

EXHIBIT 8



FINAL REPORT • JULY 2014

Phase 2 Modeling Synthesis Report Prospect Island Tidal Habitat Restoration Project



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1 INTRODUCTION

The Prospect Island Tidal Habitat Restoration Project (Project) includes levee breaches and other actions to restore tidal connection of diked lands within an approximately 1,600-acre property located in Solano County, in the northern portion of the Sacramento-San Joaquin River Delta (Delta) (Figure 1-1 and Figure 1-2). The Project is being cooperatively implemented under the Fish Restoration Program Agreement (FRPA) between the California Department of Water Resources (DWR) and Department of Fish and Wildlife (CDFW) to partially fulfill the 8,000-acre tidal restoration obligations contained within the Reasonable and Prudent Alternative (RPA) 4 of the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion (USFWS 2008) and referenced in RPA I.6.1 of the National Marine Fisheries Service Salmonid Biological Opinion (NMFS 2009), for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP). Project planning was initiated by the Fish Restoration Program (FRP) in 2011 using a two-phased approach to develop alternatives for consideration, select the preferred Project alternative for design and construction, and to support assessment of potential environmental impacts. DWR (2013a) established six objectives for the Project consistent with the FRPA and RPAs identified in the above-referenced biological opinions (BiOPs) including:

1. Enhance primary and secondary productivity and food availability for native fishes within Prospect Island and surrounding Delta waterways;
2. Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island;
3. Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes;
4. Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration;
5. To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species; and
6. Avoid promoting conditions adverse to Project biological objectives, such as those which would favor establishment or spread of invasive exotic species.

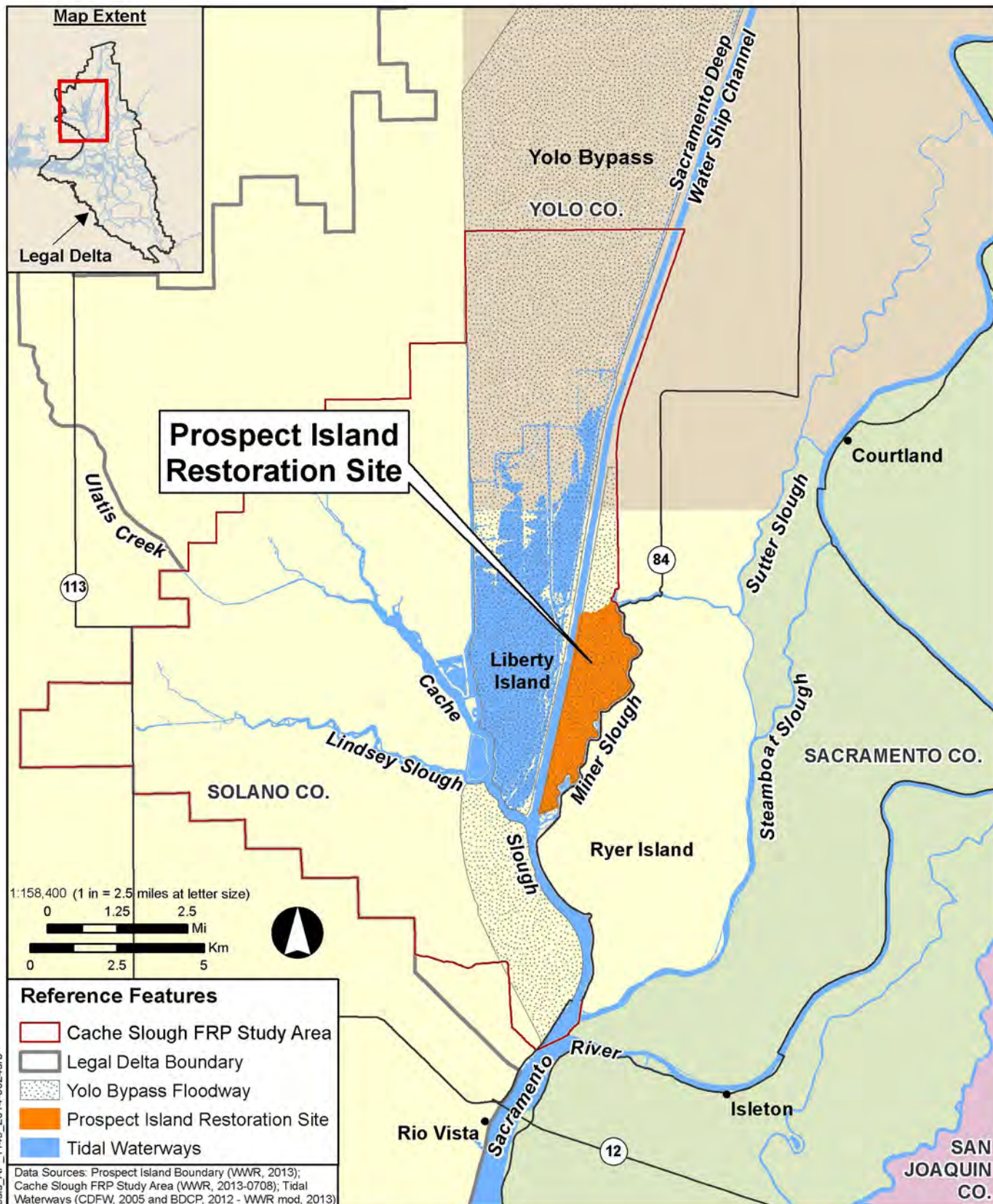
Phase 1 of the two-phased approach included the identification and screening level modeling of fifteen alternatives out of thirty conceptual alternatives initially

developed for the Project (Stillwater Sciences-WWR 2012). Modeling results were then evaluated using a suite of screening-level evaluation criteria (WWR 2012) with the purpose of determining which design alternatives would be carried forward into the second phase of Project planning (Stillwater Sciences-WWR 2012, WWR-Stillwater Sciences 2013a). Phase 1 analyses included application of the Delta Ecosystem Restoration Implementation Plan (DRERIP) conceptual models in review of the alternatives and Phase 1 modeling results. The October 2012 DRERIP review produced recommendations to the FRP regarding refinement of alternatives as well as follow-up analyses to be conducted in Phase 2 (ERP 2013).

Phase 2 modeling was conducted to support selection of final restoration alternatives for the Project, to inform environmental impact assessments, and to inform engineering design of the selected alternative. To accomplish these purposes, Phase 2 modeling included a broader range of evaluation criteria, which were applied to a subset of the restoration alternatives evaluated in Phase 1.

The purpose of this report is to present a synthesis of the Phase 2 modeling results in a format that compares and contrasts the modeled alternatives relative to the Phase 2 evaluation criteria. The remaining sections of this report are organized in the following manner:

- **Section 2** summarizes the Phase 2 evaluation criteria and their associated threshold(s), and describes how these criteria relate to restoration objectives and restoration alternatives selection.
- **Section 3** presents a brief description of each alternative modeled.
- **Section 4** summarizes the modeling findings presented in the modeling results reports. Readers are directed to Appendices A through D for the complete modeling results reports.
- **Section 5** presents a comparative analysis and discussion of the modeled alternatives relative to the evaluation criteria and thresholds. Readers are directed to this section preferentially for key comparative findings. Overall evaluation and ranking of alternatives was completed by FRP staff in a separate process that utilized these findings, among others.



Project Location

Prospect Island Tidal Habitat Restoration Project

June 2014

Project 1149

Figure 1-1

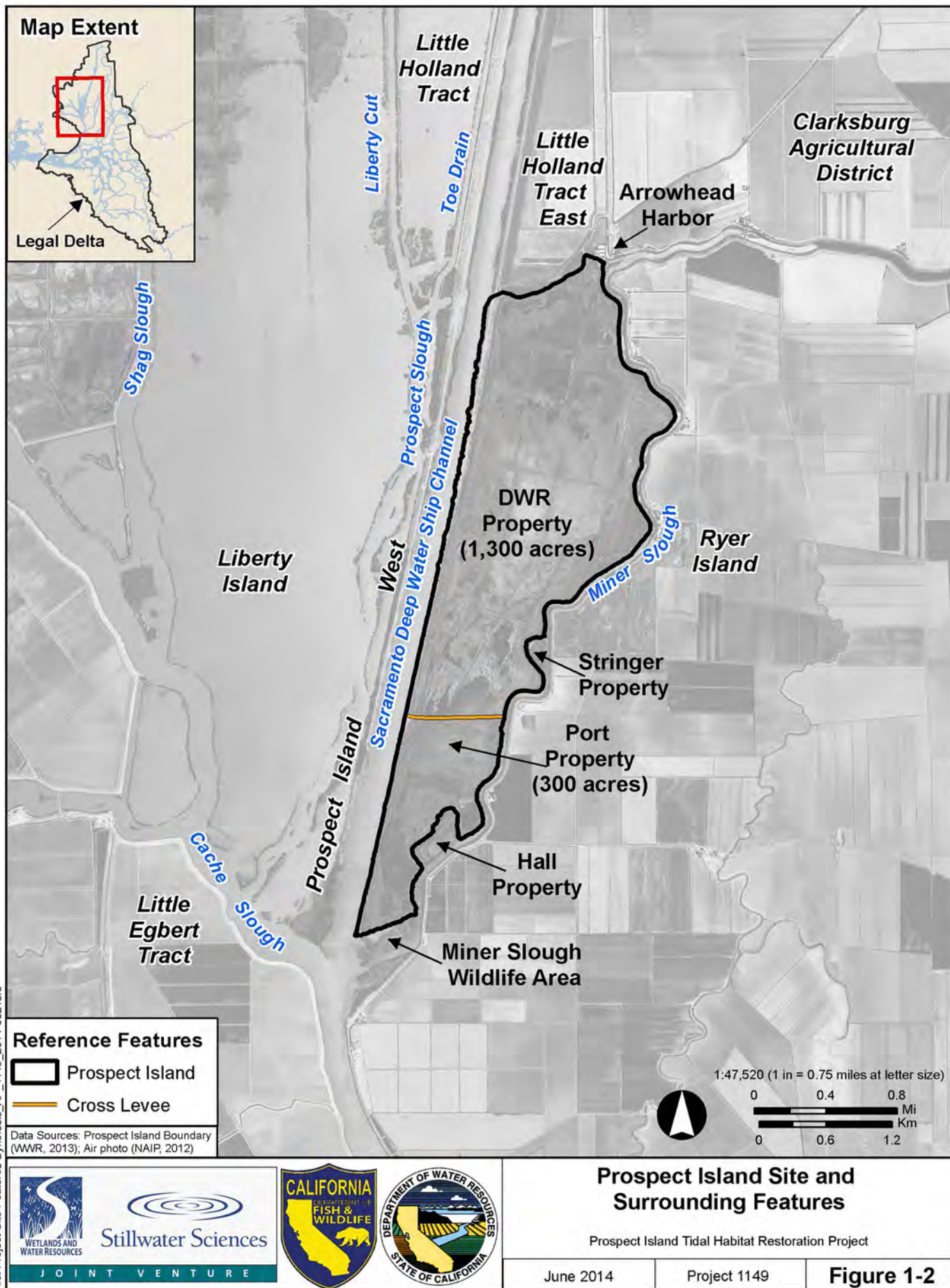


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JOINT VENTURE



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2 PHASE 2 EVALUATION CRITERIA

Establishment of the appropriate Phase 2 modeling evaluation criteria was based upon the Phase 1 screening level modeling results (Stillwater Sciences-WWR 2012, WWR-Stillwater Sciences 2013a), recommendations from the October 2012 DRERIP evaluation (ERP 2013), and information derived from recent conferences and workshops, as well as FRP technical team meetings. Contributions from these sources informed the review and elimination of some criteria originally identified for use in Phase 2 analysis, where screening-level modeling results showed these criteria produced no substantive effects, nor served to demonstrate significant differences between alternatives (WWR-Stillwater Sciences 2014).

2.1 Relationship between Project Objectives and Evaluation Criteria

Table 2-1 summarizes the relationships between modeling evaluation criteria, potential benefits (B), impacts (I), and design considerations (D) of the Project. Table 2-2 presents the relationships between the Phase 2 modeling criteria and Project objectives (Section 1), which are intended both to meet the requirements of the BiOPs and to avoid and/or minimize potential impacts (DWR 2013a).

Table 2-1. Relationship between Modeling Evaluation Criteria and Potential Project Benefits, Impacts, and Design Considerations.

Potential Benefit (B) or Impact (I) Designation	Evaluation Criterion	Phase 1 Analysis	Phase 2 Analysis
B-1	Pelagic Food Web Productivity within the Restoration Site	✓	B
B-2	Tidal Mixing of Exported Productivity	✓	B
B-3, I-4	Temperature Changes in Adjacent Water Bodies	Deferred to Phase 2	B*, I
B-4	Interior Constructed Channel Velocity	Deferred to Phase 2	I, D
I-2	Turbidity Effects	Deferred to Phase 2	B*, I
I-3	Salinity Changes at D-1641 Compliance Stations	Deferred to Phase 2	B*, I
I-8	Regional Flow Alterations	Deferred to Phase 2	B*
I-10	Predatory Fish Refuges	Deferred to Phase 2	D
I-11	Scour Potential to Ryer Island Miner Slough Levee from Cross Currents	✓	I
I-12	Scour Potential to Ryer Island Miner Slough Levee from Increased Tidal Prism	✓	I
I-13	Arrowhead Marina Boating Access	Identified in Supplemental Phase 1 Analysis	I, D

Criterion Key:

B = primary basis for alternatives selection, criterion provides key distinctions between alternatives by meeting restoration objectives, or avoiding/minimizing potential adverse impacts; criteria marked by a star () used for primary selection if modeling results indicate substantial differences between alternatives*

I = criterion applied primarily to environmental impact analyses

D = criterion applied primarily to restoration design approaches

Table 2-2. Relationship between Hydrodynamic Modeling Evaluation Criteria and Project Objectives and Impact Avoidance or Minimization.

Project Objective (defined in DWR 2013a)	Evaluation Criteria									
	B-1	B-2	B-3, I-4	B-4	I-2	I-3	I-8	I-10	I-11, I-12	I-13
	Pelagic Food Web Productivity	Tidal Mixing of Exported Productivity	Temperature Changes in Adjacent Water Bodies	Interior Constructed Channel Velocity	Turbidity Effects	Salinity Changes at D-1641 Compliance Stations	Regional Flow Alterations	Predatory Fish Refuges	Scour Potential to Ryer Island Miner Slough Levee	Arrowhead Marina Boating Access
Enhance primary and secondary productivity and food availability for native Delta fishes within Prospect Island and surrounding Delta waterways	X	X	X					X		
Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island	X	X	X	X				X		
Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes			X		X			X		
Provide other ecosystem services associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration						X	X			X
To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species			X	X	X	X	X			
Avoid promoting conditions adverse to Project biological objectives, such as those which would favor establishment or spread of invasive exotic species			X	X	X	X	X			X

2.2 Evaluation Criteria used for Alternatives Selection

For the purposes of alternatives selection, a total of three “benefits” criteria and four “potential impact” criteria were evaluated with Phase 2 hydrodynamic modeling. The criteria below are summarized in Section 2.2.

- Pelagic Food Web Productivity within the Restoration Site (B-1)
- Tidal Mixing of Exported Productivity (B-2)
- Temperature Changes in Adjacent Water Bodies (B-3, I-4)
- Turbidity Effects (I-2)
- Salinity Changes at D-1641 Compliance Stations (I-3)
- Regional Flow Alterations (I-8)

2.2.1 Pelagic food web productivity within the restoration site (B-1)

Pelagic food web support within the restoration site was evaluated based upon particle tracking simulations (Appendix A) that used an exposure time (ET) metric. This modeling tracked the length of time simulated particles remained within the Prospect Island interior in either open water or vegetated habitats (WWR-Stillwater Sciences 2014). Particles tracked within open water habitats were used to evaluate each alternative’s potential contribution of on-site phytoplankton growth to the aquatic food web (i.e., the phytoplankton-zooplankton-fish food web pathway). Particle tracking simulations of vegetated zones was used to represent relative contributions to marsh-generated productivity pathways (i.e., epiphytic and detrital pathways to insects and fish). Appendix A modeling simulations were used to provide spatial estimates of ET across nine categories: <1 day, 1–3 days, 3–5 days, 5–7 days, 7–10 days, 10–15 days, 15–20 days, 20–25 days, and >25 days. Sensitivity analyses, described in Section 3.5 of this document, were used to determine the effects of vegetation and channel network extent on three broad ET evaluations (Section 4 and Section 4.2).

1. Open water-dominated ET ranges that are either faster or slower than typical algal growth rates were used to indicate the potential for selection of desirable algal species as well as avoidance of undesirable species. Evaluation of Project alternatives focused upon ET results within the preferred 1–3 days and 3–5 days range categories (Section 4). Modeling results for other ET categories (Appendix A) may be used for future assessments.

2. Vegetated zone-dominated ET was used to inform site hydrodynamics and to examine potential differences in marsh productivity export between various Project alternatives (Section 4.2).
3. The full range of ET modeling results (Appendix A) may be used to examine spatial variations in site hydrodynamics as a basis of future comparisons with ET modeling conducted at other sites in the region, such as Liberty Island (Brennan et al. 2013) and Mildred Island (Monsen and Cloern 2002).

2.2.2 Tidal mixing of exported productivity (B-2)

Estimates of exported productivity were based on regional simulations that tracked particles and reported their locations after two days and after seven days (Appendix A). Analysis of exported productivity focused on examination of the comparative contributions to total export of particles that spent the majority of time in open water- or vegetation-dominated zones of the Project site (WWR-Stillwater Sciences 2014). Particles that spent the majority of the simulation period in open water habitats were used to assess potential pelagic food web contributions by algae, and particles that spent the majority of time in vegetated zones were used to assess potential marsh-based productivity contributions to the food web in waters surrounding Prospect Island. Project alternatives having greater rates of particle export were ranked higher than those with greater on-site particle retention.

2.2.3 Temperature changes in adjacent water bodies (B-3, I-4)

Using the RMA Delta model for water temperature results (Appendix B), average daily water temperatures were categorized based on suitability for Delta Smelt spawning and rearing, and for juvenile Chinook Salmon rearing (with 15–20°C suitable, 20–25°C sub-optimal, and >25°C lethal) (WWR-Stillwater Sciences 2014). Changes in average daily water temperatures from the no-project baseline during March through September were then used as a basis for comparison between alternatives.

2.2.4 Turbidity effects (I-2)

The potential for adverse reduction of turbidity was identified as an evaluation criterion for the Project as related to habitat use by Delta Smelt (*Hypomesus transpacificus*) within the Cache Slough region (WWR 2012). Three dimensional suspended sediment and turbidity modeling was used to examine the effects of breach locations, vegetation extent, and channel network extent on turbidity levels within the site and adjacent water bodies (Appendix C). Modeling results

were used to compare relative reduction in turbidity levels within a representative simulation period of October 1, 2012 through December 31, 2012, to capture a range of representative low and high turbidity conditions (WWR-Stillwater Sciences 2014). This window also captured an extended period during October and November, when observed turbidity in the Sacramento Deep Water Ship Channel (DWSC) and Cache Slough were elevated relative to that in Miner Slough, followed by a large outflow event in December 2012, when turbidity in Miner Slough was significantly elevated.

