

2020 Urban Water Management Plans, Delta Plan and Sites Reservoir
Discussion Points for Members
July 6, 2020
Draft – For Discussion Purposes Only

Sites M&I members are preparing their 2020 Urban Water Management Plans (UWMPs) updates. Members have reached out to the Sites team seeking guidance describing in their UWMPs how Sites would contribute to a reduced reliance on the Delta consistent with the 2009 Delta Reform Act. This paper provides potential discussion points for members to consider in this effort.

Potential Discussion Points:

- Sites Reservoir does not meet the definition of a “covered action” under the Delta Plan consistent with a letter from the Delta Stewardship Council to the Sites Project Authority on May 2, 2018. Nothing has changed in the project through the value planning process that would likely change this prior conclusion.
- The Proposition 1, Water Supply Infrastructure Program recognizes that statewide benefits would result from construction and operation of Sites Reservoir providing measurable improvements in the Delta and Delta tributaries, consistent with the Proposition 1 requirements. These benefits include the following:
 - Enhancements to the Delta ecosystem by providing water to convey food resources from the floodplain to the Delta thereby improving the foodchain and quality of the Delta’s estuarine habitat for the benefit of pelagic fishes in the north Delta (e.g. Cache Slough).
 - Additional Incremental Level 4 Refuge Water Supply water for use in the Delta watershed to improve habitat for waterfowl and native species.
 - Improved cold water pool management in Shasta Reservoir through coordination and exchanges with the Bureau of Reclamation to benefit anadromous fish. (Although, the CWC concluded in its MCED for Sites that this benefit was not funded.)
- Sites Reservoir would result in a more sustainable and resilient management of the Delta watershed which was a desired goal for the authors of the 2009 Delta Reform Act..
 - Sites results in increased storage upstream of the Delta in years when water is available above that needed to satisfy existing water rights and environmental and water quality requirements.
 - The majority of water from Sites Reservoir would then be used in subsequent dry and critically dry years – improving ecosystem conditions through the use of the Proposition 1 water and possibly through improvements in cold-water pool management in Shasta Reservoir via exchanges with the Bureau of Reclamation.
 - This improved dry and critically dry year reliability provided by Sites Reservoir reduces the need for Sites’ members to find other, less sustainable water sources in these years, while providing

environmental enhancement and benefits in the years when its needed most for the environment.

- Sites Reservoir presents a new, flexible water supply – allowing water to be moved through the Delta to south-of-Delta members when conditions are more favorable for the Delta ecosystem. Water could then be stored in south-of-Delta reservoirs for later use.
- It is important to note that the context for the UWMP 2020 updates needs to recognize the multiple mandates that define the objectives. When reviewed collectively, a strong argument can be made for net Delta improvement from the Sites project.

Sent: 1/4/2021 10:44:03 AM
To: hanak@ppic.ord
Subject: RE: Environmental Water Manager

Good Morning Ms. Hanak,

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Thursday, December 31, 2020 10:17 AM
To: mount.jeffrey@gmail.com; hanak@ppic.ord; graybeg@gmail.com
Subject: FW: Environmental Water Manager

Good Morning,

Jerry is looking forward in this discussion. Please identify your availability in the doodle poll link below or forward this email to your scheduler. Have a wonderful weekend and start to the new year.

https://doodle.com/poll/mgxs3bkf4mcpnvq3?utm_source=poll&utm_medium=link

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Jeffrey Mount <mount.jeffrey@gmail.com>
Reply-To: "mount.jeffrey@gmail.com" <mount.jeffrey@gmail.com>
Date: Wednesday, December 30, 2020 at 1:02 PM
To: jerry brown <jerry@waterologyconsulting.com>
Subject: Re: Environmental Water Manager

Jerry,

Both Brian and Ellen are more than happy to talk. Let's see if we can get this scheduled. If you like, we can have our scheduler (who has our three calendars) tackle this, but the PPIC offices are pretty much closed down until next week. Your call on whether to doodle poll this or not. In the interim:

Ellen Hanak: hanak@ppic.org

Brian Gray: graybeg@gmail.com

Looking forward to the conversation!

Jeff

On Wed, Dec 30, 2020 at 11:12 AM jerry brown <jerry@waterologyconsulting.com> wrote:

Thanks for the reply Jeff. I like the idea of a virtual meeting and appreciate the suggestion of involving your colleagues. I do see a role for PPIC if we can get this rolling, possibly as a participant, convenor, and/or author. I am also trying to identify a funding source to support the work (not PPIC, possibly water agencies, the state, or private donors). I know Ellen from my past as GM @ Contra Costa WD but don't believe I've had the pleasure of meeting Brian yet.

Can you send me best email addresses for Ellen and Brian? I'll then reach out to them similar to what I've done with you and have my assistant Marcia doodle poll for a meeting date.

Looking forward to further discussion.

Jerry

From: Jeffrey Mount <mount.jeffrey@gmail.com>

Reply-To: "mount.jeffrey@gmail.com" <mount.jeffrey@gmail.com>

Date: Wednesday, December 30, 2020 at 10:15 AM

To: jerry brown <jerry@waterologyconsulting.com>

Subject: Re: Environmental Water Manager

Jerry,

Thanks for reaching out. You are facing an important challenge here, but also a great opportunity to pioneer how water is managed as an environmental asset.

I am happy to chat, but would suggest that we bring in two of my colleagues: Brian Gray (who came up with the idea of ecosystem water budgets) and Ellen Hanak (best water economist I know).

Both of them are out this week for the holiday break, but could conceivably be on a call/zoom/whatever next week if you like. Let me know how you would like to proceed.

Jeff

On Wed, Dec 30, 2020 at 7:08 AM jerry brown <jerry@waterologyconsulting.com> wrote:

Hi Jeff - I am the Executive Director of the Sites Reservoir Project Authority. We are scheduled to receive state P1 funding to deliver significant ecosystem benefits with the this project. All combined, the 7 P1 storage project are estimated to deliver ~\$1.5B in ecosystem flexibility with new storage assets under the authority of CDFW and if operated under a "whole is greater than the sum of the parts" approach will make significant progress in meeting environmental goals for California. But if we take the traditional "regulator" approach where each project contracts and operates to a specific regime year after year, we will miss significant leveraging and climate adaptability opportunity. I have been following your work on the concept of an environmental water budget and would like to work with PPIC and NGO's, to develop a concept proposal we could take with the other P1 storage projects to CDFW where we optimize use of these valuable assets. This could make a logical stepping off platform to incorporate a similar concept into the voluntary agreements (when these get off the ground again). Please call me at 925-260-7417 so we can discuss at your earliest convenience.

.....
|
Thanks,
Jerry

Mitigation Planning Meeting Agenda



*Our Core Values – Safety, Trust and Integrity, Respect for Local Communities, Environmental Stewardship, Shared Responsibility
and Shared Benefits, Accountability and Transparency, Proactive Innovation, Diversity and Inclusivity
Our Commitment – To live up to these values in everything we do*

Meeting Information:

Date: January 8, 2021 **Location:** Webex (see invite)
Or call in (audio only)
+1-408-418-9388,,1462261024##
Start Time: 10:00 a.m. **Finish Time:** 12:00 p.m.
Purpose: Planning our approach to mitigation

Meeting Participants:

Ali Forsythe, Sites Authority Jelica Arsenijevic, Sites Integration Monique Briard, ICF
Dan Williams, Sites Integration John Spranza, Sites Integration
Harry Oakes, ICF Kristin Smith, Sites Integration

Agenda:

Discussion Topic	Topic Leader	Time Allotted
1. Introductions	John Spranza	5 min
2. Review ICF Scope of Work	TBD	15 min
a. Task F58: Mitigation Plan & Adaptive Management Plan		
(1) Subtasks F58.1, F58.2: Draft/Final Mitigation Plan		
3. Mitigation Requirements	TBD	20 min
a. Aquatic Resources (Jurisdictional and species/habitat)		
b. Terrestrial Resources (Habitat and species impacts)		
c. Status of Resource Analysis & Modeling		
d. Determination of Mitigation Needs (e.g., ratios, acres, F&V) & Timeline		
4. Mitigation Approach	TBD	20 min
a. Onsite vs Offsite Compensatory		
b. Optimizing Mitigation Approach		
(1) Stacking Credits (Species and Habitat Requirements)		
(2) Functions & Values		

5. Mitigation Opportunities Identified to-date	TBD	15 min
a. Review List (from July 2019, as revised)		
b. Review Recent Potential Opportunities		
6. Process & Timeline to Identify/Select Opportunities to Evaluate	TBD	20 min
a. What is initial screening process based on?		
(1) Mitigation requirements		
(2) feasibility/willing landowners		
(3) Distance from impact area		
b. Who identifies potential sites to evaluate?		
c. Who does outreach to owners/land managers?		
d. How firm of a commitment is needed from owners/land managers at this time before planning starts?		
7. Mitigation Planning Team	TBD	10 min
a. Identify Key Project Team Personnel/Roles		
b. Role of Agencies, Environmental NGO, Stakeholders, Others?		
8. Mitigation Measure Evaluation & Cost Estimate	TBD	15 min
a. How does this subtask fit with Mitigation Plan timeline?		
b. Separate process based on revised cost estimate schedule?		
9. Action Items and Next Steps	TBD	5 min
10. Adjourn		

OVERVIEW OF CONSTRUCTION ACCESS AND PROPERTY ACCESS

JANUARY 2021



Types of Access Needed

- Local traffic during construction
 - Sites Lodoga Road
 - Peterson Road
 - Huffmaster Road
 - Road 69
 - Sites Lodoga Road Detour
- Construction equipment access
- Property owner's access during construction
- Property owner's access post construction

Objectives

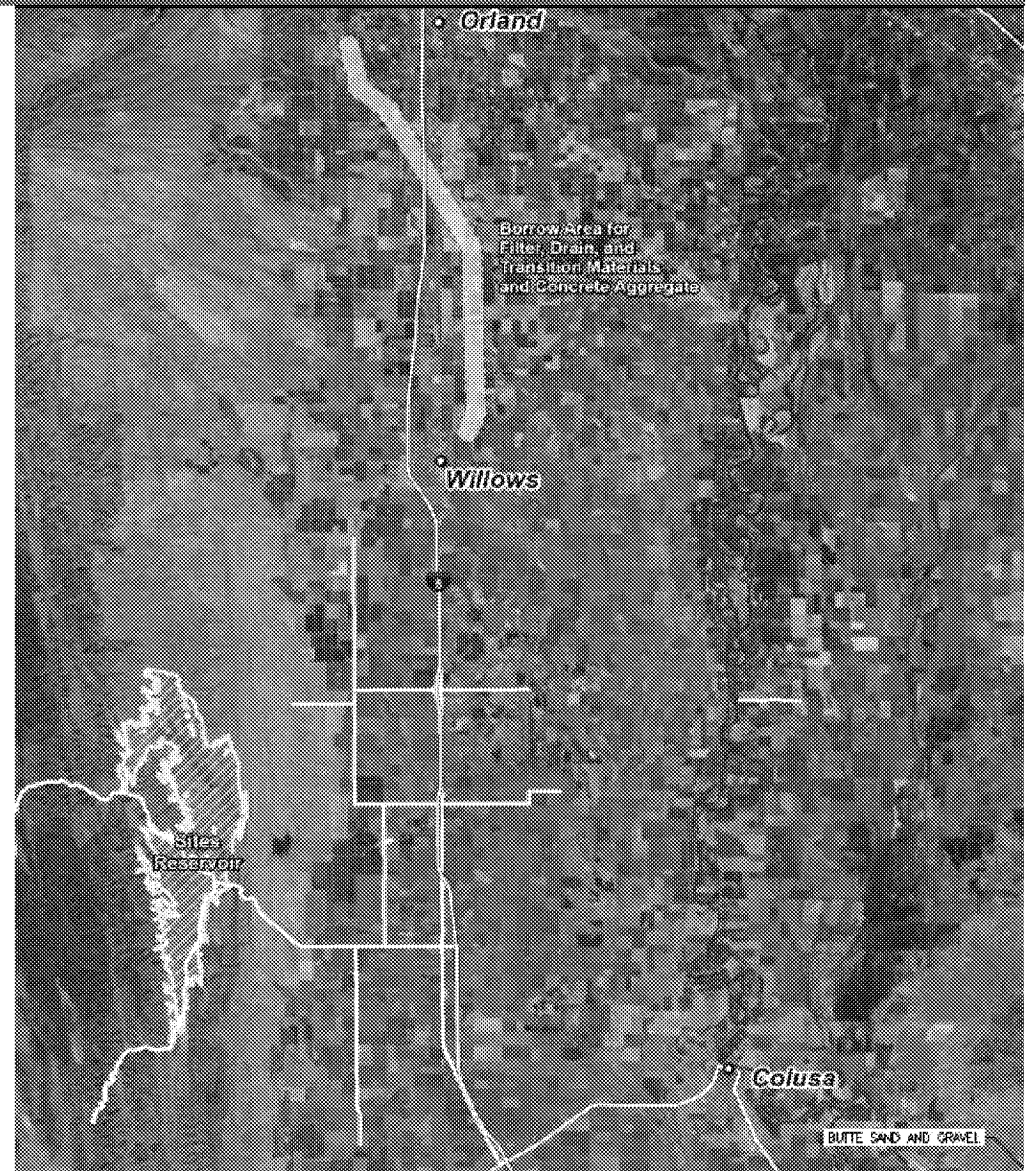
- Protect public safety – avoid, minimize, manage commingling of public and construction traffic
- Provide public and landowner access
- Provide construction access to the project site

