From: Thad Bettner [tbettner@gcid.net]
Sent: 11/5/2019 10:21:34 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Re: Sites Operations Work Group - Wed, Nov 6 1:30 pm to 3:00 pm Conference Call - No RSVP Needed

Hi Ali, yes I'm out this week. Ill try you on Monday when I'm back and catch up.

I have been coordinating with Richard Welsh on a meeting. I also talked with Jim about the role of Reclamation on Sites and we need to walk through what we want them to be doing. It still feels messy. Ill share more when we talk.

Thaddeus L Bettner, General Manager
Glenn-Colusa Irrigation District
PO Box 150
Willows, CA 95988
530.934.8881 (office)
530.588.3450 (cell)

On Nov 5, 2019, at 5:29 AM, Alicia Forsythe <aforsythe@sitesproject.org> wrote:

Thad - see below. Would you be able to provide the update on Shasta exchanges? I think I heard youre on vacation this week so wasn't sure if you'll be able to attend this work group call.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

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From: Rob Kunde <rkunde@wrmwsd.com>
Sent: Monday, November 4, 2019 5:34:52 PM
To: Dirk Marks <dmarks@scvwa.org>; Eric Leitterman <Eleitterman@valleywater.org>; jsutton@tccanal.com <jsutton@tccanal.com>; cchilmakuri@mwdh2o.com <cchilmakuri@mwdh2o.com>; ccwd2@frontiernet.net <ccwd2@frontiernet.net>; Cindy Kao <ckao@valleywater.org>; cwang@mwdh2o.com <cwang@mwdh2o.com>; Flores, Amparo <aflores@zone7water.com>; Ivory Reyburn <ireyburn@cvwd.org>; Randall Neudeck <rneudeck@mwdh2o.com>; rcheng@cvwd.org <rcheng@cvwd.org>; robert.tull@jacobs.com <robert.tull@jacobs.com>; wvanderwaal@rd108.org <wvanderwaal@rd108.org>; tbettner@gcid.net <tbettner@gcid.net>; Alicia Forsythe <aforsythe@sitesproject.org>; wmercado@zone7water.com <wmercado@zone7water.com>; DRuiz@westsidewd.com <DRuiz@westsidewd.com>; Rob Thomson <rthomson@sitesproject.org>
Cc: Jim Watson <jwatson@sitesproject.org>
Subject: Sites Operations Work Group - Wed, Nov 6 1:30 pm to 3:00 pm Conference Call - No RSVP Needed

Ladies and Gentlemen:

The next Sites Project Reservoir Operations Work Group Conference Call is as follows:

Date/Time: **Wed, Nov 6, 1:30 pm to 3:00 pm**

Call-In Phone: 310-372-7549 (tentative - if it changes, a followup email will be sent)

Call-In Passcode: 661517

No RSVP is required - I have your availability from the prior polling email.

The Call will primarily be status reports. At this time, there is no written material.

Agenda:

1. Rob Leaf (Jacobs) will provide a summary of the new BiOps for Reclamation and DWR, their anticipated effect on Reclamation and DWR operations, and their potential effects on Sites future operations (to the extent this can be qualitatively estimated at this early stage).
2. Sites staff are working on a new "chainsaw" affordability analysis for the November 15 Workshop and Nov 21 Reservoir Project Committee. Rob Tull will report on what Operations assumptions are included/not included in this analysis to date.
3. Ali Forsythe (?) will report on the status of discussions with Reclamation regarding operational exchanges between Shasta and Sites. Such exchanges will be critical to lowering the Project Cost through the Value Planning alternatives.
4. Rob Tull will provide a status report on updating the CALSIM code to allow analyses of Sites/Shasta exchanges.
5. Rob Tull will provide a status report on 2D water quality modeling for Shasta and Sites.
6. Rob Tull will provide a status report on preparation of an updated Operations Plan that includes written description of Modeling assumptions and (b) how Sites/Shasta exchanges may be implemented.

Apologies to Ivory and Shelly - Wednesday worked better for the majority and Rob Leaf was only available from 1-2pm.

Robert J. Kunde, P.E.

Retired Annuitant

Wheeler Ridge-Maricopa Water Storage District

cell: 661-345-3719

rkunde@wrmwsd.com

TECHNICAL MEMORANDUM

USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

PREPARED FOR:	USBR
PREPARED BY:	CH2M
DATE:	15 July 2019
PROJECT NUMBER:	708080CH.11.01

Introduction

The purpose of this memorandum is to provide a Draft Plan of Study to evaluate diversions into Sites Reservoir and potential impacts to fish survival associated with intake screen operations at Tehama-Colusa Canal Authority (TCCA) Red Bluff, Glenn-Colusa Irrigation District (GCID) Hamilton City and Delevan.

The memorandum includes the following sections:

- Introduction, Background and Purpose
- Study Framework
- Technical Studies
- Study Coordination
- Schedule and Sequence
- Preliminary Cost Estimates
- Attachments

Background

Sites Reservoir is a proposed 1.8 million acre-foot off-stream reservoir intended to divert and store excess Sacramento River streamflows, providing approximately 500,000 acre-feet per year of additional water supply on average. The Reservoir would provide multiple beneficial uses including a reliable water supply for cities and agriculture; dedicated water for fisheries and environmental purposes; increased habitat for migratory birds; and improved flexibility and drought resiliency for the Central Valley Project and the State Water Project.

Diversions from the Sacramento River to Sites Reservoir would be via intake facilities located at TCCA Red Bluff, GCID Hamilton City and Delevan. Key information regarding these facilities is provided in Table 1 and Figure 1 below.

Table 1. Summary of Intake Facilities

USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

Intake Facility	Location	Proposed Diversion (cfs)
TCCA Red Bluff	River mile 244 near Red Bluff, CA	2,100
GCID Hamilton City	River mile 206 near Hamilton City, CA	1,800
Sites Project Authority Delevan (Proposed)	River mile 158.5 near Maxwell, CA	2,000

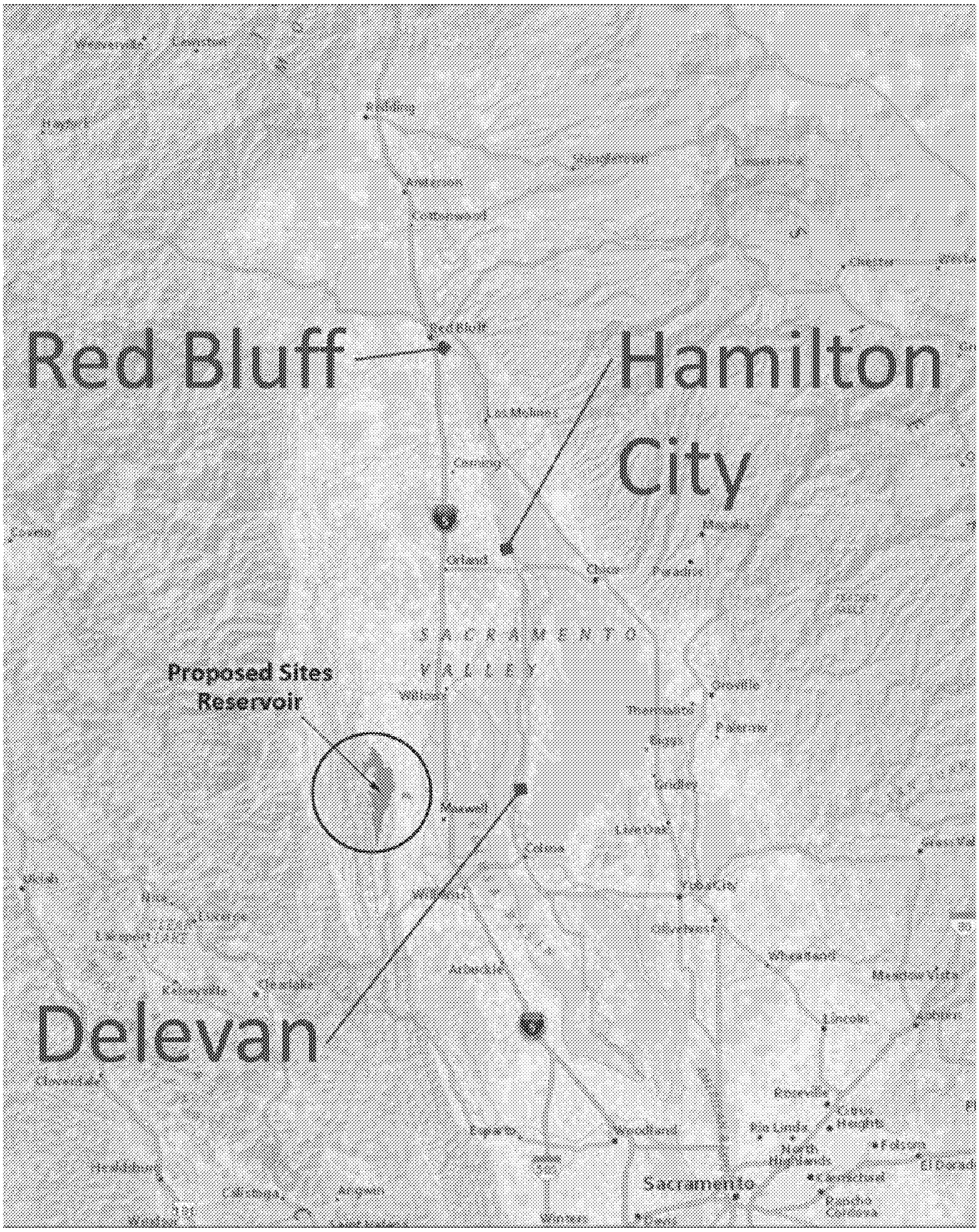

Figure 1 – Intake Facility Locations

USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

Key fish species of concern at the three locations include the following:

- Sacramento River Winter-run Chinook Salmon (*Oncorhynchus tshawytscha*)
- Central Valley Spring-run Chinook Salmon (*O. Tshawytscha*)
- Central Valley Steelhead (*O. mykiss*)
- Southern Distinct Population Segment (DPS) of North American Green Sturgeon (*Acipenser medirostris*)

Intake operations for Sites Reservoir would take place during the months of November through April, outside the normal irrigation season. This will include operations during periods of high streamflows resulting in conditions that are different than normally experienced at TCCA Red Bluff and GCID Hamilton City. This could include differing hydraulic, sediment and debris conditions, as well as exposure to other life stages of key species of concern. As such, the impact of the proposed diversions are not well understood, particularly as related to the outmigration and survival of juvenile anadromous salmonids. In addition, the Delevan facility is a proposed diversion for which no historical operations information or biological data currently exists. Therefore, additional studies will be required specifically for this intake location (and any other intake locations that may be proposed in the future).

A public Draft Environmental Impact Report (EIR) / Environmental Impact Statement (EIS) was prepared in August 2017 to address potential effects of the Sites Reservoir Project. The National Marine Fisheries Service (NMFS) provided the following comments (NMFS, 2018):

> *NMFS recommends further analysis to assess the effect of fish screens and fish screen interactions. In particular, baseline information regarding the efficiency of existing screen performance under current operations will need to be contrasted with expected performance during proposed Project operations, which include intake use at different times of the year than is permitted for current operations. As noted in the EIR/EIS, the interaction of potential stressors, such as the interaction between fish screens and predators and the efficacy of predator refugia, will need to be assessed.*

Detailed NMFS comments specifically pertaining to the fish screens are included as Attachment A of this technical memorandum.

Purpose

The purpose of this Draft Plan of Study is to identify studies that address potential impacts to fish survival associated with intake facility operations at TCCA Red Bluff, GCID Hamilton City and Delevan. The studies will address the NMFS comments on the public Draft EIR/EIS (NMFS, 2008) while also providing the following:

- Information to establish biological baselines and assess project effects.
- Information to support permitting and development of performance criteria.
- Information to inform facility design for Delevan.
- Pre- and post-construction monitoring and evaluation (M&E) requirements.
- Long-term M&E requirements.

The studies vary by intake facility due to location, facility configuration, historical operations, etc. The primary factors affecting survival of juvenile fish at the existing intake facilities (TCCA Red Bluff and GCID Hamilton City) are sweeping velocities and predation. Entrainment and/or impingement is typically not a significant source of fish mortality (Vogel, 2007). As such, the proposed studies will focus on sweeping velocity, predation and seasonal operations at these two sites.

Additional studies are required to inform the design of the proposed Delevan facility. However, the Delevan facility will be designed in accordance with NMFS and California Department of Fish and Wildlife (CDFW) criteria, so it is anticipated that the potential causes of fish injury/mortality at that facility may be similar to the two existing facilities.

It should be noted that this Plan of Study is a draft, and that the scope and quantity of studies proposed herein will likely be modified over time in response to available data and literature, stakeholder input and/or project technical requirements.

Study Framework

Development of the Draft Plan of Study included a literature search to identify existing, available data, information and research that could be used to support evaluation of the project. The Literature Search is provided as Attachment B, and includes information regarding the following:

- Published design criteria/guidelines/manuals
- Project and facility evaluations
- Technical research and studies

Current biological opinions and incidental take permits were also reviewed as related to the ongoing operation of existing facilities and associated effects on listed species. The draft study plan is described in Table 2 by facility, and the relationship and linkages of these studies are presented in Figure 2.

Table 2. Draft Study Plan by Facility
USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

Study No.	Description	Purpose	TCCA Red Bluff	GCID Hamilton City	Delevan
Pre-Construction Studies					
1	Flow Profiling Field Study	Obtain bathymetric survey data and characterize the River velocity distribution at transects within the proposed intake reach under varying flow conditions for calibration of the hydraulic models.			X
2	Site Location Numerical Study	Develop site-specific numerical hydraulic models to characterize River hydraulics and the interaction with the proposed intake under all design operating conditions.			X
3	Site Location Lab Study	Optimize hydraulics and address sediment transport issues at the proposed intake site via a physical model.			X
4	Baseline Fish Studies	Determine baseline densities and seasonal distributions of key fish species and life stages anticipated to be present during intake operations.	X	X	X
5	Baseline Juvenile Salmonid Survival Rates	Determine baseline rates of survival for juvenile Chinook salmon and steelhead within the immediate vicinity of the intake facility during existing and proposed intake operations.	X	X	X
6	Predator Habitat Locations	Identify the physical locations and biological characteristics of where predatory fish congregate, and develop design and management criteria to reduce predation risk.	X	X	X
7	Baseline Predator Density and Distribution	Determine the baseline densities and distribution of predatory fish within the immediate vicinity of the intake facility.	X	X	X
8	Refugia Field Study	Evaluate the effectiveness of using refugia as part of intake structure to provide holding habitat for juvenile fish to recover from swimming fatigue and to avoid exposure to predatory fish.	X	X	

Table 2. Draft Study Plan by Facility
USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

Study No.	Description	Purpose	TCCA Red Bluff	GCID Hamilton City	Delevan
9	Refugia Lab Study	Test and verify final recommendations for location, size, and configuration of refugia.			X
Post-Construction Studies					
10	Post-Construction Hydraulic Fish Screen Evaluation	Field hydraulic evaluations to evaluate fish screen porosity controls for anticipated operations.	X[1]	X[1]	X
11	Long-Term Hydraulic Fish Screen Evaluation	Long-term evaluation of fish screen performance.	X[1]	X[1]	X
12	Operations & Maintenance (O&M) Updates	Identify and refine O&M requirements associated with the proposed operations, including screen cleaning, sediment/debris handling, pump operations and project staffing requirements.	X[1]	X[1]	X
13	Post-Construction Fish Studies	Determine densities and seasonal distributions of all key fish species and life stages present during proposed intake operations.	X[1]	X[1]	X
14	Post-Construction Juvenile Salmonid Survival Rates	Determine rates of survival for juvenile Chinook salmon and steelhead within the immediate vicinity of the intake facility during proposed intake operations.	X[1]	X[1]	X
15	Post-Construction Predator Density and Distribution	Determine densities and distribution of predatory fish within the immediate vicinity of the intake facility.	X[1]	X[1]	X

[1] Selected studies may be very similar and/or only require minor modifications to existing permit requirements for TCCA Red Bluff and GCID Hamilton City.