2.2.5 Salinity changes at D-1641 compliance stations (I-3)

Salinity changes at seven Delta locations used for compliance monitoring of SWRCB D-1641 (Table 2-3) were modeled to examine whether Project alternatives have the potential to result in non-compliance with water quality objectives, and to evaluate potential regional effects of the Project on Delta salinity levels (Appendix D). Emmaton (D22) and Jersey Point (D15) locations were chosen for the evaluation based on their proximity to the Project site and as an indication of how the Project may affect salinity levels in the Sacramento and San Joaquin river systems. These monitoring stations were also used to indicate the potential for salinity intrusion into the north and central Delta, as they are located just east of the low salinity zone. Prisoner's Point (D29), Emmaton, and Jersey Point stations were used to evaluate potential salinity effects to agriculture and fish and wildlife beneficial uses. Contra Costa Canal (C5), West Canal (C9), Delta Mendota Canal (DMC1), and Barker Slough NBA intake (SLBAR3) were chosen for use in analyzing potential impacts to municipal and industrial uses by the State Water Project, Central Valley Project, and Contra Costa Water District. Salinity modeling results for additional D-1641 compliance stations not used for alternatives selection are presented in Appendix D.

Table 2-3. D-1641 Compliance Location Used for Alternatives Comparison.

D-1641 Station ID	Location	Associated Beneficial Use
D22	Sacramento at Emmaton	Agriculture
D15	San Joaquin at Jersey Point	Agriculture, Fish and Wildlife
D29	San Joaquin at Prisoners Point	Fish and Wildlife
C5	Contra Costa Canal at Pumping Plant 1	Municipal and Industrial
C9	West Canal at mouth of Clifton Court Forebay	Municipal and Industrial
DMC1	Delta-Mendota Canal at Tracy Pumping Plant	Municipal and Industrial
SLBAR3	Barker Slough NBA intake	Municipal and Industrial

Table 2-4 summarizes the water quality objectives for salinity (as measured by electrical conductivity) for agricultural and fish and wildlife beneficial uses, and Table 2-5 summarizes water quality objectives for municipal and industrial uses (as measured by chloride). Conversion between EC and chloride concentration is generally accomplished using site-specific empirical relationships developed by Kamyar Guivetchi (DWR 1986). Additional details about this conversion are presented in Appendix D.

Table 2-4. D-1641 Station Electrical Conductivity Water Quality Objectives—Fish and Wildlife and Agriculture.

Station	Water Year Type ¹	Fish and Wildlife		Agriculture			
		Value ²	Time Period	Value ²	Time Period	Value ²	Time Period
Sacramento at Emmaton	Wet	not applicable		0.45	Apr 1 - Aug 15	not applicable	
	Above Normal			0.45	Apr 1 - Jun 30	0.63	Jul 1 - Aug 15
	Below Normal			0.45	Apr 1 - Jun 19	1.14	Jun 20 - Aug 15
	Dry			0.45	April 1 - June 14	1.67	Jun 15 - Aug 15
	Critical			2.78	Apr 1 - Aug 15	not applicable	
San Joaquin at Jersey Point	Wet	0.44	Apr 1 - May 31	0.45	Apr 1 - Aug 15	not applicable	
	Above Normal	0.44	Apr 1 - May 31	0.45	Apr 1 - Aug 15	not applicable	
	Below Normal	0.44	Apr 1 - May 31	0.45	Apr 1 - Jun 19	0.74	Jun 20 - Aug 15
	Dry	0.44	Apr 1 - May 31	0.45	April 1 - June 14	1.35	Jun 15 - Aug 15
	Critical	not applicable		2.20	Apr 1 - Aug 15	not applicable	
San Joaquin at Prisoners Point	Wet, Above Normal, Below Normal, Dry	0.44	Apr 1 - May 31	not applicable			

Notes

1. Sacramento Valley Water Year Hydrologic Classification
2. Maximum 14-day running average of mean daily EC (mmhos/cm)

Table 2-5. D-1641 Station Chloride Water Quality Objectives—Municipal and Industrial.

Station	Water Year Type ¹	Municipal and Industrial	
		(Cl ⁻) Value ²	Days of the Calendar Year
Contra Costa Canal at Pumping Plant 1	Wet	less than or equal to 150	240
	Above Normal		190
	Below Normal		175
	Dry		165
	Critical		155
Contra Costa Canal at Pumping Plant 1	All	250	365
West Canal at mouth of Clifton Court Forebay			
Delta-Mendota Canal at Tracy Pumping Plant			
Barker Slough NBA intake			
Cache Slough at City of Vallejo Intake			

1. Sacramento Valley Water Year Hydrologic Classification

2. Maximum mean daily value in mg/L

2.2.6 Regional flow alterations (I-8)

Regional flow alterations were modeled to inform potential changes to salinity and to identify potential compliance issues in relation to flow requirements on the Sacramento River at Rio Vista (D-1641 Station D24). These flow requirements summarized in Table 2-6 are designed to maintain a sufficient net downstream flow in the Lower Sacramento River to support salmon migration (SWRCB 2006). Below normal conditions and dry conditions were modeled to determine if and/or how Project alternatives could affect flow compliance at the Rio Vista station (WWR-Stillwater Sciences 2014).

Table 2-6. Rio Vista Minimum Monthly Average Flow Rate (cfs).

Month	Water Year Types					
	All	Wet	Above Normal	Below Normal	Dry	Critically Dry
September	3,000					
October		4,000	4,000	4,000	4,000	3,000
November-December		4,500	4,500	4,500	4,500	3,500

Source: SWRCB 2006

For the Prospect Island restoration, regional channels of interest include the Delta Cross Channel, Georgiana Slough, the Lower Sacramento River, and Threemile Slough (Appendix D, Figure 8). Fresh water flow through the Delta Cross Channel and down Georgiana Slough is important in maintaining a net outward flow on the lower San Joaquin River to repel salinity from Suisun Bay.

The net flow of fresher water from the Sacramento River to the San Joaquin River through Threemile Slough is also important to control salinity intrusion into the central Delta, although this water is less fresh as compared to water flowing through Georgiana Slough. Increases and decreases in net flows were documented, with changes of 10% and greater considered significant (WWR-Stillwater Sciences 2014).

2.3 Evaluation Criteria Potentially Useful for Impact Analysis and Design

The following evaluation criteria may be used in analyzing potential Project impacts during the environmental review process and/or for Project design, rather than for selection of alternatives.

2.3.1 Interior constructed channel velocity (B-4)

Modeled velocities within the Prospect Island interior channel network may be used to support analysis of the potential for colonization by invasive submerged aquatic vegetation and of potential scour effects. Preliminary modeling results showed little difference in interior channel velocities between alternatives (Figure 2-1). As the results showed no significant differences, this criterion was deemed ill-suited for use in alternatives selection. Instead, information from velocity modeling may be used in evaluation of potential impacts during the environmental review process, and in determination of potential SAV prevention/management options.

2.3.2 Predatory fish refuges (I-10)

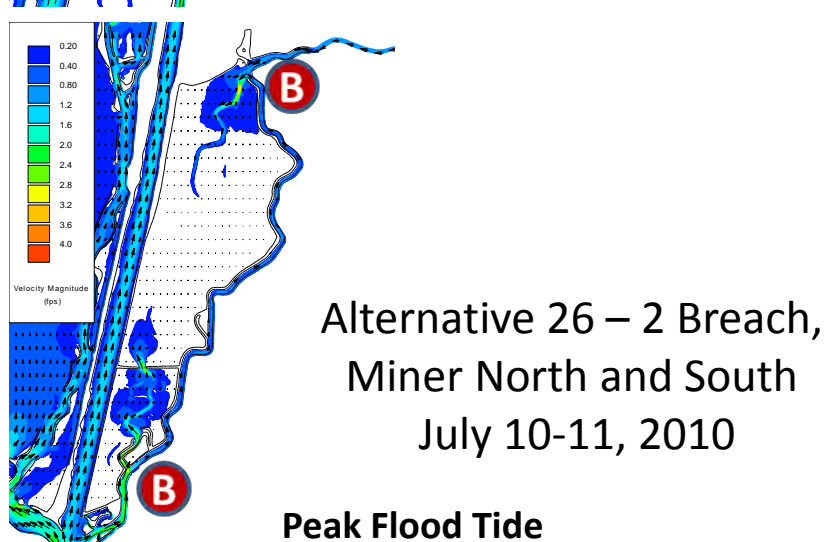
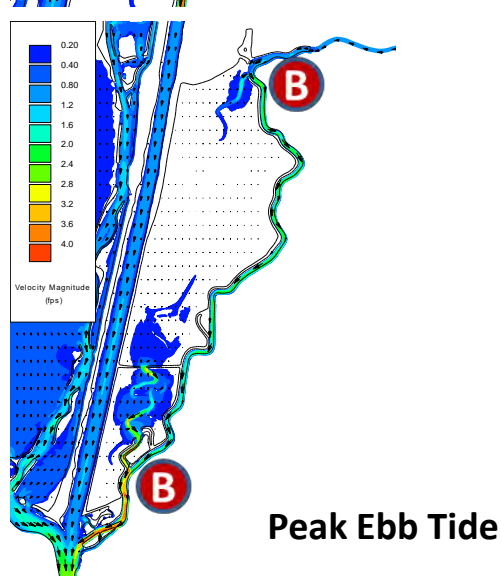
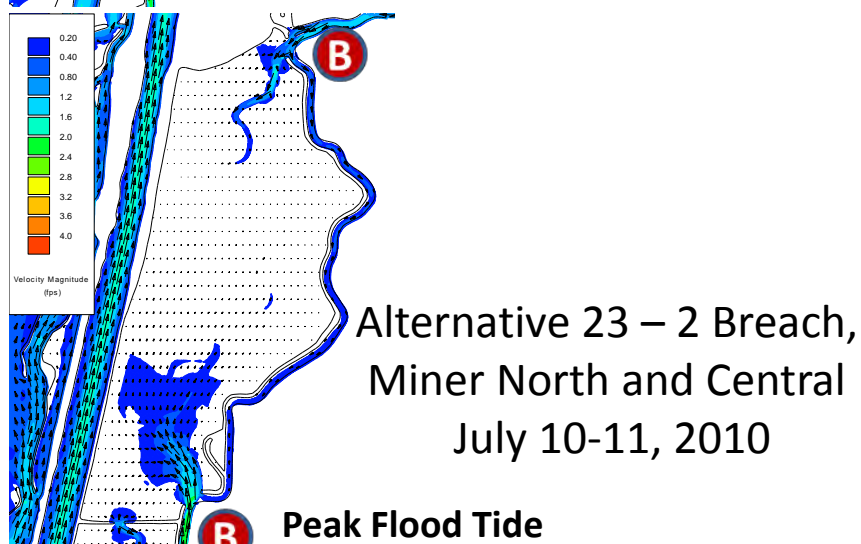
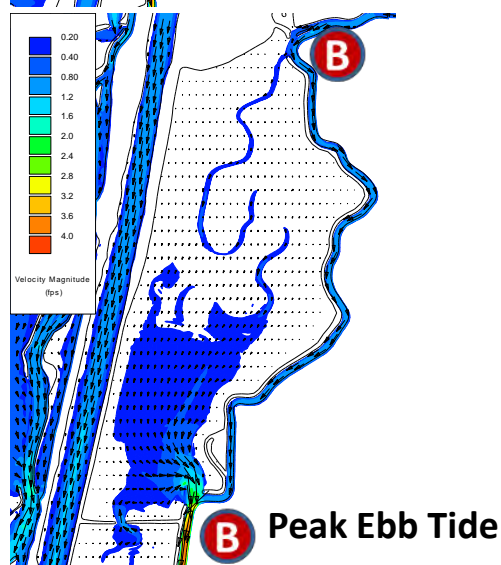
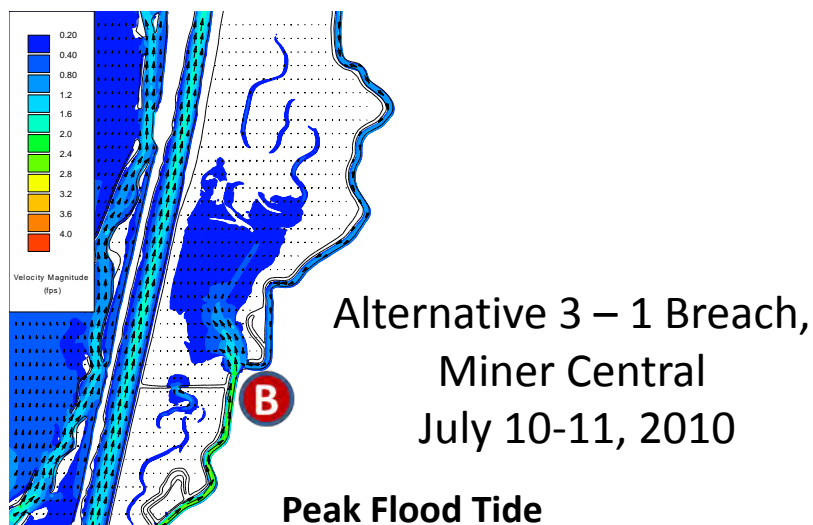
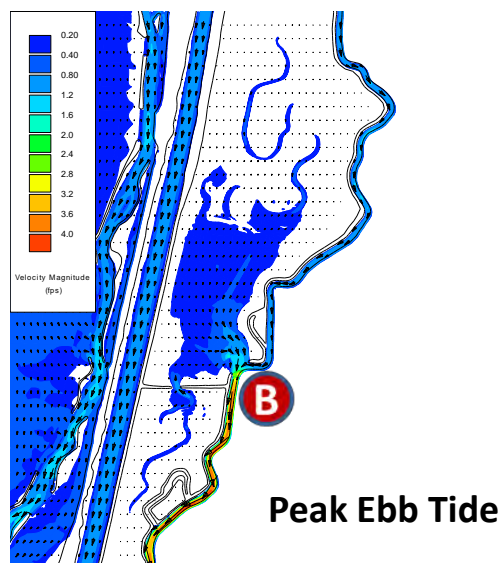
Localized velocity gradients at breach locations occur during flood tides, where high velocity inflows from outside tidal waters mix with low velocity waters just inside the breached site. Predatory fish have been observed to congregate at such localized velocity gradients. Two engineering design approaches are anticipated to minimize or potentially eliminate these conditions through flow dissipation: (1) creation of large levee breaches, and (2) placement of moderate-gradient earthen slopes on the restored island interior at breach locations. As these approaches can be applied to any alternative, this evaluation criterion may be utilized primarily for refining engineering design elements.

2.3.3 Potential scour of Ryer Island Miner Slough levee (I-11 and I-12)

Phase 1 modeling of scour potential in Miner Slough showed increases in long-channel velocities across all alternatives that were moved forward for Phase 2 analysis. As modeling showed that all alternatives have similar potential for scour, this criterion does not provide a means for comparison or selection. Modeling results regarding scour potential may, however, be used in Project environmental impacts analysis.

2.3.4 Arrowhead Harbor boating access (I-13)

Arrowhead Harbor marina is located just north of Prospect Island, along Miner Slough. The entrance to the marina is located immediately adjacent to the proposed location of the north Miner Slough breach. Modeling results showed that alternatives that included a breach to Miner Slough at this location would result in a shift of velocity and flow direction in Miner Slough, near the entrance of Arrowhead Harbor, from a north-south orientation (in line with the marina entrance) to a more east-west direction (orthogonal to the harbor entrance). This shift could potentially create a navigation hazard for recreational boaters (WWR-Stillwater Sciences 2013b). A decision to relocate the breach farther south along Miner Slough was made during subsequent alternatives selection discussions by FRP staff.



Data Source:
RMA 2013



Preliminary Interior Velocity Modeling Results for Alternatives 3, 23, and 26

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Figure 2-1

2.4 Summary of Modeling Completed to Date

In addition to the modeling results presented here, additional work was completed under Phase I to evaluate the Project alternatives. The table below provides a list of Phase I modeling documents and the criteria they addressed. All of these reports are available for review upon request.

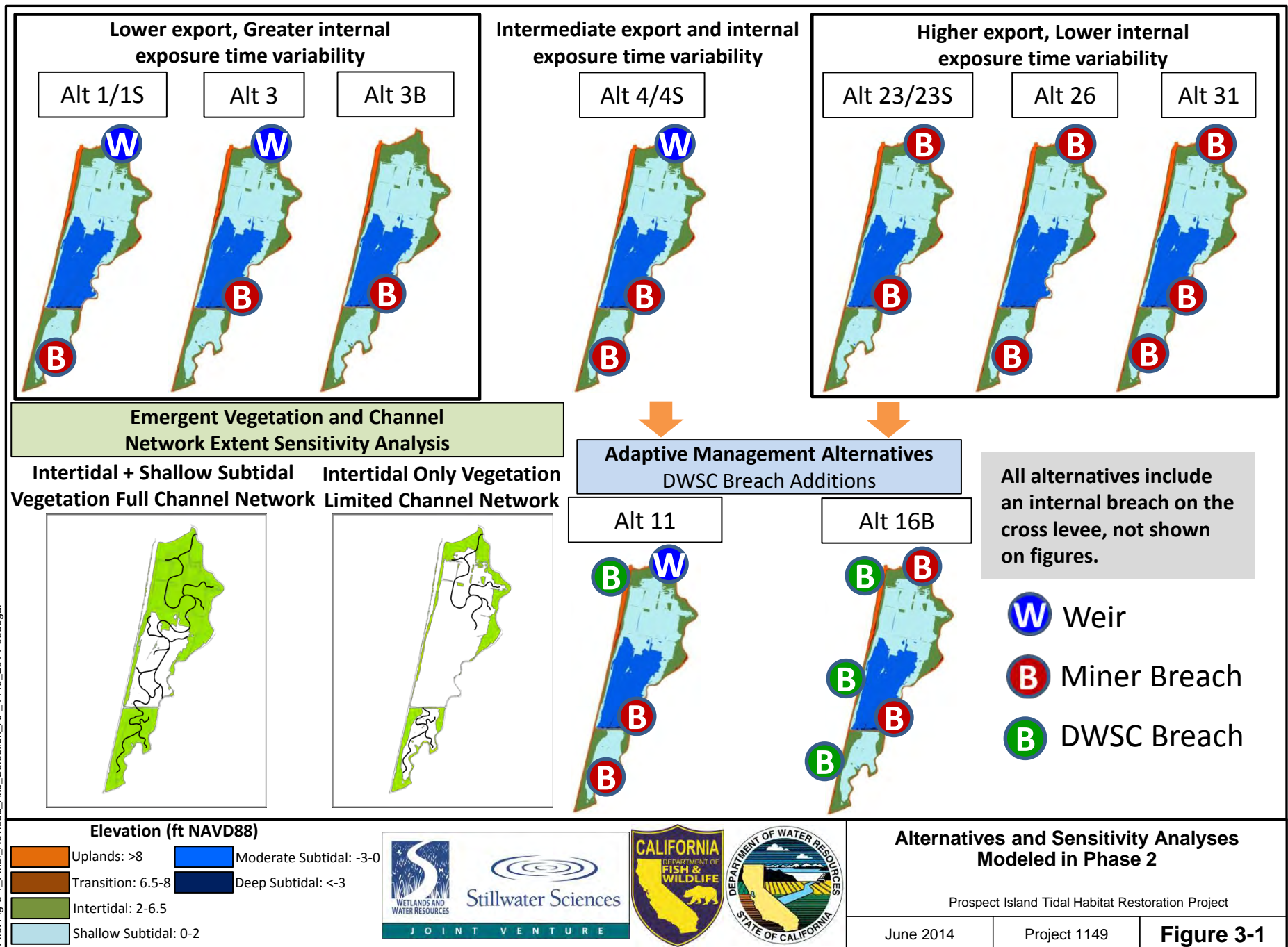
Table 2-7. Phase I Modeling Reports Produced to Date for Prospect Island.