Scope of Work Exclusions (HR Contract)

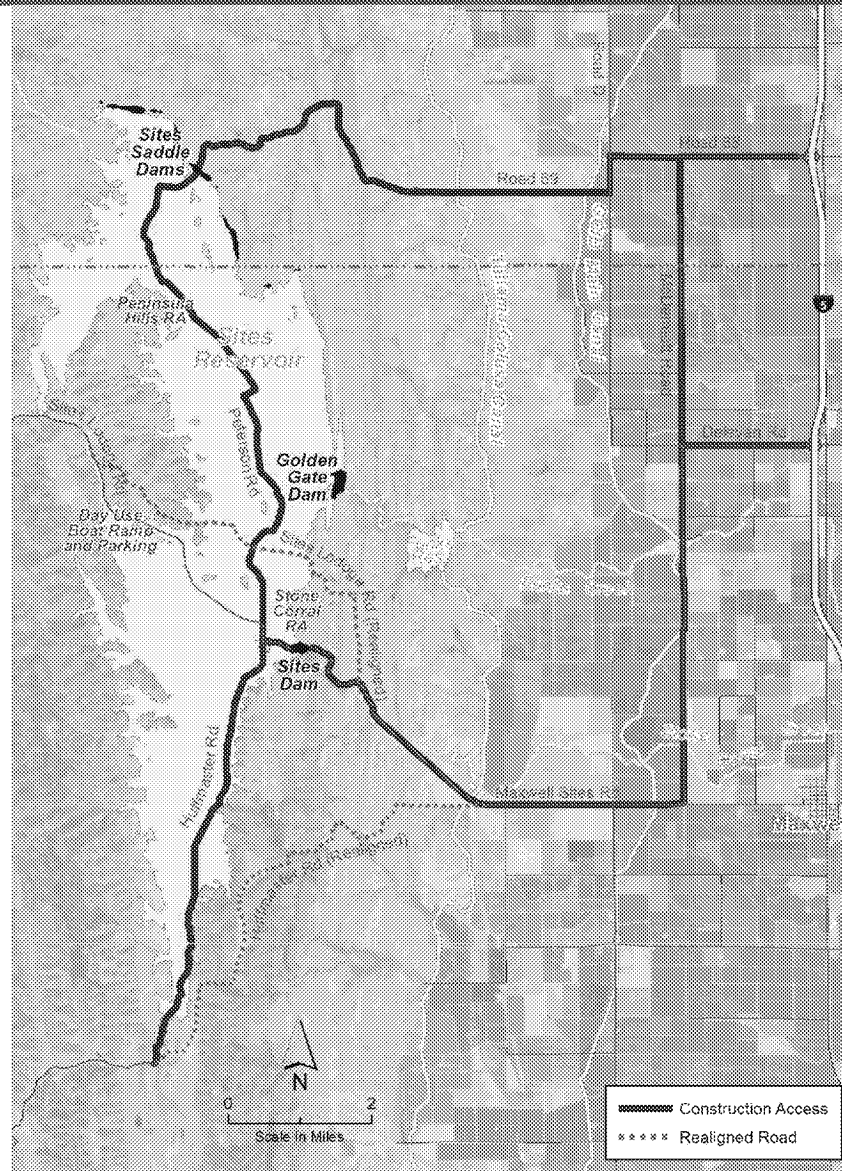
- Access roads to facilities not included in this presentation:
 - Funks Pumping Plant
 - Terminal Regulating Reservoir
 - Dunnigan Pipeline
 - Colusa Basin Drain
 - Recreation Areas

Haul Routes

- Minimize trips
- Appropriate routes

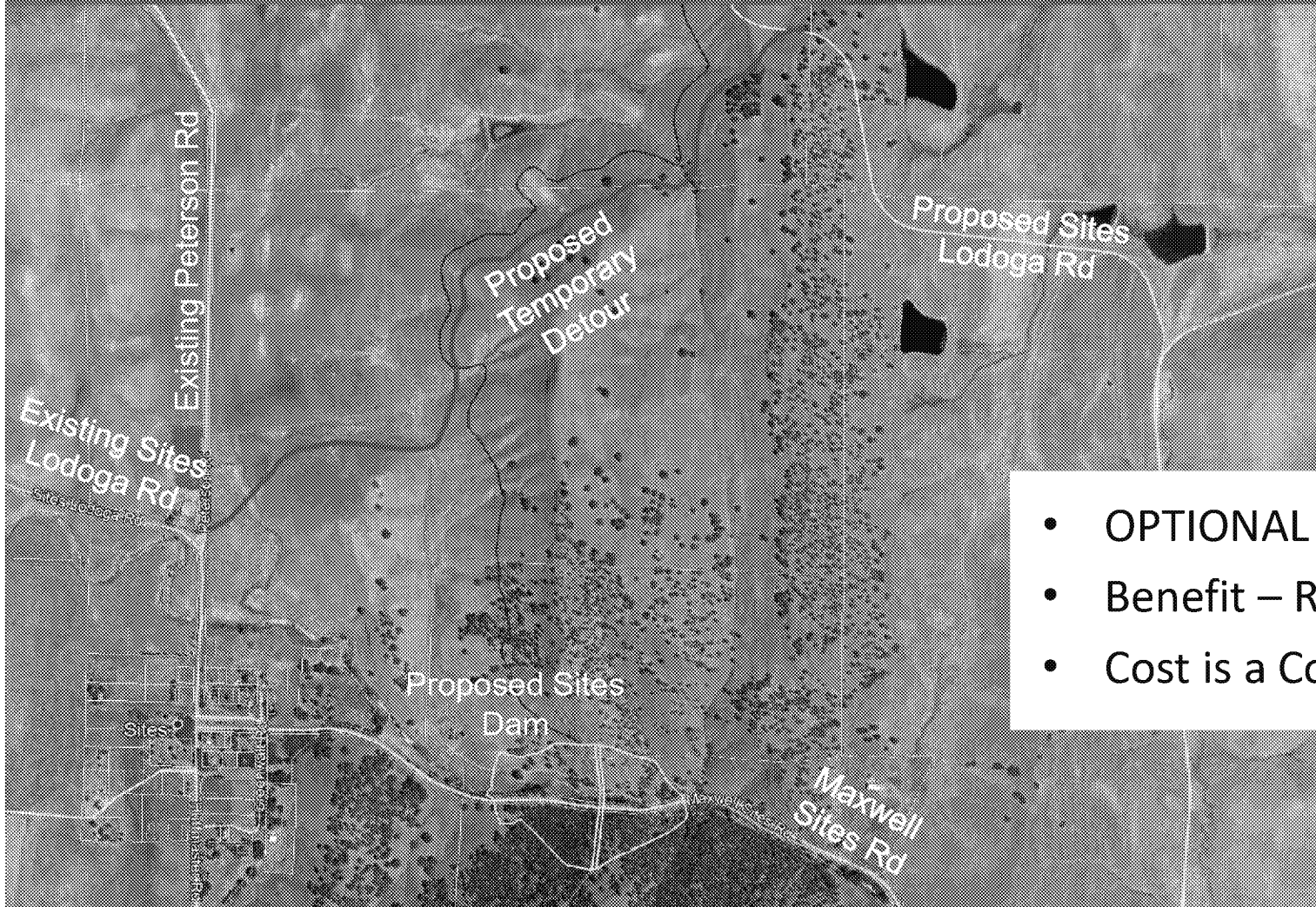


Construction Routes Overview



- Avoid Maxwell
- Road 68/ D/ 69/ Peterson
- Delevan/ McDermott/ Maxwell Sites/ Huffmaster