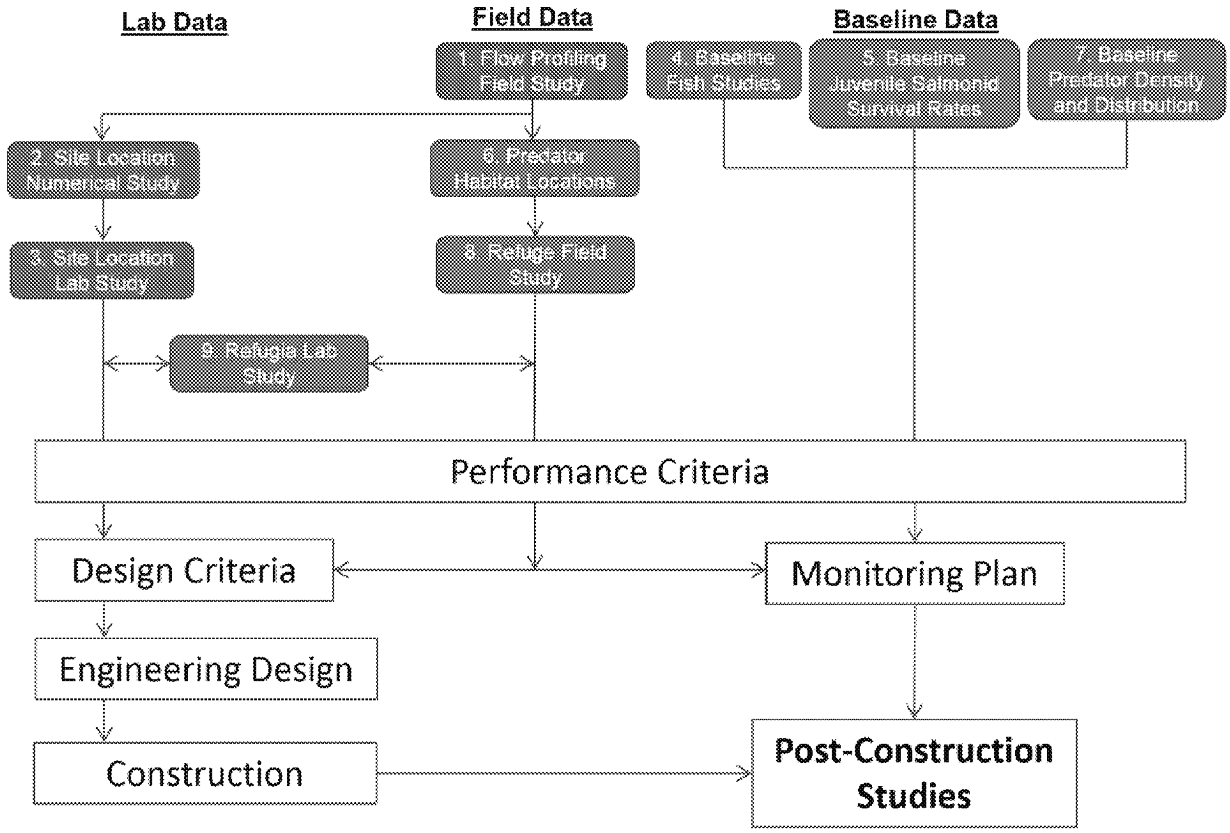

Figure 2 Study Plan Framework
USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

It is anticipated that an adaptive management approach will be utilized to address any uncertainties associated with the project following implementation of the Study Plan. New information and improved tools/methodologies will be applied on an ongoing basis to evaluate potential future changes to operating criteria and mitigation requirements.

Technical Studies

The following describes each of the 15 studies as follows:

- Study objective
- Key questions to be answered
- Scope
- Linkages to other studies
- Description of how the results would be used
- Schedule

The study descriptions are intended to serve as the basis for the development of task orders and/or requests for proposals (RFPs) to implement the studies. It is anticipated that the first task of each study will be the development of a detailed study design for review by the resource agencies prior to initiation of the work. It is expected that the study designs will take advantage of available information, data and research that exist in the literature, as well as coordination with other ongoing studies to the extent possible.

1 Flow Profiling Field Study

Objective

The objective of this study is to characterize the River velocity distribution at transects within the proposed Delevan reach under varying flow conditions for calibration of the hydraulic models. It includes the collection of survey data and sediment samples.

Key Questions

1. What is the velocity distribution at various transects at the Delevan site under various river conditions?
2. What are the concentrations and characteristics of the suspended sediment and bed load in the River at the Delevan site?
3. What is the current riverbed cross section and bathymetry in this reach?

Scope of Study

This study would pertain to the proposed Delevan site (and any other additional intake locations that may be proposed in the future). Key scope items include the following:

- Develop detailed study design.
- Establish survey control and collect topographic data.
- Collect multi-beam sonar bathymetric survey data.
- Collect field velocity data with acoustic Doppler current profiler.
- Collect bed load, bottom sediment and suspended sediment samples at various streamflow conditions.
- Collect available data and review operations at existing Maxwell Irrigation District intake.
- Prepare report and associated documentation.

Linkage to Other Studies

Provides data and information to support all subsequent studies, including the Study No. 2 - Site Location Numerical Study and the Study No. 3 - Site Location Lab Study in particular.

How Study Results Will Be Used

Provides data to calibrate the Study No. 2 - Site Location Numerical Study and provides boundary conditions for the Study No. 3 - Site Location Lab Study. Provides baseline information to support other studies.

Schedule

Duration on the order of 6 to 9 months.

2 Site Location Numerical Study

Objective

The objective of this study is to develop site-specific numerical studies (mathematical models) to characterize the River hydraulics and interaction with the proposed Delevan intake under the proposed design operating conditions.

Key Questions

1. What are the key river hydraulic characteristics, including sweeping flows, in the vicinity of the proposed Delevan intake?
2. How does the proposed Delevan intake interact with the river hydraulics under different streamflow conditions?
3. What hydraulic and operational parameters should be explored in Study No. 3 Site Location Lab Study?
4. How do hydraulic conditions at the intake structure affect the sediment movement and scour at the site?
5. What impact will the diversion have concerning the potential predation and survival of fish?

Scope of Study

This study would pertain to the proposed Delevan site (and any other additional intake locations that may be proposed in the future). Key scope items include the following:

- Develop detailed study design.
- Define boundary conditions.
- Develop model.
- Calibrate and validate model.
- Utilize model to evaluate issues of concern.
- Prepare report and associated documentation.

Linkage to Other Studies

This study is dependent on the results of Study No. 1 - Flow Profiling Field Study, and provides information in support of the Study No. 3 - Site Location Lab Study.

How Study Results Will Be Used

Informs the design of Study No. 3 - Site Location Lab Study, as well as the engineering design and permitting of the intake facility.

Schedule

Duration on the order of 6 months.

3 Site Location Lab Study

Objective

The objective of this study is to optimize the hydraulics and address sediment transport issues at the proposed Delevan site. In addition to the technical hydraulic and sediment data that will be obtained through completion of a physical model, it will also provide a substantial benefit in project understanding and visualization of the proposed facility.

Key Questions

1. How does the screen structure interact with the river hydraulics under different streamflow conditions?
2. How do these hydraulic interactions affect sediment transport past the structure and the potential for sediment scour and/or deposition?
3. How do the hydraulic impacts of the structure affect habitat for predators?
4. How would the structure impact navigation?
5. How does sediment move once it is past the fish screens and moving toward the pumps behind the screens?
6. Can porosity controls be adjusted to provide near-uniform approach velocities at the screen face?
7. Are refugia adequately spaced to limit exposure time based on the measured sweeping velocities?
8. Can transition walls, screen geometry, or channel geometry be modified to improve screen performance?

Scope of Study

This study would pertain to the proposed Delevan site (and any other additional intake locations that may be proposed in the future). Key scope items include the following:

- Develop detailed study design.
- Define boundary conditions.
- Construct model.
- Calibrate and validate model.
- Utilize model to evaluate issues of concern.
- Prepare report and associated documentation.

Linkage to Other Studies

Dependent on the results of Study Nos. 1 and 2.

How Study Results Will Be Used

Model results will be used to refine, optimize and confirm the design of the intake facility.

Schedule

Duration on the order of 6 to 9 months.

4 Baseline Fish Studies

Objective

Determine baseline densities and seasonal distributions of all key fish species and life stages anticipated to be present during intake facility operations.

Key Questions

1. What is the seasonal and geographic distribution of each life stage of key species in the vicinity of the diversion locations, and which direction (upstream or downstream) are they generally moving?
2. What are the densities of each life stage of key fish species inhabiting the Sacramento River adjacent to the diversion sites?
3. What is the fish length frequency distribution of all life stages of covered fish species observed at each of the proposed diversion sites?
4. Is the distribution of each life stage of covered fish species inhabiting the lower Sacramento River uniform within the river water column and laterally across the channel width, or does the distribution vary spatially? Does the spatial distribution vary between day and night?
5. How do the distribution and densities of covered fish species respond to variation in Sacramento River flow and other environmental conditions such as turbidity, water temperature, and dissolved oxygen?

Scope of Study

This study would pertain to all three intake facility sites. It is anticipated that significant data, information and research already exists for TCCA Red Bluff and GCID Hamilton City. Key scope items include the following:

- Collect and review available data, information and research.
- Develop detailed study design.
- Conduct first year studies (November through April timeframe).
- Revise study design as required.
- Conduct remaining studies.
- Prepare reports and associated documentation.

Linkage to Other Studies

This study would be coordinated with Study No. 5 - Baseline Juvenile Salmond Survival Rates and Study No. 7 - Baseline Predator Density and Distribution. Results would be compared with Study No. 13 – Post-Construction Fish Studies.

How Study Results Will Be Used

The results of the surveys will be used to establish baseline conditions for covered fish species within the reaches of the River where the intake facilities are sited.

Schedule

Duration on the order of 3 years.

5 Baseline Juvenile Salmonid Survival Rates

Objective

The objective of this study is to determine baseline rates of survival for juvenile Chinook salmon and steelhead within the Sacramento River in the vicinity of proposed diversions for comparison to post-project survival in the same area, with sufficient statistical power to detect on the order of a 5 percent difference in survival.

Key Questions

1. What is the baseline (current) survival of juvenile Chinook salmon and steelhead migrating downstream in the Sacramento River in the vicinity of the proposed diversions, and how much does survival vary within and among years and by species?
2. What is the sample size of acoustically-tagged juvenile salmonids that would be required to detect on the order of a 5 percent change in survival over the reach as a result of facility operations?
3. Do fish size, season, species, flow, velocity, turbidity, tidal phase and/or migration rates predict juvenile salmonid inter-reach or intra-reach survival rates?
4. Does survival, through the treatment reaches and in comparison to control reaches, differ by more than on the order of 5 percent under various environmental and biological conditions?
5. Can results of these pre-construction survival studies be used as a baseline for detecting changes in juvenile salmonid survival that may be attributable to the diversion structures and operations?
6. What is the distribution of juvenile salmonids within the river channel and how does the location and migratory path change in response to variation in factors such as river flow, species, and time of day?
7. Are hatchery-produced juvenile Chinook salmon and/or steelhead a suitable surrogate for wild fish in assessing changes in survival in the future as a function of intake operations?

Scope of Study

This study would pertain to all three intake facility sites. It is anticipated that significant data, information and research already exists for TCCA Red Bluff and GCID Hamilton City. Key scope items include the following:

- Collect and review available data, information and literature.
- Develop detailed study design.
- Conduct first year studies (November through April timeframe).
- Revise study design as required.
- Conduct remaining studies.
- Prepare reports and associated documentation.

Linkage to Other Studies

This study should be coordinated with Study No. 4 - Baseline Fish Studies and Study No. 7 - Baseline Predator Density and Distribution.

How Study Results Will Be Used

The baseline juvenile salmonid survival rates will be compared to post-construction juvenile salmonid survival rates to confirm that an overall net benefit is provided in accordance with permit requirements.

Schedule

Duration on the order of 3 years.

6 Predator Habitat Locations

Objective

The objective of this study is to identify the physical and biological characteristics of locations that attract predatory fish near the diversion facilities and to identify potential changes that would be expected to reduce predator abundance or prey vulnerability. Based on data from existing and ongoing studies and data collected at existing water diversion structures, the objective also involves identifying design and management criteria that would serve to reduce predation risk.

Key Questions

1. Where do predatory fish congregate at existing diversion structures?
2. Are birds and mammals important predators of covered fish at existing diversion structures?
3. Are there intake structures where predator congregation is most pronounced and other structures where predator congregation does not occur?
4. What are the characteristics of locations of increased predator densities (e.g., scour holes, outside bends in the River, the channel center or along the channel margin, existing structures, and/or other such characteristics)?
5. What are the water velocity and bathymetric characteristics at predator congregation sites?
6. Where do prey organisms concentrate and what are the characteristics of those locations?
7. What are the characteristics of cover (e.g., depth, substrate, woody debris) at predator congregation sites?
8. How do built features (intake facility components) contribute to cover used by predators?
9. How are predators distributed relative to refugia sites?
10. Do the characteristics of predator congregation sites differ by species of predatory fishes?

Scope of Study

This study would pertain to all three intake facility sites. It is anticipated that significant data, information and research already exists for TCCA Red Bluff and GCID Hamilton City. Key scope items include the following:

- Collect and review available data, information and research.
- Develop detailed study design.
- Conduct studies.
- Prepare reports and associated documentation.

Linkage to Other Studies

This study should be linked and coordinated with Study No. 7 - Baseline Predator Density and Distribution and Study No. 8 - Refugia Field Study.

How Study Results Will Be Used

The results of the Predator Habitat Locations Study will be used to inform the design of the Delevan intake facility (and potential modification of the other facilities) such that predation can be minimized.

Schedule

Duration on the order of 2 years.

7 Baseline Predator Density and Distribution

Objective

The objective of this study is to determine the baseline densities, species composition, and seasonal and geographic distribution of predatory fish (and birds and mammals if appropriate) within the Sacramento River in the reaches where the diversions are sited as well as adjacent control reaches. Baseline data collected on predator occurrence in the vicinity of each facility can then be used in the future to determine changes in predator density and distribution that may be associated with existence and operation of each facility.

Key Questions

1. What are baseline densities of predatory fish, birds, and mammals in the Sacramento River within reaches where the diversion structures are proposed to be sited?
2. How do predator densities within proposed diversion reaches compare to predator densities in adjacent control reaches?
3. How do predator densities vary by season and in response to changes in Sacramento River streamflow, water temperatures, turbidity, time of day, and other factors such as water velocity, areas of turbulence, and proximity to shorelines or physical structures within the river?
4. What are the predatory fish and bird species that inhabit the Sacramento River in the vicinity of the proposed diversion sites?
5. What is the species composition, relative abundance, and length and weight of predatory fish, and how do these metrics vary within and among years and among locations within this reach of the River?
6. What is the diet and selection of prey species for the predators inhabiting the river and how does the diet vary on a species-specific basis, by predator and prey size, and by season?

Scope of Study

This study would pertain to all three intake facility sites. It is anticipated that significant data, information and research already exists for TCCA Red Bluff and GCID Hamilton City. Key scope items include the following:

- Collect and review available data, information and research.
- Develop detailed study design.
- Conduct first year studies (November through April timeframe).
- Revise study design as required.
- Conduct remaining studies.
- Prepare reports and associated documentation.

Linkage to Other Studies

This study should be linked and coordinated with Study No. 6 - Predator Habitat Locations and Study No. 8 - Refugia Field Study.

How Study Results Will Be Used

The results of the Baseline Predator Density and Distribution Study will be used to assess current baseline predator densities, species composition, and seasonal and geographic distribution of predators in the Sacramento River in the vicinity of the diversions.

Schedule

Duration on the order of 3 years.

8 Refugia Field Study

Objective

The objective of this study is to evaluate the effectiveness of using refugia as part of diversion structure design for the purpose of providing areas for juvenile fish passing the screen to hold and recover from swimming fatigue and to avoid exposure to predatory fish. In addition, the objective is to gain insights (through observation) into the biological benefits of incorporating refugia into diversion structures.

Key Questions

Scope of Study

This study would pertain to the TCCA Red Bluff and GCID Hamilton City sites. Key scope items include the following:

- Develop detailed study design.
- Conduct first year studies (November through April timeframe).
- Revise study design as required.
- Conduct remaining studies.
- Prepare reports and associated documentation.

Linkage to Other Studies

This study should be linked and coordinated with Study No. 6 - Predator Habitat Locations and Study No. 7 - Baseline Predator Density and Distribution. The results of this study will inform Study No. 9 - Refugia Lab Study.

How Study Results Will Be Used

Study results will be used to identify any required modifications to the TCCA Red Bluff and GCID Hamilton City sites, and will inform the design of the proposed Delevan facility.

Schedule

Duration on the order of 2 years.

9 Refugia Lab Study

Objective

The objective of this study is to test and optimize the final recommendations for refugia that may be required for installation at Delevan.

Key Questions

1. What refugia configuration should be used at the Delevan facility to best optimize fish usage and to minimize mortality?
2. How do the results of Study No. 8 - Refugia Field Study influence the design of refugia studied in the lab?
3. What are the detailed hydraulics associated with refugia?
4. How do prey and predator fish respond in the physical model?
5. What size do refugia need to be to operate effectively?
6. What is the best location and spacing of refugia along the screen face?
7. What is the best bar rack spacing for refugia to encourage use and reduce predation?
8. Do refugia capture debris and how does the accumulation of debris affect performance?
9. How do differences in fish size and species affect use of refugia?
10. How long do individual fish use refugia before exiting, and does residence time in the refugia influence time of transit across the screen or cause a delay in migration?

Scope of Study

This study would pertain to the proposed Delevan site only. Key scope items include the following:

- Collect and review available data, information and research.
- Develop detailed study design.
- Define boundary conditions.
- Construct model.
- Calibrate and validate model.
- Utilize model to evaluate issues of concern.
- Prepare report and associated documentation.

Linkage to Other Studies

This study should be coordinated with Study No. 8 - Refugia Field Study.

How Study Results Will Be Used

The results of this study will be used to refine and optimize the design of the proposed Delevan facility.