Report Title	Date	Criteria Addressed
Modeling Results for Primary Productivity Enhancement and Export	September 2012	<ul style="list-style-type: none"> On-site Food Web Productivity Tidal Mixing of Exported Productivity
Modeling Results for DOC Impacts at Barker Slough Pumping Plant	October 2012	<ul style="list-style-type: none"> DOC Impacts at Barker Slough
Modeling Results for Flood Conveyance	September 2012	<ul style="list-style-type: none"> Flood Conveyance Impacts in the Yolo Bypass Flood Conveyance Impacts in Miner Slough
Modeling Results for Tidal Range Impacts	August 2012	<ul style="list-style-type: none"> Tide Range
Modeling Results for Deep Water Ship Channel Cross Currents	September 2012	<ul style="list-style-type: none"> DWSC Navigation
Modeling Results for Scour Potential to Ryer Island Miner Slough Levee	September 2012	<ul style="list-style-type: none"> Scour Potential in Miner Slough
Prospect Island Tidal Restoration Supplemental Phase 1 Screening-Level Modeling Results Memorandum	March 2013	<ul style="list-style-type: none"> On-site Food Web Productivity Tidal Mixing of Exported Productivity Arrowhead Marina Access

3 ALTERNATIVES FOR PHASE 2 MODELING AND ANALYSIS

A total of twelve (12) conceptual design alternatives were modeled under Phase 2: seven with breaches along Miner Slough only, two with levee breaches along the DWSC for potential implementation in the future as an adaptive management measure, and three sensitivity model simulations combining reduced vegetation and channel network extents (Figure 3-1). FRP staff selected from alternatives modeled in Phase 1 (WWR-Stillwater Sciences 2013a) based upon DRERIP recommendations (ERP 2013), results of refined on-site and exported productivity analyses (WWR-Stillwater Sciences 2013b), feasibility issues associated with private property access (i.e., adjacent Stringer property), and

consideration of regulatory constraints associated with breaching the DWSC (i.e. lengthy permitting processes and potential navigation impacts). The seven Miner Slough-only breach alternatives were further sorted into three groupings, based on refined Phase 1 productivity modeling results (WWR-Stillwater Sciences 2013b). Each of these groups of alternatives is shown in Figure 3-1 and briefly described in the sections below.



3.1 Lower Export and Greater Internal Exposure Time Variability Alternatives (Alternatives 1, 3, and 3B)

The first alternative group consists of Alternatives 1 and 3, both of which are single breach alternatives that would maintain access to the Stringer property by including an overflow weir at the north Miner Slough location, near Arrowhead Harbor. A modification of Alternative 3 (Alternative 3B) includes no weir at this location, for the purposes of examining the effect of the weir upon regional turbidity levels (Figure 3-1). The presence of only one external breach for alternatives in this group limits tidal connectivity, and results in lower exports of productivity to the surrounding waters and greater internal exposure time variability (WWR-Stillwater Sciences 2013b). Each of these alternatives includes an internal breach through the internal cross-levee, connecting the DWR- and Port-owned portions of the island.

3.2 Intermediate Export and Intermediate Exposure Time Variability Alternative (Alternative 4)

The second alternative group consists of a single alternative (Alternative 4). This is a two-breach alternative, with an overflow weir at the north Miner Slough location, and an internal breach through the internal cross-levee, connecting the DWR- and Port-owned portions of the property (Figure 3-1). The presence of two external breaches increases the tidal connectivity in this alternative as compared to the single breach alternatives, results in intermediate levels of productivity export to the surrounding waterways, and produces intermediate internal exposure time variability as compared to other alternatives modeled. This alternative configuration also maintains access to the Stringer property.

3.3 Higher Export and Lesser Internal Exposure Time Variability Alternatives (Alternative 23, 26, and 31)

The third group of alternatives consists of Alternatives 23, 26, and 31 (Figure 3-1). Alternatives 23 and 26 are flow-through, two-breach alternatives, and Alternative 31 is a three-breach alternative. All of these alternatives include a breach, rather than an overflow weir, at the north Miner Slough location, and all have an internal breach connecting the DWR- and Port-owned portions of the property. The presence of multiple breaches in these alternatives maximizes tidal connectivity, results in higher productivity exports to the surrounding waterways, and lower internal exposure time variability. None of the alternatives in this group maintain access to the Stringer property.

3.4 Adaptive Management Alternatives (Alternative 11 and 16B)

All of the alternatives recommended for additional modeling by the 2012 DRERIP evaluation (Alternatives 11, 16 [with addition of northeast Miner Slough breach], 25, 27 [with suggested addition of operable weir], and 29) included breaches to or partial removal of the DWSC levee. However, it was later determined that the lengthy regulatory process and potential for navigation problems associated with such project elements rendered these alternatives infeasible. Two of these alternatives were retained for Phase 2 modeling as future adaptive management alternatives. Alternative 11 includes a breach along the DWSC and was originally recommended for Phase 2 evaluation because this configuration performed well in Phase 1 productivity modeling (ERP 2013). Alternative 16B is a modification of Alternative 23 with three breaches added along the DWSC (Figure 3-1). This new configuration was recommended during the DRERIP evaluation process (WWR-Stillwater Sciences 2013b). Both adaptive management alternatives would produce higher export and lower internal exposure time variability. However, only Alternative 11 would maintain access along the DWSC levee to the Stringer property.

3.5 Vegetation and Channel Network Sensitivity Analysis (Alternative 1S, 4S, and 23S)

For each of the nine alternatives discussed above, the baseline hydrodynamic modeling condition assumed presence of vegetation at intertidal and shallow subtidal elevations (vegetation to 0 feet NAVD88) and full channel network extent (Figure 3-1). To determine the sensitivity of the alternatives to these design variations, one alternative from each groups described above was modeled again, in this instance using a reduced vegetated extent (vegetation at intertidal elevations only) and limited channel network extent condition (Figure 3-1). Alternative 1 was modeled from the lower export-greater internal exposure time variability group, Alternative 4 was modeled from the intermediate export and internal exposure time variability group, and Alternative 23 was modeled from the higher export-lower internal exposure time variability group. This approach was intended to provide a “bookend” view of the combined effects of channel network and vegetation extents, comparing maximum vegetation coverage and channel extent with minimal vegetation coverage and channel extent. This approach did not allow for differentiation between effects due to channel extent and those due to vegetation extent variations.

4 MODELING RESULTS SUMMARY

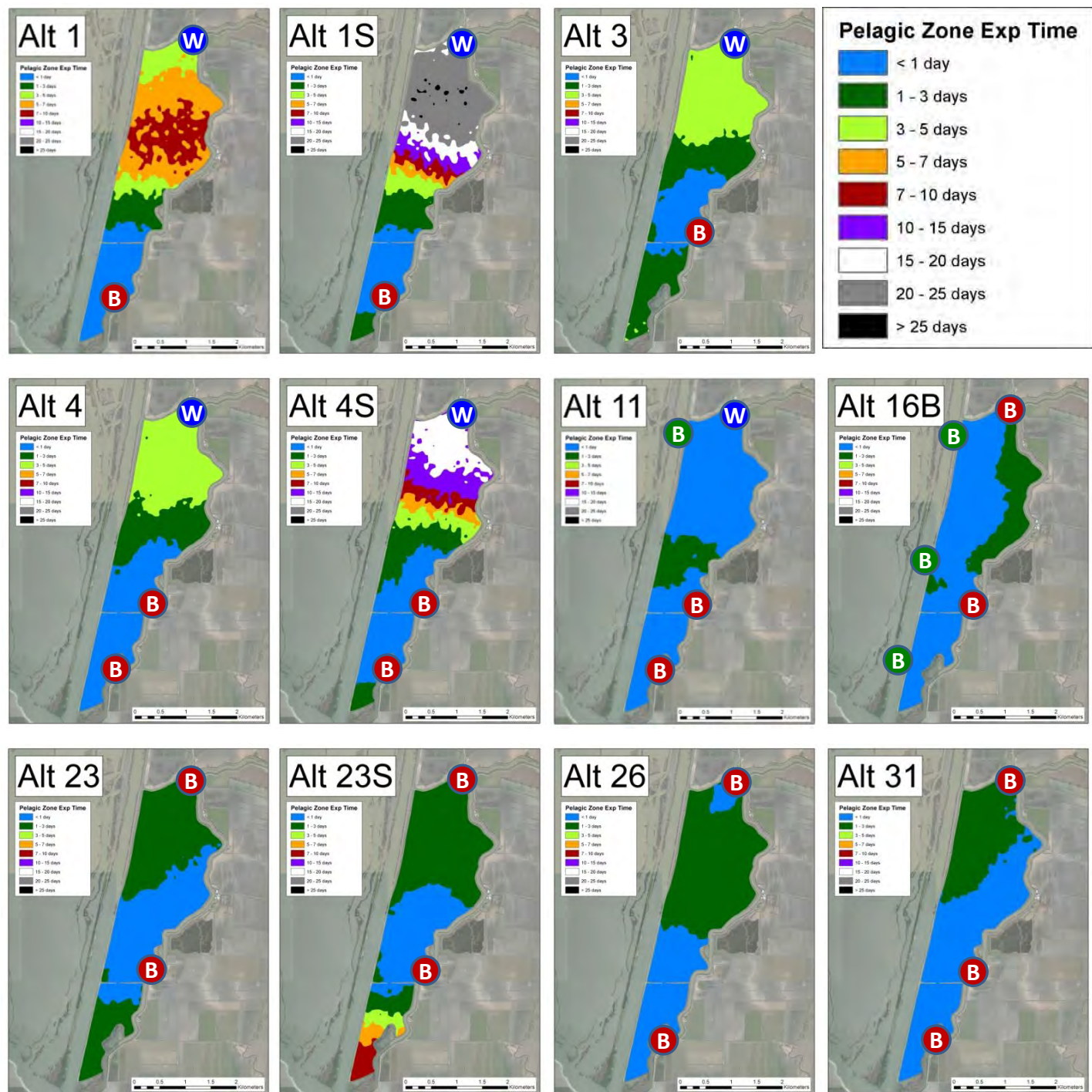
4.1 Pelagic Food Web Productivity within the Restoration Site (B-1)

The calibrated RMA Delta model with computational grid modifications within the restoration site and surrounding waterways was used to evaluate hydrodynamics within the restoration site (Appendix A). The RMA Delta model is a 2-D depth averaged / 1-D cross-sectionally averaged model extending from Martinez at the west end of Suisun Bay to the Sacramento River above the confluence with the American River, and to the San Joaquin River near Vernalis.

For each of the alternatives selected for continued evaluation in Phase 2 (Section 3), hydrodynamic modeling was used to simulate and compare particle movements within the interior of Prospect Island in response to tidal mixing (Appendix A). Relative differences in potential pelagic food web production were assessed by tracking the ET of particles within open water areas of the Prospect Island interior (i.e., areas conducive to phytoplankton growth). For modeling purposes, open water areas were defined as un-vegetated subtidal habitat deeper than 0 ft (NAVD 88, Figure 3-1). Appendix A presents results of a 26-day particle tracking simulation conducted to estimate the percentage of particles in each of nine ET classes, ranging from less than 1 day to maximums in excess of 25 days (Section 2.2.1). The full modeling results presented in Appendix A are summarized for open water zone ET in Figure 4-1 and discussed in the sections below:

- Alternative 1 and 3—Lower export, greater ET variability
- Alternative 4—Intermediate export, ET variability
- Alternative 23, 26, and 31—Higher export, lower ET variability
- Alternative 11 and 16B—adaptive management DWSC breach additions
- Alternative 1S, 4S, and 23S—alternative configurations for sensitivity analysis

For off-site comparison, Liberty Island modeling results showed ET variations between 0 and 25 days (Brennan et al. 2013). As habitat conditions in Liberty Island have been found to be beneficial for native fish (BREACH III, etc.), comparison of modeling results on the basis of the ET classes used for Prospect Island should be limited to alternatives selection and general productivity effects.



Design Symbol



Weir



Miner Slough Breach



DWSC Breach

Data Source:
RMA 2013



**Particle Pelagic Exposure Time within
Prospect Island for Model Simulations
between June 20 and July 31, 2010**

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Figure 4-1

The results presented in (Table 4-1) and the sections below are focused on six ET classes (<1 day, 1–3 days, 3–5 days, 5–7 days, 7–25 days, and >25 days). At ET <1 day, removal by tidal flushing is expected to exceed algal growth rates, and therefore to limit productivity within the site. The target ET for diatom based productivity is in the 1–3 day range; the 3–5 days range is considered close to optimal. At longer ET, represented by the 5–7 days, 7–25 days, and >25 days classes, low rates of tidal exchange create risk of domination of the algal community by slower growing blue-green algae. To indicate the dominance of various ET classes, class percentages greater than 20% are highlighted in Table 4-1 for ease of interpretation, with blue highlighting ET of <1 day, dark green highlighting ET of 1–3 days, light green highlighting ET of 3–5 days, and gray highlighting ET of >25 days. The 20% threshold for highlighting guides focus on dominance but does not represent any absolute factors.

Table 4-1. Particle Exposure Time within Open Water Areas of Prospect Island for Model Simulations between June 20 and July 31, 2010.

Alternative Description		Alt. No.	Percent of Total Particles within Prospect Island Open Water Zone Exposure Time Classes [%]					
			< 1 day	Target 1–3 days	3–5 days	5–7 days	7–25 days ¹	> 25 days
Base Alternative Configuration	Lower export, greater ET variability	1	23	16	16	14	1–15	0
		3	27	32	21	12	0–6	0
	Intermediate export, ET variability	4	39	27	18	10	0–5	0
	Higher export, lesser ET variability	23	50	43	5	1	0	0
		26	39	52	9	0	0	0
		31	64	36	1	0	0	0
	DWSC breach additions	11	85	14	1	0	0	0
		16B	72	26	2	0	0	0
Sensitivity Alternative Configuration		1S	18	14	7	4	5–11	24
		4S	30	19	8	5	6–9	7
		23S	34	48	9	3	1–3	0

¹ Percent ranges for time classes 7–10 days, 10–15 days, 15–20 days, and 20–25 days.

4.1.1 Lower export and greater exposure time variability (Alternatives 1 and 3)

Results for Alternative 1 indicated long open water exposure times that could potentially favor slow-growing blue green algae growth. Of the total particles within Prospect Island, 45% of them were classified with ETs >5 days for this

alternative (Table 4-1). Modeling results for Alternative 3 showed a more optimal exposure time distribution, with 32% of total particles having the target ET class of 1–3 days and 77% experiencing ETs <5 days. In this case, the location of the breach appears to have affected the amount of time particles spent in the open water zone and the quantity that was available for pelagic food web productivity (Figure 3-1).

4.1.2 Intermediate export and intermediate exposure time variability (Alternative 4)

For Alternative 4, model results showed higher proportions of particles within the <1 day ET class (39%) and the optimal ET classes (1–3 days = 27% and 3–5 days = 18%) (Table 4-1). Only 16% of particles were exposed to the open water zone for >5 days. These results indicate that Alternative 4 may produce high rates of primary productivity with favorable species composition.

4.1.3 Higher export and lesser exposure time variability (Alternative 23, 26, and 31)

Alternative 23, 26, and 31 resulted in the highest proportions of particles within the target 1–3 days open water zone ET class and the lowest proportions of particles with ET classes >5 days (Table 4-1). Of the three, Alternative 26 exhibited the highest proportion of particles in the target 1–3 days ET class (52%) and Alternative 31 exhibited the lowest proportion (36%). The presence of the open water adjacent breaches in Alternative 23 and 31 resulted in shorter ETs. Model results indicate that all three alternatives may produce high primary productivity with favorable phytoplankton species composition.

4.1.4 Adaptive management alternatives (Alternative 11 and 16B)

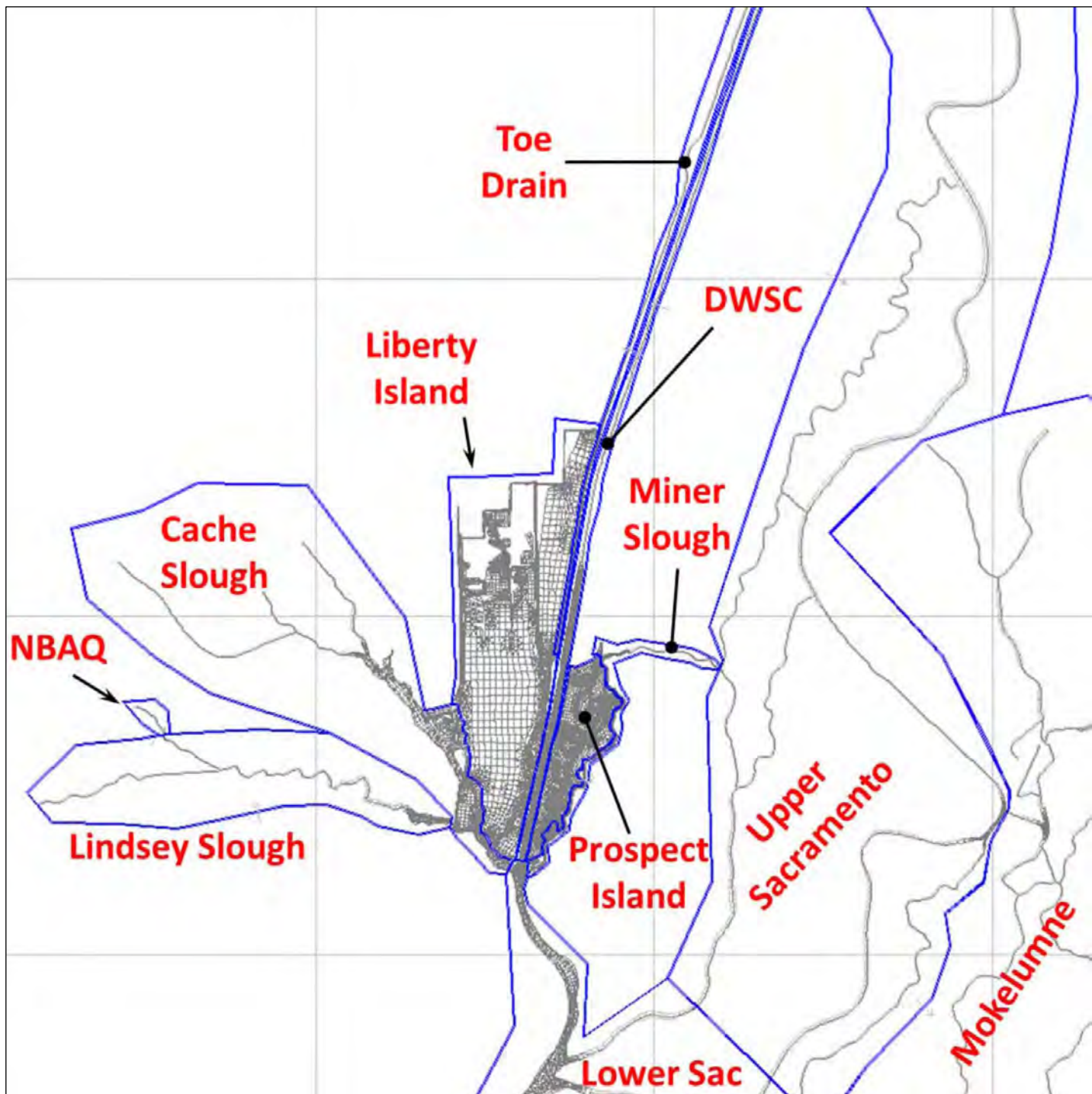
The addition of DWSC breaches in alternatives 11 and 16B resulted in the highest proportions of particles within the <1 day open water zone ET class (Alternative 11 = 85%, Alternative 16B = 72%) and low to intermediate proportions with the target 1–3 days ET class (Alternative 11 = 14%, Alternative 16B = 26%) (Table 4-1). Particles tracked in Alternative 16B experienced longer exposure times than Alternative 11, and no particles spent more than 7 days within the Prospect Island open water zone. These results indicate Alternative 11 may exhibit low primary productivity due to frequent tidal flushing in excess of maximum algal growth rates. Alternative 16B may exhibit high primary productivity with favorable phytoplankton species composition.