Sites Lodoga Road Detour for Local & Construction Traffic



- OPTIONAL
- Benefit – Reduces Schedule
- Cost is a Consideration

Reservoir & Saddle Dam Construction Access / New Maintenance Roads



Sites Lodoga Road Realignment & Access to Bridges Alternative 1 Only



New Maintenance Roads



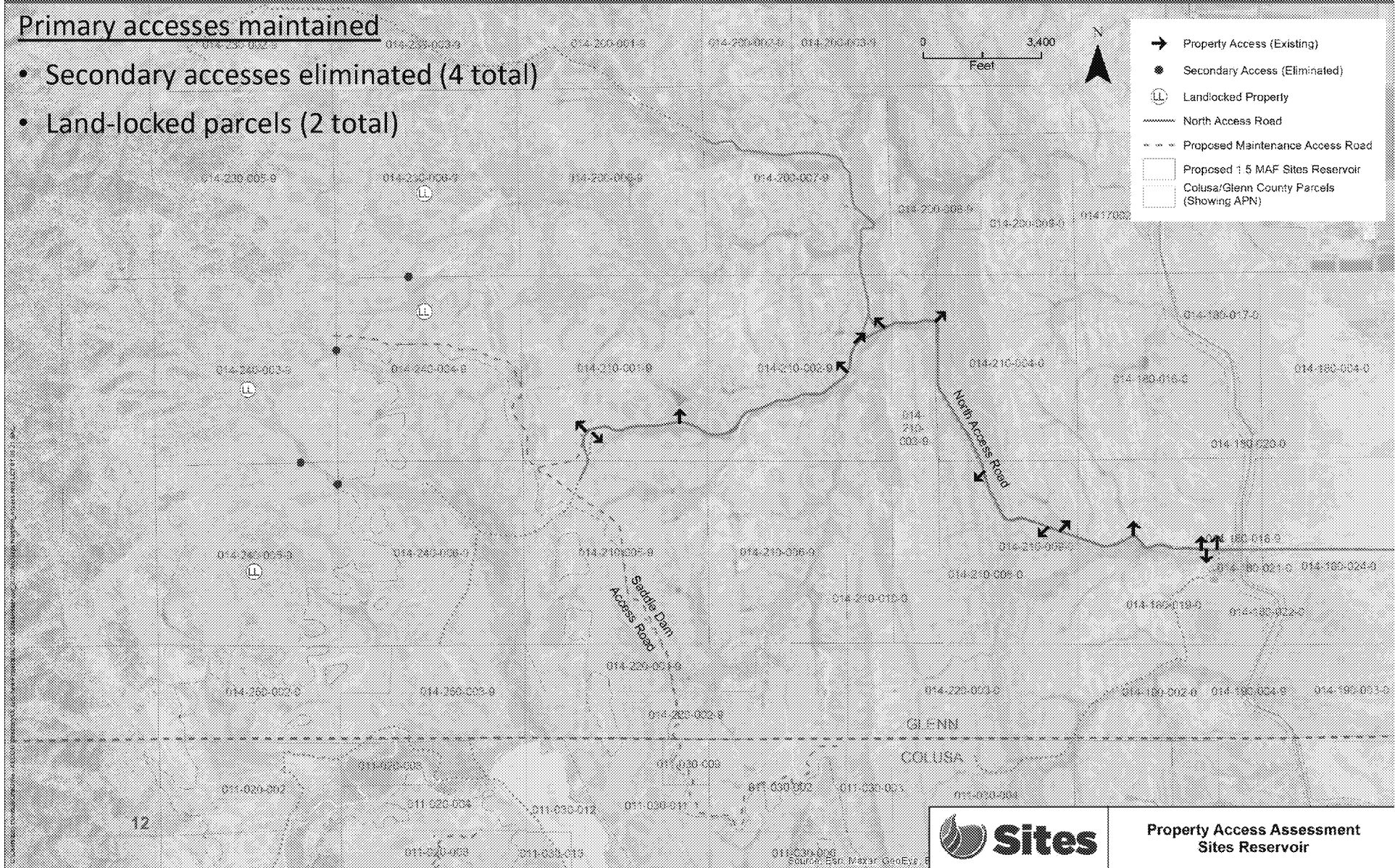
Huffmaster Road Realignment



Access for Landowners – North Access Rd Access Route

Primary accesses maintained

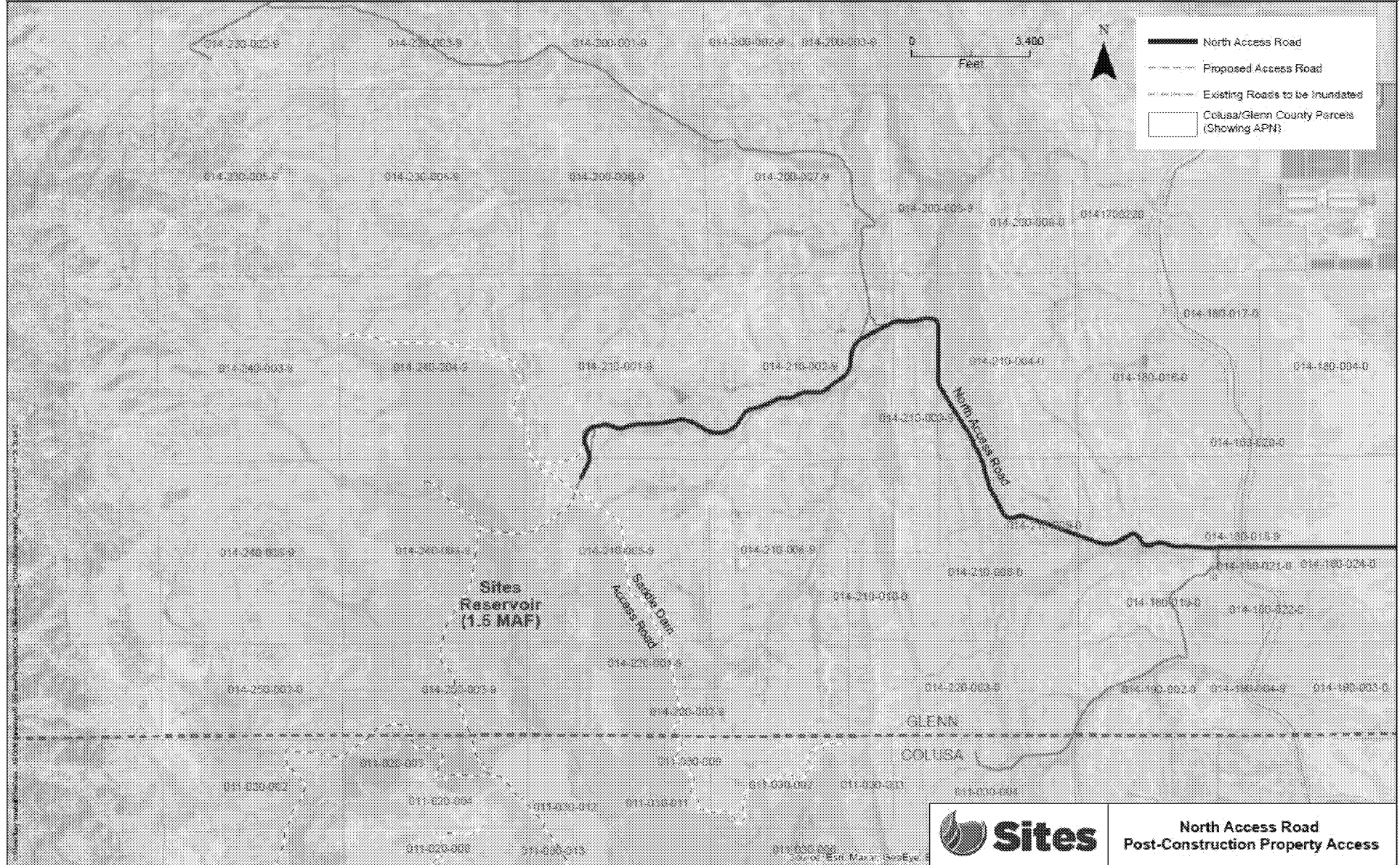
- Secondary accesses eliminated (4 total)
- Land-locked parcels (2 total)



Access for Landowners – North Access Rd Topography



Access for Landowners – North Access Rd Post Construction



Access for Landowners – Sites Lodoga Rd Area Access Route (Alt. 1 Only)

SITES LODOGA ROAD

- Primary access eliminated (4 tot)
- Relocated access to remnant (1 tot)
- Land-locked remnant parcels (4 tot)

PETERSON ROAD

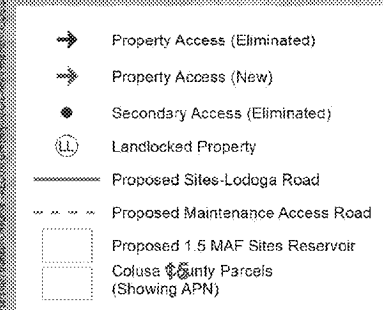
- Primary access eliminated (2 total)
- Relocated access to remnant (1 total)
- 2ndry access replaced w/ primary (2 tot)

HUFFMASTER ROAD

- Primary access eliminated (3 tot)
- 2ndry access eliminated (1 tot)
- Relocated access to remnant (1 tot)
- Land-locked remnant parcels (1 tot)

MAXWELL SITES ROAD

- Primary access eliminated (1 tot)
- 2ndry access eliminated (1 tot)
- Relocated access to remnant (1 tot)



0 500 Feet

COMM ROAD

Access across
Sites Dam

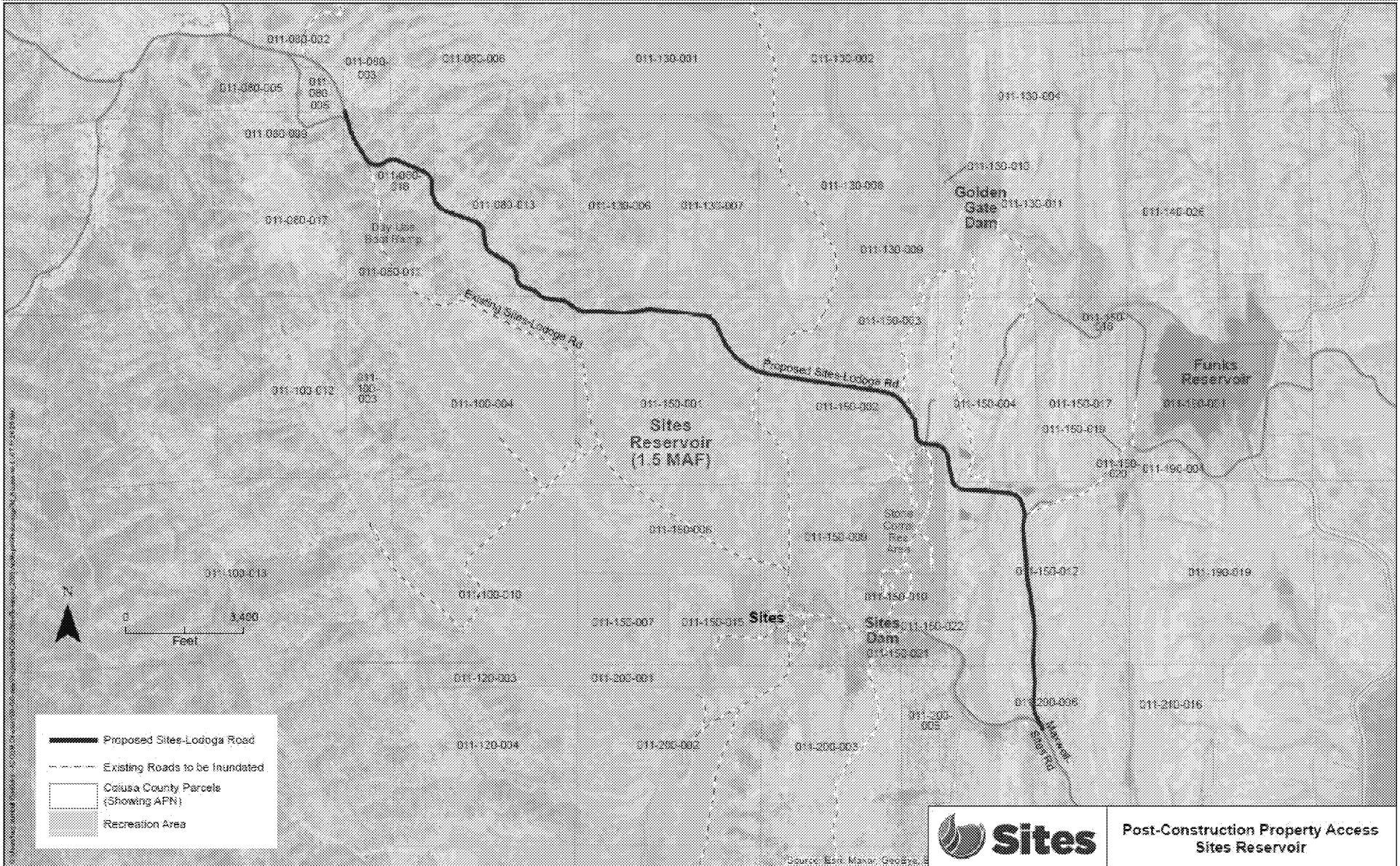


Property Access Assessment
Sites Reservoir

Access for Landowners – Sites Lodoga Rd Area Topography (Alt. 1 Only)