Schedule

Duration on the order of 9 months.

10 Post-Construction Hydraulic Fish Screen Evaluation

Objective

The objective of this study is to confirm/establish porosity control settings and to confirm compliance with design and permitting criteria.

Key Questions

1. Are approach and sweeping velocities within criteria at the intake facilities for the diversion rates and streamflows expected during operation?
2. Are porosity controls for the existing intake facilities at TCCA Red Bluff and GCID Hamilton City operating as designed and intended, particularly with the provision of an additional pump at TCCA Red Bluff?
3. Are adjustments to the existing porosity control settings for the existing TCCA Red Bluff and GCID Hamilton City intake facilities required to accommodate the diversion rate and streamflow conditions associated with the proposed project?
4. Are variable porosity control settings required to accommodate the range of anticipated diversion rates and streamflow conditions?
5. What porosity control settings are required to satisfactorily operate the Delevan facility once it has been constructed?
6. Are different porosity control settings and/or fish exclusion measures required to operate the Delevan facility in a water return/discharge mode if the water diversion and water return functions are co-located within a single facility?

Scope of Study

This study would pertain to all three intake facility sites. Key scope items include the following:

- Develop detailed study design in accordance with NMFS, 2018.
- Collect field data with an acoustic Doppler velocimeter.
- Adjust intake operations and/or porosity control settings as required.
- Collect and evaluate field data to confirm compliance.
- Prepare report and associated documentation.

Linkage to Other Studies

This study should be coordinated with Study No. 3 - Site Location Lab Study for the Delevan site.

How Study Results Will Be Used

This study will confirm compliance with intended design criteria and objectives at Delevan. This study may also inform Study No. 11 - Long-Term Hydraulic Fish Screen Evaluation and Study No. 12 - Operations and Maintenance Updates for all three intake facilities.

Schedule

Duration on the order of 6 to 9 months.

11 Long-Term Hydraulic Fish Screen Evaluation

Objective

The objective of this study is to ensure operational criteria are within acceptable tolerances over the long term, across multiple seasons. Sediment transport and accumulation within the intake will be evaluated during the proposed period of operation. Changes to porosity control settings and/or sediment management practices will be identified to address changes in River conditions and diversion rates.

Key Questions

1. Are approach and sweeping velocities within criteria?
2. Are porosity controls operating as designed and intended?
3. Are the sediment control measures operating as designed and intended?
4. Are associated O&M requirements reasonable and achievable?

Scope of Study

This study would pertain to all three sites.

- Develop detailed study design.
- Collect and evaluate field data.
- Adjust intake operations and/or porosity control settings as required.
- Collect and evaluate field data to confirm compliance.
- Prepare report and associated documentation.

Linkage to Other Studies

It is anticipated that this study will provide hydraulic data to support the various biological evaluations (Study Nos. 4 through 9 and 13 through 15).

How Study Results Will Be Used

The study results will be used to optimize and refine performance of the facility while confirming continued compliance with design criteria and operational objectives.

Schedule

Duration on the order of 3 to 6 months every 5 years or so during operations.

12 O&M Updates

Objective

The objective of this study is to evaluate and adjust O&M procedures as required to accommodate any changes associated with the proposed project operation period from November through April. This could include screen cleaning, sediment/debris handling, pump operations and/or project staffing requirements.

Key Questions

1. Are existing and proposed O&M requirements reasonable and achievable?
2. Are additional sediment and debris handling provisions required?
3. Is staffing and equipment adequate for the proposed operations?
4. Does installation and use of an additional pump at TCCA Red Bluff require any special considerations?
5. Do winter flood flows, including overtopping of the structure at GCID Hamilton City at a streamflow of approximately 100,000 cfs, necessitate any revised O&M procedures to protect fish?

Scope of Study

This study would pertain to all three sites.

- Develop detailed study design.
- Collect and evaluate field data, including collaborative workshop with operators.
- Prepare report and associated documentation, including recommended adjustments to intake maintenance and operations as required.

Linkage to Other Studies

This study should be coordinated with Study No. 11 – Long-Term Hydraulic Fish Screen Evaluation.

How Study Results Will Be Used

The study results will be used to optimize and refine performance of the facility while confirming continued compliance with design criteria and operational objectives.

Schedule

Duration on the order of 3 to 6 months.

13 Post-Construction Fish Studies

Objective

The objective of this study is to collect post-construction fish survey data for comparison to baseline, and to identify any changes in densities or seasonal distribution as a result of intake operations.

Key Questions

See Study No. 4 – Baseline Fish Studies.

Scope of Study

This study would pertain to all three intake facility sites. It is anticipated that significant data, information and research already exists for TCCA Red Bluff and GCID Hamilton City. Key scope items include the following:

- Develop detailed study design.
- Conduct studies (November through April timeframe).
- Prepare reports and associated documentation.

Linkage to Other Studies

Results would be comparted to Study No. 4 – Baseline Fish Studies. This study would be coordinated with Study No. 14 – Post-Construction Juvenile Salmond Survival Rates and Study No. 15 – Post-Construction Predator Density and Distribution.

How Study Results Will Be Used

The results of the study will be used for comparison with baseline conditions for covered fish species within the reaches of the River where the intake facilities are sited.

Schedule

Duration on the order of 3 years.

14 Post-Construction Juvenile Salmonid Survival Rates

Objective

The objective of this study is to collect post-construction survival data for comparison to baseline, and to identify any changes in survival rates as a result of intake operations.

Key Questions

See Study No. 5 – Baseline Juvenile Salmonid Survival Rates.

Scope of Study

This study would pertain to all three intake facility sites. It is anticipated that significant data, information and research already exists for TCCA Red Bluff and GCID Hamilton City. Key scope items include the following:

- Develop detailed study design.
- Conduct studies (November through April timeframe).
- Prepare reports and associated documentation.

Linkage to Other Studies

Results would be comparted to Study No. 5 – Baseline Juvenile Salmonid Survival Rates. This study would be coordinated with Study No. 13 – Post-Construction Fish Studies and Study No. 15 – Post-Construction Predator Density and Distribution.

How Study Results Will Be Used

The results of the study will be used for comparison with baseline conditions for covered fish species within the reaches of the River where the intake facilities are sited.

Schedule

Duration on the order of three years.

15 Post-Construction Predator Density and Distribution

Objective

The objective of this study is to collect post-construction predator data for comparison to baseline, and to identify any changes in density and distribution as a result of intake operations.

Key Questions

See Study No. 7 – Predator Habitat Density and Distribution.

Scope of Study

This study would pertain to all three intake facility sites. It is anticipated that significant data, information and research already exists for TCCA Red Bluff and GCID Hamilton City. Key scope items include the following:

- Develop detailed study design.
- Conduct studies (November through April timeframe).
- Prepare reports and associated documentation.

Linkage to Other Studies

Results would be comparted to Study No. 7 – Predator Habitat Density and Distribution. This study would be coordinated with Study No. 14 – Post-Construction Juvenile Salmonid Survival Rates and Study No. 15 – Post-Construction Predator Density and Distribution.

How Study Results Will Be Used

The results of the study will be used for comparison with baseline conditions for covered fish species within the reaches of the River where the intake facilities are sited.

Schedule

Duration on the order of three years.

Study Coordination

Selected studies are linked and should be closely coordinated. Opportunities may exist to improve the cost and technical efficiency of studies by combining them with other study efforts, sharing elements of the study (e.g., use the same tagged fish for multiple purposes and combining permits), and by sharing equipment and staff resources. This coordination would sequence studies and tasks to help ensure that information flows efficiently from one study to the other and would maximize the utilization of resources among the studies.

The coordination element should also include collaboration with similar ongoing studies conducted in the Sacramento River, particularly for the baseline biological studies. Collaborating and coordinating with organizations, such as other state, federal, and academic programs that have historically gathered data within the vicinity of the proposed intakes, is necessary to avoid duplication of effort and to broaden the utility of the collected information.

Schedule and Sequence

A preliminary schedule and anticipated sequence for the various pre-construction studies was developed for planning purposes. The schedule does not show actual calendar dates because it is not currently known when these studies would be approved and funded. Although the timing of study implementation will be influenced by several factors, the general priority and sequence of studies should remain the same.

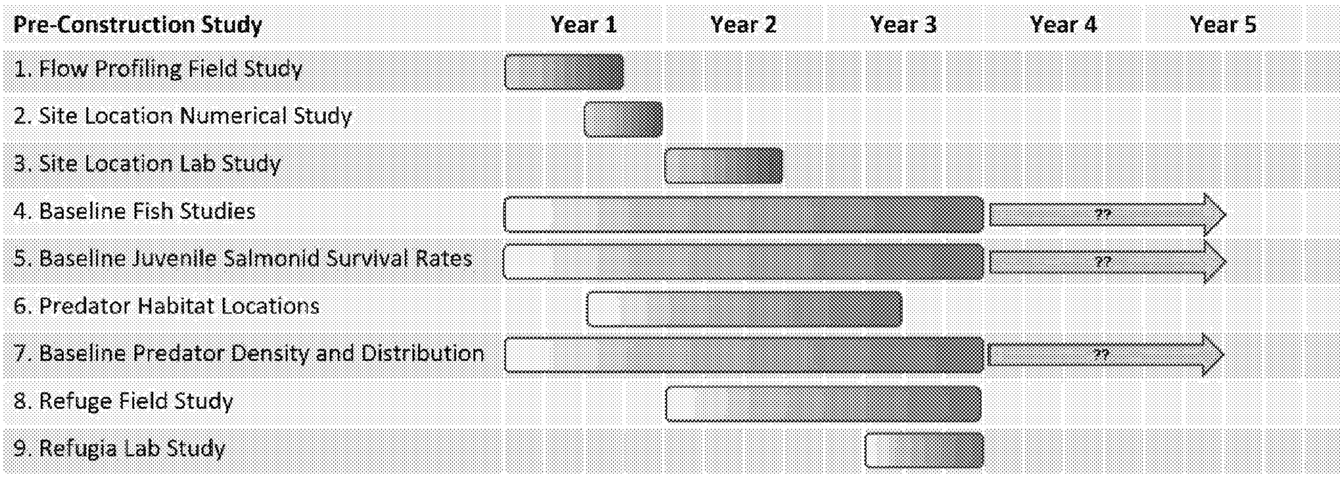

Figure 3 – Schedule and Sequence for Pre-Construction Studies
USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

Preliminary Cost Estimates

Preliminary order-of-magnitude cost estimates were developed for each study plan and are intended to provide a relative comparison of the funding required. The initial cost estimates may be influenced by the timing of the studies, and the extent to which the studies can take advantage of existing data or be integrated with other ongoing studies. It is anticipated that more detailed estimates will be developed as the studies are further scoped and refined.

Table 3. Preliminary Cost Estimates
USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

Study No.	Description	Relative Order-of-Magnitude Cost Estimate	Assumptions
1.	Flow Profiling Field Study	Low	
2.	Site Location Numerical Study	Low	
3.	Site Location Lab Study	Moderate	Assumes construction of physical model.
4.	Baseline Fish Studies	Moderate	First-year study only.
5.	Baseline Juvenile Salmonid Survival Rates	High	First-year study only.
6.	Predator Habitat Locations	Moderate	
7.	Baseline Predator Density and Distribution	Moderate	First-year study only.
8.	Refugia Field Study	Moderate	Assumes construction of physical model.
9.	Refugia Lab Study	Low	
10.	Post-Construction Hydraulic Fish Screen Evaluation	Low	
11.	Long-Term Hydraulic Fish Screen Evaluation	Low	First-year study only.
12.	Operations & Maintenance (O&M) Updates	Low	First-year study only.
13.	Post-Construction Fish Studies	Moderate	First-year study only.
14.	Post-Construction Juvenile Salmonid Survival Rates	High	First-year study only.
15.	Post-Construction Predator Density and Distribution	Moderate	First-year study only.

Notes:

Low Cost: Up to approximately $500k.

Moderate Cost: Approximately $500k to $1M.

High Cost: Above approximately $1M.

Attachments

Attachment A – NMFS Draft EIR/EIS Comments
Attachment B – Literature Search

Attachment A – NMFS Draft EIR/EIS Comments

The following provides a summary of NMFS comments on the public Draft Sites Reservoir EIR/EIS that specifically pertain to fish screens.

Table 1. NMFS Comments

USBR Sites Reservoir – Draft Plan of Study for Fish Screen Interactions

Comment No.	Comment	Page No.	Associated Sections	Keywords
EIS3-1	Operation and efficiency of the fish screens at the RB pumping plant (TC canal) is unclear/not identified	54 of 118		fish screen, operations
EIS3-3	The GCID intake fish screen facility is expected to operate similar to current operations but year-round. What kind of analysis is there for current operations and why are the screens expected to perform the same during different periods/seasons of operations? NMFS would likely need to see baseline operations and compare them to future operations.	64 of 118	Would need similar analysis of TC Canal fish screens operations as well.	fish screen, operations
EIS12-6	"Existing screens at the pumping plants are designed to prevent entrainment of Chinook salmon and steelhead into the canals" This does not negate effect, NMFS criteria are that screens are expected to be 95% effective (this goes for existing facilities as well). For the consultation NMFS would need further analysis of the fish screens (new and existing) and the effect of operations on the screen efficiency.	50 of 118		fish screens, assumptions
EIS12-16	Existing TC Canal Connections and existing GCID Main Canal Facilities are not analyzed but should they be? For the consultation NMFS would need further analysis of the fish screens (new and existing) and the effect of operations (timing and fish presence) on the screen efficiency.	65 of 118		fish screens, assumptions
EIS12-17	"Because fish screens would be designed to meet NMFS and CDFW design criteria, no further evaluation of direct fish screen mortality is conducted in this EIR/EIS. However, while the fish screen associated with the Delevan Pipeline Intake/Discharge Facilities would be designed to meet all NMFS and CDFW criteria, and diversions would occur at flow rates that would allow adequate approach and sweeping velocities, potential indirect impacts on fish migrating past the screens could occur." Fish Screen/Predation interaction.	71 of 118	Vogel et. al., 1998	fish screens, predation

Attachment B – Literature Search

USBR Sites Reservoir – Fish Protection Intake Screen Literature Search

PREPARED FOR:	USBR
PREPARED BY:	CH2M
DATE:	15 July 2019
PROJECT NUMBER:	708080CH.11.01

The purpose of this memorandum is to briefly summarize the results of a literature search concerning intake fish protection screen technology and interaction with migrating anadromous salmonids, particularly as related to conditions and species present within the Sacramento River basin.

The literature is generally organized into the following categories:

- Published design criteria/guidelines/manuals
- Project and facility evaluations
- Technical research and studies

Literature that contains information anticipated to be of key importance to the Sites Reservoir project is specifically identified.

Table 1. Published Design Criteria/Guidelines/Manuals
USBR Sites Reservoir – Fish Protection Intake Screens Literature Search

No.	Reference	Type of Content	Key Information Relevant to Project
1	Bell, M.C. 1991. *Fisheries Handbook of Engineering Requirements and Biological Criteria*. Fish Passage Development and Evaluation Program. North Pacific Division, U.S. Army Corps of Engineers, Portland, Oregon.	Design and operations information; biological data.	Biological data including fish swimming ability.
2	California Department of Fish and Game (CDFG). 2000. *Fish Screening Criteria*. 19 June.	Resource agency design criteria and guidelines.	Latest resource agency design criteria and guidelines.
3	Canada Department of Fisheries and Oceans. 1995. *Freshwater Intake End-of-Pipe Fish Screen Guideline*. Ottawa, Ontario. March.	Resource agency design criteria and guidelines.	
4	Clay, Charles H. 1995. *Design of Fishways and Other Fish Facilities, Second Edition*. Lewis Publishers, Boca Raton, Florida.	Design and operations information.	
5	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA) - German Association for Water, Wastewater and Waste. 2006. *Fish Protection Technologies and Downstream Fishways*. April.	Design, technology and operations information.	
6	Electric Power Research Institute (EPRI). 2002. *Upstream and Downstream Fish Passage and Protection Technologies for Hydroelectric Application, A Fish Passage and Protection Manual*. December.	Design, technology and operations information.	
7	Katopodis, C. 1992. *Fish Screening Guide for Water Intakes*. Working Document, Freshwater Institute, Department of Fisheries and Oceans. Winnipeg, Manitoba.	Design criteria and guidelines.	
8	National Marine Fisheries Service (NMFS) Environmental & Technical Services Division. 1990. *Fish Passage Facilities Functional Design Guidelines and Supplemental Criteria*. Portland, Oregon. 16 November.	Resource agency design criteria and guidelines (superseded).	
9	NMFS Northwest Region. 1995. *Anadromous Salmonid Passage Facility Design*. Portland, Oregon. 16 February.	Resource agency design criteria and guidelines (superseded).	
10	NMFS Northwest Region. 1996. *Anadromous Salmonid Passage Facility Design*. Portland, Oregon. 9 May.	Resource agency design criteria and guidelines (superseded).	
11	NMFS Northwest Region. 2008. *Anadromous Salmonid Passage Facility Design*. Portland, Oregon. February.	Resource agency design criteria and guidelines (superseded).	
12	NMFS Northwest Region. 2011. *Anadromous Salmonid Passage Facility Design*. Portland, Oregon. July.	Resource agency design criteria and guidelines (superseded).	
13	NMFS Southwest Region. 1997. *Southwest Region Fish Screening Criteria for Anadromous Salmonids*. January.	Resource agency design criteria and guidelines (superseded).	
14	National Oceanic and Atmospheric Administration (NOAA) Fisheries, U.S. Department of Commerce. 2016. *Fish Screening and Guidance at Water Diversions*. Presented to Fish Screening Oversight Committee (FSOC). 13 September.	Resource agency design criteria and guidelines.	