4.1.5 Vegetation and channel network sensitivity analysis (Alternative 1S, 4S, and 23S)

Sensitivity simulations exhibited variable increases in the representation of the longest ET classes (Table 4-1). Decreased vegetation and channel network extent translated to an increase in the extent of open water habitat under the sensitivity analysis configurations. This caused a shift towards longer open water zone hydraulic residence times commensurate to longer ET classes, relative to the base run. This effect was most pronounced for the single breach Alternative 1S, which showed approximately 57% of all particles within open water zone ET classes in excess of 7 days. Alternative 23S showed an increased representation in particles within the optimal 1–3 days class (43 to 48%) and a decreased representation in the lowest <1 day ET class (50 to 34%).

4.2 Tidal Mixing of Exported Productivity (B-2)

The calibrated RMA Delta model was used to track the regional transport of particles that spent the majority of time in either open water or vegetated habitats of Prospect Island (Appendix A). Figure 4-2 shows the regional boundaries used for particle tracking. Particles that spent the majority of time within the open water habitats of Prospect Island were used to assess potential export of phytoplankton to regional locations after 2 and 7 days (Table 4-2). Recognizing the potential importance of marsh-based productivity, a parallel assessment was conducted by tracking particles that spent the majority of time within the vegetated habitats of Prospect Island (Table 4-3). Project alternatives having the greatest combined export of all (both open water- and vegetation-dominated) were ranked higher than those with the majority of modeled particles remaining on-site at the end of the simulation.



Data Source: RMA 2013



Regional Boundaries for Particle Transport Simulations of Exported Productivity

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Figure 4-2

Table 4-2. Percentage of Open Water Zone Dominant Particles Remaining On Site and Exported to Other Locations in the Project Region after 2 and 7 Days.

Alternative grouping	Alt. No.	Percent of total particles (% of open water zone dominant)			Percent of total particles (% of open water zone dominant) transported to regional locations						
		Open water zone dominant	Remaining On-Site	Exported Off-Site	Lower Sac	DWSC	Liberty Island	Cache Slough	Lindsey Slough	Miner	Other Regions
OPEN WATER ZONE DOMINANT PARTICLES AFTER 2 DAYS OF MODEL SIMULATION											
Lower export, higher ET variability	1	36	26 (73)	10 (27)	3 (9)	2 (5)	2 (6)	1 (4)	0 (1)	1 (3)	0 (0)
	1S	83	62 (75)	21 (25)	8 (10)	4 (5)	5 (6)	3 (3)	0 (0)	2 (2)	0 (0)
	3	34	12 (36)	22 (64)	7 (21)	3 (10)	5 (14)	3 (8)	0 (1)	3 (10)	0 (0)
Intermediate export, ET variability	4	31	13 (42)	18 (57)	7 (21)	3 (8)	4 (12)	2 (8)	0 (1)	2 (7)	0 (0)
	4S	81	49 (61)	32 (39)	13 (16)	4 (5)	7 (8)	4 (5)	1 (1)	4 (4)	0 (0)
Higher export, lesser ET variability	23	52	12 (23)	40 (78)	14 (27)	6 (12)	8 (15)	5 (10)	1 (1)	7 (13)	0 (0)
	23S	87	35 (40)	52 (60)	18 (21)	8 (9)	10 (11)	6 (7)	1 (1)	10 (11)	0 (0)
	26	48	27 (56)	21 (45)	8 (17)	3 (7)	4 (8)	3 (5)	0 (1)	3 (6)	0 (0)
	31	48	14 (29)	34 (71)	13 (27)	5 (10)	7 (14)	4 (9)	1 (1)	5 (11)	0 (0)
DWSC breach additions	11	19	10 (52)	9 (49)	3 (16)	3 (17)	1 (7)	1 (5)	0 (1)	1 (4)	0 (0)
	16B	36	8 (21)	28 (79)	10 (28)	10 (28)	4 (12)	3 (8)	0 (1)	1 (3)	0 (0)
OPEN WATER ZONE DOMINANT PARTICLES AFTER 7 DAYS OF MODEL SIMULATION											
Lower export, higher ET variability	1	35	15 (42)	20 (57)	10 (28)	3 (7)	3 (8)	2 (6)	1 (1)	1 (2)	2 (6)
	1S	86	51 (59)	35 (41)	17 (20)	4 (5)	5 (5)	3 (4)	1 (1)	1 (1)	5 (5)
	3	35	3 (8)	32 (92)	16 (46)	3 (9)	4 (10)	3 (8)	1 (2)	1 (3)	4 (13)
Intermediate export, ET variability	4	30	3 (9)	28 (92)	14 (47)	3 (8)	3 (11)	3 (8)	1 (2)	1 (2)	4 (13)
	4S	85	34 (40)	51 (60)	26 (31)	4 (5)	6 (7)	4 (5)	1 (1)	2 (2)	8 (9)
Higher export, lesser ET variability	23	55	1 (1)	55 (100)	28 (51)	5 (9)	6 (11)	5 (9)	1 (2)	1 (2)	8 (16)
	23S	91	8 (9)	82 (90)	43 (47)	8 (9)	9 (10)	7 (8)	2 (2)	2 (3)	11 (12)
	26	56	1 (2)	55 (97)	29 (52)	6 (10)	7 (12)	5 (9)	1 (2)	1 (2)	6 (10)
	31	48	0 (1)	47 (99)	25 (52)	4 (9)	5 (11)	4 (8)	1 (2)	1 (2)	8 (16)
DWSC breach additions	11	14	0 (3)	14 (96)	6 (42)	4 (24)	1 (9)	1 (6)	0 (1)	0 (1)	2 (12)
	16B	38	1 (2)	37 (99)	20 (53)	3 (8)	4 (9)	3 (7)	1 (2)	0 (1)	7 (18)

Table 4-3. Percentage of Vegetation Zone Dominant Particles Remaining On Site and Exported to Other Locations in the Project Region after 2 and 7 Days.

Alternative grouping	Alt. No.	Percent of total particles (% of vegetation zone dominant)			Percent of total particles (% of vegetation zone dominant) transported to regional locations						
		Vegetation zone-dominant	Remaining On-Site	Exported Off-Site	Lower Sac	DWSC	Liberty Island	Cache Slough	Lindsey Slough	Miner	Other Regions
VEGETATION ZONE DOMINANT PARTICLES AFTER 2 DAYS OF MODEL SIMULATION											
Lower export, higher ET variability	1	64	52 (81)	12 (19)	5 (8)	2 (3)	3 (4)	2 (3)	0 (0)	1 (1)	0 (0)
	1S	18	15 (84)	3 (16)	1 (6)	1 (3)	1 (3)	0 (2)	0 (0)	0 (1)	0 (0)
	3	66	60 (91)	6 (9)	2 (3)	1 (1)	1 (2)	1 (1)	0 (0)	1 (2)	0 (0)
Intermediate export, ET variability	4	70	51 (73)	19 (27)	8 (12)	2 (3)	4 (5)	2 (3)	0 (0)	2 (3)	0 (0)
	4S	19	14 (72)	5 (28)	3 (13)	1 (4)	1 (5)	1 (4)	0 (0)	1 (3)	0 (0)
Higher export, lesser ET variability	23	49	37 (76)	12 (24)	4 (8)	2 (3)	2 (4)	1 (2)	0 (0)	3 (7)	0 (0)
	23S	13	9 (69)	4 (31)	2 (14)	1 (5)	1 (5)	1 (4)	0 (0)	1 (4)	0 (0)
	26	51	30 (59)	21 (41)	9 (17)	3 (6)	4 (8)	3 (6)	0 (1)	2 (4)	0 (0)
	31	52	26 (50)	26 (50)	11 (21)	3 (6)	5 (9)	3 (6)	0 (1)	4 (8)	0 (0)
DWSC breach additions	11	80	23 (29)	57 (72)	11 (14)	36 (45)	5 (6)	3 (4)	0 (0)	2 (2)	0 (0)
	16B	65	23 (35)	42 (64)	17 (26)	15 (23)	5 (8)	3 (5)	0 (1)	1 (2)	0 (0)
VEGETATION ZONE DOMINANT PARTICLES AFTER 7 DAYS OF MODEL SIMULATION											
Lower export, higher ET variability	1	65	48 (74)	17 (26)	8 (12)	2 (3)	2 (3)	2 (2)	0 (1)	0 (1)	3 (4)
	1S	13	9 (68)	4 (32)	2 (15)	1 (4)	1 (5)	0 (3)	0 (0)	0 (1)	1 (5)
	3	65	48 (74)	17 (26)	8 (12)	2 (3)	2 (4)	2 (3)	0 (1)	2 (3)	1 (2)
Intermediate export, ET variability	4	70	40 (57)	30 (43)	15 (21)	3 (4)	4 (5)	3 (4)	1 (1)	1 (2)	5 (7)
	4S	15	8 (52)	7 (48)	4 (25)	1 (4)	1 (5)	1 (4)	0 (0)	0 (1)	1 (9)
Higher export, lesser ET variability	23	45	10 (22)	35 (77)	18 (40)	4 (9)	4 (10)	3 (7)	1 (2)	2 (3)	3 (7)
	23S	9	2 (22)	7 (79)	4 (40)	1 (8)	1 (10)	1 (7)	0 (0)	0 (3)	1 (11)
	26	44	5 (12)	39 (88)	20 (45)	4 (9)	5 (11)	3 (8)	1 (2)	1 (2)	5 (11)
	31	52	2 (3)	51 (97)	27 (52)	4 (9)	6 (11)	4 (8)	1 (2)	1 (2)	7 (13)
DWSC breach additions	11	86	4 (4)	82 (96)	33 (39)	26 (30)	7 (9)	5 (6)	1 (1)	1 (1)	8 (9)
	16B	63	3 (5)	59 (95)	31 (49)	7 (11)	5 (8)	4 (6)	1 (2)	1 (1)	11 (17)

4.2.1 Lower export, greater exposure time variability (Alternative 1 and 3)

Model results for Alternative 1 and 3 indicated a low proportion of open water zone dominant particles, and relatively low export of those particles after 2- and 7-days simulation (Table 4-2). For both ET classes, 34–36% of all particles spent the majority of time in the open water zone with 57–92% of those exported by the end of the 7-day simulation. The location of the breach affected the proportion of total open water zone particles exported by each alternative. For example, Alternative 3 had a greater proportion of exported open water zone particles than Alternative 1, due to the location of the breach adjacent to the open water area of Prospect Island (Figure 3-1, Table 4-2).

In terms of potential marsh contributions to productivity export, the potential export of vegetation zone dominant particles was relatively low. For both alternatives, the majority of particles remained on site (Table 4-3). Of all the particles generated during the simulation period, 64–66% spent the majority of time in the vegetated zone and approximately 26% of those were exported by both alternatives by the end of the 7-day simulation.

4.2.2 Intermediate export and intermediate exposure time variability (Alternative 4)

Model results for Alternative 4 indicated a low proportion of open water zone dominant particles and higher export of those particles after 2- and 7-days (Table 4-2). Approximately 30% of the total particles generated during the simulation spent the majority of time in the open water zone, and 92% of those were exported after 7 days.

Approximately 70% of total particles simulated for Alternative 4 spent the majority of time in the vegetated zone (Table 4-3). As compared to the lower export 1 and 3), the additional breach improved the proportion of particles exported from the vegetated zone (Table 4-3). After 7 days, 43% of the vegetation zone dominant particles were exported off of Prospect Island.

4.2.3 Higher export and lesser exposure time variability (Alternative 23, 26, and 31)

Model results for Alternative 23, 26, and 31 indicated a moderate proportion of open water zone dominant particles, but relatively higher export of those particles after 2 and 7 days (Table 4-2). Open water zone particles composed approximately 48–56% of the total particles during the simulation, and 97–100%

of those were exported after 7 days. Alternative 23 and 31 showed slightly higher production and algal export potential than Alternative 26.

All three alternatives exhibited moderate proportions of vegetation dominant particles with moderate to high export of those particles after 2- and 7- days (Table 4-3). Alternatives 26 and 31, having breaches situated near vegetated zones, were able to export more particles from vegetated habitats (88% and 97%) among the three alternatives (Figure 3-1).

4.2.4 Adaptive management alternatives (Alternative 11 and 16B)

With the addition of DWSC breaches, results for Alternative 11 and 16B indicated a low proportion of open water zone dominant particles, but generally high export of all particles after 2- and 7- days (Table 4-2, Table 4-3). Of all particles simulated, 14–38% spent most of the time in the open water zone and 96–99% of those were exported after 7 days. Most simulated particles remained in vegetated areas for both alternatives. Vegetation zone dominant particles comprised 86% (Alternative 11) and 63% (Alternative 16B) of the total, and 95–96% were exported after 7 days.

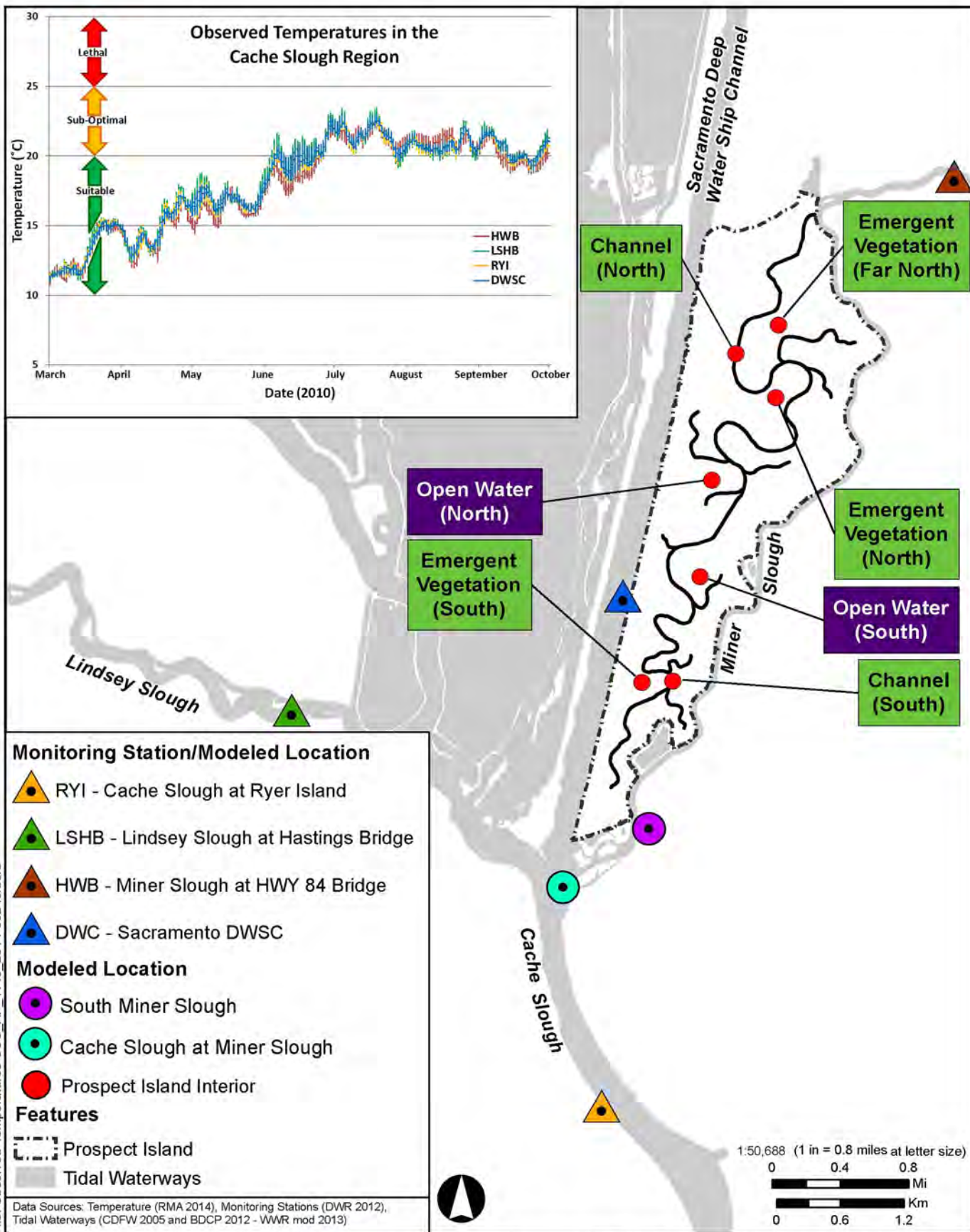
4.2.5 Vegetation and channel network sensitivity analysis (Alternative 1S, 4S, and 23S)

Sensitivity simulations generally exhibited greater proportions of open water vs. vegetation zone dominant particles (Table 4-2, Table 4-3). Consistent with the increased extent of open water habitats, 7-day simulations for all three sensitivity alternative configurations (Alternative 1S, 4S, and 23S) resulted in much higher proportions of on-site and exported open water zone dominant particles than the corresponding alternatives with greater vegetation extents (Alternative 1, 4, and 23). The export of vegetation zone dominant particles was substantially decreased under the sensitivity alternative configurations.

4.3 Temperature Changes in Adjacent Water Bodies (B-3 and I-4)

The RMA Delta water model was used to model hydrodynamic (RMA2) and water quality (RMA11) parameters to predict temperature conditions within Prospect Island and in the adjacent water bodies (Appendix B and RMA 2013). The water temperature model (RMA11) considered heat sources and sinks at both the air-water and sediment-water interfaces. Meteorological inputs included air temperature, wind speed, relative humidity, and cloud cover. The model was also calibrated to include the effects of sun shading and wind sheltering related

to the presence of vegetation. Additional details can be found in Appendix B. The year 2010 was chosen for evaluation as it represented the most recent year having less than extreme hydrologic classifications—above normal conditions for the San Joaquin Valley and below normal conditions for the Sacramento Valley (DWR 2013b). For this analysis, seven locations were selected to track temperature in adjacent water bodies, and seven locations were selected to track temperature within Prospect Island: two in open water (north and south), two in channel (north and south), and three in emergent vegetation (far north, north, and south) (Figure 4-3).



Modeled Temperature Locations and Existing Temperature Conditions in Project Area (March-Sept 2010)

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Figure 4-3

4.3.1 Existing water temperature conditions

Under existing conditions, water temperatures in the Project area ranged from suitable (less than 20°C) to sub-optimal (between 20°C and 25°C) during the period of interest (from March through September 2010) (Figure 4-3). From March through May, temperatures were always in the suitable range for juvenile salmonids and Delta Smelt, varying from 11°C to 19°C. June temperatures reflected the transition from the cooler winter/spring temperatures to warmer summer/fall temperatures. Most of the channels exhibited suitable temperatures for a majority of the month, but temperatures in some areas increased to sub-optimal conditions for Delta Smelt. July and August were dominated by sub-optimal conditions for Delta Smelt, followed by transitional cooling in September to more suitable temperatures. Observed and modeled water temperatures did not approach or exceed lethal temperatures (greater than 25°C) at any time during the analysis period.

4.3.2 Modeled water temperatures within Prospect Island

The temperature modeling results for the Prospect Island interior are presented in Table 4-4. Average water temperatures ranged from approximately 11–12°C during March up to 21–22°C during July and August (Appendix B). For ease of interpretation, months with all days having suitable temperatures are highlighted in green; months exhibiting a majority of days with suitable temperatures, but also including sub-optimal temperatures, are highlighted in yellow; months with an even split between suitable and sub-optimal are shown in white; and months with a majority of days with sub-optimal temperatures are highlighted in pink. The values shown for each location type (emergent vegetation, channel, and open water) are the average of the sample locations by type (Appendix B). For example, the open water values are the average of the open water north and open water south locations seen in Figure 4-3.