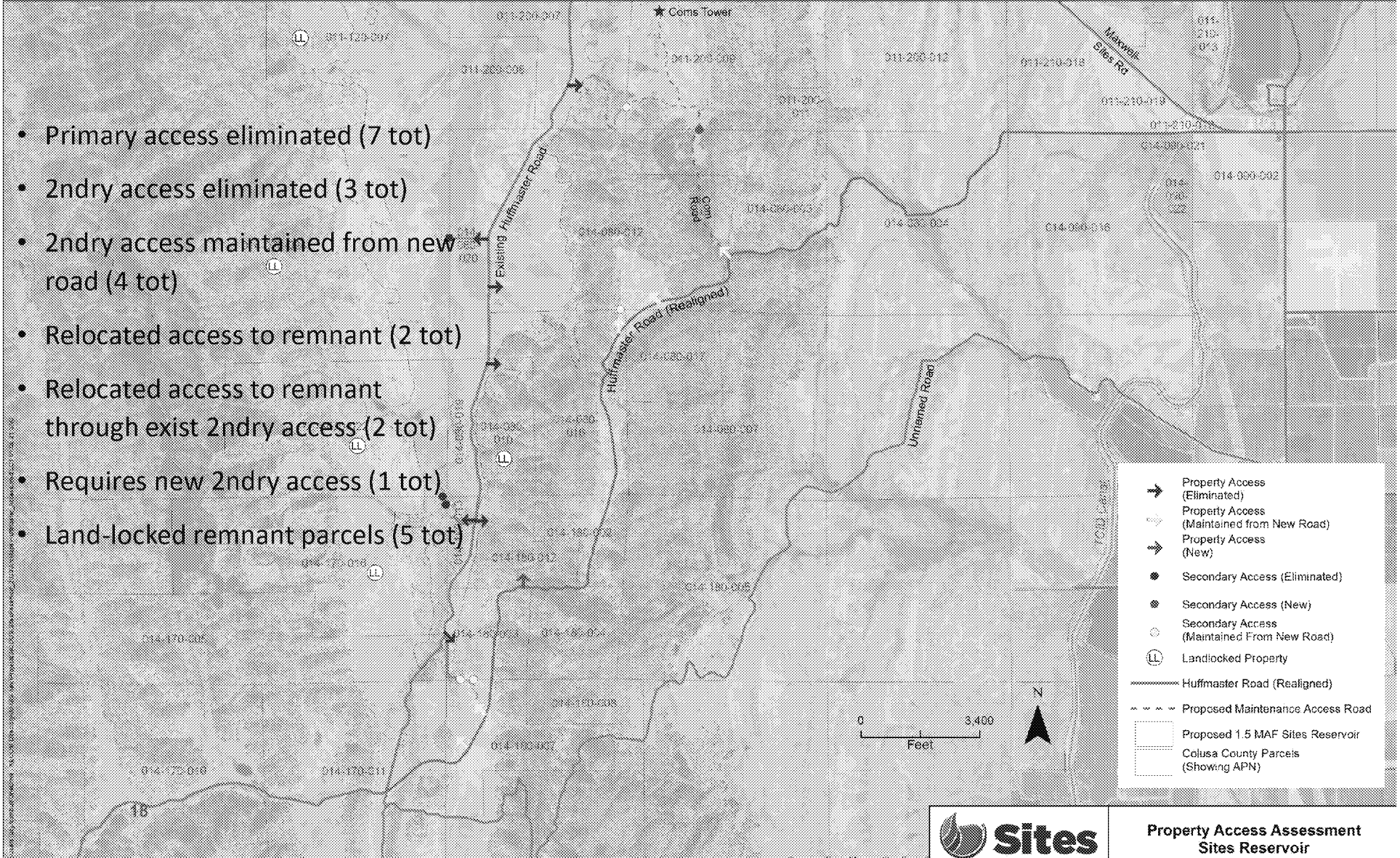


**Access for Landowners – Sites Lodoga Rd
Post Construction (Alt. 1 Only)**



**Access for Landowners – Huffmaster Rd
Access Route**

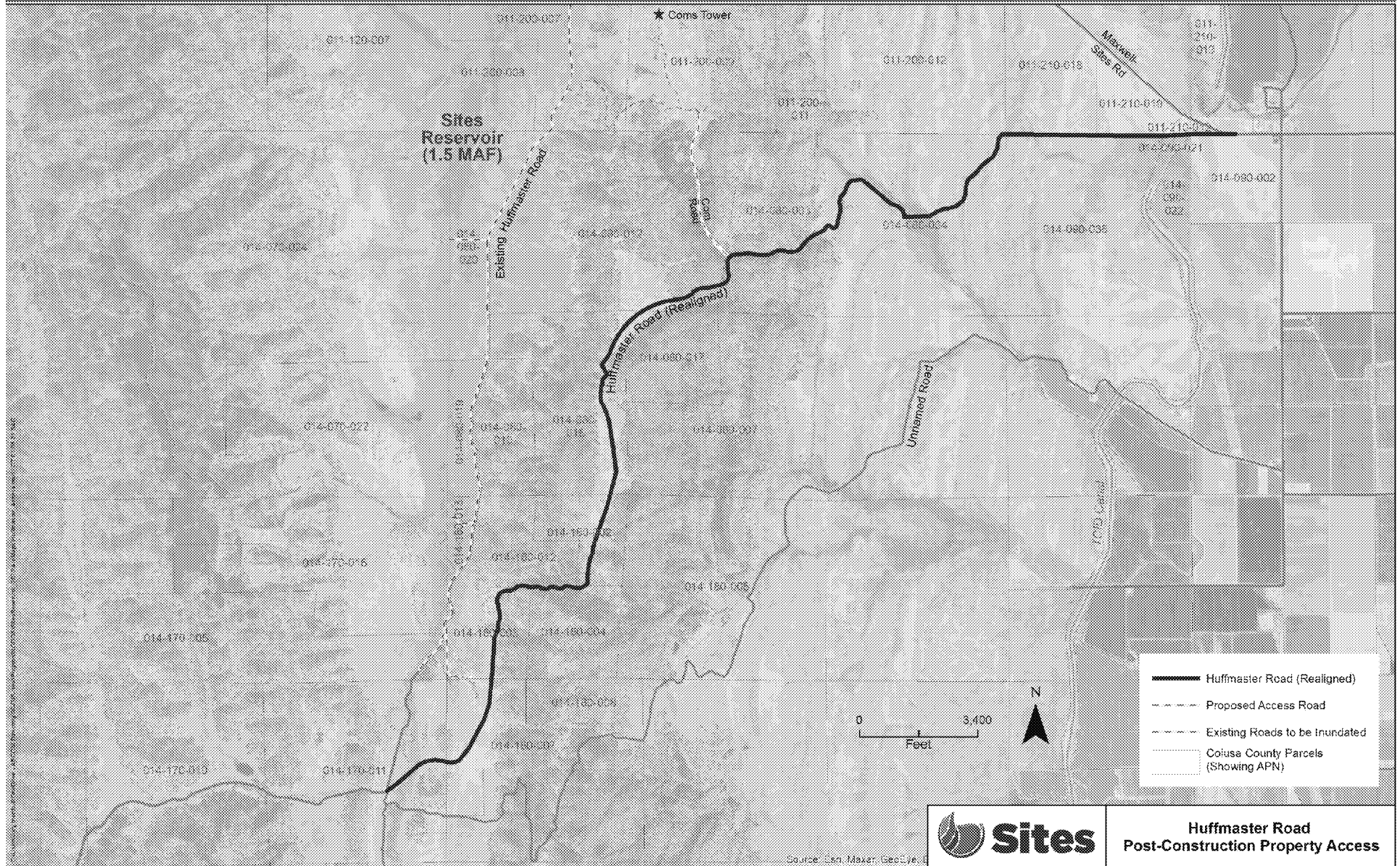
- Primary access eliminated (7 tot)
- 2ndry access eliminated (3 tot)
- 2ndry access maintained from new road (4 tot)
- Relocated access to remnant (2 tot)
- Relocated access to remnant through exist 2ndry access (2 tot)
- Requires new 2ndry access (1 tot)
- Land-locked remnant parcels (5 tot)



Access for Landowners – Huffmaster Rd Topography

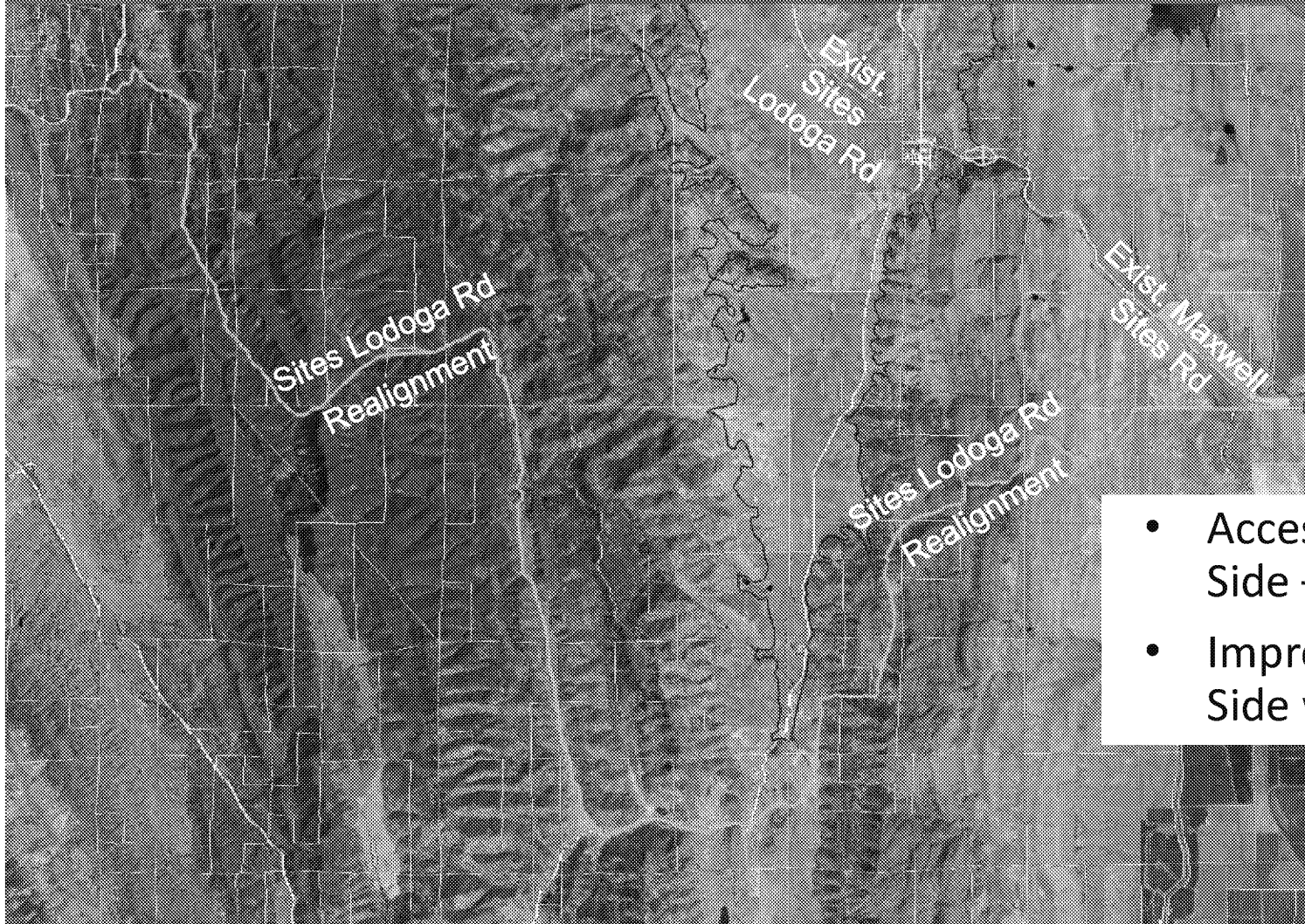


Access for Landowners – Huffmaster Rd Post Construction



**Huffmaster Road
Post-Construction Property Access**

Access for Landowners – Sites Lodoga Rd Alternative 2 Only



- Access Changes East Side – See Alt 1
- Improved Access West Side w/ New Road

QUESTIONS?



Sites

From: Kayla Granados [granados@ppic.org]
Sent: 1/5/2021 12:14:53 PM
To: Marcia Kivett [MKivett@sitesproject.org]
Subject: RE: Environmental Water Manager

Okay, sounds good!

Thanks,
Kayla

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Tuesday, January 5, 2021 11:33 AM
To: Kayla Granados <granados@ppic.org>
Subject: RE: Environmental Water Manager

Thank you. Would you like to be copied on the event as an FYI only?

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Kayla Granados <granados@ppic.org>
Sent: Tuesday, January 5, 2021 10:37 AM
To: Ellen Hanak <hanak@ppic.org>; Marcia Kivett <MKivett@sitesproject.org>
Subject: RE: Environmental Water Manager

Hi Marcia,

I just filled this out on behalf of Ellen.

Best,
Kayla

From: Ellen Hanak <hanak@ppic.org>
Sent: Monday, January 4, 2021 12:12 PM
To: Marcia Kivett <MKivett@sitesproject.org>
Cc: Kayla Granados <granados@ppic.org>
Subject: RE: Environmental Water Manager

Hi Marcia
I've shared with Kayla Granados who helps with my schedule, and she'll be able to help tomorrow when we are back in the virtual office.
Best

Ellen

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Thursday, December 31, 2020 10:18 AM
To: Ellen Hanak <hanak@ppic.org>
Subject: FW: Environmental Water Manager

Good Morning,

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Email: mkivett@sitesproject.org
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Maxwell, CA 95955

From: Jeffrey Mount <mount.jeffrey@gmail.com>
Reply-To: "mount.jeffrey@gmail.com" <mount.jeffrey@gmail.com>
Date: Wednesday, December 30, 2020 at 1:02 PM
To: jerry brown <jerry@waterologyconsulting.com>
Subject: Re: Environmental Water Manager

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Reply-To: "mount.jeffrey@gmail.com" <mount.jeffrey@gmail.com>

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To: jerry brown <jerry@waterologyconsulting.com>

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Thanks,

Jerry

Sent: 1/7/2021 3:09:00 PM
To: Janis Offermann [janis@horizonh2o.com]; Kevin Spesert [kspesert@sitesproject.org]; Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Subject: RE: AB 52 - Yocha Dehe field visit

Hi all – I don't think I will be able to attend the site visit. We have only one car right now as mine is in the shop. I feel like Laurie can address any EIR/EIS questions.