15	NOAA Fisheries. 2018. *NOAA Technical Memorandum NMFS-NWFSC-1xx, NOAA Fisheries West Coast Region Anadromous Salmonid Passage Design Guidelines*. Peer Review Draft. 16 August.	Resource agency design criteria and guidelines.	Latest resource agency design criteria and guidelines.
16	Nordlund, B. 1996. *Designing Fish Screens for Fish Protection at Water Diversions.* NMFS Northwest Region.	Resource agency design criteria and guidelines (superseded).	
17	Nordlund, B. 2008. *Designing Fish Screens for Fish Protection at Water Diversions.* NMFS Northwest Region. Lacey, Washington. 16 April.	Resource agency design criteria and guidelines.	
18	Nordlund, B., and Bates, K. 2000. *Fish Protection Guidelines for Washington State (Draft)*. Washington Department of Fish and Wildlife.	Resource agency design criteria and guidelines (superseded).	
19	Natural Resources Conservation Service (NRCS). 2007. *Fish Passage and Screening Design, Technical Supplement 14N, Part 654, National Engineering Handbook*. U.S. Department Of Agriculture. August.	Design, technology and operations information.	
20	Pearce, R.O., J. Ferguson, M. Lindgren and J. Nestler. 1995. *Fish Passage and Protection, Chapter 7 in Guidelines for Design of Intakes for Hydroelectric Plants*. pp 215-283. American Society of Civil Engineers, New York, NY.	Design criteria and guidelines.	
21	Turnpenny, A.W.H. , H.G. Struthers, and K.P. Hanson. 1998. *A UK Guide to Intake Fish Screening Regulations, Policy and Best Practice.* ETSU H/06/0052/00/00. Report to the Department of Trade and Industry, Energy Technology Support Unit, Harwell, United Kingdom.	Design, operations and regulatory information.	
22	Turnpenny, A.W.H. and O'Keeffe, N. 2005. *Screening for Intake and Outfalls: A Best Practice Guide.* Science Report SC0302331 prepared for the Environment Agency. Bristol, UK. February.	Operations and best practice information.	
23	Turnpenny, A.W.H. and Horsfield, R.A. 2014. *International Fish Screening Techniques.* WIT Press, Southampton, UK.	Design criteria and guidelines.	
24	U.S. Department of the Interior, Bureau of Reclamation (USBR), 2006. Water Resources Technical Publication. *Fish Protection at Water Diversions*. Denver, Colorado. April.	Design criteria and guidelines.	Key design criteria and guidelines.
25	USBR. 2009. Water Resources Technical Publication. *Guidelines for Performing Hydraulic Field Evaluations at Fish Screening Facilities*. Denver, Colorado. April.	Hydraulic testing guidelines.	Guidelines for performing post-construction hydraulic evaluations.
26	USBR. 2017. *Investigation of Fish Screen Cleaning by Air Burst and Water Jet Systems.* Research and Development Office, Science and Technology Program, Final Report ST-2017-1710-01, Hydraulic Laboratory Report HL-2017-05. September.	Design, technology and operations information.	
27	U.S. Environmental Protection Agency (EPA). 2014. 40 CFR Parts 122 and 125. *National Pollutant Discharge Elimination System—Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities*. 15 August.	Design, operations and regulatory information.	
28	Washington Department of Fisheries. 1981. *General Fish Screening Criteria Applicable to Rotary Screens, Travelling Screens, Belt Screens, Stationary Vertical Flat Plate Screens.* December.	Resource agency design criteria and guidelines (superseded).	

29	Washington Department of Fisheries. 1998. *Screen Criteria for Juvenile Salmon*. Olympia, WA. Prepared by Bates, K.M.	Resource agency design criteria and guidelines (superseded).
30	Washington Department of Fish and Wildlife (WDFW). 2000. *Fish Protection Screen Guidelines for Washington State, Draft Report*. Prepared by B. Nordlund and K. Bates. Olympia, WA. 53 pp.	Resource agency design criteria and guidelines.
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Table 2. Project and Facility Evaluations
USBR Sites Reservoir – Fish Protection Intake Screens Literature Search

No.	Reference	Type of Content	Key Information Relevant to Project
California WaterFix			
1	Bay Delta Conservation Plan. 2011. *Fish Facilities Technical Team. Technical Memorandum*. 15 July.	Example design criteria and guidelines.	
2	California WaterFix. 2017. California Department of Fish and Wildlife (CDFW). *Incidental Take Permit*. 26 July.	Example permit document.	
3	California WaterFix. 2017. National Marine Fisheries Service (NMFS). *Biological Opinion*. 16 June.	Example permit document.	
4	California WaterFix. 2018 (working draft). *Biological Assessment. Chapter 3. Description of the Proposed Action Conveyance Facility Construction*.	Example permit document.	
5	CH2M. 2013. *Work Plan: Intake Design Criteria and Performance Monitoring Development*. 28 June.	Example technical studies with scope, schedule and cost information.	Example work plan of technical studies for fish screen evaluation.
6			
Central Valley Project (CVP) and State Water Project (SWP)			
7	NMFS, 2009 and USFWS, 2008 . *Biological Opinions for the Continued Long-term Coordinated Operation of the CVP and SWP.*	Related permit document (now with amendments)	
8			
Sites Reservoir			
9	CH2M. 2017. *Sites Reservoir Project Preliminary Operations Plan Under a Range of Hydrologic Conditions*. August.	Project operations evaluation.	
10	NMFS. 2018. Letter to Rob Thompson, Sites Project Authority. *NMFS Comments in the Site Reservoir Draft Environmental Impact Statement.*	Project permitting document.	
11	URS Group, Inc. 2018. *North-of-the-Delta Offstream Storage Investigation Final Feasibility Study*. Prepared for the U.S. Bureau of Reclamation, Mid-Pacific Region. 18 October.	Project feasibility study.	
12			

GCID Hamilton City		
13	CH2M. 2008. *Fish Protection Evaluation and Monitoring Program 200 Annual Report*. Prepared for Glenn-Colusa Irrigation District. January.	Facility hydraulic monitoring and evaluation.
14	USBR. 2007. *Amendment to the Biological Opinion for the Hamilton City Pumping Plant Fish Screen Improvement Project*. 26 July.	Facility permit document.
15	USBR. 2010. *Designer's Operating Criteria for Hamilton City Pumping Plant Fish Screen Structure and Downstream Channel Stuctures*. Prepared for Glenn-Colusa Irrigation District, California. Technical Service Center, Denver, Colorado. 26 January.	Facility operations information.
16	USBR and U.S. Army Corps of Engineers (USACE). 2000. *Amendment to the Biological Opinion for the Hamilton City Pumping Plant Fish Screen Improvement Project*. 10 January.	Facility permit document.
17	Vogel, D. 1995. Natural Resource Scientists, Inc. *1994 Biological Evaluation of the New Fish Screens at the Glenn-Colusa Irrigation District's Sacramento River Pump Station*. February.	Facility biological performance evaluation.
18	Vogel, D. 1995. Natural Resource Scientists, Inc. *1995 Evaluation of Juvenile Chinook Salmon Transport Timing in the Vicinity of the New Fish screens at the Glenn-Colusa Irrigation District's Sacramento River Pump Station*. November.	Facility biological performance evaluation.
19	Vogel, D. 2003. Natural Resource Scientists, Inc. *Fish Monitoring in the Vicinity of the Glenn-Colusa Irrigation District Sacramento River Gradient Facility, 1998-2001 (Pre- and Post-Construction)*. February.	Facility biological baseline data.
20	Vogel, D. 2008. Natural Resource Scientists, Inc. *Biological Evaluations of the Fish screens at the Glenn-Colusa Irrigation District's Sacramento River Pump Station, 2002 - 2007*. April.	Facility biological performance evaluations.
21		
Delevan		
22	CH2M. 2008. *North-of-Delta Offstream Storage – Sacramento River Fish Screen Facility Feasibility Study*. Prepared for California Department of Water Resources. June.	Facility design assumptions and preliminary layout.
23	CH2M. 2019. *Sites Project Authority – Sacramento River Intake Fish Screen Operations*. April.	Facility design and operations document.
24		

TCCA Red Bluff		
25	CH2M. 2009. *Design Development Report, Fish Passage Improvement Project at the Red Bluff Diversion Dam*. Prepared for the Tehama-Colusa Canal Authority and the U.S. Bureau of Reclamation. November.	Facility design basis and assumptions.
26	CH2M. 2009. *Construction Drawings for the Red Bluff Pumping Plant and Fish Screen.* Four volumes. Prepared for the Tehama-Colusa Canal Authority and the U.S. Bureau of Reclamation. 29 October.	Facility construction drawings.
27	USBR. 2018. *Tehama-Colusa Canal Authority Red Bluff Pumping Plant Post-Construction Fish Screen Hydraulic Evaluation*. March.	Facility hydraulic monitoring and evaluation.
28	USBR and USFWS. 1957. *Fish Protection at the Tracy Pumping Plant*. Sacramento, California and Portland, Oregon.	Adjacent facility biological performance evaluation.
29		

Table 3. Technical Research and Studies
USBR Sites Reservoir – Fish Protection Intake Screens Literature Search

No.	Reference	Type of Content	Key Information Relevant to Project
1	Adams, S.R.; G. Adams and G. Parsons. 2007. *Critical swimming speed and behavior of juvenile shovelnose and pallid sturgeon*. Transactions of the American Fisheries Society 132:392-297.	Sturgeon swimming performance and other biological data.	
2	Bates, K. and Fuller, R. 1992. *Salmon Fry Screen Mesh Study*. State of Washington Department of Fisheries Habitat Management Division. Olympia, WA. 22 pp.	Ability of various screen mesh configurations to protect fish by species.	
3	Boys, C.; Robinson, W.; Baumgartner, L.; Rampano, B. and Lowry, M. 2012. *Development of Fish Screening Criteria for Water Diversions in the Murray-Darling Basin*. Prepared for NSW Department of Primary Industries and Murray-Darling Basin Authority. Cronulla, NSW. June.	Mesh size and approach velocity.	
4	Boys, C.; Robinson, W.; Baumgartner, L.; Rampano, B. and Lowry, M. 2013. *Influence of Approach Velocity and Mesh Size on the Entrainment and Contact of a Lowland River Fish Assemblage at a Screened Irrigation Pump*. Prepared for the Murray-Darling Basin Authority, the Cooperative Research Centre for Cotton Communities and Catchments, the Namoi Catchment Management Authority and the NSW Department of Primary Industries. Nelson Bay, NSW. 20 June.	Mesh size and approach velocity.	
5	Brett, J.R., Hollands, M., and Alderdice, D.F. 1958. *The effect of temperature on the cruising speed of young sockeye and coho salmon*. Fisheries Research Board of Canada, Journal 15(4): pp 587-605.	Temperature with regard to the critical swimming velocity of subyearling sockeye and coho.	
6	Cech Jr., J. and Mussen, T. 2006. *Determining How Fish Detect Fish Screens and Testing Potential Fish Screen Enhancements*. California Energy Commission, PIER Energy-Related Environmental Research Program. CEC-500-2006-117.	Vision and mechanoreception in screen avoidance for steelhead trout.	
7	Colt, J. and White, R.J. 1991. *Fisheries Bioengineering Symposium*. Portland, OR. Published by American Fisheries Society.	Papers based on the interface of fisheries biology and engineering.	
8	Congress of the United States Office of Technology Assessment. 1995. *Fish Passage Technologies: Protection at Hydropower Facilities*. OTA-ENV-641. U.S. Government Printing Office, Washington D.C. September	Existing fish passage and fish protection technologies.	
9	Davis, G.E., J. Foster, C.E. Ward and P. Doudoroff. 1968. *The Influence of Oxygen on the Swimming Performance of Juvenile Pacific Salmon at Various Temperatures*. Technical Paper No. 1475, Oregon Agricultural Experiment Station, Corvallis, OR.	Oxygen with regard to swimming performance.	

10	Easterbrooks, J.A. 1984. *Juvenile Fish Screen Design Criteria: A review of the Objectives and Scientific Data Base.* State of Washington Department of Fisheries. Yakima, WA.	Fish screen literature review.
11	Fisher, F.W. 1981. *Long Term Swimming Performance of American Shad and Chinook Salmon.* State of California Department of Fish and Game, Administrative Report No. 81-2, Bay-Delta Fisheries Project, Sacramento, CA.	Swimming performance data for Chinook.
12	Glova, G.J. and F.E. McInerney. 1972. *Critical Swimming Speeds of Coho Salmon Fry to Smolt Stages in Relation to Salinity and Temperature.* Journal of the Fisheries Board of Canadian Journal 34:151-154.	Salinity and temperature with regard to critical swimming velocities.
13	Greenland, D.C. and A.E. Thomas. 1972. *Swimming Speed of Fall Chinook Salmon Fry.* Transactions of the American Fisheries Society, 101(4):696-700.	Chinook swimming performance data.
14	Grimaldo, Lenny F.; Sommer, Ted; Van Ark, Nick; Jones, Gardner; Holland, Erika; Moyle, Peter B.; Herbold, Bruce and Smith, Pete. 2011. *Factors Affecting Fish Entrainment into Massive Water Diversion in a Tidal Estuary: Can Fish Losses be Managed?* North American Journal of Fisheries Management, Volume 29, 2009 – Issue 5. 9 Jan.	Historical pump operations and environmental characteristics affecting fish entrainment.
15	Hallock, R.J., and W.F. Van Woert. October 1959. *A Survey of Anadromous Fish Losses in Irrigation Diversions from the Sacramento and San Joaquin Rivers.* California Fish and Game. Vol. 45, No. 4, pp. 227-266.	Biological background data.
16	Hallock, R.J. 1977. *A Description of the California Department of Fish and Game Management Program and Goals for the Sacramento River System Salmon Resource.* California Fish and Game, Anadromous Fisheries Branch Administrative Report. 16 pp.	Biological background data.
17	Hanson C.H. and H.W. Li, 1983. *Behavioral Response of Juvenile Chinook Salmon to Trashrack Bar Spacing.* California Fish and Game 69(1) 18-22.	Chinook behavior at trashracks.
18	Haro, A., M. Odeh, J. Noreika, and T. Castro-Santos. 1998. *Effect of water acceleration on downstream migratory behavior and passage of Atlantic salmon juvenile salmonids and juvenile American shad at surface bypasses.* Trans. Am. Fish. Soc., 127: 118–127.	Fish behavior at surface bypasses.
19	Henderson, M.J.; Iglesias, I.S.; Michel, C.J..; Ammann, A.J. and Huff, D.D. 2018. *Estimating Spatial-temporal Differences in Chinook Salmon Outmigration Survival with Habitat and Predation Related Covariates.*	Sacramento River outmigration data.
20	Hunter, M.A. 1992. *Hydropower flow fluctuations and salmonids: a review of biological effects, mechanical causes and options for mitigation.* Technical Report No. 119. State of Washington, Department of Fisheries. 46 pp.	Biological effects of flow fluctuations.
21	Iglesias, I.S.; Henderson, M.J.; Michel, C.J.; Ammann, A.J. and Huff, D.D. 2017. *Chinook Salmon Smolt Mortality Zones and the Influence of environmental Factors on Out-migration Success in the Sacramento River Basin*. April.	Sacramento River outmigration data.
22	Kano, R.M. 1982. *Responses of Juvenile Salmon and American Shad to Long Term Exposure to Two-Vector Velocity Flows.* Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Technical Report No. 4., Stockton, CA.	Fish behavior with regard to vector velocities.