In general, water temperatures within Prospect Island reflected the temperature trends in the surrounding water bodies with suitable temperatures from March through May, increasing temperatures in June, sub-optimal temperatures in July and August, and cooling temperatures in September. There were no days in the lethal temperature range for any of the alternatives. Though following the general trends observed in the adjacent water bodies, water temperatures within the island tended to be in the suitable range for longer periods of time than in the surrounding water bodies. This condition was best seen in July and August when temperatures in Miner Slough and the DWSC were fully in the sub-optimal range,

whereas in Prospect Island, across all alternatives, temperature conditions were within both suitable and sub-optimal ranges for the target species.

There was little temperature difference by location within the island. Areas with emergent vegetation tended to have slightly more days in the suitable range compared to the channelized areas, which in turn had slightly more days in the suitable range compared to the open water areas. Although potential biological effects would require more extensive modeling (e.g., species specific bioenergetics), some benefits of the emergent vegetation and full channel network alternatives (1S, 4S, and 23S) upon water temperature are shown in Table 4-4. Reducing the extent of emergent vegetation (and channels in the deep area) increased the number of days temperatures fell within the sub-optimal ranges. This pattern is replicated in the channel and open water comparison locations (Table 4-4).

Table 4-4. Modeled Prospect Island Interior Temperatures by Alternative (March-September 2010).

Comparison Locations	Month	Days per Month Temperatures Fall within Each of the Temperature Range Classes <i>Temperature Range Class: suitable (<20 °C)/sub-optimal (20-25°C)/lethal (>25°C)</i>										
		1	1S ¹	3	4	4S ¹	23	23S ¹	26	31	11	16B
Emergent Vegetation ¹	Mar	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0
	Apr	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0
	May	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0
	Jun	17 / 13 / 0	8 / 22 / 0	17 / 13 / 0	16 / 14 / 0	9 / 21 / 0	22 / 8 / 0	14 / 16 / 0	22 / 8 / 0	21 / 9 / 0	15 / 15 / 0	18 / 12 / 0
	July	6 / 25 / 0	3 / 28 / 0	5 / 26 / 0	5 / 26 / 0	2 / 29 / 0	4 / 27 / 0	2 / 29 / 0	4 / 27 / 0	4 / 27 / 0	3 / 28 / 0	2 / 29 / 0
	Aug	16 / 15 / 0	4 / 27 / 0	13 / 18 / 0	10 / 21 / 0	3 / 28 / 0	9 / 22 / 0	3 / 28 / 0	8 / 23 / 0	7 / 24 / 0	6 / 25 / 0	6 / 25 / 0
	Sep	20 / 10 / 0	7 / 23 / 0	20 / 10 / 0	17 / 13 / 0	7 / 23 / 0	20 / 10 / 0	8 / 22 / 0	19 / 11 / 0	18 / 12 / 0	15 / 15 / 0	17 / 13 / 0
Channel	Mar	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0
	Apr	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0
	May	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0
	Jun	18 / 12 / 0	9 / 21 / 0	17 / 13 / 0	16 / 14 / 0	9 / 21 / 0	20 / 10 / 0	13 / 17 / 0	22 / 8 / 0	20 / 10 / 0	16 / 14 / 0	18 / 12 / 0
	July	6 / 25 / 0	3 / 28 / 0	5 / 26 / 0	4 / 27 / 0	2 / 29 / 0	4 / 27 / 0	2 / 29 / 0	4 / 27 / 0	4 / 27 / 0	3 / 28 / 0	2 / 29 / 0
	Aug	13 / 18 / 0	3 / 28 / 0	12 / 19 / 0	9 / 22 / 0	3 / 28 / 0	9 / 22 / 0	3 / 28 / 0	8 / 23 / 0	7 / 24 / 0	6 / 25 / 0	6 / 25 / 0
	Sep	19 / 11 / 0	8 / 22 / 0	20 / 10 / 0	17 / 13 / 0	7 / 23 / 0	20 / 10 / 0	8 / 22 / 0	18 / 12 / 0	18 / 12 / 0	14 / 16 / 0	16 / 14 / 0
Open Water	Mar	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0
	Apr	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0	30 / 0 / 0
	May	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0	31 / 0 / 0
	Jun	14 / 16 / 0	10 / 20 / 0	18 / 12 / 0	18 / 12 / 0	15 / 15 / 0	18 / 12 / 0	15 / 15 / 0	15 / 15 / 0	19 / 11 / 0	19 / 11 / 0	19 / 11 / 0
	July	5 / 26 / 0	3 / 28 / 0	3 / 28 / 0	3 / 28 / 0	2 / 29 / 0	4 / 27 / 0	2 / 29 / 0	4 / 27 / 0	3 / 28 / 0	1 / 30 / 0	2 / 29 / 0
	Aug	9 / 22 / 0	4 / 27 / 0	3 / 28 / 0	2 / 29 / 0	2 / 29 / 0	6 / 25 / 0	2 / 29 / 0	8 / 23 / 0	4 / 27 / 0	0 / 31 / 0	2 / 29 / 0
	Sep	16 / 14 / 0	8 / 22 / 0	14 / 16 / 0	14 / 16 / 0	10 / 20 / 0	15 / 15 / 0	8 / 22 / 0	15 / 15 / 0	15 / 15 / 0	12 / 18 / 0	14 / 16 / 0

Green = All suitable temperatures, Yellow = Majority suitable, White = Even suitable, sub-optimal split, Pink = Majority sub-optimal

Note 1 - Alternatives 1S, 4S, and 23S have no emergent vegetation in the emergent vegetation location

4.3.3 Modeled temperature changes in adjacent water bodies

To determine the Project's potential effects on water temperature in the adjacent water bodies, six locations were chosen for evaluation: Miner Slough at the Highway 84 bridge, Miner Slough south of the most southern breach, Cache Slough at the confluence with Miner Slough and the DWSC, DWSC near the cross levee, Lindsey Slough near Hastings bridge, and Cache Slough at Ryer Island (Figure 4-3). The baseline daily average water temperatures at each location were tallied by month for each defined temperature bin (suitable, sub-optimal, and lethal). This process was repeated for each alternative and the bin counts for alternatives were differenced from the baseline conditions. Positive values in the suitable bin indicated a greater number of days within the suitable temperature range, negative values in the suitable bins indicated the opposite (Table 4-5). Increases of two days or more in the number suitable water temperature days are highlighted in green, 2-day decreases in the number of suitable days are highlighted in yellow, and decreases greater than two days are highlighted in pink. No-change results are shown in white and 1 day changes are highlighted in grey. Changes of one day are likely insignificant for the purposes of evaluation, but are called out to separate them from the no-change months.

Overall, no lethal conditions (temperatures above 25°C) were present under any alternative, under any month, at any location. In addition, there were no changes from base conditions at any location for March, April, or May under any alternative. Changes that did occur tended to be very small, in the 1- to 2-day range.

Miner Slough at the Highway 84 Bridge

- No changes from base conditions under any alternative, during any month.

Miner Slough south of the southern – most breach location

- Increase in number of suitable days in July by two days (Alternative 3, 4S, 23S, 11, and 16B) and three days (Alternative 4, 23, 26, and 31).
- Decrease in number of suitable days in September across all alternatives (two days - Alternative 1, 1S, 3, 4, 23, 26, 31, 11, and 16B; three days - Alternative 4S and 23S).

Cache Slough at the confluence with Miner Slough and the DWSC

- No changes from base for any other months besides June that only shows 1 day changes.

DWSC near the cross levee

- Largest beneficial changes are seen in the adaptive management alternatives, which include breaches to the DWSC. Increases in number of suitable days in July by two (Alternative 11, 16B) and in September by two (Alt 16B).
- Decrease in number of suitable days in June across all Miner-only, multi-breach alternatives (two days - Alternative 4, 4S, 23, 26, 31; five days - Alternative 23S). The five day change under Alternative 23S is the largest change under any alternative during any month.

Lindsey Slough near Hastings Bridge

- Decrease in number of suitable days in June by two days (Alternative 1S, 4S, and 23S). These alternatives have limited emergent vegetation and a reduced channel network
- Increase in number of suitable days in September by two days (Alternative 26, 31, 11, and 16B).

Cache Slough at Ryer Island

- Decrease in number of suitable days in June by two days (Alternative 23, 23S, 31, and 16B)
- Increase in number of suitable days in July by two days across all alternatives

Table 4-5. Changes in Temperature in Adjacent Water Bodies by Alternative.

Comparison Locations	Baseline Temperature Days Per Month (<20/20-25/>25°C)	Changes in Days per Month from Baseline										
		Temperatures Fall within Each of the Temperature Range Classes										
		Temperature Range Class: suitable (<20°C)/sub-optimal (20-25°C)/lethal (>25°C)										
		1	1S	3	4	4S	23	23S	26	31	11	16B
Miner Slough at HWY 84 Bridge (HWB)	Mar (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Apr (30 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	May (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Jun (24 / 6 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Jul (0 / 31 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Aug (0 / 31 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Sep (19 / 11 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
Miner Slough (South)	Mar (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Apr (30 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	May (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Jun (22 / 8 / 0)	1 / -1 / 0	0 / 0 / 0	1 / -1 / 0	0 / 0 / 0	-1 / 1 / 0	-1 / 1 / 0	-3 / 3 / 0	0 / 0 / 0	0 / 0 / 0	1 / -1 / 0	0 / 0 / 0
	Jul (0 / 31 / 0)	0 / 0 / 0	0 / 0 / 0	2 / -2 / 0	3 / -3 / 0	2 / -2 / 0	3 / -3 / 0	2 / -2 / 0	3 / -3 / 0	3 / -3 / 0	2 / -2 / 0	2 / -2 / 0
	Aug (0 / 31 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	1 / -1 / 0	0 / 0 / 0	2 / -2 / 0	0 / 0 / 0	1 / -1 / 0	2 / -2 / 0	0 / 0 / 0	0 / 0 / 0
	Sep (17 / 13 / 0)	-2 / 2 / 0	-2 / 2 / 0	-2 / 2 / 0	-2 / 2 / 0	-3 / 3 / 0	-2 / 2 / 0	-3 / 3 / 0	-2 / 2 / 0	-2 / 2 / 0	-2 / 2 / 0	-2 / 2 / 0
Cache Slough (at Miner Slough and DWSC confluence)	Mar (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Apr (30 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	May (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Jun (20 / 10 / 0)	1 / -1 / 0	0 / 0 / 0	1 / -1 / 0	1 / -1 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	1 / -1 / 0	0 / 0 / 0
	Jul (3 / 28 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Aug (0 / 31 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Sep (13 / 17 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
DWSC (DWC)	Mar (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Apr (30 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	May (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Jun (18 / 12 / 0)	-1 / 1 / 0	-1 / 1 / 0	-1 / 1 / 0	-2 / 2 / 0	-2 / 2 / 0	-2 / 2 / 0	-5 / 5 / 0	-2 / 2 / 0	-2 / 2 / 0	1 / -1 / 0	1 / -1 / 0
	Jul (1 / 30 / 0)	1 / -1 / 0	0 / 0 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	2 / -2 / 0	2 / -2 / 0
	Aug (0 / 31 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	1 / -1 / 0	1 / -1 / 0
	Sep (12 / 18 / 0)	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	-1 / 1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	2 / -2 / 0
Lindsey Slough near Hasting Bridge (LSHB)	Mar (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Apr (30 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	May (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Jun (12 / 18 / 0)	0 / 0 / 0	-2 / 2 / 0	-1 / 1 / 0	0 / 0 / 0	-2 / 2 / 0	-1 / 1 / 0	-2 / 2 / 0	-1 / 1 / 0	-1 / 1 / 0	-1 / 1 / 0	0 / 0 / 0
	Jul (3 / 28 / 0)	0 / 0 / 0	0 / 0 / 0	1 / -1 / 0	1 / -1 / 0	0 / 0 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0
	Aug (0 / 31 / 0)	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0
	Sep (11 / 19 / 0)	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	1 / -1 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0
Cache Slough at Ryer Island (RYI)	Mar (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Apr (30 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	May (31 / 0 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Jun (22 / 8 / 0)	1 / -1 / 0	-1 / 1 / 0	0 / 0 / 0	0 / 0 / 0	-1 / 1 / 0	-2 / 2 / 0	-2 / 2 / 0	-1 / 1 / 0	-2 / 2 / 0	0 / 0 / 0	-2 / 2 / 0
	Jul (1 / 30 / 0)	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0	2 / -2 / 0
	Aug (0 / 31 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
	Sep (13 / 17 / 0)	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0	1 / -1 / 0	0 / 0 / 0

4.4 Turbidity Effects (I-2)

An analysis period of October 1, 2012 through December 31, 2012 was selected to evaluate the potential turbidity effects of the Project (Figure 4-4). This period captured a range of representative low and high turbidity conditions. October and November represented lower-wind conditions outside of storm periods that typically reflect very low Miner Slough turbidity and lower turbidity in the DWSC and Cache Slough versus winter time periods. December included a first flush storm sediment load in Miner Slough. This time period also included flow high enough to activate the proposed overflow weir in December, although for a relatively short duration.

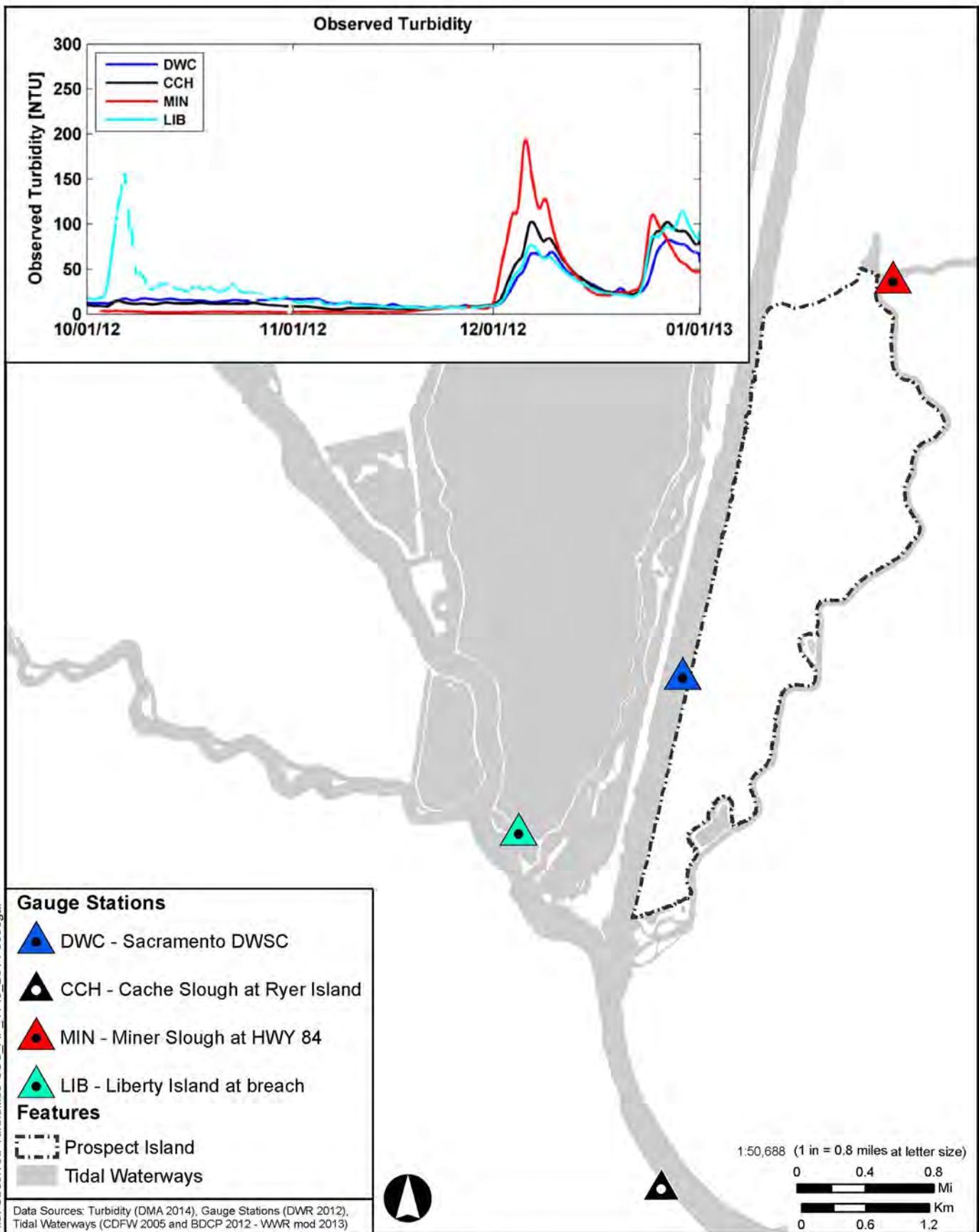
Turbidity analysis examined both conditions external and internal to Prospect Island. The sedimentation and erosion potential both inside and outside of the Island was also simulated. Evaluation of regional effects focused on the following four locations (CDEC monitoring station ID shown in parentheses):

- Miner Slough north of Prospect Island at Highway 84 (HWB);
- Cache Slough downstream of the confluence with Miner Slough and the DWSC (CCH);
- DWSC near the internal Prospect cross levee (DWC); and
- Liberty Island at the breach to Cache Slough (LIB).

Overall, modeling indicated that the restoration of Prospect Island would reduce turbidity somewhat in the Cache Slough region. During low Delta outflow conditions, sediment was transported from Cache Slough, up Miner Slough, and sediment was deposited in Prospect Island. During high Delta outflow conditions, sediment from Miner Slough was transported into Prospect Island, where some deposition occurred. Deposition within Prospect Island would increase site elevations, improve long-term ecological resiliency, and promote natural tidal marsh function. Turbidity within open water areas would provide cover to Delta Smelt, aiding in predator avoidance.

The interaction of tides, winds, waves, and sediments results in complex physical processes which need to be simplified and parameterized in order to be represented in a numerical model (Appendix C). The interpretation of the model results must therefore take into account how these assumptions influence both the model predictions and any conclusions drawn from the model predictions. The largest uncertainty was associated with evaluations based on absolute turbidity thresholds, while relative comparisons between scenarios were less affected by model uncertainty. The modeling results presented here are relative

comparisons between alternatives and not absolute comparisons. For further information on the details, uncertainties, and usage limitations of this analysis, please see Appendix C.



Observed Turbidities in the Cache Slough Region

Prospect Island Tidal Habitat Restoration Project

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Figure 4-4

4.4.1 Turbidity changes in the Cache Slough region

The results of the turbidity modeling in the Cache Slough region are presented by groupings based on connectivity. Table 4-6 provides a summary of the average predicted monthly percent changes in tidally averaged turbidity at the four locations of interest. All alternatives resulted in a reduction of turbidity in the Cache Slough region in at least one location during one of the evaluated months. Sensitivity testing results of emergent vegetation and channel network extent indicated that turbidity outside Prospect Island was not sensitive to differences in combined vegetation and channel network extent. When vegetation was limited to the intertidal zone and the channel network was reduced (Alternative 1S, 4S, and 23S), predicted turbidities were almost always within 1 Nephelometric Turbidity Unit (NTU) of the predicted turbidity for the corresponding intertidal and shallow subtidal vegetation and full channel network alternatives (Alternative 1, 3, and 23).

4.4.1.1 Lower connectivity alternatives (Alternative 1, 1S, 3, and 3B)

As stated above, Alternative 1 and 1S behaved almost identically and generally exhibited the smallest reductions in the adjacent water bodies of all the alternatives across all months (Table 4-6). In Miner Slough, percent reductions are higher in October and November when turbidities are lower and lower during December when turbidities were higher. Percent changes remained consistent in Cache Slough regardless of time of year and gradually increased in the DWSC from October through November. At the Liberty Island breach, percent reductions slightly increased from October through November, and then decreased in December.