Kevin, if you feel like I should attend, let me know ASAP and I can get a rental car and get up there.

Ali

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

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From: Janis Offermann <janis@horizonh2o.com>
Sent: Thursday, January 7, 2021 10:31 AM
To: Kevin Spesert <kspesert@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: RE: AB 52 - Yocha Dehe field visit

Hi, all
I talked with Laverne and we are all set to meet him at your Maxwell office at 9am on Monday.
See you then!

Janis

Janis Offermann
Cultural Resources Practice Leader
Horizon Water and Environment
400 Capitol Mall, Suite 2500
Sacramento, CA 95814
916.465.8076 – office
530.220.4918 – mobile

From: Kevin Spesert <kspesert@sitesproject.org>
Sent: Thursday, January 07, 2021 6:30 AM
To: Janis Offermann <janis@horizonh2o.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: Re: AB 52 - Yocha Dehe field visit

Thanks Janis...I would recommend meeting at the Maxwell Office around 9am...I also have Geotech field crews in the field that day...

For the tour I am thinking the area around GCID/TRR and the Sites Valley...we are pretty limited in where we can go as most of the land is private property

From: Janis Offermann <janis@horizonh2o.com>
Sent: Thursday, January 7, 2021 6:24 AM
To: Alicia Forsythe; Kevin Spesert; Laurie Warner Herson
Subject: RE: AB 52 - Yocha Dehe field visit

Good morning, Ali

I talked with Laverne Bill last week and he still wants to move forward with the field visit next week; however, given weather and increased COVID cases at Yocha Dehe, he wanted to wait to make a final decision late this week. Contacting him was on my to-do list for today, as well as reaching out to you, Kevin, and Laurie about coordinating a place and time to meet. It looks like the weather should be fine, but Laverne said he may be told he can't go anywhere by tribal leaders, depending on what is happening at their offices with regard to COVID. (You may have seen in today's Sacramento Bee that one their tribal elders, Marshall McKay recently passed from COVID.)

I will call Laverne a little later, but we should decide when and where to meet.

Thanks
Janis

Janis Offermann
Cultural Resources Practice Leader
Horizon Water and Environment
400 Capitol Mall, Suite 2500
Sacramento, CA 95814
916.465.8076 – office
530.220.4918 – mobile

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Thursday, January 07, 2021 6:16 AM
To: Janis Offermann <janis@horizonh2o.com>; Kevin Spesert <kspesert@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: RE: AB 52 - Yocha Dehe field visit

Hi all – Have we heard anything more about this field trip?

Ali

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

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From: Janis Offermann <janis@horizonh2o.com>
Sent: Tuesday, December 29, 2020 7:22 AM

To: Kevin Spesert <kspesert@sitesproject.org>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Alicia Forsythe <aforsythe@sitesproject.org>

Subject: RE: AB 52 - Yocha Dehe field visit

OK. great. I will do that this morning.

Thanks

janis

From: Kevin Spesert <kspesert@sitesproject.org>

Sent: Tuesday, December 29, 2020 7:21 AM

To: Janis Offermann <janis@horizonh2o.com>; Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Alicia Forsythe <aforsythe@sitesproject.org>

Subject: Re: AB 52 - Yocha Dehe field visit

Yeah...please give them a call...Thanks!

From: Janis Offermann <janis@horizonh2o.com>

Sent: Tuesday, December 29, 2020 6:55 AM

To: Laurie Warner Herson; Kevin Spesert; Alicia Forsythe

Subject: RE: AB 52 - Yocha Dehe field visit

Hi Laurie,

Thanks for the reminder. I think a car caravan works well; I have done a couple of those recently for field reviews. But we should just ask Laverne what Yocha Dehe's preference is.

Kevin, would you like me to reach out to him on that topic?

Thanks

janis

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>

Sent: Monday, December 28, 2020 3:05 PM

To: Janis Offermann (Janis@Horizonh2o.com) <Janis@Horizonh2o.com>; Kevin Spesert <kspesert@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>

Subject: AB 52 - Yocha Dehe field visit

All:

Just a reminder that we have a field visit scheduled with the Yocha Dehe on January 11th. This may be problematic given COVID restrictions. We should think about how best to approach Laverne and Isaac about rescheduling or otherwise adjusting logistics of this meeting (e.g., car caravan with minimal attendance).

As you know, ICF was able to finalize the GIS files for the Alt 1 and Alt 2 footprints and Janis forwarded those the Yocha Dehe contact (Andrew) last week. If we don't conduct the field visit in January, we can meet to discuss the project footprints and potential tribal cultural resources effects.

Thanks,

Laurie

Laurie Warner Herson
Principal/Owner



Environmental Planning

916.201.3935

laurie.warner.herson@phenixenv.com

State of California Small Business (#1796182)

Supplier Clearinghouse Women Business Enterprise (#16000323)

<http://phenixenv.com/>

From: Marcia Kivett [MKivett@sitesproject.org]
Sent: 1/8/2021 6:53:34 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: FW: Sites Reservoir Project Discussion with Julie Zimmerman, TNC

OK, now that I'm reading this, I understand your text. I know the only secured meeting we have is TU. I will wait for Ashley's response and I'm still trying to get with American Rivers.

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Thursday, January 7, 2021 2:50 PM
To: Julie.zimmerman@tnc.org; Jay_Ziegler@TNC.ORG
Cc: Marcia Kivett <MKivett@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Re: Sites Reservoir Project Discussion with Julie Zimmerman, TNC

Hi Julie and Jay –

Consider this a friendly reminder to hear back from you on whether you would be interested in being an active participant on this initiative and to give you an update on other discussions. We have confirmed EDF and Cal Trout are interested. We meet with Trout Unlimited, American Rivers and Sustainable Conservation in the next few days. Also PPIC is interested in being a convenor. Happy to discuss if you'd like 925-260-7417.

Looking forward to hearing from you soon.

Jerry

From: Jerry Brown <jbrown@sitesproject.org>
Date: Tuesday, December 22, 2020 at 6:46 PM
To: "Julie.zimmerman@tnc.org" <Julie.zimmerman@tnc.org>, "Jay_Ziegler@TNC.ORG" <Jay_Ziegler@TNC.ORG>
Cc: Marcia Kivett <MKivett@sitesproject.org>, Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Re: Sites Reservoir Project Discussion with Julie Zimmerman, TNC

Hi Julie – Nice to meet you today. Following up on our conversation (and for Jay's benefit) here's a bit more description of what we are looking at exploring and wish your consideration to be an active participant. The statement in the meeting invite below does a good job of describing our ask of you at this time. To go a little further into the history of the Sites project as I understand it, consider the following and refer to the attached slide deck for current status:

- Sites applied for \$1B+ of public benefits under the P1 storage program assuming 1.8MAF reservoir and a new intake/release to the Sacto River called the Delevan Pipeline. \$5B+ project cost
- The CWC awarded \$816M, with ~\$500M in ecosystem benefits between Yolo Bypass flows and SOD Refuge supplies. This was in 2018.
- Subsequently Sites tried to get the 1.8MAF project permitted by CDFW (flow bypass criteria main sticking point) and were unsuccessful.
- The "assumed" permittable criteria drove the project to re-evaluate its configuration and led to "rightsizing" in 2020 on a 1.5MAF and no new intakes project which reduced cost to ~\$3B. This is the current direction of the project.
- The project still delivers the necessary Public benefits to receive the full P1 award.
- The Sites project is beneficiary pays and costs are divided in storage shares which means the ecosystem benefits have a seat at the table when it comes to operating decisions along side water users.
- Sites feels there are opportunities to optimize the use of the ecosystem portion but would need CDFW to reflect these conditions on the benefits agreements, which have they yet to show a willingness to do.

- The Sites situation along with the opportunities presented from the other P1 storage project presents an opportunity to bring an environmental water manager role to operating decisions of the total P1 investments which are in the \$1.5B neighborhood of new assets to the state.

If you or Jay have any further questions, concerns, or reactions to the ask please let me know. Also, one final note, the next meeting of the P1 storage projects roundtable is Jan14. I've asked for this topic to be on the agenda and it would nice if you all would be interested in possibly participating so I could let the other projects know that we have active NGO involvement, should we decide to go forward.

Thanks in advance for your consideration. Happy holidays.

Jerry

From: MKivett@sitesproject.org

When: 4:00 PM - 4:30 PM December 22, 2020

Subject: Sites Reservoir Project Discussion with Julie Zimmerman, TNC

Location: Microsoft Teams Meeting

Thank you, Julie.

The purpose will be to explore your interest in collaborating in developing a concept proposal with the Prop 1 storage projects (or a subset thereof) and other NGOs which would offer to CDFW how an environmental water manager approach to the implementation and benefits agreements of the ~\$2B of storage assets would results in a "whole that is greater than the sum of the parts."

Microsoft Teams meeting

Join on your computer or mobile app

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Phone Conference ID: 288 150 844#

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A Brown and Caldwell Teams meeting has been created for this event.

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From: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Sent: 1/11/2021 3:11:06 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Spranza, John [john.spranza@hdrinc.com]; Heydinger, Erin [erin.heydinger@hdrinc.com]
Subject: NGO survey results
Attachments: NGO Survey.pdf

FYI - I downloaded the attached from Smartsheet. I don't think there is much new info but The Bay Institute does mention reasonable range of alternatives and looking at a non-dam alternative. Ryan also asked me recently if we had looked at a non-structural alternative.

Laurie Warner Herson
Principal/Owner



Environmental Planning

916.201.3935
laurie.warner.herson@phenixenv.com
State of California Small Business (#1796182)
Supplier Clearinghouse Women Business Enterprise (#16000323)

<http://phenixenv.com/>

	Organization	Name	Interested Topic				Meeting Type	Form of Outreach	Meeting location	Primary Concern	Comment
1	Save California Salmon	Tom Stokely	Consideration of the Trinity River effects	Diversion rates, bypass flows, and minimum flows	Fisheries effects	Modeling approach, including baseline		Monthly updates emailed to your organization		Trinity River, water quality, Sacramento River minimum bypass flows, water rights	
2	Golden Gate Salmon Assoc.	John McManus	Diversion rates, bypass flows, and minimum flows baseline	Fisheries effects	Modeling approach, including baseline		Small group meetings with multiple organizations	General update meetings, similar to the first workshop	Sacramento	10 Sea Breeze Court	don't know if this is covered in any of the workshops mentioned above in the drop down menu but there were comments about toxic soils and contamination which I'd be interested to hear follow up on.
3	Humboldt County	Hank Seemann	Consideration of the Trinity River	Water rights			Small group meetings with multiple organizations			Assurance of no additional diversions from the Trinity River.	
4	Aqualliance	James Brobeck	Water quality					Monthly updates emailed to your organization		Source water quality, impounded water quality, regional soil impacts resulting from anti degradation policy restrictions on putting impounded water in the river,	A meeting should be held in Chico California, the largest city in the region. A clear accounting of taxpayer funds that have been invested and promised during the planning process.
5	NRDC	Doug Obegi	Diversion rates, bypass flows, and minimum flows	Fisheries effects	Water quality		Small group meetings with multiple organizations			Protective operational criteria for water diversions from the Sacramento River	
6	Defenders of Wildlife	Rachel Zwillinger	Diversion rates, bypass flows, and minimum flows species effects	Water quality	Fisheries effects	Project benefits	Terrestrial	Monthly updates emailed to your organization	Sacramento	Minimizing wildlife impacts and maximizing WSIP ecosystem benefits	
7	The Bay Institute	Greg Reis	Diversion rates, bypass flows, and minimum flows baseline	Project benefits	Water quality	Water rights	Modeling approach, including baseline	General update meetings, similar to the first workshop Monthly newsletters posted to Authority's website Monthly updates emailed to your organization	Sacramento	Minimization of impacts on Sacramento River and Delta: adequate bypass flows and a detailed plan for water deliveries (routes, timing, volumes)	Thanks for the outreach and we are looking forward to a new EIR--this time with adequate & truthful analysis, mitigation, project description, and a genuine consideration of a reasonable range of alternatives that can meet the purpose and need for similar/less cost (e.g. seriously including non-dam alternatives that meet water needs)
8	Grassland Water District	Ellen Wehr	Project benefits	Water rights					Sacramento	200 West Willmott Avenue	

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 1/11/2021 3:30:21 PM
To: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]; Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]
Subject: RE: NGO survey results

Is there a non-dam alternative to creating 1/5 MAF of storage north of delta? I'm thinking no.