23	Marquette, M. W. and C. W. Long. 1971. *Laboratory studies of screens for diverting juvenile salmon and trout from turbine intakes.* Transactions of the American Fisheries Society, 3: 439–447.	Fish screen studies.
24	McMichael, Geoffrey A.; Vucelick, Jessica A.; Abernethy, Cary S.; Neitzel, Duane A. 2011. *Comparing Fish Screen Performance to Physical Design Criteria*, Fisheries Journal, Volume 29, 2004 – Issue 7. 9 Jan.	Performance data for installed fish screens and conformance to design criteria.
25	Michel, C.J. 2016. *Preliminary Late-fall Chinook Salmon Smolt Outmigration Analysis for SIT team, December 2016 Meeting*. December.	Sacramento River outmigration data.
26	Moyle, P.B. and White, D. 2002. *Effects of Screening Diversions on Fish Populations in the Central Valley: What Do We Know?* Prepared for the CALFED Ecosystem Restoration Program Science Board. January.	Effects of water diversions in the Central Valley with bibliography.
27	Moyle, Peter B. and Israel, Joshua A. 2011. *Untested Assumptions, Effectiveness of screening diversion for conservation of fish populations.* Fisheries Journal, Volume 30, 2005 – Issue 5. 9 Jan.	Fish screen literature review.
28	Myrick, C.A. and J.J. Cech Jr. 2000. *Swimming Performance of Four California Stream Fishes: Temperature Effects.* Environmental Biology of Fishes 58: 289-295.	Biological effects of temperature.
29	NMFS. 2017. *Chinook salmon smolt mortality zones and the influence of environmental factors on out-migration success in the Sacramento River Basin*. Prepared for U.S. Fish and Wildlife Service. April.	Environmental factors affecting out-migration
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32	Perry, R.W.; Pope, A.C.; Romine, J.G.; Brandes, P.L.; Burau, J.R.; Blake, A.R.; Ammann, A.J. and Michel, C.J. 2017. *Flow-mediated Effects on Travel Time, Routing, and Survival of Juvenile Chinook Salmon in a spatially Complex, Tidally Forced River Delta*. 17 December.	Sacramento River outmigration data.
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34	Rainey, W.S. 1985. Considerations in the Design of Juvenile Bypass systems. Paper presented at the Symposium on Small Hydropower and Fisheries. Denver, CO.	Fish bypass design.
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47	Tomljanovich, D.A., and J.H. Heuer. 1979. *Protection of Fish Larvae using Fine-Mesh Screening.* Presented at American Society of Engineers Convention, Atlanta, GA.	Protection of larvae.
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53	Zydlewski, G.B., J. Johnson, J. Stow, C. Burger. 2000. *Validation of Existing Fish Screen Criteria for Juvenile Bull Trout (Salvelinus confluentus)*. U.S. Fish & Wildlife Service, Abernathy Fish Technology Center, Technical Information Leaflet No. AB-00-001, Longview, WA. October.	Evaluation of the ability of existing screen criteria to protect bull trout fry.
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From: Jeff Sutton [jsutton@tccanal.com]
Sent: 11/7/2019 12:36:56 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Robert.Tull@CH2M.com; Jim Watson [jwatson@sitesproject.org]; 'John Spranza' [john.spranza@hdrinc.com]
Subject: RE: Notice of status review for the Bay-Delta Distinct Population Segment of Longfin Smelt (Spirinchus thaleichthys)

I agree with your thoughts related to what we negotiate now. However, it very well could affect operations of Shasta, and spring operations on the Sacramento River, potentially having an effect spring time Sites diversions/operations if all of a sudden some of the water for Longfin becomes a federal responsibility. On the other hand, it may provide a broader federal benefit that Sites can help with in the spring when the Feds are trying to preserve cold water, while simultaneously perhaps trying to meet this requirement (if it becomes real) as well.

Not sure exactly what it will mean yet, but probably worth thinking about and paying attention to.

Jeffrey P. Sutton
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From: Alicia Forsythe [mailto:aforsythe@sitesproject.org]
Sent: Thursday, November 07, 2019 12:29 PM
To: Jeff Sutton; Robert.Tull@CH2M.com; Jim Watson; John Spranza (john.spranza@hdrinc.com)
Subject: RE: Notice of status review for the Bay-Delta Distinct Population Segment of Longfin Smelt (Spirinchus thaleichthys)

It will be interesting to see how this plays out in a Presidential election year.

On the Sites side – we can include Longfin in the BA. They cant give us "take" under ESA until its listed but we can essentially agree now on what we would need to do to get take and they can amend the consultation if its listed. Being that its state listed and of particular concern for CDFW, it will be covered in our State ITP. I would expect the Feds to go along with what the State says as the State is really the regulatory expert on longfin right now. So, I would not expect a federal listing of longfin to result in any more measures or actions than what we negotiate in the first place as we'll have to cover it from the State side now for the State ITP. (This is a little different than for Federal only projects, like Reclamation's operations as there is no State ITP for Reclamation's operations. So a Federal listing of longfin may result in more avoidance, minimization or mitigation measures as they have not had to consult on longfin thru a State ITP process to date.)

Thanks for sending this on!

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Jeff Sutton <jsutton@tccanal.com>
Sent: Thursday, November 7, 2019 11:51 AM
To: Robert.Tull@CH2M.com; Jim Watson <jwatson@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>
Subject: FW: Notice of status review for the Bay-Delta Distinct Population Segment of Longfin Smelt (Spirinchus thaleichthys)

See below, something I had expected we might see at some point soon. Something we should be thinking about and keeping a close eye on related to potential effects on proposed Sites operations, particularly as it relates to spring outflow.

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From: shane_hunt@fws.gov [mailto:shane_hunt@fws.gov] **On Behalf Of** SFBD Longfin, FWS
Sent: Wednesday, November 06, 2019 1:52 PM
To: FWS SFBD Longfin
Subject: Notice of status review for the Bay-Delta Distinct Population Segment of Longfin Smelt (Spirinchus thaleichthys)

Dear Interested Party,

The U.S. Fish and Wildlife Service (Service) is responsible for identifying species in need of protection under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). We received a petition from the Bay Institute and the Center for Biological Diversity (dated August 8, 2007) requesting the Service list the San Francisco Bay-Delta population of Longfin Smelt (*Spirinchus thaleichthys*) as a threatened or endangered species with critical habitat under the Act. We published a notice of petition findings in the **Federal Register** on April 2, 2012, indicating that the listing of the San Francisco Bay-Delta Distinct Population Segment (DPS) of the longfin smelt is warranted under the Act, but precluded by higher priority actions. We are currently conducting a Species Status Assessment (SSA) for the DPS, which will help inform our proposed rulemaking for potential listing under the Act.

The longfin smelt DPS is a species endemic to the San Francisco Bay-Delta, where it is found throughout the lower reaches of the Sacramento and San Joaquin Rivers, the Delta, the San Francisco Bay, and as far into the ocean as the Greater Farallones. Additional information for this species and our review of the petition can be found in our 12-month finding and associated documents, which are available online at *www.regulations.gov* (Docket ID: FWS-R8-ES-2008-0045).

The Service has been gathering and analyzing available information about the longfin smelt DPS to assist us in making a listing determination. We are required to use the best scientific and commercial data available for this process to ensure that our determination is as accurate as possible. We also reach out to stakeholders with a request for additional information pertinent to our determination (specific information regarding this request can be found here).

We will provide a public notification of our proposed listing rule in the **Federal Register.** Any future proposed rulemakings will include an opportunity for public review and comment. At this time, we expect the proposed listing rule will be delivered to the **Federal Register** no later than September 2020. The Bay-Delta Fish and Wildlife Office is the lead field office working on the status review of the Longfin Smelt Bay-Delta DPS.

Please submit any further inquiries or relevant information to baydelta_longfin@fws.gov. All information submitted to us, including names and addresses, will become part of the decisional file and may be subject to Freedom of Information Act requests.

Thank you for your continued interest in and support of the conservation of sensitive, threatened, and endangered species. We appreciate your participation in our listing determination process. If you have any additional questions, please feel free to contact us by email at the address listed above.

File Provided Natively

FISH EFFECTS ANALYSIS

Methods Overview, 10/30/2019

Sites

Agenda items

- Overview of effects analysis
  - Construction effects
  - Operations effects
    - Sacramento River - near field
    - Sacramento River - far field
    - Feather River
    - American River
    - Delta
    - Life cycle models
  - Cross-walk NMFS-provided model matrix and methods used to date

Construction Effects

- (Geotechnical Explorations)
- Turbidity and suspended sediment
- Release and exposure of contaminants
- Underwater noise
  - NMFS spreadsheet model
- Fish stranding
- Direct physical injury
- Loss and alteration of habitat

Near-Field Effects (Sacramento River) - Salmonids

- Spatial distribution (screen exposure)
  - Horizontal/vertical: literature review, with specific info. for water surface elevations of screens, etc., % flow split at GCID
- Entrainment through screens
  - Consideration of size distribution (RBDD) vs. mesh size
- Impingement, screen contact, and screen passage
  - Literature review & Swanson et al. equations
- Predation
  - Literature review, including Vogel GCID studies
- Stranding behind screens during high flow
  - High flow, based on water surface elevation
- Attraction to screens during reservoir discharge

Near-Field Effects (Sacramento River) – Green Sturgeon

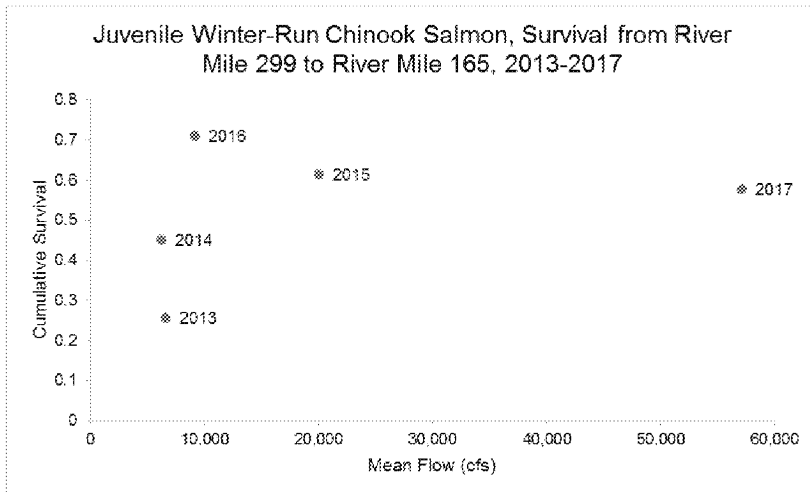
- Review of protective velocity criteria
  - Verhille et al. (2014)
- Entrainment through screens
  - Size distribution

Far-Field Effects (Sacramento River) - Salmonids

- Temperature effects
  - HEC-5Q/USRWQM, incl. 7DADM, etc.; Anderson/Martin models (Winter-Run)
- Redd scour/entombment
  - USRDOM, >40,000 cfs
- Redd dewatering
  - USRDOM, USFWS relationships
- Habitat capacity
  - Spawning WUA w/ CalSim
  - Rearing WUA w/ CalSim
- Juvenile stranding
  - USRDOM, USFWS relationships
- SALMOD
- Floodplain inundation and access
  - Yolo Bypass: daily downscaled CalSim; habitat inundation area (DWR 2016); mean number of days flooded (considering Takata et al. 2017)

Far-Field Effects (Sacramento River) - Salmonids

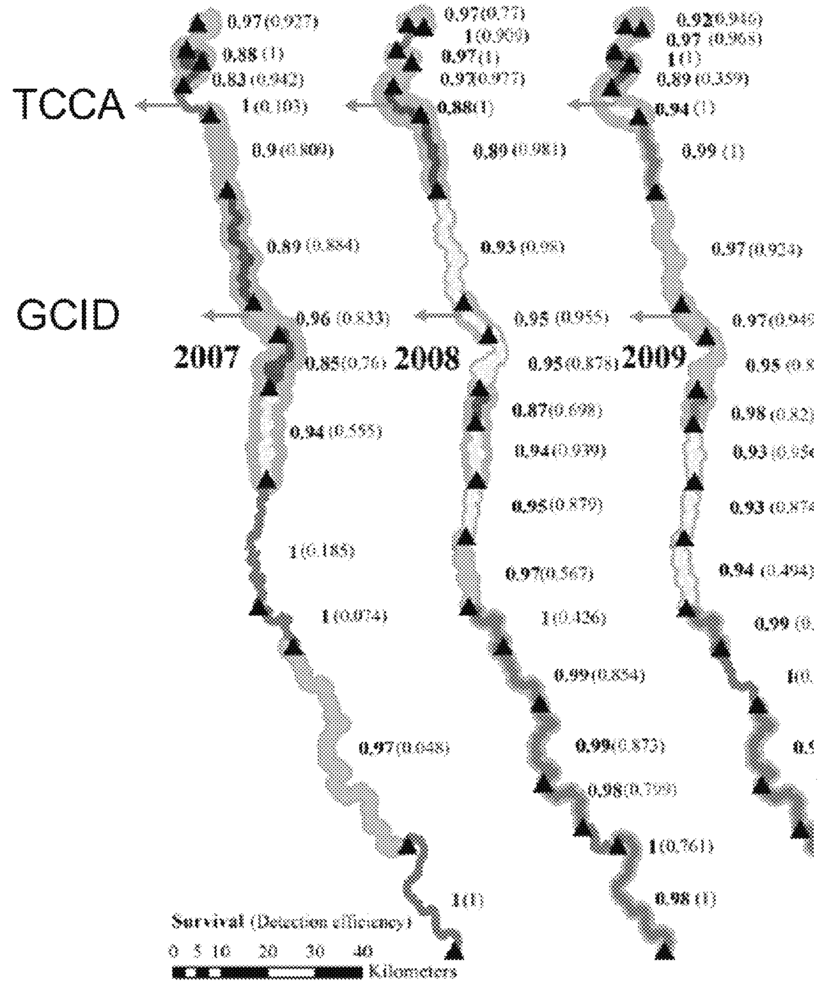
- Migration flow-survival
  - Quantitative analysis based on Henderson et al. (2018) – see next slides
  - Qualitative discussion considering Michel (2018) and Hassrick et al. in prep.



- Sites reservoir releases effects
  - Temperature
  - Water quality (mercury, salinity, false attraction)

Far-Field Flow-Survival Analysis

- Henderson et al. (2018) paper for quantitative analysis
  - Multiple reaches from above Red Bluff down to Knights Landing
  - Focus on Sites withdrawal period (winter/spring), daily timescale
  - Incorporates flow and temperature effects
  - Also includes other (non-operations) covariates
  - Results will allow adjustment of other models, e.g., OBAN



NRC Research Press

ARTICLE

Estimating spatial–temporal differences in Chinook salmon outmigration survival with habitat- and predation-related covariates

Mark J. Henderson, Ilysa S. Iglesias, Cyril J. Michel, Arnold J. Ammann, and David D. Huff

Far-Field Flow-Survival Analysis

Table 1: A description of the covariates included in the mark recapture model.

Category	Covariate	Range	Definition	Hypothesized relationship with survival
Individual	Fish Length[1]	135 - 204 mm	Fork length	Larger fish may exceed gape width of predators
	Fish Condition[1]	0.59 - 1.32	Fulton's K	Increased condition improves predator escape capability
	Transit speed[2]	0.02 - 8.25 km h^{-1}	Reach specific transit speed	Faster moving fish have less exposure to predators
Release group	Batch release[3]	Binary	Tagged fish released concurrently with large hatchery releases.	Predator swamping
	Release reach[1]	Binary	Difference in survival between newly released fish and those released upstream.	Newly released hatchery fish are naïve and susceptible to predation
	Annual flow[3]	179 - 499 cms	Mean flow measured at Bend Bridge throughout outmigration (December-March).	Increased flows produce more habitat and predator refugia throughout the river
Reach specific	Sinuosity[4]	1.04 - 2.74	River distance divided by Euclidean distance.	More natural habitats have more predator refugia
	Diversion density[5]	0 - 1.05 num km^{-1}	Number of diversions per reach length.	Increased predator densities near diversions
	Adjacent cover density[6]	0.2 - 0.76 %	Percent of non-armored river bank with adjacent natural woody vegetation.	Increased cover produces more predator refugia
	Off-channel habitat density[6]	0 - 1.62 %	Off-channel habitat within 50 m of river expressed as percentage of river area	Increased off-channel habitat produces more predator refugia
Time varying	Temperature[7]	6.2 - 12.9 °C	Mean water temperature per reach	Increased temperatures results in increased predation due to higher metabolic demands of predators
	Inter-annual Reach flow[7]	215 – 447 cms	Mean water flow per reach	Higher flows within a reach will produce more habitat and predator refugia within that reach
	Intra-annual Reach flow[7]	129 – 902 cms	Mean water flow per reach and year	Higher intra-annual flows (e.g., precipitation or dam releases) decreases predation due to increased turbidity and increased predator refugia.

[1]Measured during tagging and release; [2]Observed travel times and mixed effects model estimates; [3]California Water Data Library; [4]National Hydrography Dataset; [5]Passage Assessment Database - verified by field survey; [6]Department of Water Resources; [7]River Assessment for Forecasting Temperature (RAFT) model

Far-field effects: Henderson et al.

Category	Covariate	Range	Definition	Hypothesized relationship with survival	Notes/source	Source/assumption for analysis of proposed action
Individual	Transit speed	0.02–8.25 km/h	Reach-specific transit speed	Faster fish have less exposure to predators	Observed travel times and mixed effects model estimates	Assumed mean value from Henderson et al.
Release group	Batch release	Binary	Tagged fish released concurrently with large hatchery releases	Predator swamping	Observed travel times and mixed effects model estimates	Assumed fish not released with large hatchery releases
	Annual flow	179–499 cumecs (6,321–17,622 cfs)	Mean flow measured at Bend Bridge throughout outmigration (December–March)	Increased flows produce more habitat and predator refugia throughout the river	California Water Data Library	USRDOM
Reach-specific	Sinuosity	1.04–2.74	River distance divided by Euclidean distance	More natural habitats have more predator refugia	National Hydrography Dataset	Assumed same values as Henderson et al.
	Diversion density	0–1.05 diversions/km	No. of diversions per reach length	Increased predator densities near diversions	Passage Assessment Database—verified by field survey	Added one to reach 13 to account for Delevan intake; otherwise assumed same values as Henderson et al.
Time-varying	Temperature	6.2–12.9°C (42–55°F)	Mean water temperature per reach	Increased temperatures results in increased predation due to higher metabolic demands of predators	River Assessment for Forecasting Temperature (RAFT) model	USRWQM
	Intra-annual reach flow	129–902 cumecs (4,556–31,853 cfs)	Mean water flow per reach and year	Higher intra-annual flows (e.g., precipitation or dam releases) decrease predation due to increased turbidity and increased predator refugia	RAFT model	USRDOM

Far-field effects: Henderson et al.

