salmon that better reflects the natural hydrograph during the winter and spring and fall for juvenile out-migration and adult migration.
- Maintain or improve flow conditions in the summer and fall in the upper reaches of the Sacramento and San Joaquin River tributaries, below rim dams, for spawning and rearing.
- Provide outflow from the Delta, past Chipps Island, in the winter, spring and fall which better reflects the natural hydrograph, for juvenile out-migration and adult migration.
- Provide outflow to maintain X2 at appropriate locations in the fall, winter and spring to provide habitat for Delta smelt and longfin smelt.
- Maintain OMR flows slightly negative to positive as determined by tidal condition in the late fall, winter and spring for salmonids, Delta smelt, and longfin smelt.
- Restore and enhance intertidal and floodplain natural communities in the Delta and upstream to re-establish natural ecosystem processes and heterogeneity.

Next Steps

- Scientific Review
- Public Comments
- Submittal to Water Board

Questions and Comments

Written comments are due: **October 15, 2010**

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