John Spranza

D 916.679.8858 M 818.640.2487

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Monday, January 11, 2021 3:11 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Spranza, John <John.Spranza@hdrinc.com>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Subject: NGO survey results

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

FYI - I downloaded the attached from Smartsheet. I don't think there is much new info but The Bay Institute does mention reasonable range of alternatives and looking at a non-dam alternative. Ryan also asked me recently if we had looked at a non-structural alternative.

Laurie Warner Herson
Principal/Owner



Environmental Planning

916.201.3935
laurie.warner.herson@phenixenv.com
State of California Small Business (#1796182)
Supplier Clearinghouse Women Business Enterprise (#16000323)

<http://phenixenv.com/>

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 1/11/2021 5:58:44 PM
To: Jerry Brown [jbrown@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Subject: RE: Plant Surveys
Attachments: delpuertocomplaint_2020.pdf

I finally found a PDF of the complaint and had some time to review it in detail. I have summed up some of the key components that I feel are the most relevant to Sites from my resource permitting seat. I'm sure others will find similarly interesting components in the attached complaint, but these are the ones that caught my attention. I will note that the botanical components of this complaint do not really concern me as much as they initially did as Sites and Del Puerto are taking very different approaches in that Sites: 1) is disclosing all potential effects to sensitive plant species that have a better than low chance of being present, 2) is not attempting to put forth any surveys that directly result in the project's finding of less than significant impacts on plant species and 3) reliance on future surveys for a particular biological resource is not uncommon, has been pretty standard for the last 20+ years and has continued to be used and upheld in litigation provided the rationale for the lack of surveys is discussed in detail and is not due to the, "we didn't have time to do them" excuse. We are acknowledging the DWR NODOS surveys, we are acknowledging the lack of access and inability to provide comprehensive surveys (for any species, not just plants) and we are putting forth a very well designed set of mitigation measures that identify the species, surveys, timing and put forth specific and enforceable mitigation ratios for presence/absence determinations once we have access and perform surveys during the appropriate survey window. Still, that does not mean we won't see this in any complaint filed for Sites, it just means the we have thought about this and are using industry standard techniques that CDFW and USFWS would have bought off on.

Here's my highlighted excerpts from the complaint:

Baseline as it relates to increased delta pumping

Here, the District's use of the wrong baseline had precisely that pernicious effect. As the FEIR states repeatedly, the Project's *raison d'être* is to provide the District and its partners with the ability to store excess CVP water that would otherwise be lost due to a shortage of storage capacity. For example, on page 9-129, the FEIR states, "Increasing storage allows the Project Partners to accept water when excess is available that would otherwise be lost due to a lack of means to store the water." But the FEIR expressly refuses to analyze whether the approval of the Project would impact the Delta by increasing the amount of harmful pumping that occurs there, despite numerous requests for such a discussion from the public and from state agencies. The FEIR's stated justification is that the Project will not affect the Delta or CVP or SWP operations because the CVP and SWP will continue to be operated within the parameters of existing approvals.

But as our Supreme Court noted, using "maximum permitted operational levels as a baseline," as the FEIR does, "is not a realistic description of the existing conditions without the . . . Project." Put differently, under CEQA, it is irrelevant whether or not the increased pumping that the Project will cause is within the maximum bounds of current CVP operations; what matters is whether approval of the Project will cause a change in baseline conditions. And here, the answer is indisputably yes: without the Project, some water portion of contracted water is "lost due to a lack of means to store the water," as the FEIR puts it, but if the Project is approved, this logistical barrier will be lifted. CEQA requires the District to consider the effects of this change.

Biological Resources

The FEIR's combination of poor or nonexistent surveys and undefined mitigation measures makes it impossible to even understand which species the Project is going to affect, much less to what degree. The timing of the FEIR's surveys seems almost deliberately designed to find as few protected species as possible. No wildlife surveys were conducted in the wet months, despite the Project's potential effects on amphibians. The only springtime plant surveys were conducted during a dry year. Grasslands surveys were inconclusive – and a reader of the FEIR must ferret out a report unlawfully “buried in an appendix” to find out that the reason the FEIR deems those surveys inadequate is that they, like the others, were improperly conducted in especially dry conditions. Vineyard, 40 Cal.4th at 442. Meanwhile, the formulation of mitigation plans for all of the species that were identified during these few surveys was deferred until after Project approval, as discussed below. The FEIR's combination of vague mitigation and poor surveys make it impossible for the public to discern how the most vulnerable species in our state will be affected by the Project.

Alternatives

The District's FEIR violates CEQA because it uses an artificially narrow statement of the Project's objectives. *Id.* Rather than the actual goal of increasing the reliability of the District's water supplies, the FEIR states that the objective of the Project is to construct a dam with a capacity of at least 80,000 acre-feet. It uses this narrow objective to dismiss potentially feasible alternatives. And yet it is not at all clear that an 80,000 acre-foot dam like the Project is either necessary or the optimal way to achieve reliable water supplies – for instance, the FEIR identifies only 70,000 acre-feet of unmet demand for storage; water cannot leave the reservoir during algal blooms; water is unlikely to be available during unusually long droughts; the reservoir must be dewatered every five years; evaporation and seepage total nearly 2,500 acre-feet annually; it is unknown whether the new reservoir capacity would actually be available when it is needed; and it is unknown whether and how often the three parties sharing the reservoir capacity actually require water storage simultaneously. A broader set of objectives would have allowed the District to balance the various costs and benefits of different ways of achieving a more reliable water supply, instead of simply excluding everything except the predetermined outcome of a new 80,000 acre-foot dam. The 80,000 acre-foot requirement was used as a justification for refusing to provide a detailed analysis of numerous alternatives, including groundwater recharge. This artificially narrow analysis is contrary to CEQA. *NCRA*, 243 Cal.App.4th at 668. The FEIR fails this test. It analyzes only two alternative actions to the proposed Project, both of which are similar to the Project, rather than the required reasonable range. The FEIR also provides only conclusory assertions to support the dismissal of many other potentially feasible alternatives. The FEIR's failure to consider the required “range of reasonable alternatives” that “would avoid or substantially lessen” the Project's impacts (Guidelines § 15126.6(a)) is perhaps most dramatically illustrated by the fact that the FEIR concedes that none of the alternatives it analyzed are environmentally superior to the Project.

John Spranza

D 916.679.8858 M 818.640.2487

From: Jerry Brown <jbrown@sitesproject.org>

Sent: Monday, November 23, 2020 12:04 PM

To: Alicia Forsythe <aforseythe@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Spranza, John <John.Spranza@hdrinc.com>

Subject: Plant Surveys

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

I hope you saw the newspaper article reporting on the litigation on the Del Puerto Reservoir Project. Its interesting to note the basis for the challenge is primarily impact on sensitive species.

I was advised of the name of the DWR person that was involved in the 20 yrs ago plant surveys of Sites. Her name is Amy Lyons. She is still a DWR employee in the Red Bluff office. Has someone spoken with here about what's available in the files?

It seems to me we should consider using this information as a starter when it comes to describing the current situation. I'd like to hear more about what we've done to evaluate the DWR prior work as it relates to plant surveys. Thanks

DANIEL P. GARRETT-STEINMAN (CSB #269146)
GARRETT-STEINMAN LAW OFFICES
584 Castro Street # 904
San Francisco, California 94114
Telephone: (415) 996-7823
Email: dan@dpgslaw.com

Attorney for Petitioners and Plaintiffs
SIERRA CLUB, CALIFORNIA NATIVE PLANT
SOCIETY, CENTER FOR BIOLOGICAL DIVERSITY,
and FRIENDS OF THE RIVER

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF STANISLAUS

SIERRA CLUB, CALIFORNIA NATIVE PLANT	)	No.
SOCIETY, CENTER FOR BIOLOGICAL	)	
DIVERSITY, and FRIENDS OF THE RIVER,	)	VERIFIED PETITION FOR WRIT OF
	)	MANDATE AND COMPLAINT FOR
Petitioners and Plaintiffs,	)	DECLARATORY AND INJUNCTIVE
	)	RELIEF AND ATTORNEY'S FEES
vs.	)	
	)	(CEQA CASE)
DEL PUERTO WATER DISTRICT, and DOES I	)	
through X, inclusive,	)	
	)	
Respondents and Defendants,	)	
	)	
and	)	
	)	
SAN JOAQUIN RIVER EXCHANGE	)	
CONTRACTORS WATER AUTHORITY, and	)	
DOES XI through XX, inclusive,	)	
	)	
Real Parties in Interest.	)	

Petitioners SIERRA CLUB, CALIFORNIA NATIVE PLANT SOCIETY, CENTER FOR
BIOLOGICAL DIVERSITY, and FRIENDS OF THE RIVER hereby petition this Court for a writ of
mandate and declaratory and injunctive relief against respondent DEL PUERTO WATER DISTRICT and
DOES I-X, inclusive (collectively, the "District"), and by this verified petition allege as follows:

INTRODUCTION

1. Just west of Patterson, there is a treasured place with a long and celebrated history that
stretches back centuries. This place provides important habitat to protected plants and animals and is

1 valued by nearby residents as a place to hike, birdwatch, and bicycle. This place is called Del Puerto
2 Canyon, and its entrance is known as the Gateway. The District plans to use the Gateway to dam Del
3 Puerto Canyon.

4 2. Petitioners bring this action to challenge the District’s (1) approval of the Del Puerto
5 Canyon Reservoir Project (the “Project”); and (2) certification of the Project’s Final Environmental
6 Impact Report (“FEIR”). In taking these actions, the District violated the California Environmental
7 Quality Act, Public Resources Code section 21000 *et seq.* (“CEQA”) in the respects set forth below.

8 3. The District’s FEIR concludes that the Project will substantially harm the environment.
9 For example, the FEIR acknowledges that the Project would permanently destroy a prehistoric occupation
10 site that contains information important in prehistory, concedes that the Project would eliminate habitat
11 for special-status species and permanently obstruct habitat connectivity, and admits that the proposed
12 project will contribute to global climate change because of its significant greenhouse gas emissions
13 during construction and operation.

14 4. And yet, a member of the public who wades through the FEIR’s hundreds of pages seeking
15 to understand the basis for its alarming conclusions will find only platitudes, unexplained conclusions,
16 and vague promises of future action – not a detailed analysis calculated to truly inform the reader, nor one
17 that enables meaningful public review.

18 5. In addition to the unduly murky analysis of the impacts it does disclose, the FEIR also
19 completely ignores many environmental impacts. To list just a few omissions from one topic, the FEIR
20 excludes Del Puerto Creek below the dam from the geographic scope of its analysis of every species
21 except fish; it blinds itself to the question of whether building new water storage will lead to more water
22 pumping in the Sacramento-San Joaquin River Delta (“the Delta”), even though the Delta’s ecosystem is
23 teetering on the brink of collapse; and though it acknowledges the water pollution caused by agricultural
24 return flows, the FEIR overlooks how increasing the District’s water supplies will affect the volume of
25 those flows.