- Focused on Dec-Mar
  - Bend Bridge mean flow covariate period
- Scenario 1
  - Equal numbers of fish beginning migrating on each day, Dec-Mar
  - All fish begin migration at Jellys Ferry (upstream of Red Bluff and all project intakes)

Far-field effects: Henderson et al.

- Scenario 2
  - Equal numbers of fish beginning migrating on each day, Dec-Mar
  - Equal numbers of fish beginning migration at the upstream end of each Henderson et al. reach
- Scenario 3
  - Equal numbers of fish beginning migration at the upstream end of each Henderson et al. reach
  - Fish moving in proportion to daily proportion of flow

Far-Field Effects (Feather River) - Salmonids

- Temperature effects
  - Reclamation temperature model
- Redd scour/entombment
- Redd dewatering
- Habitat capacity
  - Spawning WUA
  - Rearing WUA

Far-Field Effects (American River) - Salmonids

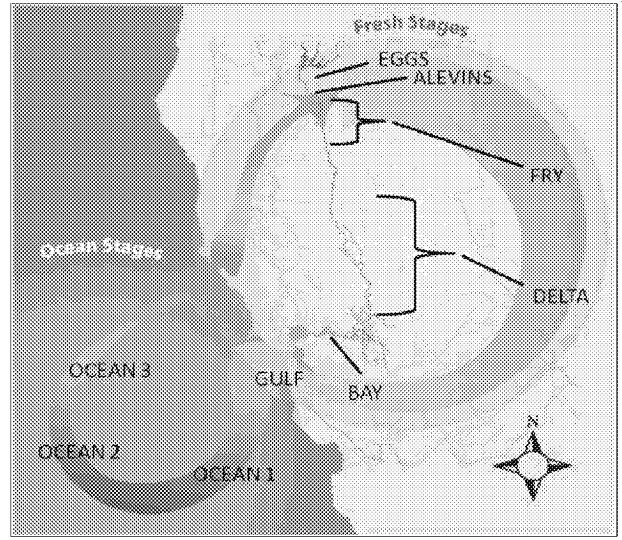
- Temperature effects
  - HEC-5Q, e.g., for 7DADM
- Redd scour
  - CalSim
- Redd dewatering
  - CalSim/Bratovich et al. (2017)
- Habitat capacity
  - Spawning WUA (USFWS)
  - Rearing WUA (USFWS)

Delta - Salmonids

- South Delta Entrainment
  - Qualitative consideration of CalSim OMR, etc.
- Juvenile through-Delta survival
  - DSM2-HYDRO Velocity Summary
  - Analysis based on Perry et al. (2018) - STARS
  - Delta Passage Model

Sites

Life Cycle Modeling: OBAN



General Details:

- Winter-Run Chinook Salmon
- Egg/alevin temperature effects
- Fry rearing flow effects
- Juvenile Yolo flow effects
- Juvenile south Delta export effects
- Juvenile DCC effects
- Ocean conditions not affected by project but included in model (productivity and harvest)
- Incorporate flow-survival adjustment based on Henderson et al. (2018) model

Sites

Life cycle modeling: IOS

Application of a Life Cycle Simulation Model to Evaluate Impacts of Water Management and Conservation Actions on an Endangered Population of Chinook Salmon

(1) spawning, models the number and temporal distribution of eggs deposited in the gravel at the spawning grounds

(2) Early development, models the impact of temperature on maturation timing and mortality of eggs at the spawning grounds

(3) fry rearing, models the relationship between temperature and mortality of salmon fry during the river rearing period

(4) river migration, estimates mortality of migrating salmon smolts in the Sacramento River between the spawning and rearing grounds and the Delta

(5) Delta passage, models the impact of flow, route selection, and water exports on the survival of salmon smolts migrating through the Delta to San Francisco Bay

(6) ocean survival, that estimates the impact of natural mortality and ocean harvest to predict survival and spawning returns (escapement) by age

Zeug et al. Environ Model Assess (2012) 17:455–467

Sites

Critical Habitat

Salmonids:

- Adult migration corridors
- Spawning habitat
- Adequate river flows
- Water temperatures
- Habitat and adequate prey free of contaminants
- Riparian and floodplain habitat
- Juvenile emigration corridors
- Estuarine areas

Green Sturgeon

- Sacramento and Feather River far-field effects
  - Temperature effects (Sac-USRWQM, Feather-Reclamation temp. model)
    - Spawning and egg incubation
    - Non-spawning adult presence
    - Pre- and post-spawn adult holding, immigration, and post-spawn emigration
    - Larval and juvenile rearing and emigration
  - Flow effects (CalSim)
- Flow effects Delta
  - South Delta entrainment – salvage-density method (CalSim)
  - Delta outflow – White Sturgeon year-class strength regression (CalSim)
- Critical Habitat
  - Food resources
  - Substrate type / size
  - Water flow and quality
  - Migration corridor
  - Water depth
  - Sediment quality

Delta Smelt

- North Delta food subsidy from Colusa Basin Drain
  - Qualitative discussion based on pilot study years
- South Delta entrainment
  - Adults & Larvae/early juveniles – consideration of OMR flows
- Flow effects
  - Spring – *Eurytemora affinis* – X2 regression
  - Summer – *Pseudodiaptomus forbesi* subsidy to LSZ (QWEST)
  - Fall – consideration of Delta outflow/X2 in relation to habitat attributes
- Upstream sediment entrainment
  - Modeling of sediment concentration in river flow in relation to diversions
- Critical habitat
  - Physical habitat, water, river flow, salinity

Longfin Smelt Outflow-Abundance

Transactions of the American Fisheries Society 145:44–58, 2016

ISSN: 0002-8487 print / 1548-8659 online
DOI: 10.1080/00028487.2015.1100136

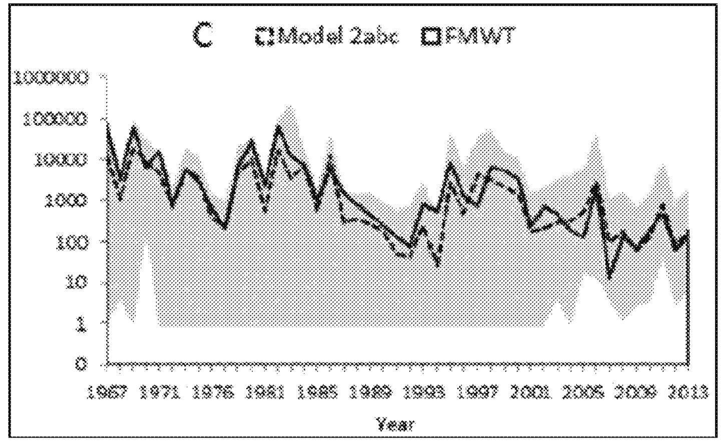
ARTICLE

Population Dynamics of an Estuarine Forage Fish: Disaggregating Forces Driving Long-Term Decline of Longfin Smelt in California's San Francisco Estuary

Matthew L. Nobriga*
U.S. Fish and Wildlife Service, Bay Delta Fish and Wildlife Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95831, USA

Jonathan A. Rosenfield
The Bay Institute, Pier 39, Box Number 200, San Francisco, California 94133, USA

(b) Original



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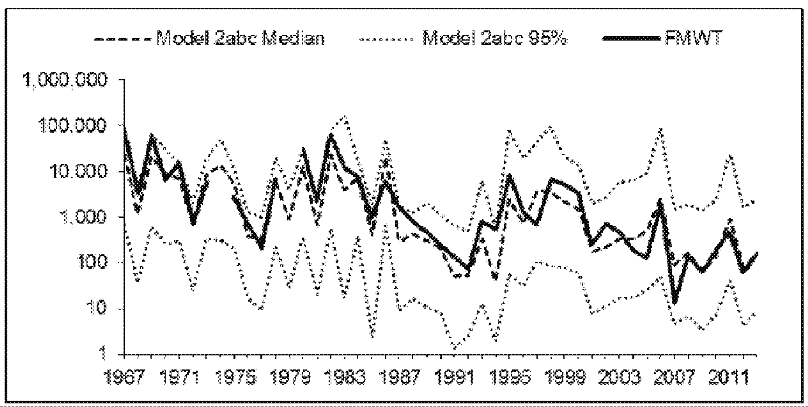

ICF

Exhibit DWR-1352

Technical Memorandum

To: California Department of Water Resources (DWR)

From: Marin Greenwood, Ph.D. (Aquatic Ecologist, ICF) and Corey Phillis, Ph.D. (Resource Specialist, Metropolitan Water District of Southern California)

Date: 7/2/2018

Re: Comparison of Predicted Longfin Smelt Fall Midwater Trawl Index for Existing Conditions, No Action Alternative, and California WaterFix CWF H3+ Operational Scenarios Using the Nobriga and Rosenfield (2016) Population Dynamics Model

File Provided Natively

From: Rob Thomson [rthomson@sitesproject.org]
Sent: 11/18/2019 9:45:17 AM
To: Herrin, Jeff [jeff.herrin@aecom.com]; 'Lee.Frederiksen@hdrinc.com' [Lee.Frederiksen@hdrinc.com]; Alicia Forsythe [aforsythe@sitesproject.org]
CC: Jim Watson [jwatson@sitesproject.org]; Joe Trapasso [jtrapasso@sitesproject.org]
Subject: RE: Project Description and Determination of Feasibility

Thanks Jeff. I concur with you general observations but please remember the approach we have described with Reclamation. Something like:

The Sites Project Authority and Reservoir Committee participants are determining the project implementation strategy prior to developing permit applications, final designs and the initiation of construction. While there are water supply and environmental merits to building Sites Reservoir at full capacity, some facilities and project capacity can be built in the future when the participants better understand changes in cropping patterns, urban demands and the needs of the environment that can be fulfilled by the Project. The Authority has initiated the preparation of specific development concepts that will allow the evaluation of initial construction options that would allow for the development of a scalable project.

It is important that the lead agencies plan and build a project that makes sense for project participants – local, state and federal. This means rightsizing and optimizing the project for current conditions, while maintaining flexibility to expand and adapt the project to changing conditions. The Authority is committed to evaluating a project to create benefits for today and still ensure we have adaptability and flexibility to meet future needs. In the determination of the implementation strategy, the Authority recognizes that participants and investments should be allocated based on the benefits each investor receives and will continue considering this balance in both programmatic and individual investor discussions.

From: Herrin, Jeff <jeff.herrin@aecom.com>
Sent: Monday, November 18, 2019 9:39 AM
To: 'Lee.Frederiksen@hdrinc.com' <Lee.Frederiksen@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>
Cc: Jim Watson <jwatson@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Rob Thomson <rthomson@sitesproject.org>
Subject: Project Description and Determination of Feasibility

Lee and Ali,

Last Friday's meeting introduced some potential assignments for the next six months. The current version of Alternative D is the product of several years of work. I don't think we can advance a project description for a new alternative all the way to the level of what we have for Alternative D in just a few months. We need some direction regarding what we need to prioritize and how we should sequence the work. I tend to think that most of the value planning configurations are new alternatives – the operations, conveyance system locations and features are so different from existing alternatives that it will be difficult to address them as options under Alternatives A, B, C, and D.

Here are my initial thoughts on potential activities and some of the difficult issues that will eventually need to be resolved.

1. Alignments/Fatal Flaws – The value planning alternatives were developed in 7 working days. Some of them are literally lines on a map. I think we need to determine if there are fatal flaws before we ask the Authority to pick their favorite. This will require looking at the alignments in the field. We need to evaluate and obtain reasonable topographic information. There is probably some further right sizing of the alternatives as well – Rob Leaf indicated that a 1.3 MAF reservoir appears to be larger than is needed for a 250 TAF/yr diversion. We also need some support from Kevin Spesert, Mike Azevedo, and Bill Vanderwaal to figure out landowner and utility constraints that have been largely ignored to this point. In summary, the alignments and costs need to be adjusted to address the implementation constraints before they are ready for decision-making. (High Priority – seems unavoidable)

2. Criteria for Alternative Selection – We should confirm or modify our current planning objectives and constraints. I don't think any of the objectives need to change from the current Reclamation feasibility report. The value planning effort introduced new conveyance measures that will need to be evaluated, but before we do that we need to determine what the selection criteria will be. I think we will likely rely on Technical, Economic, Environmental, and Financial feasibility, but will need to tailor the specific requirements for how these will be evaluated to the project. (High Priority – required by *Principles and Requirements for Feasibility Study*).

3. Technical Feasibility – Constructability is straightforward and will be derived using the findings from #1 above. There should be an operations analysis tech memo (Jacobs?) to support the determination of technical feasibility. (High Priority – consistent with *Principles and Requirements*)

4. Economic Feasibility – It seems to me that this is going to be hard. First we need to decide what model to base the analysis on (consistent with WSIP or the EIR/EIS or something else). I don't think we should rush into economics – but getting the results we need will be a challenge if we want WSIP or Federal funding. It appears that the value planning alternatives increase financial feasibility but decrease economic feasibility (I've never seen this degree of tradeoff between these two criteria before). Assuming economic benefits are proportional to diversions, we are cutting our diversion rates by a much greater percentage than we have been able to cut our costs. A back of the envelope calculation puts our Benefit Cost Ratio (BCR) at 0.9. If we need to demonstrate a BCR > 1.0, I think we have a big lift ahead of us. I suspect we will need iterative operations models and economic analysis to raise the BCR. (Low to Medium Priority? Next phase?)

5. Environmental Feasibility – None of the value planning alternatives had the Delevan intake. I think differentiating between the value planning alternatives will be based primarily on impacts to terrestrial species, cultural resources, and land use impacts (ICF?). I think this is a high priority and the appropriate level of effort will need to be scoped with the environmental team. We should complete #1 above before launching this effort. (High Priority?)

6. Financial Feasibility – I think this is the $/AF and annual repayment amount that we are getting from MDA. I think the Authority needs this information to support their decision making. As we tweak the alignments and cost, there will be a need for MDA to update their spreadsheet (High Priority?).

7. Decision Document – We will probably require a series of decision documents (not just a single Feasibility Report), but I'm not sure what the most effective sequence is. I think we should narrow the alternatives before the full Feasibility Report, including a documented evaluation of all the value planning alternatives against decision criteria, so that is a medium to high priority. The initial project descriptions to support this decision probably will not be sufficient for the EIR/EIS. (Priority Medium?)

8. Project Descriptions –I don't think it is reasonable to assume that we can get as much design data for the value planning alternatives as we have for the current alternatives. We have no geotechnical information on the new alignments. A lot more work is needed to advance even one of these alternatives to a level that would support the EIR/EIS project description. We need to finalize the alignment, develop a construction schedule, identify the construction footprint, come up with equipment use, etc. Hopefully we can narrow this effort down to one value planning alternative to reduce costs. Completing the project description is important, but I recommend some decisions to reduce the number of alternatives (see #7 above) before we do the heavy lifting for the project description. (Priority – important, but not immediately urgent - Low to Medium from a scheduling perspective).

9 Risk Assessment – It sounds like the Authority wants to do this. I personally like sticking with a consistent percentage for all alternatives. If we re-evaluate this, we will need to come up with a percentage unique to each alternative. In my opinion, the new facilities should have higher risks because they have more unknowns (especially geotech data). I think some of the Reservoir Committee members perceive of this as primarily a deletion exercise, but we are introducing new risks as well. (Priority – Low to Medium).

10 Construction Cost Estimate – Eventually, I suspect the CWC will want an updated cost estimate (i.e., Basis of Estimate Report) in the WSIP feasibility report to justify the project costs. We will also have to update the economic analysis after we have the final cost. This is pretty costly – I would delay until we are confident what alternative will be selected. (Priority – Low – maybe next phase)

11 Pumping Costs – These should probably be updated. Maybe the Jacobs modeling analysis is adequate for now, but eventually you will need someone to dig more deeply into this. (Priority – probably next phase, scary – could be expensive – DWR did this modeling previously)

It might be good to flowchart this effort to help define the sequence. There will be specific tasks for other contractors to support the analysis (ICF and Jacobs). Regarding AECOM work, you may want to think about whether this should come through our contract directly or through ICF. Perception might be better initially if it goes through the environmental contract, but I'm not sure what the subconsultant fee is if we are accessed through ICF.

Jeff Herrin
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From: Frederiksen, Lee E. [Lee.Frederiksen@hdrinc.com]
Sent: 11/18/2019 10:37:23 AM
To: Herrin, Jeff [jeff.herrin@aecom.com]; Alicia Forsythe [aforsythe@sitesproject.org]
CC: Jim Watson [jwatson@sitesproject.org]; Joe Trapasso [jtrapasso@sitesproject.org]; Rob Thomson [rthomson@sitesproject.org]
Subject: RE: Project Description and Determination of Feasibility

Jeff,

I agree with your comments and appreciate your thoughts. I will follow up with you.