Alternative 3 and 3B differ from each other in structure in that Alternative 3 includes an overflow weir at the northern-most connection location on Miner Slough and Alternative 3B does not. The overflow weir was activated in the model during December for Alternative 3; however the inundation time was relatively short and did not result in a measurable difference with Alternative 3B. Alternative 3 and 3B have slightly larger reductions in turbidity as compared to Alternatives 1 and 1S (Table 4-6). Alternative 3 and 3B follow the same trends as seen in Alternatives 1 and 1S, except with slightly greater reductions across all months and locations.

4.4.1.2 Intermediate connectivity alternatives (Alternative 4 and 4S)

Alternative 4 and 4S behaved almost identically, as discussed above (Table 4-6). In Miner Slough, percent reductions were higher in October and November when

turbidities were lower and lower during December when turbidities were higher. Percent changes gradually increased in both Cache Slough and the DWSC from October to December. At the Liberty Island breach, percent reductions slightly increased from October through November, and then decreased in December.

4.4.1.3 Higher connectivity alternatives (Alternative 23, 23S 26, and 31)

The higher connectivity alternatives had larger percent reductions in turbidity than the lower and intermediate connectivity alternatives, but unlike the other groupings, also exhibited percent increases. These alternatives exhibited larger differences in effects depending on whether turbidity is higher in the DWSC and Cache (October and November) or Miner Slough (December).

As with the other sensitivity alternatives, Alternative 23 and 23S behave almost identically to each other (Table 4-6). In Miner Slough, percent reductions decrease from October and November when turbidities are lower. During December when turbidities are higher, Alternative 23 and 23S show percent increases in turbidity compared to baseline. In Cache Slough, the DWSC, and at the Liberty Island breach percent reductions increase slightly from October to November, and then double or more in value in December. While these increases are large, it is useful to keep in mind that turbidities are significantly higher during much of December as compared to October and November and larger percent reductions in may not be important when examining absolute values well above critical values for Delta smelt.

Alternative 26 has similar, but slightly smaller impacts and slightly larger benefits as compare to Alternative 23 and 23S and follows the same percent reductions and increases patterns across all months and locations (Table 4-6).

Alternative 31 followed the same patterns in percent reductions and increases as the other higher connectivity alternatives across all months and locations (Table 4-6). The magnitude of the changes, both positive and negative, under Alternative 31 was the greatest of the higher connectivity alternatives.

4.4.1.4 Adaptive management alternatives (Alternative 11 and 16B)

The adaptive management alternatives had the smallest percent decreases and largest percent increases in turbidity in Cache and Miner Sloughs, while conversely having the largest percent decrease in turbidity in the DWSC.

Model results for Alternative 11 showed reduced turbidity in Miner Slough during both October and November when turbidities were low, and then increased turbidity in December when turbidities were high (Table 4-6). In Cache Slough, there was a small percent increase in October and no effect in November. The percent increase was likely due to Prospect acting like a shortcut between the DWSC and the lower portion of Cache Slough, via Miner Slough. Conversely, a percent reduction was predicted in December, when turbidities and flows were higher. At both the DWSC and Liberty Island stations, percent reductions increased slightly from October to November, and then doubled or more in value in December, similar to the trends observed in the higher connectivity alternatives.

Alternative 16B is the only alternative that increased turbidity in Miner Slough in all the modeled months (Table 4-6). These increases were paired with relatively large percent decreases in the DWSC. These changes were likely due to the change in flow patterns described above. In Cache Slough, Alternative 16B exhibited minor percent increases in October and decreases in November, followed by larger percent decreases in December when turbidities were higher overall. At the Liberty Island station, percent reductions increased slightly from October through December.

In examining these alternatives, it should also be noted that turbidity in the DWSC increased downstream of breaches along the DWSC and decreased upstream of the breaches. The values described above and in Table 4-6 only reflect changes in monthly averaged turbidities at the monitoring location, which is located downstream of the DWSC breach in Alternative 11 and between DWSC breaches in Alternative 16B.

Table 4-6. Average Predicted Monthly Percent Change in Tidally Averaged Turbidity.

Averaging Period	Grouping	Alt	Station			
			Miner Slough	Cache Slough	DWSC	Liberty Island
October 2012	Lower Connectivity	Alt 1	-14	-6	-12	-10
		Alt 1SA	-15	-6	-12	-10
		Alt 3	-19	-5	-15	-11
		Alt 3B	-19	-5	-15	-11
	Intermediate Connectivity	Alt 4	-15	-5	-16	-12
		Alt 4SA	-15	-5	-16	-12
	Higher Connectivity	Alt 23	-16	-6	-16	-12
		Alt 23SA	-16	-6	-16	-12
		Alt 26	-18	-5	-13	-10
		Alt 31	-13	-5	-17	-12
	Adaptive Management (DWSC breaches)	Alt 11	-4	3	-13	-7
		Alt 16B	36	1	-22	-10
November 2012	Lower Connectivity	Alt 1	-13	-6	-13	-11
		Alt 1SA	-13	-6	-13	-11
		Alt 3	-15	-7	-16	-12
		Alt 3B	-15	-7	-16	-12
	Intermediate Connectivity	Alt 4	-12	-7	-18	-14
		Alt 4SA	-12	-7	-18	-14
	Higher Connectivity	Alt 23	-12	-7	-17	-13
		Alt 23SA	-12	-7	-17	-13
		Alt 26	-11	-6	-14	-11
		Alt 31	-10	-8	-19	-15
	Adaptive Management (DWSC breaches)	Alt 11	-4	0	-18	-10
		Alt 16B	30	-3	-28	-14
December 2012	Lower Connectivity	Alt 1	-2	-5	-15	-8
		Alt 1SA	-2	-6	-15	-8
		Alt 3	-5	-7	-19	-10
		Alt 3B	-5	-7	-19	-10
	Intermediate Connectivity	Alt 4	-2	-8	-22	-11
		Alt 4SA	-2	-8	-22	-11
	Higher Connectivity	Alt 23	8	-18	-36	-23
		Alt 23SA	8	-18	-35	-22
		Alt 26	10	-14	-28	-18
		Alt 31	11	-19	-37	-24
	Adaptive Management (DWSC breaches)	Alt 11	3	-10	-38	-16
		Alt 16B	17	-11	-31	-15

4.4.2 Sediment deposition and erosion potential within Prospect Island

Prospect Island is subsided, with elevations ranging from shallow subtidal (2.5 to 0 ft NAVD88) to moderate subtidal (0 to -2.5 ft NAVD88). Sediment accretion will help reverse subsidence, build marsh plain elevations, and provide adaptability for the site in terms of long-term sea level rise. The potential for sediment deposition within Prospect Island followed an inverse pattern as compared to that seen in the regional turbidity analysis: alternatives with greater connectivity accreted more sediment, thereby decreasing regional turbidity more, and alternatives with lesser connectivity accreted less sediment, thereby decreasing regional turbidity less. Deposition within the island was not uniform, but rather was concentrated near the breach locations and the deeper central area of the site (Appendix C). Alternatives are described by connectivity grouping below, while Table 4-7 provides a summary of accumulated sediment mass by alternative for the three-month period of October – December 2012 and Figure 4-5 provides insight into temporal accretion patterns.

Table 4-7. Prospect Island Modeled Cumulative Sediment Accretion (October-December 2012).

Grouping	Alternative	Sediment Mass (kilograms x10 ⁷)
Lower Connectivity	1	1.12
	1S	1.15
	3	1.68
	3B	1.68
Intermediate Connectivity	4	2.07
	4S	2.02
Higher Connectivity	23	4.39
	23S	4.34
	26	3.31
	31	4.59
Adaptive Management	11	3.04
	16B	4.60

Erosion potential was uniform across the alternatives with some scour predicted within all breach locations. Higher shear stresses were predicted at the cross levee breach, especially in alternatives that include the southern Miner Slough breach (Alternative 1, 4, 26, and 31). The associated erosion potential at the cross levee breach indicates that the breach should be resized to wider than 200 feet, especially for the alternatives with the southern breach.

4.4.2.1 Lower connectivity alternatives (Alternatives 1, 1S, 3, and 3B)

Alternative 1 had the smallest modeled cumulative accretion of all the alternatives (Table 4-7). Most deposition was seen near the breach in the southern portion of the property as the cross levee breach limited flow and transport between the northern and southern portion of the site, trapping sediment mostly in the south (Appendix C). Alternative 1S had slightly more sediment accretion than Alternative 1. The smaller vegetation extent and reduced channel network in Alternative 1S resulted in greater sediment dispersal in the northern part of the island, which was then trapped in the low energy subtidal area of the northern portion of the site. The southern portion of Alternative 1S had less accretion than Alternative 1. Alternative 3 and 3B accreted the same amount of sediment with the presence or absence of the overflow weir having no effect. Deposition was concentrated near the breach (Miner central location) and in the deeper central portion of the site (Appendix C).

4.4.2.2 Intermediate connectivity alternatives (Alt 4, 4S)

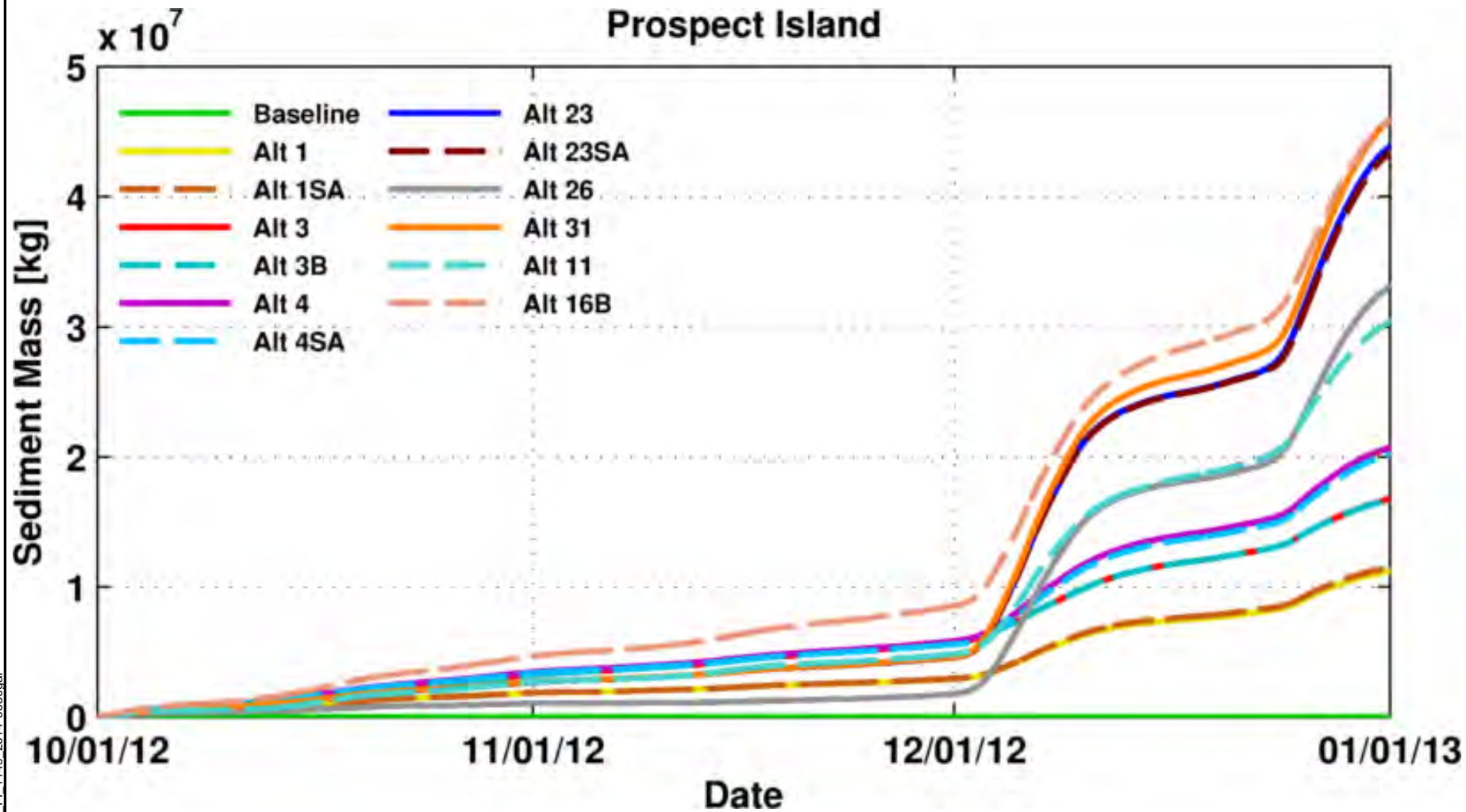
The increase in connectivity results in slightly higher sediment accumulation for Alternatives 4 and 4S as compared to the lower connectivity alternatives (Table 4-7). In Alternative 4, deposition is concentrated in the southern property, near breaches, and in deeper central portion of northern property. There is little deposition in most northern portions of the site. Alternative 4S has less accretion than Alternative 4, following expectation that less vegetation results in less sediment trapping. Deposition patterns are similar to those seen in Alternative 4.

4.4.2.3 Higher connectivity alternatives (Alternatives 23, 23S 26, and 31)

The higher connectivity alternatives accreted the highest levels of sediment of the non-DWSC breach alternatives (Table 4-7). Alternative 23 had deposition concentrated in the northern property, with very little in the southern property, due to the restriction caused by the cross-levee breach (Appendix C). Alternative 23S accreted slight less than Alternative 23, but both showed similar deposition patterns. Alternative 26 produced the most accretion during high flows (December) (Figure 4-5), with relatively low accretion, as compared to the other alternatives, during the lower flow times of October and November. Alternative 31 produced the most accretion and broader deposition than all other alternatives.

4.4.2.4 Adaptive management alternatives (Alternatives 11 and 16B)

The adaptive management alternatives accreted sediment at levels equal to the higher connectivity alternatives. The presence of breaches on the DWSC resulted in accretion of more sediment in the northern portion of the site and more uniform distribution of sediment throughout the site (Appendix C).



Source: DMA 2014



**DELTA
MODELING
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JOINT VENTURE



Cumulative Sediment Accretion within Prospect Island for All Alternatives

Prospect Island Tidal Habitat Restoration Project

June 2014

Project 1149

Figure 4-5

4.4.3 Additional turbidity observations

Under existing conditions, turbidity in Miner Slough is lower than Cache Slough and the DWSC in October and November. This low turbidity forms a movement barrier for Delta Smelt, preventing them from traveling up Miner Slough from Cache Slough. Depending on the alternative, the model predicted increases in Miner Slough turbidity from the confluence with Cache Slough to the southern or central breach, forming a turbidity “bridge” that connected Cache Slough to Prospect Island. This increase was due to the increased tidal prism from the Project, which transported sediment from Cache Slough into Miner Slough and into the Project site via the breaches (Appendix C). North of the breaches, turbidity was predicted to decrease. Graphical representations of this can be seen in Appendix C, Figures 5.2-23 and 5.2-24. This increase in turbidity may allow Delta Smelt to travel into Miner Slough and Prospect Island.

4.5 Salinity Changes at D-1641 Compliance Stations (I-3)

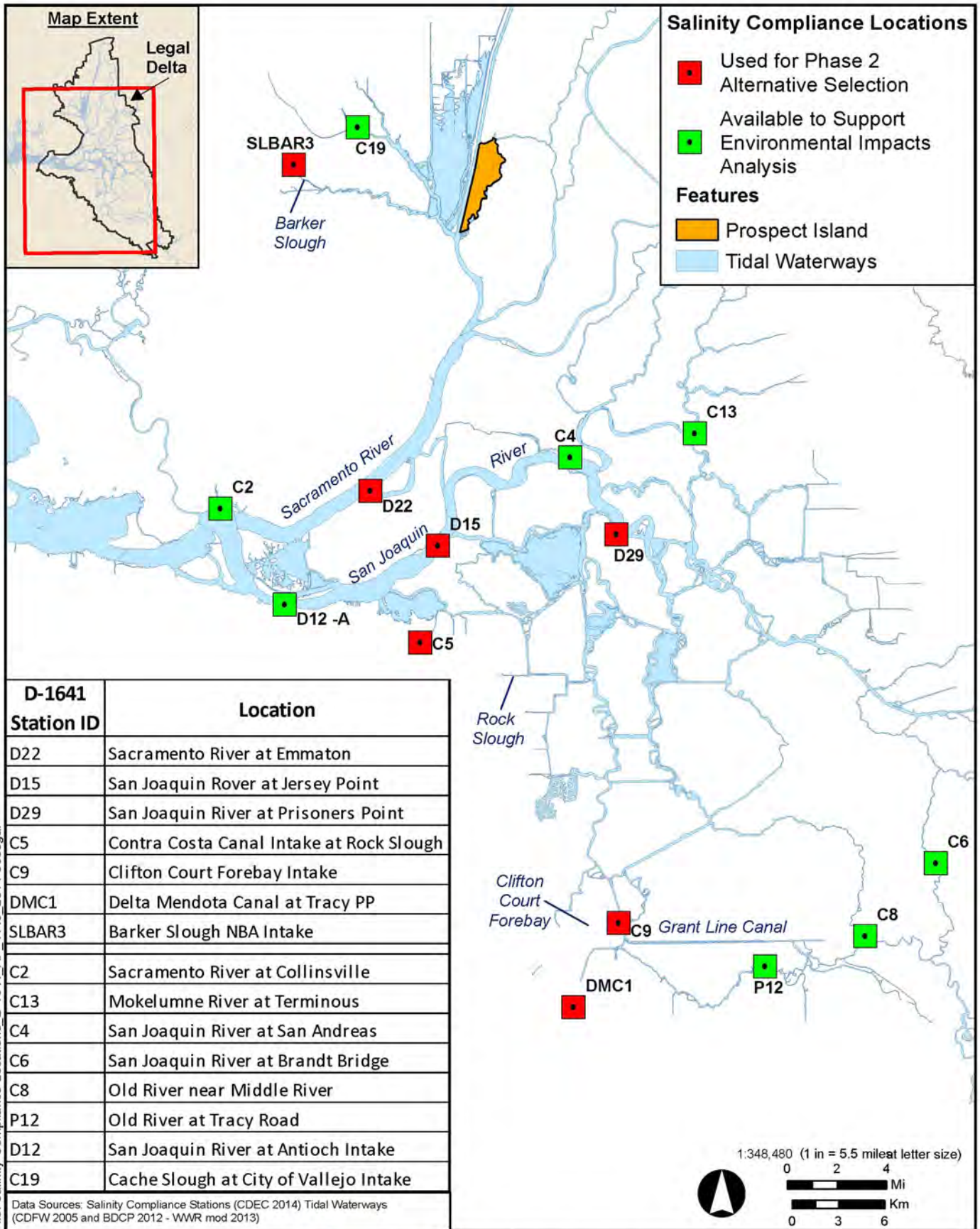
The RMA Delta model was used to evaluate potential changes in salinity for the Project (Appendix D). Electrical conductivity (EC) was modeled as a surrogate for salinity for 2009 and 2010. EC was used as a stand-in for the more precise term of Specific Conductance (SC) for the electrical conductance corrected to 25°C. The primary goal of the salinity model evaluation was to determine the potential for a Project alternative to be non-compliant with the D-1641 water quality objectives. These compliance results are presented first, followed by a general description of changes in salinity seen at different locations of interest in the Delta. Figure 4-6 shows the locations of the representative compliance stations used for alternatives comparison. Figure 4-6 also shows additional compliance stations modeled to support environmental impact analyses in the EIR, but not used for alternatives selection.

4.5.1 Agricultural and fish and wildlife compliance

Seasonal EC standards apply to the three representative Agriculture and Fish and Wildlife compliance stations: the Sacramento River at Emmaton (D22), and the San Joaquin River at Jersey Point (D15), and Prisoners Point (D29). Compliance was examined from April 1 – August 15 at Emmaton (D22) and Jersey Point (D15) and from April 1 – May 31 for Prisoners Point (D29). No potential compliance issues were identified at any location, under any alternative.