26 6. More than 40 years ago, the California Supreme Court sounded a note of caution to
27 agencies intending to skirt their CEQA duties: “It is, of course, too late to argue for a grudging, miserly
28 reading of CEQA [T]he Legislature intended CEQA ‘to be interpreted in such manner as to afford

1 the fullest possible protection within the reasonable scope of the statutory language.” *Bozung v. Local*
2 *Agency Form. Com.* (1975) 13 Cal.3d 263, 283. The Court further reminded agencies not to treat CEQA
3 compliance as simply another bureaucratic obstacle to overcome on the way to a predetermined outcome,
4 observing that the “purpose of CEQA is not to generate paper, but to compel government at all levels to
5 make decisions with environmental consequences in mind.” *Id.* at 283. But based on the abundance of
6 platitudes and dearth of substance in its FEIR, it appears these warnings have yet to reach the District.

7 VENUE AND JURISDICTION

8 7. This Court has jurisdiction over this action pursuant to Code of Civil Procedure sections
9 526 (injunctive relief), 1060 (declaratory relief), 1085 (traditional mandate), and 1094.5 (administrative
10 mandate); Civil Code section 3422 (injunctive relief); and article VI, section 10, of the California
11 Constitution (original jurisdiction of superior courts).

12 8. Venue is proper in this Court pursuant to Code of Civil Procedure sections 393-395, 1085,
13 and 1094.5, in that the District’s offices are located in Stanislaus County, the Project site is located in
14 Stanislaus County, and the Project’s environmental impacts will be felt in Stanislaus County.

15 9. This petition is timely filed within all applicable statutes of limitations, including Public
16 Resources Code sections 21152 and 21167.¹

17 10. Pursuant to Code of Civil Procedure section 388, petitioners are serving the California
18 Attorney General with a copy of this Verified Petition and Complaint, and consistent with section
19 21167.5, petitioners have served respondent by mail with notice of this suit.

20 PARTIES

21 11. Petitioner SIERRA CLUB was formed on May 28th, 1892. Its mission is to explore,
22 enjoy, and protect the earth’s wild places; to practice and promote the responsible use of ecosystems and
23 resources; to educate humanity and enlist help in protecting and restoring the quality of the natural and
24 human environment; and to use all lawful means to carry out these objectives. Del Puerto Canyon is a
25 treasured local wild place enjoyed by Sierra Club members, and to dam it up for use as a storage basin for
26 water pumped from the Central Valley – thereby destroying an important ecosystem, while also depriving
27

28 ¹ Undesignated references are to the Public Resources Code.

1 the Delta of much-needed water – runs counter to all the Sierra Club stands for. By doing so, the Project
2 will harm the interests of Sierra Club and its members.

3 12. Petitioner CALIFORNIA NATIVE PLANT SOCIETY (“CNPS”) is a statewide,
4 non-profit organization with more than 10,000 members distributed across 35 local chapters. The mission
5 of CNPS is to conserve California native plants and their natural habitats, and to increase the
6 understanding, appreciation, and horticultural use of native plants. CNPS works closely with
7 decision-makers, scientists, and local planners to advocate for well-informed policies, regulations, and
8 land management practices. CNPS’ members use Del Puerto Canyon for recreational purposes. The
9 interests of CNPS and its members will be harmed by the Project’s environmental impacts.

10 13. Petitioner CENTER FOR BIOLOGICAL DIVERSITY (the “Center”) is a non-profit
11 conservation organization dedicated to the protection of native species and their habitats through science,
12 policy, and environmental law. The Center has approximately 74,000 members worldwide, including
13 members who reside within communities in the vicinity of the Project. The Center has worked for many
14 years to protect imperiled plants and wildlife, open space, air and water quality, and the overall quality of
15 life for people in the region where the Project is proposed. Members of the Center will be directly and
16 adversely affected by the approval and construction of the Project.

17 14. Petitioner FRIENDS OF THE RIVER was founded in 1973 during the struggle to save the
18 Stanislaus River from New Melones Dam, and has grown to become California's statewide river
19 conservation organization. Friends of the River is dedicated to preserving and restoring California’s
20 rivers, streams, and their watersheds, as well as advocating for sustainable water management. Friends of
21 the River is nationally recognized as an authority on the adverse impacts of dams on rivers and
22 ecosystems, and has led successful campaigns for the permanent protection of many outstanding
23 California rivers and streams – including the Kings, Kern, Merced, Tuolumne, upper Klamath, West
24 Walker, East Carson, Sisquoc, and Big Sur Rivers, as well as Sespe Creek and Cache Creek. Friends of
25 the River has 3,500 members, 10 staff, and a 12-member Board of Directors. The interests of Friends of
26 the River and its members will be adversely affected by the inundation of Del Puerto Canyon and the
27 Project’s water withdrawals.

28 15. Petitioners have authorized their attorney to file this lawsuit on their behalves to vindicate

1 their substantial beneficial interests and those of their members in securing the District's compliance with
2 the laws whose violation is alleged herein.

3 16. The DEL PUERTO WATER DISTRICT ("District") is a special district located within
4 Stanislaus, San Joaquin, and Merced Counties that provides water to farmland near the Delta-Mendota
5 Canal. The District is charged by law with serving as the lead agency for the Project under CEQA, and
6 assuring compliance with CEQA and the other laws whose violation is alleged herein. On October 21,
7 2020, the District approved the Project and certified its EIR. The District has a duty to administer and
8 assure compliance with the requirements of CEQA and Code of Civil Procedure sections 1085 and
9 1094.5 before approving the Project. In purporting to approve the Project, the District failed to comply
10 with these laws.

11 17. The true names and capacities of respondents DOES I-X, inclusive, are unknown to
12 petitioners, who therefore sue said respondents by such fictitious names pursuant to Code of Civil
13 Procedure section 474. Petitioners will amend this Verified Petition when the true names and capacities
14 of said DOE respondents have been ascertained, with leave of court if necessary.

15 18. Real Party in Interest SAN JOAQUIN RIVER EXCHANGE CONTRACTORS WATER
16 AUTHORITY (the "Authority") is comprised of four local water agencies: Central California Irrigation
17 District, San Luis Canal Company, Firebaugh Canal Water District, and the Columbia Canal Company.
18 The Authority is listed as a recipient of the District's approval in the Notice of Determination filed by the
19 District for the Project, and is therefore named as a real party in interest pursuant to section 21167.6.5(a).

20 19. Petitioners are unaware of the true names and capacities of real parties in interest DOES
21 XI-XX, inclusive, and sue such real parties herein by fictitious names pursuant to Code of Civil
22 Procedure section 474. Petitioners are informed and believe, and based on such information and belief
23 allege, that the fictitiously named real parties are entities or individuals who have a direct and substantial
24 economic interest in, or are the recipients of, respondents' approval of the Project. When the true
25 identities and capacities of these DOE real parties have been determined, petitioners will amend this
26 Verified Petition to insert such identities and capacities, with leave of court if necessary.

27 **GENERAL ALLEGATIONS**

28 20. Petitioners have no plain, speedy, and adequate remedy in the ordinary course of law,

1 within the meaning of Code of Civil Procedure section 1086. The environmental interests of petitioners
2 and the public will be substantially and irreparably harmed unless this Court issues a writ of mandate that
3 orders the District to comply with the laws whose violation is alleged herein, and sets aside both the
4 District's approval of the Project and certification of its EIR. No monetary damages or other legal
5 remedy could adequately compensate for the harms to petitioners and the environment that would arise if
6 respondent's unlawful conduct were allowed to stand.

7 21. Petitioners are also entitled to injunctive relief or an administrative stay under Code of
8 Civil Procedure section 526 and 1094.5(g), and Civil Code section 3422, because the Project threatens
9 irreparable environmental harm. Unless enjoined, respondent and real party in interest will implement
10 the Project despite its lack of compliance with applicable environmental laws, causing environmental
11 harm. Petitioners will thereby suffer irreparable harm due to respondent's failure to take the required
12 steps to adequately protect the environment. Injunctive relief and an administrative stay are thus
13 warranted under section 21168.9, Code of Civil Procedure sections 525 *et seq.* and 1094.5(g), and Civil
14 Code section 3422, to prevent irreparable harm to the environment.

15 22. An actual controversy exists between petitioners and respondent under Code of Civil
16 Procedure section 1060. Petitioners contend that the District has acted in violation of law as alleged
17 herein, and must therefore vacate and set aside its approval of the Project and certification of the Project's
18 EIR. A judicial resolution of this controversy is therefore necessary and appropriate.

19 23. Petitioners have performed any and all conditions precedent to the filing of this Verified
20 Petition and have exhausted all adequate and available administrative remedies to the extent required.

21 24. Pursuant to section 21177(b), each petitioner objected to approval of the Project orally or
22 in writing prior to the close of the public hearing on the Project before the issuance of the Notice of
23 Determination.

24 25. Pursuant to Public Resources Code section 21167.6(b)(2), and as stated in petitioners'
25 Notice of Preparation of CEQA Record of Proceedings, filed concurrently herewith, petitioners elect to
26 prepare the administrative record in this action.

27 **STATEMENT OF FACTS**

28 26. On June 26, 2019, the District issued a Notice of Preparation of an Environmental Impact

1 Report and Scoping Meeting (“NOP”) for the Project. In that notice, the District solicited comments and
2 concerns from organizations and other interested parties about the Project’s environmental issues.

3 27. One of the many organizations responding to the NOP was the State Water Resources
4 Control Board (“SWRCB”), which sent a responsive letter to the District by mail on July 26, 2019. In
5 this letter, the SWRCB requested that the EIR provide specific information about the effects of the
6 Project on the Delta, including whether the Project would affect salinity and water quality in the Delta,
7 and whether the Project would result in more fish dying after becoming entrained in the Delta’s massive
8 pumps. The EIR does not provide information on any of these topics – perhaps because, as the FEIR later
9 conceded, the District completely failed to consider this comment during the scoping process. The EIR
10 blames this omission on California’s CEQA Clearinghouse, which supposedly did not turn over the letter
11 – but the letter was addressed to the District’s post office box, not the state CEQA Clearinghouse.²

12 28. On December 12, 2019, the District released the Draft EIR. Petitioners, other members of
13 the public, and numerous state agencies submitted comments. Two petitions with a combined total of
14 over 1,500 signatures were also submitted in opposition to the Project.

15 29. The FEIR was issued on October 9, 2020. It is three volumes and exceeds 1,500 pages.
16 The District approved the Project and certified the EIR less than two weeks later.

17 30. Notwithstanding the extreme time pressures, petitioners collectively submitted over 30
18 pages of detailed written comments about the FEIR’s inadequacies to the District prior to its approval of
19 the Project. For example, for illustrative purposes only, and among other concerns too numerous to list
20 here:

21 a. The Sierra Club and Friends of the River described the FEIR’s unlawful refusal to
22 analyze the Project’s effects on the Delta, its improperly vague and conclusory analysis of traffic impacts,
23 and its failure to mitigate the Project’s air quality and greenhouse gas emissions in an enforceable
24 manner, as required. In addition to a variety of other comments, these organizations also pointed out that

26 ² The letter’s address is consistent with the practice described in the latest State Clearinghouse Handbook,
27 which states, on page 6, “When a state agency comments on a [Notice of Preparation of an EIR], the
28 original comment letter must be sent directly to the Lead Agency and a copy sent to the SCH.” (Office of
Planning & Research, June 21, 2012; available at https://opr.ca.gov/docs/SCH_Handbook_2012.pdf)

1 the Project site is popular with recreational hikers and wildlife enthusiasts, and noted that the FEIR uses
2 an incorrect legal understanding of trespassing to ignore the Project's impacts on recreational activities.

3 b. CNPS noted that the additional plant surveys conducted after release of the Draft
4 EIR were inadequate because they were timed during a dry year. CNPS observed that the fact that these
5 surveys were conducted after release of the Draft EIR prevented the public from reviewing and
6 commenting upon their significance and adequacy. CNPS further pointed out that many of the FEIR's
7 mitigation measures for biological resources are speculative and unenforceable.

8 c. The Center noted that the absence of concrete information in the FEIR's analysis of
9 impacts to biological resources precluded meaningful review by the public and decision-makers. The
10 Center pointed out that the FEIR ignores the Project's impacts on downstream riparian habitat and what
11 the FEIR terms terrestrial biological resources. The Center also provided a detailed demonstration of the
12 deficiencies in the FEIR's discussions of specific species, including vernal pool branchiopods,
13 special-status amphibians, the western pond turtle, and numerous birds.