Thanks.
Lee

Lee Frederiksen, PE
D 916.817.4863 M 916.213.0569

hdrinc.com/follow-us

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Sent: Monday, November 18, 2019 9:39 AM
To: Frederiksen, Lee E. <Lee.Frederiksen@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>
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Sites Project
Environmental Benefits/Detriments Summary

The following summarizes the potential environmental benefits and detriments of the Sites Project.

Item/Issue	Benefit	Detriment
Project Facilities		
Diversion Screens	Compliant with all existing regulations	Increases locations for predators. Incidental take of outmigrating salmonids – 3-5%
Pipelines		Adversely impacts GGS habitat in ditches in and adjacent to construction corridor
Powerlines		Creates new impact potential for bird movement. Cross valley alignment is a much greater risk for migrating birds
Reservoir(s)	Provides new aquatic habitat for waterfowl, water source for wildlife	Removes 14,000 acres of winter foraging habitat for golden eagles. Removes about 200 mature oak trees. Converts potential CRLF upland and riparian habitats to deep water lake habitat
Salmonids		
Increase in travel time for out migrating chinook and steelhead smolts	None	Increase in time for predation and other mortality to occur. See flow-mortality analysis in WSIP Appeal
Increase in flow stability in the spawning reach of the Upper Sacramento River from Red Bluff to Shasta	Reduction in redd dewatering	
Decrease in water temperature below Keswick particularly in drier years	Increase length of anticipated successful spawning area. Reduction in temperature of the critical reach for winter run. See SALMOD and OBAN results in WSIP Appeal	

Decrease in water surface elevation in the Upper Sacramento River below Red Bluff due to water diversion		Increase in travel time. Reduction on rearing habitat – particularly in the reach near Hamilton City. See OBAN results in WSIP Appeal
Change in the amount and duration of floodplain inundation	May increase frequency of inundation in drier years if public /environmental benefit water is allocated to the activation of weir notches. Not evaluated	WSIP Protest analysis identified a slight reduction in inundation due to water diversion in wetter periods. Diversions would have a slight adverse effect in drier periods. See floodplain inundation analysis in WSIP Appeal
Pelagic Native Fish		
Late Summer releases through the Colusa Basin Drain (or Freemont Weir Notch?) to the Yolo Basin Toe Drain	Would add lower trophic level food to Cache Slough to benefit Delta smelt. Limited ecological analysis	
Late Spring Diversions		Potentially adversely affect Longfin Smelt minimized by spring outflow compliance from CA WaterFix
Sturgeon		
Giant Garter Snake		
Construction of the Delevan Pipeline/ Terminal Regulating Reservoir and other facilities		Could adversely impact GGS habitat and individuals
Late Summer releases through the Colusa Basin Drain	Would increase water levels and flow rates in the Colusa Basin drain for the short periods to benefit Delta smelt	
Golden Eagle/Bald Eagle		

Inundation of 14,000 acres of Antelope Valley	Converts Golden Eagle winter range habitat to potentially support Bald Eagles	Removes 14000 acres of winter range habitat
Dedication of 'Buffer Zone' lands to Conservation Easement - Rangeland	Protects buffer zone lands for rangeland and eagles	
Waterfowl		
Supplies 40,000 acre/ft/yr to refuges		
CA Red-legged frog		
		Removes upland and ephemeral wetland habitat in Antelope Valley
		Removes upland and ephemeral wetland habitat along pipeline corridor, pump stations and other facilities east of the Antelope Valley and west of the irrigated agricultural areas in the Sacramento Valley

Sent: 11/19/2019 12:58:48 PM
To: Obegi, Doug [dobegi@nrdc.org]; jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) [barry@westernwaterstrategies.com]; greg@bayecotarium.org; Chris Shutes [blancapaloma@msn.com]; Kim Delfino [KDelfino@defenders.org]; Zwillinger, Rachel (Mail Contact) [rzwillinger@defenders.org]
CC: Monique Briard (Monique.Briard@icf.com) [Monique.Briard@icf.com]; Jim Watson [jwatson@sitesproject.org]; Jim Lecky (jim.Lecky@icf.com) [jim.Lecky@icf.com]; Tull, Robert/SAC [Robert.Tull@jacobs.com]; Kevin Spesert [kspesert@sitesproject.org]; John Spranza (john.spranza@hdrinc.com) [john.spranza@hdrinc.com]; Grimaldo, Lenny [Lenny.Grimaldo@icf.com]
Subject: RE: Sites Meeting with NRDC, et al. - Follow-up
Attachments: 20191115 Workshop Presentation.pdf

Hi all – I thought I would circle back with you all for a quick update.

Sites has continued our discussions with CDFW on operating criteria (diversion criteria), albeit at a little slower pace more recently. We have also recently had a joint meeting with NMFS, USFWS, and CDFW to begin dialogue on operational criteria as a group. Not much progress has been made on the running the NMFS winter-run life-cycle model for the Project – we continue to work thru the contracting process and refine the operating criteria so we're not ready to run the model yet.

We have also continued to work on refinements to the Project to right-size it for the current participants. We are considering a number of right-sizing actions, such as reducing the size of the reservoir along with no Delevan intake. The Authority embarked on an initial Value Planning effort to look at a number of possible cost reduction measures. The initial options out of the this effort and the potential resulting cost savings are identified in the attached presentation. Once the Authority identifies a preferred project, we will assess the changes and how best to move forward with the CEQA / NEPA compliance effort.

We held a joint public workshop of the Reservoir Committee and Authority Board late last week. We talked through we where are with operational criteria, the value planning effort and the affordability analysis. I've attached the workshop presentation. It will be posted to the Authority website shortly.

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Alicia Forsythe
Sent: Monday, October 14, 2019 7:47 AM
To: Obegi, Doug <dobegi@nrdc.org>; jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) <barry@westernwaterstrategies.com>; greg@bayecotarium.org; Chris Shutes <blancapaloma@msn.com>; Kim Delfino <KDelfino@defenders.org>; Zwillinger, Rachel (Mail Contact) <rzwillinger@defenders.org>
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Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Thank you Doug and Chris for the refinements to the Action Items. Below is an updated list – text of items 3 and 4 have been updated and items 5 and 6 were added.

I've also attached a PDF of the presentation. Note that the PDF file changes templates and page numbers part way thru. We actually used 2 presentations that day and I combined them both into one PDF file. The actual PPT files are too large to send via email.

And thanks Doug for the four papers!

Revised Action Items:
1. Schedule a terrestrial focused meeting to focus on (among other topics): (1) terrestrial species and habitat impacts; (2) impacts to refuge and refuge easements; (3) impacts to giant garter snake; and (4) mitigation strategy for terrestrial species.
2. Look at possibility of releasing the Daily Model. (Note, I talked with the team on this late last week. We are scheduling an internal Sites discussion on the possibility of releasing the model along with the timing and what documentation should accompany a release. I should have more info on this in about 2 weeks.)
3. Can Sites add the Yolo Bypass to the floodplain modeling effort? (Note, we are already planning on adding the Sutter Bypass to the floodplain modeling effort, but had not planned on including Yolo. So this action item is focused on Yolo as we had not originally planned on including the Yolo Bypass in the floodplain modeling effort. Sutter will be included.)
4. Continue discussion on effects to salmonid survival throughout the Sacramento River and Delta. – Doug sent over papers on 10/9.
5. Email copy of PPT presentation from meeting. – Completed with this email.
6. Provide deliveries and current demands in the Glenn-Colusa and Tehama-Colusa canals downstream of a prospective Sites Reservoir -- what volume of water annually could Sites serve to current water users on the Glenn-Colusa and Tehama-Colusa canals?

We are working on the action items and I'll provide an update on status next week.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Obegi, Doug <dobegi@nrdc.org>
Sent: Wednesday, October 9, 2019 5:25 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) <barry@westernwaterstrategies.com>; greg@bayecotarium.org; Chris Shutes <blancapaloma@msn.com>; Kim Delfino <KDelfino@defenders.org>; Zwillinger, Rachel (Mail Contact) <rzwillinger@defenders.org>
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Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Hi Ali,

Thank you for following up on our prior meeting, and I agree that it makes sense to hold off on scheduling another meeting at this point.

Attached are 3 papers from 2018 and 2019 regarding Sacramento River flows and salmon survival, including the Friedman et al 2019 paper I mentioned in the meeting, as well as the Zeug et al 2014 paper showing a very strong correlation between Stanislaus River flows and juvenile salmon survival.

In terms of the action items from the meeting, I thought that item #4 was not limited to impacts downstream of Freeport (see Perry et al 2018), but instead was regarding impacts in the Sacramento River below the intakes as well as further downstream. I believe item #3 was broader floodplain inundation modeling, not limited to Yolo Bypass (?). In addition, would you please email us a copy of the PPT presentation that was shared at the meeting with us? That was on my list of action items from the meeting.

Thanks,
-d

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Wednesday, October 9, 2019 4:16 PM
To: jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) <barry@westernwaterstrategies.com>; greg@bayecotarium.org; Obegi, Doug <dobegi@nrdc.org>; Chris Shutes <blancapaloma@msn.com>; Kim Delfino <KDelfino@defenders.org>; Zwillinger, Rachel (Mail Contact) <rzwillinger@defenders.org>
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Subject: Sites Meeting with NRDC, et al. - Follow-up

All –

I sincerely apologize for the long delay in circling back to you all after our meeting. I know how important it is to follow up on our commitments and time just got away from me on this. My apologies.

I wanted to say thank you very much for taking the time to chat with us. Below are the action items that I recorded. Please let me know if I missed any or have mischaracterized any.

I also wanted to share that we continue with our discussions with CDFW on operating criteria (diversion criteria). We have also had an initial re-engagement meeting with NMFS and plan to meet with them and CDFW together in the coming weeks. NMFS is agreeable to us entering into a contract with them to run their winter-run life-cycle model for the Project. We are starting to work on the contracting effort and are hopeful that this wraps up about the time we have revised operational criteria for NMFS to run – likely late this calendar year.

We have also continued to work on refinements to the Project to right-size it for the current participants. We continue to consider a number of right-sizing actions, such as reducing the size of the reservoir along with no Delevan intake. Once the Authority identifies a preferred project, we will assess the changes and how best to move forward with the CEQA / NEPA compliance effort.

There is a lot in flux right now, so I'd like to hold off on meeting again. As we narrow down on a preferred project and new operations criteria, I would like to circle back and get your input on these. I am always happy to chat if you have questions or suggestions in the meantime.

Action Items:
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3. Can Sites add the Yolo Bypass to the floodplain modeling effort?
4. Continue discussion on effects to salmonid survival downstream of Freeport. Check Freedman (spelling?) 2019 paper and a recent paper from the Stanislaus River (Doug, I didn't catch the title of this one. Can you send it over or send the title?)

We will follow up on these action items in the coming weeks.

Please don't hesitate to contact me if you have any questions, thoughts or concerns on the Sites Project.

Ali

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We will follow up on these action items in the coming weeks.

Please don't hesitate to contact me if you have any questions, thoughts or concerns on the Sites Project.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Greg Reis [greg@bayecotarium.org]
Sent: 11/25/2019 12:01:44 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Thanks for the very helpful, quick reply.
Happy Thanksgiving,
Greg

Greg Reis
Staff Hydrologist, The Bay Institute
Mobile: 415-342-6390

The Bay Institute | Aquarium of the Bay | EcoCenter at Heron's Head Park
Sea Lion Center | The Bay Academy | Bay Model Alliance

Our mission is to protect, restore, and inspire conservation of San Francisco Bay and its watershed, from the Sierra to the Sea™

From: Alicia Forsythe [mailto:aforsythe@sitesproject.org]
Sent: Monday, November 25, 2019 11:50 AM
To: Greg Reis <greg@bayecotarium.org>
Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

WIFIA is the Water Infrastructure Finance and Innovation Act. It's a Federal program administered by the US EPA that provides low interest loans for water infrastructure projects. They will only loan up to 49% of the cost of the project. We have assumed only a $1.1 Billion WIFIA loan in the "With WIFIA" scenario to be conservative. It's a great program for financed water projects – including environmental projects. Here's more info: https://www.epa.gov/wifia/learn-about-wifia-program#overview.

Yep, you are correct on cell E4. It should be TAF. Thank you!!

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Greg Reis <greg@bayecotarium.org>
Sent: Monday, November 25, 2019 11:40 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Thanks! One question: what does WIFIA stand for?
Also, I noticed a typo: cell E4 should say TAF, not AF

Greg Reis
Staff Hydrologist, The Bay Institute
Mobile: 415-342-6390

From: Alicia Forsythe [mailto:aforsythe@sitesproject.org]
Sent: Monday, November 25, 2019 11:35 AM
To: Greg Reis <greg@bayecotarium.org>
Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Sure thing! The tool is attached. Let me know if you have any questions using it or any questions on the slides.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

From: Greg Reis <greg@bayecotarium.org>
Sent: Friday, November 22, 2019 12:00 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Hi Ali,

I called in a little late to Friday's meeting—and it was a little hard to follow some things without seeing this. Thanks for sending the presentation, that answers some questions I had from the call. Please also send the Excel tool that was offered on the call and covered in the slides.
Thanks,
Greg

Greg Reis
Staff Hydrologist, The Bay Institute
Mobile: 415-342-6390

The Bay Institute | Aquarium of the Bay | EcoCenter at Heron's Head Park
Sea Lion Center | The Bay Academy | Bay Model Alliance
Our mission is to protect, restore, and inspire conservation of San Francisco Bay and its watershed, from the Sierra to the Sea™

From: Alicia Forsythe [mailto:aforsythe@sitesproject.org]
Sent: Tuesday, November 19, 2019 1:19 PM
To: Obegi, Doug <dobegi@nrdc.org>; jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) <barry@westernwaterstrategies.com>; Greg Reis <greg@bayecotarium.org>; Chris Shutes <blancapaloma@msn.com>; Kim Delfino <KDelfino@defenders.org>; Zwillinger, Rachel (Mail Contact) <rzwillinger@defenders.org>
Cc: Monique Briard (Monique.Briard@icf.com) <Monique.Briard@icf.com>; Jim Watson <jwatson@sitesproject.org>; Jim Lecky (jim.Lecky@icf.com) <jim.Lecky@icf.com>; Tull, Robert/SAC <Robert.Tull@jacobs.com>; Kevin Spesert <kspesert@sitesproject.org>; John Spranza (john.spranza@hdrinc.com) <john.spranza@hdrinc.com>; Grimaldo, Lenny <Lenny.Grimaldo@icf.com>
Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Hi all – I thought I would circle back with you all for a quick update.

We held a joint public workshop of the Reservoir Committee and Authority Board late last week. We talked through where we are with operational criteria, the value planning effort and the affordability analysis. I've attached the workshop presentation. It will be posted to the Authority website shortly.

As you'll see in the attached presentation, Sites has continued our discussions with CDFW on operating criteria (diversion criteria), albeit at a little slower pace more recently. We have also recently had a joint meeting with NMFS, USFWS, and CDFW to begin dialogue on operational criteria as a group. Not much progress has been made on the running the NMFS winter-run life-cycle model for the Project – we continue to work thru the contracting process and refine the operating criteria so we're not ready to run the model yet.

We have also continued to work on refinements to the Project to right-size it for the current participants. We are considering a number of right-sizing actions, such as reducing the size of the reservoir, no Delevan intake, no Delevan outfall, and other options. The Authority embarked on an initial Value Planning effort to look at a number of possible cost reduction measures. The initial options out of the this effort and the potential resulting cost savings are identified in the attached presentation. Also identified is the potential cost of water for different reservoir costs and deliveries at Holthouse (deliveries to participants, including the CWC / WSIP water).

With so much in flux right now, we have taken a break from following up on the action items from our August meeting. We will continue to hold these out there and intend to follow up on them once we have a better sense of how the Authority Board would like to move forward with the project.

If you have any questions on Sites or the attached presentation, please don't hesitate to reach out to me.

Hope everyone is well and you all have a great Thanksgiving next week (I can't believe we're already there)!

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

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From: Alicia Forsythe
Sent: Monday, October 14, 2019 7:47 AM
To: Obegi, Doug <dobegi@nrdc.org>; jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) <barry@westernwaterstrategies.com>; greg@bayecotarium.org; Chris Shutes <blancapaloma@msn.com>; Kim Delfino <KDelfino@defenders.org>; Zwillinger, Rachel (Mail Contact) <rzwillinger@defenders.org>
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Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Thank you Doug and Chris for the refinements to the Action Items. Below is an updated list – text of items 3 and 4 have been updated and items 5 and 6 were added.

I've also attached a PDF of the presentation. Note that the PDF file changes templates and page numbers part way thru. We actually used 2 presentations that day and I combined them both into one PDF file. The actual PPT files are too large to send via email.

And thanks Doug for the four papers!