4.5.2 Municipal and industrial compliance

Year round chloride concentration limits apply to the four representative water export locations: the North Bay Aqueduct Intake at Barker Slough (SLBAR3), the Contra Costa Canal Intake at Rock Slough (C5), the Clifton Court Forebay Intake (C9), and the Delta Mendota Canal at the Tracy Pumping Plant (DMC1). There was little difference between computed base chloride concentrations and alternative chloride concentrations. All were within the D-1641 water quality compliance limits.



D-1641 Salinity Compliance Locations

Prospect Island Tidal Habitat Restoration Project

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Figure 4-6

4.5.3 General trends in salinity changes

While modeling results did not show the potential for non-compliance with D-1641 salinity standards, they did show that alternatives produce both decreases and increases in computed EC both seasonally and spatially (Figure 4-7).

Summaries of maximum and minimum absolute and percent changes can be seen in Table 4-8 and Table 4-9.

4.5.3.1 North Delta

In the northern Delta, at Barker Slough North Bay Aqueduct Intake (SLBAR3), EC decreased year round, with greater decreases in the spring (up to 7%), when salinities were higher, and smaller decreases in the summer though winter (between 1 and 2%), when salinities were lower. Alternative 16B exhibited the greatest decreases in salinity, while Alternative 1 exhibited the smallest decreases in salinity.

4.5.3.2 West Delta

All alternatives generally decreased salinity in the western Delta. At the Sacramento River at Emmaton (D22), Alternative 1, 3, 4, 23, 26, and 31 decreased salinity in the summer and fall, when salinities were higher, and had no effect in the winter and spring, when salinities were lower. Alternative 11 and 16B also had no effect on salinity in the winter and spring, but both exhibited smaller decreases and some increases ($\leq 1\%$) during the summer and fall months. All alternatives showed little effect on salinity at the San Joaquin River at in the winter and spring when salinities are low and decreases in salinity in the summer as salinities begin to increase under existing conditions. In the fall of the dry year, Alternative 3, 4, 23, 26, and 31 all exhibited increases in salinity of $\leq 1\%$

4.5.3.3 Central Delta

In the central Delta at the San Joaquin River at Prisoners Point (D29) and the Contra Costa Canal Rock Slough Intake (C5), the alternatives generally followed the same pattern of little to no change in the winter and spring (existing salinities low), followed by small decreases in summer (existing salinities increasing), and increases in the fall (peak existing salinities). Increases in salinity at Prisoners Point ranged from a high of 7% under Alternative 23 and 31 to a low of 1.5% under Alternative 1. Increases at Rock Slough Intake followed the same trend with a high of 4% under Alternative 23 and 31 to a low of 0.5% under Alternative 1.

4.5.3.4 South Delta

Changes in the southern Delta at the Clifton Court Forebay (C9) and the Delta Mendota Canal at the Tracy Pumping Plant (DMC1) followed the trends seen in the central Delta, but with slightly less magnitude. Results for all alternatives modeled generally showed little to no change in the winter and spring (existing salinities lower), followed by small decreases in summer (existing salinities increasing), and increases in the fall (peak existing salinities). Increases in salinity at both Clifton Court and Delta Mendota Canal ranged from a high of around 3% under Alternative 23 and 31 to a low of 0.5% under Alternative 1. Decreases in salinity were $\leq 2\%$.

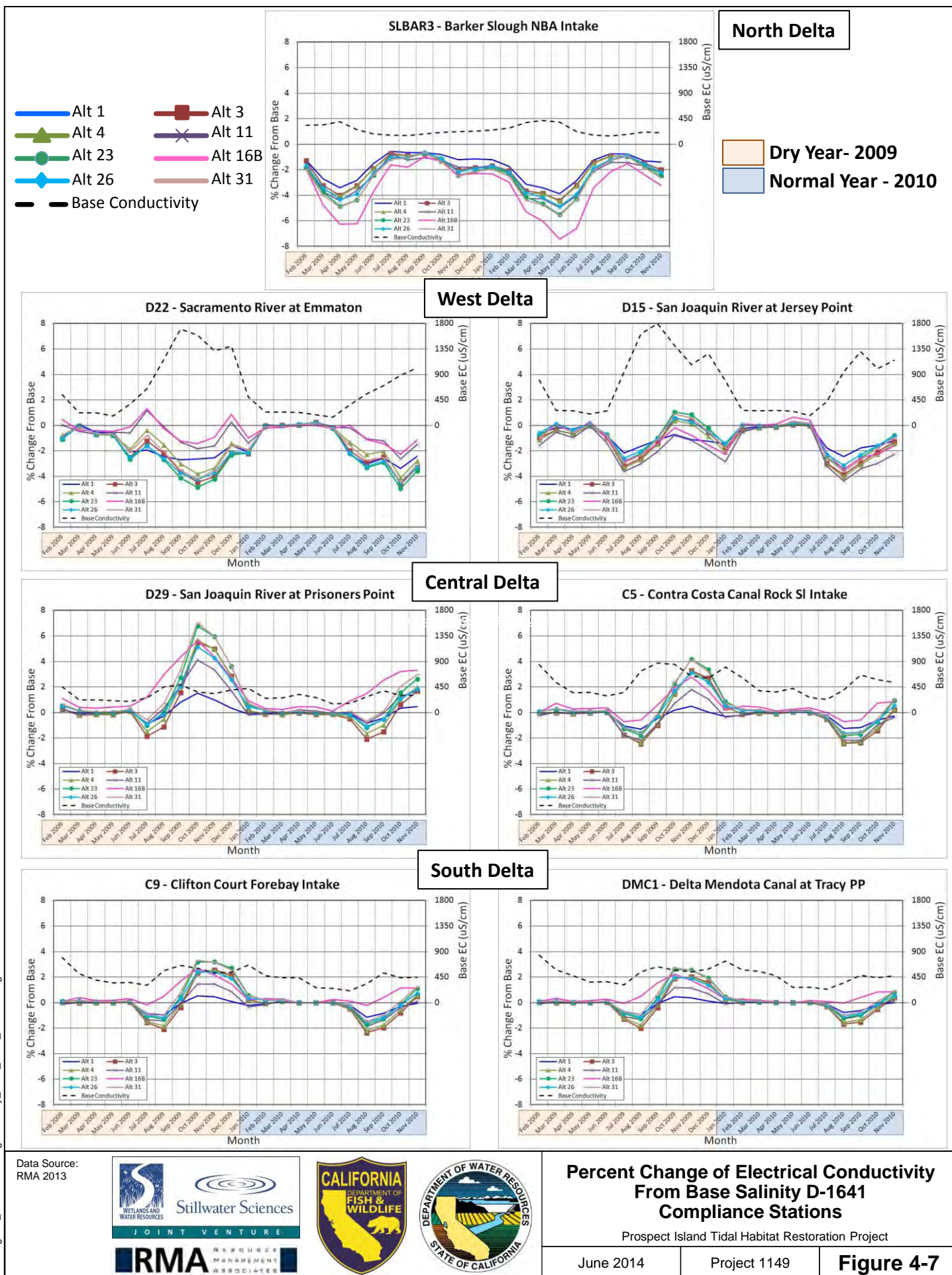


Table 4-8. Minimum and Maximum Computed Absolute and Percentage Change from Base Condition Monthly Averaged EC in 2009

D1641 Station	Monthly Avg Base EC uS/cm		Change from Base EC (uS/cm and %): Feb 2009 - Dec 2009																															
			Alt 1				Alt 3				Alt 4				Alt 11				Alt 23				Alt 16B				Alt 26				Alt 31			
	min	max	min		max		min		max		min		max		min		max		min		max		min		max		min		max		min		max	
			uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%
D22	167	1700	-46	-2.7	0.1	0.1	-71	-4.5	-0.1	0.0	-61	-3.8	-0.2	-0.1	-29	-1.8	8	1.2	-78	-4.9	-0.1	0.0	-23	-1.4	11.9	1.3	-68	-4.2	-0.1	0.0	-67	-4.2	-0.2	-0.1
D15	203	1793	-27	-2.2	0.2	0.1	-42	-3.2	7	0.5	-44	-3.4	5	0.4	-49	-3.6	-0.1	0.0	-36	-2.8	15	1.0	-38	-2.8	1	0.3	-33	-2.6	8	0.6	-38	-2.9	12	0.9
D29	192	486	-2	-0.9	5	1.5	-5	-1.9	20	5.5	-4	-1.5	20	5.7	-2	-0.8	15	4.1	-3	-1.0	24	6.8	1	0.3	21	5.6	-2	-0.9	19	5.1	-1	-0.6	25	7.0
DMC1	308	833	-5	-0.9	3	0.4	-11	-2.0	11	2.0	-10	-1.8	11	2.0	-7	-1.3	7	1.2	-7	-1.3	15	2.6	-0.2	-0.1	13	2.2	-6	-1.1	11	2.0	-5	-0.9	16	2.7
C9	303	794	-6	-1.0	3	0.5	-12	-2.1	14	2.6	-10	-1.8	14	2.5	-8	-1.4	9	1.4	-7	-1.3	19	3.2	-1	-0.2	16	2.7	-7	-1.2	15	2.4	-6	-1.0	20	3.3
C5	287	868	-10	-1.3	3	0.5	-18	-2.5	21	3.3	-17	-2.4	21	3.2	-16	-2.2	12	1.8	-13	-1.8	27	4.2	-4	-0.7	18	2.8	-12	-1.6	20	3.1	-12	-1.7	26	4.1
SLBAR3	148	397	-14	-3.4	-1	-0.6	-16	-4.0	-1	-0.7	-16	-4.1	-1	-0.7	-18	-4.4	-1	-0.8	-19	-4.9	-1	-0.7	-25	-6.3	-2	-1.0	-17	-4.3	-1	-0.6	-20	-4.9	-1	-0.6

Table 4-9. Minimum and Maximum Computed Absolute and Percentage Change from Base Condition Monthly Averaged EC in 2010

D1641 Station	Monthly Avg Base EC uS/cm		Change from Base EC (uS/cm and %): Feb 2010 - Dec 2010																															
			Alt 1				Alt 3				Alt 4				Alt 11				Alt 23				Alt 16B				Alt 26				Alt 31			
	min	max	min		max		min		max		min		max		min		max		min		max		min		max		min		max		min		max	
			uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%	uS/cm	%
D22	147	1018	-30	-3.4	0.4	0.2	-41	-4.6	0.4	0.2	-36	-4.1	0.3	0.2	-23	-2.6	0.0	0.0	-44	-5.0	0.4	0.2	-20	-2.3	0.1	0.0	-40	-4.5	0.4	0.2	-40	-4.5	0.3	0.1
D15	172	1303	-23	-2.5	0.3	0.1	-39	-3.9	0.5	0.0	-40	-4.0	0.4	0.1	-44	-4.4	0.7	0.3	-33	-3.4	1	0.1	-33	-3.5	2	0.6	-30	-3.1	0.6	0.2	-35	-3.6	0.9	0.3
D29	155	422	-2	-0.8	1	0.5	-6	-2.1	5	1.7	-5	-1.7	6	2.0	-2	-0.9	5	1.7	-3	-1.2	8	2.6	0.2	0.1	10	3.3	-3	-1.1	6	1.8	-2	-0.7	9	3.0
DMC1	237	728	-3	-0.8	0.1	0.0	-7	-1.7	2	0.4	-6	-1.6	2	0.4	-5	-1.3	0.7	0.1	-5	-1.2	4	0.8	-0.2	-0.1	4	0.8	-4	-1.1	3	0.5	-4	-1.0	4	0.9
C9	208	657	-4	-1.1	0.3	0.1	-10	-2.4	2	0.5	-9	-2.2	3	0.6	-7	-1.9	0.6	0.1	-7	-1.7	5	1.1	-0.7	-0.2	5	1.1	-6	-1.5	3	0.7	-5	-1.5	5	1.2
C5	225	799	-8	-1.2	0.1	0.0	-16	-2.4	4	0.5	-15	-2.4	3	0.4	-14	-2.2	0.6	0.2	-11	-1.8	7	0.9	-4	-0.7	4	0.8	-10	-1.6	4	0.6	-11	-1.7	6	1.0
SLBAR3	145	414	-15	-3.9	-1	-0.7	-17	-4.4	-1	-0.9	-17	-4.5	-1	-0.9	-19	-5.0	-2	-1.4	-21	-5.5	-2	-0.9	-29	-7.5	-3	-1.5	-19	-4.9	-2	-0.9	-22	-5.6	-2	-0.9

4.6 Regional Flow Alterations (I-8)

The RMA Delta model was also used to estimate potential changes to the existing regional flow (Appendix D). The evaluation period spanned from February 1, 2009 to November 30, 2010, covering generally dry and below normal hydrologic conditions in the Sacramento Valley and dry and above normal conditions in the San Joaquin Valley (DWR 2013b)

4.6.1 Compliance with D-1641 flow requirements

The primary objective of the regional flow change analysis was to determine the potential for non-compliance with the D-1641 minimum flow requirements for the Sacramento River at Rio Vista. Analysis of flow at Rio Vista for all alternatives showed no potential for non-compliance with the D-1641 minimum monthly average flow requirements. All alternatives were predicted to slightly increase the net flow at Rio Vista (Table 4-10).

Table 4-10. Monthly Average Flow Rates at Rio Vista by Alternative.

Year	Month	Required Minimum	Monthly Averaged Flow (cfs)								
			Base	Alt 1	Alt 3	Alt 4	Alt 11	Alt 23	Alt 16B	Alt 26	Alt 31
2009	September	3,000	5,591	5,711	5,814	5,833	5,827	5,850	5,884	5,807	5,871
	October	4,000	5,493	5,593	5,741	5,750	5,718	5,771	5,751	5,716	5,782
	November	4,500	5,083	5,154	5,297	5,298	5,262	5,319	5,284	5,264	5,321
	December	4,500	7,252	7,303	7,367	7,372	7,359	7,387	7,391	7,363	7,394
2010	September	3,000	8,610	8,652	8,641	8,677	8,745	8,682	8,858	8,671	8,723
	October	4,000	6,386	6,507	6,584	6,605	6,647	6,618	6,709	6,578	6,674
	November	4,500	7,706	7,798	7,865	7,889	7,909	7,898	7,980	7,862	7,925

Source: Appendix D

4.6.2 General trends in regional and net tidal flow changes

To analyze regional and net tidal flow changes, three differing conditions of north Delta flow were examined within the full evaluation period: 1) July–September 2010, with inflow of 16,865 cfs at Freeport (representing summer months during below normal conditions for the Sacramento Valley and above normal conditions for the San Joaquin Valley) ; 2) July–September 2009, with inflow of 15,013 cfs at Freeport (representing summer months during dry conditions for the Sacramento and San Joaquin Valleys); and 3) October – November 2009, with inflow of 9,378 cfs at Freeport (representing fall months during dry conditions for the Sacramento and San Joaquin Valleys). Results are presented in Table 4-11, Table 4-12, and Table 4-13, respectively.

Generally, the breaching of Prospect Island levees increased net flow in Miner Slough, which in turn increased net flow in the Sacramento River at Rio Vista. The increase in flow in Miner Slough corresponded with decreases in flow through both the Delta Cross Channel and Georgiana Slough from the Sacramento River towards the San Joaquin River. Maintaining flows through the Delta Cross Channel and Georgiana Slough from the Sacramento River towards the San Joaquin River is important to help control salinity intrusion into the Central Delta from Suisun Bay via the San Joaquin River. The flow magnitude decreased in the Delta Cross Channel but increased in Georgiana Slough as Sacramento River inflow decreased (i.e. there were larger decreases in the fall months when flow at Freeport was lower than in summer when flow at Freeport was higher). The decreases in Delta Cross Channel and Georgian Slough flow were partially compensated by increases in flow from the Sacramento River to the San Joaquin River through Threemile Slough. The combined effect of the increases in Miner Slough flow, decreases in Delta Cross Channel and Georgiana Slough flow, and increases in Threemile Slough flow was a net increase of flow in the San Joaquin River at Jersey Point in the flood flow direction. As discussed above, increases in net flow in the flood direction could result in salinity changes in the Delta. Potential salinity changes are analyzed in Section 4.5.

Table 4-11. Computed Net Flow Change for July-September 2010

Station ID	Location Name	Base Net Q (cfs)	Alternative Net Flow - Base Net Flow (cfs)							
			Alt 1	Alt 3	Alt 4	Alt 11	Alt 23	Alt 16B	Alt 26	Alt 31
FPT CACHE-CMPLX	Sacramento River at Freeport	16,865	—	—	—	—	—	—	—	—
	Cache SI above DWSC	-735	—	—	—	—	—	—	—	—
HWB	Miner SI at Hwy 84 Bridge	2,289	33	-111	-41	72	93	493	57	189
SRV	Sacramento River at Rio Vista	8,589	60	46	82	150	89	263	79	130
DLC+GSS	Delta Cross Chan + Georgiana SI	7,138	-61	-47	-83	-150	-90	-264	-80	-131
TMS	Threemile Slough	-2,329	-1	-4	-29	-76	-21	-119	-9	-48
EMM	Sacramento R at Emmaton	6,197	59	42	54	74	69	144	70	83
SJJ	San Joaquin R at Jersey Pt	-562	-56	-39	-51	-70	-65	-137	-66	-78

Table 4-12. Computed Net Flow Change for July-September 2009

Station ID	Location Name	Base Net Q (cfs)	Alternative Net Flow - Base Net Flow (cfs)							
			Alt 1	Alt 3	Alt 4	Alt 11	Alt 23	Alt 16B	Alt 26	Alt 31
FPT CACHE-CMPLX	Sacramento River at Freeport	15,013	—	—	—	—	—	—	—	—
	Cache SI above DWSC	-760	—	—	—	—	—	—	—	—
HWB	Miner SI at Hwy 84 Bridge	1,964	78	6	65	115	177	455	132	258
SRV	Sacramento River at Rio Vista	7,217	82	109	138	174	151	265	129	184
DLC+GSS	Delta Cross Chan + Georgiana SI	6,631	-81	-109	-138	-175	-151	-266	-129	-184
TMS	Threemile Slough	-2,268	-6	-25	-47	-84	-42	-119	-26	-66
EMM	Sacramento R at Emmaton	4,896	76	84	91	91	109	146	104	118
SJJ	San Joaquin R at Jersey Pt	-584	-68	-75	-82	-84	-99	-137	-94	-107

Table 4-13. Computed Net Flow Change for October-November 2009

Station ID	Location Name	Base Net Q (cfs)	Alternative Net Flow - Base Net Flow (cfs)							
			Alt 1	Alt 3	Alt 4	Alt 11	Alt 23	Alt 16B	Alt 26	Alt 31
FPT CACHE-CMPLX	Sacramento River at Freeport	9,378	—	—	—	—	—	—	—	—
	Cache SI above DWSC	-95	—	—	—	—	—	—	—	—
HWB	Miner SI at Hwy 84 Bridge	1,177	112	247	260	163	322	305	244	345
SRV	Sacramento River at Rio Vista	5,037	92	239	241	203	265	227	210	268
DLC+GSS	Delta Cross Chan + Georgiana SI	4,015	-89	-233	-236	-199	-260	-224	-205	-264
TMS	Threemile Slough	-1,392	-8	-62	-68	-67	-72	-75	-47	-80
EMM	Sacramento R at Emmaton	3,609	84	178	174	137	193	153	164	189
SJJ	San Joaquin R at Jersey Pt	1,490	-76	-162	-159	-124	-177	-140	-150	-174

5 ALTERNATIVES COMPARISON

This section presents a comparison of the six base alternatives along with additional comparisons of the two adaptive management and three sensitivity analysis configurations on the basis of Phase 2 modeling criteria (Section 2.2). Table 5-1 provides a comparative summary of the modeled alternatives relative to the evaluation criteria (Section 2). In the Sections below, individual modeling criteria to be used for alternatives selection (Section 2.2) by FRP staff are discussed with reference to modeling results summaries (Section 4) and supporting modeling reports (Appendices A through D).

5.1 On-site Productivity (B-1)

The top three alternatives that resulted in the greatest proportion of modeled particles within the preferred open water zone dominant ET classes (1–3 days and 3–5 days to represent selection for diatom species) are (Table 4-1 and Figure 4-1):

1. Alternative 26: A two-breach, flow-through alternative with an internal breach of the cross-levee connecting the DWR and Port-owned properties.
2. Alternative 3: A single breach alternative along Miner Slough providing connectivity to deeper open water portions of the site north of the internal cross-levee.
3. Alternative 23: A two-breach, shorter-distance flow-through design along Miner Slough connecting northeast Miner Slough to deeper open water portions of the site north of the internal cross-levee.

Because Alternative 3 and other single breach alternatives have lower hydraulic connectivity than Alternative 26 and 23, a greater proportion of the modeled particles were found to have longer exposure times potentially associated with selection for undesirable algae, such as *Microcystis*. However, it should be noted that the large overlap in growth rates of many algal species, effects of wind, light and nutrient availability, interactions of benthic algae, as well as potential grazing pressures from filter feeding organisms (e.g., *Corbula amurensis*) may alter phytoplankton population dynamics. For example, ET modeling conducted for Liberty Island (Brennan et al. 2013) found high spatial variability with ET well in excess of 20–25 days in some locations. Because food web conditions on Liberty Island appear to support Delta Smelt and other fish species, the ET classes used for Phase 2 modeling may be considered as reasonable proxies for, but not absolute determinants of, phytoplankton species composition or productivity export.

5.1.1 Effects of reduced vegetation and channel extent

Modeling sensitivity evaluations that included reduced vegetation and channel extent resulted in increased representation of preferred ET classes (e.g., 1–3 and 3–5 days) for the two-breach Alternative 23/23S, but reduced representation of these classes for the alternatives with a weir at the northern end of Miner Slough (Alternatives 1/1S and 4/4S). Considering only the effects upon pelagic productivity, these results suggest that increased open water extent will not necessarily result in greater production or export of pelagic productivity unless it is coupled with breaches providing tidal exchange with open water habitats.

5.1.2 Potential future adaptive management breaches to the Sacramento DWSC

These adaptive management alternatives are modifications of Alternatives 4 and 23 (Figure 3-1). When compared to Alternatives 4 and 23, the additional breaches on the Sacramento DWSC by Alternatives 11 and 16B is accompanied by a reduced ET for particles. These alternatives also exhibited large increases in the shortest ET class (< 1-day) (Table 4-1), indicating flushing rates in excess of algal doubling times. The lower proportion of particles within preferred ET classes (e.g., 1–3 and 3–5 days) under these alternatives suggests lower production and export of diatom-based phytoplankton than for other alternatives analyzed. However, depending upon the observed species composition following implementation of the preferred alternative, the results here suggest that additional breaches along the DWSC represent an effective means of manipulating algal productivity within Prospect Island.

5.2 Productivity Export (B-2)

Selection of alternatives maximizing the tidal export of productivity generated within Prospect Island to the Project vicinity, and especially toward the Cache Slough region, meets primary objectives of the Project (Section 1). Although particle modeling simulations of on-site productivity and export conducted for Phase 1 considered phytoplankton-based productivity (Stillwater Sciences-WWR 2012), it was recognized that productivity generated within marsh vegetation (e.g., epiphytic algae, detritus, and invertebrates) may supplement the food-web of pelagic and littoral species. This section highlights alternatives with the greatest relative export of modeled particles dominated by exposure to open water and vegetated habitats within Prospect Island.

For the short-term (2-day) export of open water-zone dominant particles, Alternative 23, 31, and 26 provided the greatest export (Table 4-2) in combination with the majority of these particles arising from preferred ET classes for the selection of diatom species (Table 4-1). For longer-term (7-day) export of both open water zone dominant particles (Table 4-2) and vegetation zone dominant particles (Table 4-3), the following are top three alternatives ranked in order of total export:

1. Alternative 31: A three-breach alternative along Miner Slough connecting northeast Miner Slough to deeper open water portions of the site on both sides of the internal cross-levee.
2. Alternative 26: A two-breach, flow-through alternative with an internal breach of the cross levee connecting the DWR and Port-owned properties.
3. Alternative 23: A two-breach, shorter-distance flow-through design along Miner Slough connecting northeast Miner Slough to deeper open water portions of the site north of the internal cross levee.

The potential linkages of marsh productivity exports to the pelagic food web have not been well studied in the Delta (see Howe and Simenstad 2011 as one example). However, the alternatives above also represent the greatest export of open water zone dominant particles (Table 4-2) and lowest representation of ET classes representing selection of undesirable algal species.

5.2.1 Effects of reduced vegetation and channel extent

Modeling sensitivity evaluations that included reduced extent of marsh vegetation and channel on the interior of Prospect Island resulted in minor increases in total particles exported and large increases in particles dominated by open water zone exposure (Table 4-2 and Table 4-3). For directly comparable alternatives, Table 4-2 shows that open water-zone dominant particle export for all low-vegetation alternatives (Alternative. 1S, 4S, and 23S) was substantially higher than for the vegetated base alternative counterparts (Alternative 1, 4, and 23). Because elevations at Prospect Island comprise a mix of shallow sub-tidal (up to about 4 feet below mean lower low water) and low intertidal habitats, if existing vegetation is removed and not re-established prior to breaching, the Project would support primarily open water tidal and subtidal aquatic habitat. Under an assumption of retaining existing marsh vegetation or its pre-breach re-establishment, or after successional processes increase marsh extent, these results suggest that the export of phytoplankton-based productivity may be partially replaced by marsh-based productivity in the long term.

5.2.2 Potential future adaptive management breaches to the Sacramento DWSC

When compared to Alternative 4 and 23, the additional breaches on the DWSC by Alternative 11 and 16B is accompanied by reduced exposure of particles to the open water zone within Prospect Island, as well as reduced export of open water zone dominant particles (Table 4-2). This appears to be the result of locating the additional levee breaches along the DWSC adjacent to vegetated habitats within Prospect Island (Figure 3-1). The increased connectivity to vegetated habitats increased the proportion of vegetation zone dominant particles as well as export of these particles (Table 4-3). Alternative 11 and 16B resulted in a greater percentage of both open water and vegetation zone dominant particle export into the DWSC, an area known to support Delta Smelt, than for Alternative 4 and 23 (Table 4-2 and Table 4-3).

5.3 Temperature Changes in Adjacent Water Bodies (B-3, I-4)

Water temperature conditions within Prospect Island and in the sloughs and channels adjacent to Prospect Island were modeled to determine the potential effects of the project on spawning and rearing of Delta Smelt and juvenile rearing and smolt emigration for Chinook Salmon.

5.3.1 Water temperatures within Prospect Island

Water temperature conditions within Prospect Island under most alternatives reflected general trends in existing water temperatures in the Project region, with suitable temperatures from March through May, temperatures transitioning from suitable to sub-optimal in June, sub-optimal temperature dominating in July and August, and temperatures transitioning back toward suitable, but still dominantly sub-optimal dominant in September. Exceptions to this behavior are alternatives with intertidal vegetation only (Alternative 1S, 3S, and 23S). These alternatives have longer periods of sub-optimal from June through September and have sub-optimal majorities in June and September, which is warmer than conditions seen in adjacent water bodies under existing conditions. Differences between alternatives with both intertidal and shallow subtidal vegetation are very minor (generally 2 to 3 days differences), with no alternative clearly providing greater benefits. As alternatives without shallow subtidal vegetation provide less suitable conditions and there is little difference between the remaining alternatives, any of the intertidal and shallow subtidal alternatives, Alternative 1, 2, 3B, 4, 23, 26, 31, 11 or 16B, could be chosen.

5.3.2 Water temperatures changes in adjacent water bodies

No lethal conditions (temperatures above 25°C) are present under any alternative, under any month, at any location. In addition, there were no changes from base conditions at any location for March, April, or May under any alternative. Changes that did occur tended to be small, in the 1- to 2-day range. As differences between alternatives across all locations were negligible or equivalent, alternatives should not be selected based on this criterion.

5.4 Turbidity in the Cache Slough Region (I-2)

Modeling of turbidity in the Cache Slough Region examined periods with both low and high turbidity conditions. Alternatives are compared and contrasted by these two conditions separately below.

During the months of October and November, turbidity conditions in Cache Slough, the DWSC, and Liberty Island, while relatively low, vary between suitable to less than suitable for Delta Smelt. Predicted reductions in turbidity across the alternatives at these locations were relatively constant: reductions at Cache Slough between 5–8%, at the DWSC between 12–19%, and at the Liberty Island breach between 10–15%. Conditions in Miner Slough during this time are not expected to support Delta Smelt. That being said, predicted reductions in Miner Slough were also relatively consistent between alternatives and varied from 10–19%.

The two alternatives, 11 and 16B, did not follow these patterns. In contrast to the other alternatives, Alternative 11 increased or had no effect on turbidity in Cache Slough and only slightly decreased turbidity in Miner Slough (i.e. by 4%). Turbidity reductions in the DWSC and at the Liberty Island breach were similar to the other alternatives, varying between 13–18% and 7–10%. Alternative 16B produced even more pronounced differences as compared to the other alternatives. Alternative 16B increased turbidity in Cache Slough in October by 1% and decreased turbidity in November by 3%. In the DWSC, Alternative 16B showed far greater reductions than any other alternative, between 22–28%, but exhibited similar reductions at the Liberty Island breach (10–14%). The biggest difference between Alternative 16B and the other alternatives was seen in Miner Slough, where Alternative 16B increased turbidity by 30–36%. Based on the discussion above, the alternatives are listed below by smallest to largest potential percent reductions in turbidity during times of lower turbidity.

Alternatives by potential percent turbidity reduction (Oct-Nov), smallest to largest

1. Alternative 11
2. Alternative 1, 1S, 3, 3B, 4, 4S, 23, 23S, 26, and 31—little variation
3. Alternative 16B—twice the percent reduction in the DWSC compared to other alternatives

During the month of December, predicted reductions in turbidity varied between alternatives, with lower connectivity alternatives having lesser reductions and higher connectivity alternatives having greater reductions. The lower connectivity alternatives had percent reductions between 5–7% in Cache Slough, 15–19% in the DWSC, 8–10% in Liberty Island, and 2–5% in Miner Slough. The intermediate connectivity alternatives had percent reductions of 8% in Cache Slough, 22% in the DWSC, 11% in Liberty Island, and 2% in Miner Slough. The higher connectivity alternatives had percent reductions between 14–19% in Cache Slough, 28–37% in the DWSC, 18–24% in Liberty Island, and increases of 8–10% in Miner Slough. The adaptive management alternatives had percent reductions between 10–11% in Cache Slough, 31–38% in the DWSC, 15–16% in Liberty Island, and increases of 3–17% in Miner Slough. Though these turbidity changes were generally larger than those seen in October and November, the higher turbidity during this period (greater than 18 NTU, with long periods of time they have less potential to be impacting as the turbidity levels in the water bodies during December are comparatively high (greater than 18 NTU, with long periods of time greater than 50NTU). Based on this, the alternatives are listed below by smallest to largest potential impacts.

Alternatives by impacts during higher turbidities (Dec), smallest to largest

1. Lower Connectivity—Alternative 1, 1S, 3, 3B
2. Intermediate Connectivity—Alternative 4, 4S
3. Adaptive Management—Alternative 11, 16B
4. Higher Connectivity—Alternative 23, 23S, 26, 31

Prospect Island is subsided, with elevations ranging from shallow to moderate subtidal. Sediment accretion will help reverse subsidence, build marsh plain elevations, and provide adaptability for site in terms of long-term sea level rise. As expected, sediment accretion at the site directly corresponds with the connectivity of the alternative. Alternatives with higher connectivity have higher predicted sediment accumulation and alternatives with lower connectivity have lower predicted sediment accumulation. There is little variation between

alternatives by grouping. Based on this, the alternatives are listed below by grouping from highest to lowest sediment accumulation potential.

Alternatives ranked by sediment accumulation potential

1. Higher Connectivity—Alternative 23, 23S, 26, 31 and Adaptive Management—Alternative 11 and 16B
2. Intermediate Connectivity—Alternative 4 and 4S
3. Lower Connectivity—Alternative 1, 1S, 3, 3B

5.5 Salinity Changes at D-1641 Compliance Stations (I-3)

Prospect Island alternatives were modeled to determine the potential for non-compliance with both agricultural, fish and wildlife beneficial uses, and municipal and industrial beneficial uses under D-1641 standards. All alternatives were shown to be in compliance with all D-1641 standards. There are no recommended alternatives based on this criterion as there were no differences between the alternatives.

Although below threshold levels, both increases and decreases in salinity were observed at all of the compliance stations. These changes were relatively small (less than 8%), followed the same trends across all alternatives, and varied little between alternatives. The relative uniformity of the changes did not allow for differentiation between the alternatives; however, the results may be useful in evaluating potential water quality impacts from the project in the environmental review process.

5.6 Regional Flow Alterations (I-8)

Maintaining minimum flow rates to support fish and wildlife beneficial uses is required by Water Rights Decision D-1641. Modeling indicated that all alternatives increased net flow in the Sacramento River at Rio Vista and therefore none of the alternatives showed the potential for non-compliance with the flow requirement. There are no recommended alternatives based on this criterion as there were no differences between the alternatives.

All alternatives increased flows in the lower Sacramento River. The mechanism for this change was increasing flows from the Sacramento River through Miner Slough and decreasing flows from the Sacramento River through the Delta Cross Channel and Georgiana Slough. Some of this decrease was compensated by increases in flow from the Lower Sacramento River to the San Joaquin River

through Threemile Slough, however all alternatives resulted in increased net flow in the flood direction in the San Joaquin River at Jersey Point, which in turn could alter salinity conditions. The magnitude of change in net flow increased with the number of breaches, although these changes were too small to allow for differentiation between alternatives. The modeling results may be useful in evaluating potential impacts due to the Project during the environmental review process.

Table 5-1. Prospect Island Evaluation Criteria Summary by Alternative

Details	Alternatives											
	Low Export, High Internal Exposure Time Variability				Intermediate Export and Internal Exposure Time Variability		High Export, Low Internal Exposure Time Variability				Adaptive Management (DWSC breaches)	
	1	1S	3	3B	4	4S	23	23S	26	31	11	16B
Pelagic Food Web Productivity within the Restoration Site												
Pelagic Zone exposure time (ET)	Long Pelagic Zone ET; Potential blue-green algae growth	Long Pelagic Zone ET; Potential blue-green algae growth	Optimal Pelagic Zone ET (1-3 day >20%)		Optimal Pelagic Zone ET (1-3 day >20%)	Long Pelagic Zone ET; Potential blue-green algae growth	Optimal Pelagic Zone ET (1-3 day >20%)	Optimal Pelagic Zone ET (1-3 day >20%)	Optimal Pelagic Zone ET (1-3 day >20%)	Optimal Pelagic Zone ET (1-3 day >20%)	Short Pelagic Zone ET	Optimal Pelagic Zone ET (1-3 day >20%)
Tidal Mixing of Exported Productivity (Results presented for 7 day model simulation)												
Pelagic Zone Dominant Particle Export (2-day)	Low Pelagic Zone Export (<30%)	Low Pelagic Zone Export (<30%)	High Pelagic Zone Export (>50%)		High Pelagic Zone Export (>50%)	Intermediate Pelagic Zone Export	High Pelagic Zone Export (>50%)	High Pelagic Zone Export (>50%)	Intermediate Pelagic Zone Export	High Pelagic Zone Export (>50%)	Intermediate Pelagic Zone Export	High Pelagic Zone Export (>50%)
Total Export (7-day)	Low Total Export (<50%)	Low Total Export (<50%)	Low Total Export (<50%)		Intermediate Total Export	Intermediate Total Export	High Total Export (>80%)	High Total Export (>80%)	High Total Export (>80%)	High Total Export (>80%)	High Total Export (>80%)	High Total Export (>80%)
On-Site Temperature Conditions and Changes in Adjacent Water Bodies												
On-site Temperatures	Reflects existing trends in adjacent water body temps; No lethal conditions	Temps slightly warmer for longer periods, especially in June and September	Reflects existing trends in adjacent water body temps; No lethal conditions		Reflects existing trends in adjacent water body temps; No lethal conditions	Temps slightly warmer for longer periods, especially in June and September	Reflects existing trends in adjacent water body temps; No lethal conditions	Temps slightly warmer for longer periods, especially in June and September	Reflects existing trends in adjacent water body temps; No lethal conditions	Reflects existing trends in adjacent water body temps; No lethal conditions	Reflects existing trends in adjacent water body temps; No lethal conditions	Reflects existing trends in adjacent water body temps; No lethal conditions
Changes in Adjacent Water Bodies	Differences between alternatives across all locations are negligible or equivalent. No lethal conditions are induced.											

Table 5-1. Prospect Island Evaluation Criteria Summary by Alternative

Details		Alternatives											
		Low Export, High Internal Exposure Time Variability				Intermediate Export and Internal Exposure Time Variability		High Export, Low Internal Exposure Time Variability				Adaptive Management (DWSC breaches)	
		1	1S	3	3B	4	4S	23	23S	26	31	11	16B
Turbidity in the Cache Slough Region													
% Turbidity change at Miner Slough	October	-14	-15	-19	-19	-15	-15	-16	-16	-18	-13	-4	36
	November	-13	-13	-15	-15	-12	-12	-12	-12	-11	-10	-4	30
% Turbidity change at Cache Slough	October	-5	-6	-5	-5	-5	-4	-6	-6	-5	-5	3	1
	November	-6	-6	-7	-7	-7	-7	-7	-7	-6	-8	0	-3
% Turbidity change at Sacramento DWSC	October	-12	-12	-15	-15	-16	-16	-16	-16	-13	-17	-13	-22
	November	-13	-13	-16	-16	-18	-18	-17	-17	-14	-19	-18	-28
% Turbidity change at Liberty Island (breach)	October	-10	-10	-11	-11	-12	-12	-12	-12	-10	-12	-7	-10
	November	-11	-11	-12	-12	-14	-14	-13	-13	-11	-15	-10	-14
% Turbidity change at Miner Slough	December	-2	-2	-5	-5	-2	-2	8	8	10	11	3	17
% Turbidity change at Cache Slough		-5	-6	-7	-7	-8	-8	-18	-18	-14	-19	-10	-11
% Turbidity change at Sacramento DWSC		-15	-15	-19	-19	-22	-22	-36	-35	-28	-37	-38	-31
% Turbidity change at Liberty Island (breach)		-8	-8	-10	-10	-11	-11	-23	-22	-18	-24	-16	-15
Prospect Island Cumulative Sediment Accretion (kilograms x 10^7)		1.12	1.15	1.68	1.68	2.07	2.02	4.39	4.34	3.31	4.59	3.04	4.60
Salinity Changes at D-1641 Compliance Stations													
D-1641 Compliance		No alternatives show potential for non-compliance with D-1641 water quality requirements for fish and wildlife, agricultural, or municipal and industrial objectives. ¹											
Regional Flow Alterations													
D-1641 Compliance		No alternatives show potential for non-compliance with D-1641 flow requirements at Rio Vista. ¹											
Notes: 1. Evaluation not performed for Alts 1S, 3B, 4S, and 23S													

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Appendices

Appendix A

Phase 2 Analysis for Primary Productivity Enhancement and Export

Appendix B

Phase 2 Alternatives Modeling Evaluation for Water Temperature Changes

Appendix C

Evaluation of Effects of Prospect Island Restoration on Sediment Transport and Turbidity: Phase 2 Alternatives

Appendix D

Phase 2 Alternatives Modeling Evaluation for Flow and Salinity Changes