Revised Action Items:
1. Schedule a terrestrial focused meeting to focus on (among other topics): (1) terrestrial species and habitat impacts; (2) impacts to refuge and refuge easements; (3) impacts to giant garter snake; and (4) mitigation strategy for terrestrial species.
2. Look at possibility of releasing the Daily Model. (Note, I talked with the team on this late last week. We are scheduling an internal Sites discussion on the possibility of releasing the model along with the timing and what documentation should accompany a release. I should have more info on this in about 2 weeks.)
3. Can Sites add the Yolo Bypass to the floodplain modeling effort? (Note, we are already planning on adding the Sutter Bypass to the floodplain modeling effort, but had not planned on including Yolo. So this action item is focused on Yolo as we had not originally planned on including the Yolo Bypass in the floodplain modeling effort. Sutter will be included.)

4. Continue discussion on effects to salmonid survival throughout the Sacramento River and Delta. – Doug sent over papers on 10/9.
5. Email copy of PPT presentation from meeting. – Completed with this email.
6. Provide deliveries and current demands in the Glenn-Colusa and Tehama-Colusa canals downstream of a prospective Sites Reservoir -- what volume of water annually could Sites serve to current water users on the Glenn-Colusa and Tehama-Colusa canals?

We are working on the action items and I'll provide an update on status next week.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676 | aforsythe@sitesproject.org | www.SitesProject.org

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From: Obegi, Doug <dobegi@nrdc.org>
Sent: Wednesday, October 9, 2019 5:25 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) <barry@westernwaterstrategies.com>; greg@bayecotarium.org; Chris Shutes <blancapaloma@msn.com>; Kim Delfino <KDelfino@defenders.org>; Zwillinger, Rachel (Mail Contact) <rzwillinger@defenders.org>
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Subject: RE: Sites Meeting with NRDC, et al. - Follow-up

Hi Ali,

Thank you for following up on our prior meeting, and I agree that it makes sense to hold off on scheduling another meeting at this point.

Attached are 3 papers from 2018 and 2019 regarding Sacramento River flows and salmon survival, including the Friedman et al 2019 paper I mentioned in the meeting, as well as the Zeug et al 2014 paper showing a very strong correlation between Stanislaus River flows and juvenile salmon survival.

In terms of the action items from the meeting, I thought that item #4 was not limited to impacts downstream of Freeport (see Perry et al 2018), but instead was regarding impacts in the Sacramento River below the intakes as well as further downstream. I believe item #3 was broader floodplain inundation modeling, not limited to Yolo Bypass (?). In addition, would you please email us a copy of the PPT presentation that was shared at the meeting with us? That was on my list of action items from the meeting.

Thanks,
-d

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Wednesday, October 9, 2019 4:16 PM
To: jon@baykeeper.org; Barry Nelson (barry@westernwaterstrategies.com) <barry@westernwaterstrategies.com>;

greg@bayecotarium.org; Obegi, Doug <dobegi@nrdc.org>; Chris Shutes <blancapaloma@msn.com>; Kim Delfino <KDelfino@defenders.org>; Zwillinger, Rachel (Mail Contact) <rzwillinger@defenders.org>
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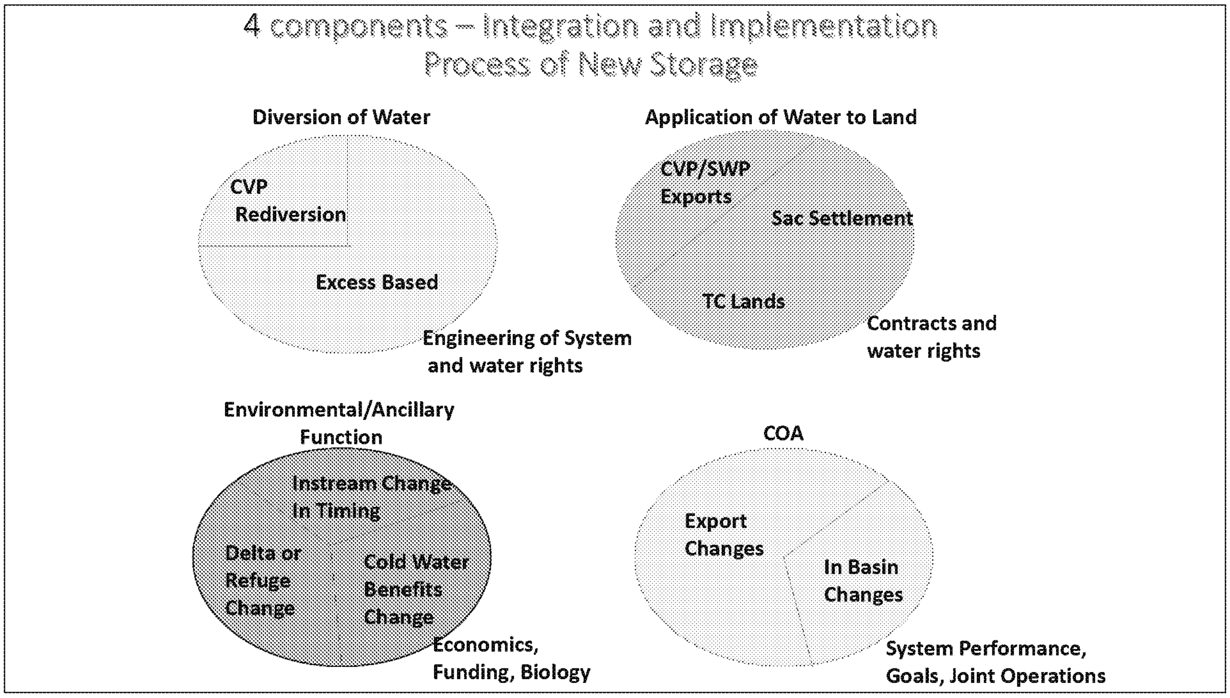
File Provided Natively


4 components – Integration and Implementation
Process of New Storage
Diversion of Water
CVP
Rediversion
Excess Based
Engineering of System
and water rights
Application of Water to Land
CVP/SWP
Exports
Sac Settlement
TC Lands
Contracts and
water rights
Environmental/Ancillary
Function
Instream Change
In Timing
Delta or
Refuge
Change
Cold Water
Benefits
Change
Economics,
Funding, Biology
COA
Export
Changes
In Basin
Changes
System Performance,
Goals, Joint Operations

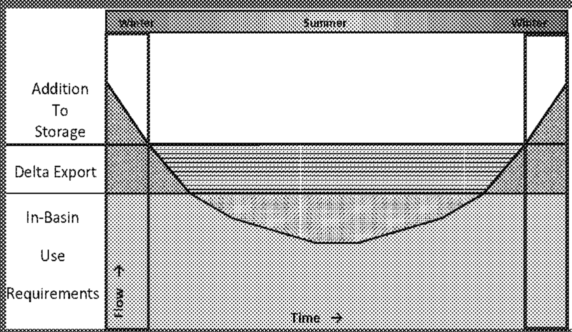
COA Sharing Concepts

<u>Suspended COA accounting</u>

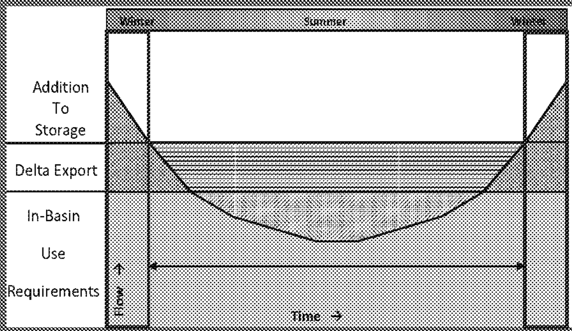
Excess condition

Water available to:

- **Meet all In-Basin Uses**
- **Export all available Delta supply**
  - **Subject to Export constraints**
- **Divert to reservoir storage (existing/new)**



COA In Basin Use Seasonality



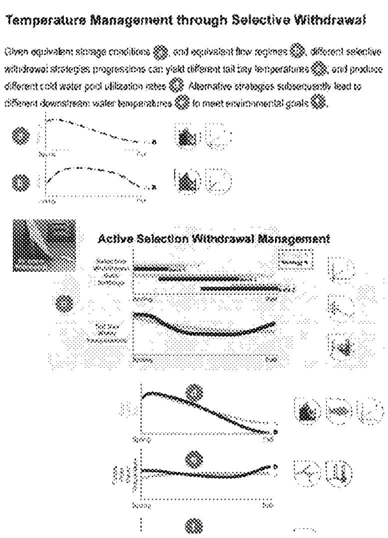
- With Sites Reservoir, the issues are integrated under 'In Basin Use' definitions
- In Basin Uses will change with the existence of Sites
- The water rights of the CVP/SWP/Sites are used on CVP/SWP lands simultaneously

Operational Flexibility with New Storage Facilities

- Operational flexibility equates to delivery capability with ancillary benefits, which are performance goals
- Operational flexibility fundamentals (which are COA)
  - Ancillary benefits
  - Determining performance goals
  - Administrative actions – water rights/contract for water to CVP/SWP lands
  - Redirected funding to facilities
  - Need for a BON

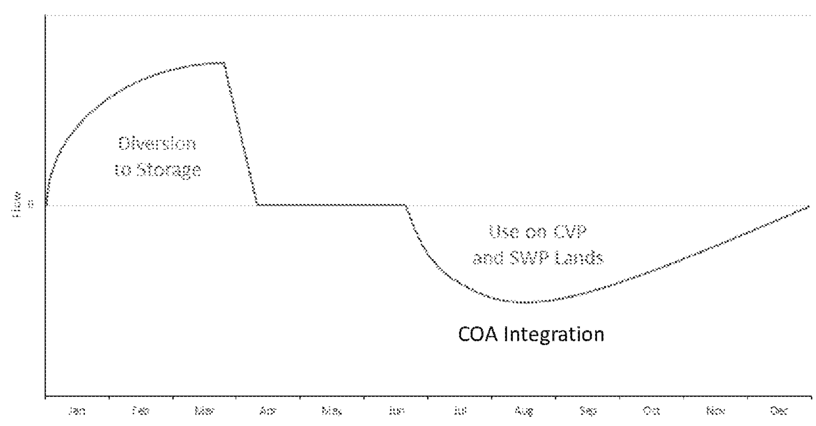
COA fundamentals

- Evaluate delivery capability
- Identify who pays – in FR, economic benefits are ancillary to get to funding with Federal $
- Economic valuations of projects are the shifts in yield between surface water, groundwater and conservation (which keeps annual variability down)
- Feasibility determination should include draft amendatory contract administration and terms
- BON and COA functionalities – how the new storage is integrated with the CVP/SWP
- No assurances of benefits, only potential performance of system for delivery capability for project purposes.
- New COA 2018 – adding new facilities to enhance existing facilities and enhance reliability.



- With the Sites-Shasta Exchange proposal, the intent is to improve the Shasta cold water pool and if the exchange provides a temperature benefit
- Reclamation is seeking to understand how the exchange could functionally work, both through technical analysis and illustrations.
- This graphic can be used as an example to illustrate leveraging selective withdrawal capabilities at Shasta with the ability to manage river temperatures for environmental objective.

- Reclamation's Basis of Negotiation will address policy direction on water right permit conditions, contractual relationships, and coordination of operation in order to have a basis to develop draft operation principles and plans.
- Reclamation's role is cooperative and administrative from a water rights and contractual basis. We are sharing the water resource of California to apply to CVP/SWP lands and purposes.
- For new storage project water right permits, the following questions must be answered:
  - What is the season of diversion?
  - What is the place of use?
  - What is/are the season/purpose of use?

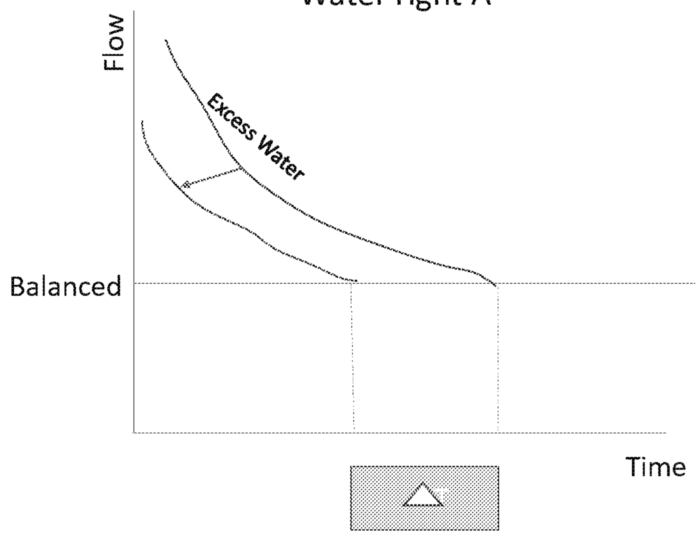


Diversion
to Storage
Use on CVP
and SWP Lands
COA Integration
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

The following items are intended to assist in developing an integrated water supply management framework for integration within CA's water system:

· Implementation strategy framework to help lay out how Reclamation is partnering with the project proponent into the future in order to make this a viable project?
· Basis of Negotiation to begin framing how Reclamation intends to begin the real process of initiating administrative commitments from a water rights and contractual basis?
· What water rights are being used to store and divert water?
· What land uses are being considered for the application of water associated with the water right(s)?
· What contractual mechanisms are needed in order to implement the project?

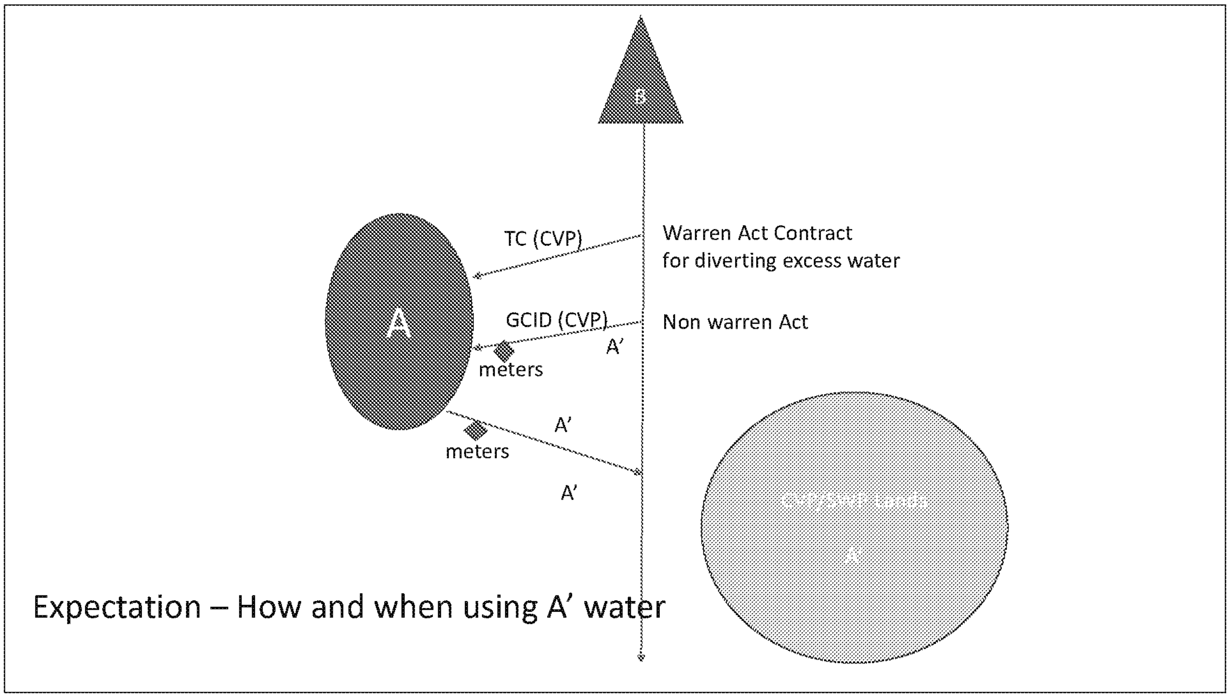
Sites
Water right A



WR A – goes to CVP/SWP contractors or place of use

Assume 500cfs diversion to Sites Reservoir example

Does this change CVP/SWP In Basin Use obligation?


B
TC (CVP)
Warren Act Contract
for diverting excess water
A
GCID (CVP)
Non warren Act
A’
meters
A’
meters
A’
Expectation – How and when using A’ water

Components of an Integrated Water Supply Management Framework

These are the specific terms and conditions that all parties would need to be in agreement with in order to develop a new COA for the functioning of Sites Reservoir, (or any new storage projects) whose goals and objectives integrate with the CVP/SWP. The terms and conditions include but are not limited to the following:

- Description of the project and its facilities
- Description of who owns and operates the facilities
- Description of what water is used to fill the facility and the water rights permits(

(Continued)

- Description of how operations are regulated under what Biological regulations and water right terms
- Goals of all parties involved – water quality, water supply, environmental, coordination of operations, etc
- Terms of the Agreement including seasonal consultations with the CVP/SWP
- Any Covenants to minimize conflicts in the operation of facilities in coordination with CVP/SWP operations
- Considerations for Assessment and Monitoring on the coordination of operations of new facilities with CVP/SWP and affects to CVP water deliveries and carryover storage