14 31. Petitioners' FEIR comments also requested that the District postpone its approval of the
15 Project to the District's next regularly scheduled meeting, based upon the quantity of additional
16 information in the FEIR and the ongoing global pandemic, among other reasons. A postponement would
17 have enabled the District to more fully consider public comment on the FEIR.

18 32. The District declined to postpone certification of the EIR and chose not to respond to any
19 of petitioners' FEIR comments. Yet as observed by the court in *Bakersfield Citizens for Local Control v.*
20 *City of Bakersfield* (2004) 124 Cal.App.4th 1128, "If the decision making body elects to certify the EIR
21 without considering comments made at th[e FEIR certification] hearing, it does so at its own risk. If a
22 CEQA action is subsequently brought, the EIR may be found to be deficient on grounds that were raised
23 at any point prior to close of the hearing."

24 33. The District approved the Project on October 21, 2020.

25 34. At the approval and certification hearing that day, the District's general manager, Anthea
26 Hansen, expressed gratitude to the District's consultants for producing a "very succinct" EIR.

27 35. Notwithstanding this apparent rush to complete the CEQA process, the District's claimed
28 approval of the Project does not actually authorize any earth-moving activity or otherwise commit the

District to a definite course of action on the Project.

FIRST CAUSE OF ACTION

(Writ of Mandate, Declaratory and Injunctive Relief to Set Aside District's

Approval of the Project as Contrary to Requirements of CEQA)

36. The paragraphs set forth above and below this cause of action are realleged and incorporated herein by reference.

37. Petitioners bring this First Cause of Action pursuant to sections 21168 and 21168.5, on the grounds that the District committed a prejudicial abuse of discretion by failing to proceed in accordance with the law, and in making findings that are not supported by substantial evidence. The District considered and approved the Project without adequately describing, analyzing and mitigating its potential environmental impacts.

38. The District is a "public agency" and its actions in approving and carrying out the Project are subject to the requirements of CEQA. § 21063.

39. The Project is a "project" subject to CEQA. § 21065(c). "'Project' means the whole of an action, which has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment," and refers to the "activity which is being approved and which may be subject to several discretionary approvals by government agencies" rather than to the separate governmental approvals themselves. CEQA Guidelines [14 C.C.R.; "Guidelines"] § 15378(a), (c).

40. CEQA requires public agencies to conduct environmental review before approving any project that may have a significant impact on the environment. §§ 21002.1, 21061, 21100, 21151; Guidelines § 15004(a). The purpose of an EIR is to provide agencies and the public with information about a proposed project's potential environmental effects, ways to minimize those effects, and potential alternatives to the project. § 21061.

41. The EIR is "the heart of CEQA" and "an environmental alarm bell whose purpose it is to alert the public and its responsible officials to environmental changes before they have reached ecological points of no return." *Laurel Heights Imp. Ass'n v. Regents of Univ. of Calif.* (1988) 47 Cal.3d 376, 392 ("*Laurel Heights*") (internal quotation marks and citations omitted). It serves as "the primary means of

1 achieving the Legislature’s considered declaration that it is the policy of this state to ‘take all action
2 necessary to protect, rehabilitate, and enhance the environmental quality of the state.’” *Id.* (quoting §
3 21001(a)). As such, an EIR must “include a detailed statement” describing, *inter alia*, all of the proposed
4 project’s significant effects on the environment, alternatives to the project, and potential mitigation
5 measures. § 21100(b).

6 42. Agencies must file a “Notice of Determination” within 5 days after approving a project
7 and certifying an EIR. Guidelines § 15094. It is contrary to CEQA for an agency to file a notice of
8 determination before it commits to a definite course of action on a project. *County of Amador v. El*
9 *Dorado County Water Agency* (1999) 76 Cal.App.4th 931, 963.

10 43. In approving the Project and certifying its EIR, the District failed to proceed in the manner
11 required by CEQA, or its approval is not supported by substantial evidence, in the following respects,
12 among others.

13 **The Project Description Violates CEQA**

14 44. An EIR must include a “description of the project” that includes a map of the project’s
15 location, its “technical, economic, and environmental characteristics,” and a statement of the project’s
16 objectives. Guidelines § 15124.

17 45. “An accurate, stable, and finite project description is the *sine qua non* of an informative
18 and legally sufficient EIR.” *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 193. “Only
19 through an accurate view of the project may affected outsiders and public decisionmakers balance the
20 proposal’s benefit against its environmental costs, consider mitigation measures, assess the advantage of
21 terminating the proposal (i.e., the ‘no project’ alternative) and weigh other alternatives in the balance.”
22 *Id.* at 192-193; *City of Santee v. County of San Diego* (1989) 214 Cal.App.3d 1438, 1454. By contrast, a
23 “curtailed, enigmatic or unstable project description draws a red herring across the path of public input.”
24 *County of Inyo*, 71 Cal.App.3d. at 192-193.

25 46. The FEIR’s description of the Project is precisely the type of “curtailed, enigmatic or
26 unstable” description condemned in *County of Inyo*, 71 Cal.App.3d at 199. For example, and for
27 illustrative purposes only, the FEIR’s description of how the new reservoir will interact with CVP
28 operations is somehow both conclusory and impenetrable, and its descriptions of existing storage options

1 are contradictory. The FEIR implausibly asserts in the project description section that the Project would
2 not increase available water supplies, and yet, in other sections, the FEIR simultaneously acknowledges
3 the obvious fact that the proposed dam is indeed intended to provide farmers with additional water.
4 Because it is contradictory, conclusory, and cryptic in these respects, among others, the FEIR's project
5 description violates CEQA.

6 47. The EIR's description of the Project is further inadequate because, as discussed more fully
7 in the portion of this cause of action relating to alternatives, the EIR fails to accurately describe the
8 Project's objectives.

9 48. The EIR also fails to include the required detailed and comprehensive map, contrary to
10 Guidelines section 15124(a). Anyone wishing to get an overview of the Project's location and vicinity is
11 required to laboriously cross-reference multiple overlapping maps simply to get a comprehensive
12 overview of Project's location and vicinity. Such obfuscation violates CEQA. *San Joaquin Raptor*
13 *Rescue Center v. County of Merced* (2007) 149 Cal.App.4th 645, 659 ("decision makers and [the] general
14 public should not be forced to sift through obscure minutiae or appendices in order to ferret out"
15 fundamental aspects of the project's description).

16 49. Under CEQA, the "project" is defined as "the whole of an action" potentially causing
17 direct or indirect "physical change in the environment." Guidelines § 15378(a). This expansive
18 definition of "project" mandates comprehensive environmental review at the earliest possible time, in
19 service of CEQA's mandate "that environmental considerations do not become submerged by chopping a
20 large project into many little ones – each with a minimal potential impact on the environment – which
21 cumulatively may have disastrous consequences." *Bozung*, 13 Cal.3d at 284; *see Plan for Arcadia, Inc. v.*
22 *City Council of Arcadia* (1974) 42 Cal.App.3d 712, 726 (CEQA's "requirements cannot be avoided by
23 chopping up proposed projects into bite-size pieces"); *Tuolumne County Citizens for Responsible Growth*
24 *v. City of Sonora* (2007) 155 Cal.App.4th 1214, 1230 ("if the two matters are analyzed in sequence . . .
25 and the combined or interactive environmental effects are not fully recognized until the review of the
26 second matter, the opportunity to implement effective mitigation measures as part of the first matter may
27 be lost").

28 50. CEQA specifically mandates that an EIR "include an analysis of the environmental effects

1 of future expansion or other action if: (1) it is a reasonably foreseeable consequence of the initial project;
2 and (2) the future expansion or action will be significant in that it will likely change the scope or nature of
3 the initial project or its environmental effects.” *Laurel Heights*, 47 Cal.3d at 396.

4 51. In this case, the “project” includes the construction and operation of the Del Puerto
5 Canyon Reservoir, the corresponding increase in the District’s available water supplies, realignment of
6 Del Puerto Canyon Road, and utility relocation.

7 52. But contrary to CEQA’s requirements, the District failed to analyze the whole of the
8 Project in its FEIR. The FEIR segments the Project both temporally and geographically, and thereby fails
9 to fully disclose the Project’s environmental impacts, in the following illustrative respects, among others:

10 a. The new planned road alignment analyzed in the Draft EIR was rejected by
11 Stanislaus County. The particular alignment of the roadway will affect the Project’s environmental
12 impacts; for instance, the FEIR concedes that the slope of the new roadway will affect impacts on special-
13 status species. (The reason is that some nearby special-status species are unable to traverse steep slopes;
14 the chance of such animals becoming roadkill is inversely proportional to the roadway’s steepness.) The
15 design of the roadway will also affect fuel use, among other impacts. But rather than recirculate the FEIR
16 with an acceptable alternative alignment to allow for meaningful public review, as CEQA requires, the
17 FEIR instead promises that the District will choose a roadway alignment and complete associated
18 environmental review at some unspecified future time.

19 b. Instead of analyzing the issue itself, the FEIR vaguely promises some unspecified
20 type of future federal environmental review will consider the environmental impacts of any modifications
21 to Delta pumping that the Project’s new reservoir may enable.

22 c. The FEIR improperly circumscribes the geographic scope of its analysis by
23 omitting discussion of how the Project will affect downstream terrestrial biological resources and
24 amphibians, and by failing to disclose or discuss the ways in which the Project’s intended increase in
25 available water supplies will affect pumping in the Delta.

26 53. CEQA requires the impacts of these aspects of the Project to be disclosed in the FEIR
27 before certification, not postponed until afterwards when bureaucratic momentum renders the later
28 approvals a foregone conclusion. *Bozung*, 13 Cal.3d at 284; *Laurel Heights* 47 Cal.3d at 396. The

1 FEIR's failure to disclose the environmental impacts of the entire Project is a failure to comply with
2 CEQA.

3 54. CEQA requires agencies to disclose, analyze, and, if possible, mitigate, inconsistencies
4 between a proposed project and any applicable general, regional, or specific plans. Guidelines §
5 15125(d); *Endangered Habitats League, Inc. v. County of Orange* (2005) 131 Cal.App.4th 777, 782-85
6 (EIR inadequate because it used the wrong traffic model and thereby was inconsistent with general plan,
7 but EIR failed to disclose inconsistency); *see also FUTURE v. Board of Supervisors* (1998) 62
8 Cal.App.4th 1332, 1341-42 (overturning project approval based on inconsistency with one policy in the
9 land use element of the general plan). It is irrelevant whether the plan in question is in draft form. *Id.* at
10 1336-1338.

11 55. Here, the FEIR fails to fully disclose all such inconsistencies, contrary to CEQA.
12 Guidelines § 15125(d). For example, and for illustrative purposes only, the FEIR's failures include, but
13 are not limited to:

14 a. In its Draft 2012 General Plan Update of the Parks and Recreation Element, the
15 City of Patterson required the Project site "to be preserved" and identified it as "a special sensitive
16 species habitat" where additional hiking, biking, and equestrian trails are planned. FEIR Chapter 10,
17 comment 85-7. The Project is plainly inconsistent with these designations, yet the FEIR's only response
18 is that the plan is an unadopted draft, a response contrary to law. *FUTURE*, 62 Cal.App.4th at 1336-
19 1338.

20 b. The Project is plainly inconsistent with California's plan to eliminate carbon
21 dioxide emissions. Although it acknowledges the Project's substantial greenhouse gas emissions, and
22 finds them to be a significant impact under CEQA, the FEIR fails to clearly disclose the Project's
23 inconsistency with the state's adopted climate change plan, and in fact affirmatively, and inexplicably,
24 asserts that the Project would be consistent with that plan;

25 c. The Project would inundate, and thereby permanently destroy, at least 75 acres of
26 designated "prime farmland and unique farmland." The Agriculture Element of the Stanislaus County
27 General Plan prohibits the conversion of particularly productive agricultural land, and the Project is
28 inconsistent with these requirements. But rather than disclose this blatant inconsistency, as required, the

1 FEIR simply asserts that “it can reasonably be argued that the proposed project would be consistent with
2 the general agriculture zone despite the conversion of agricultural land within portions of the project
3 area”; and

4 d. The FEIR fails to disclose the Project’s inconsistency with the Stanislaus County
5 General Plan provisions that require the protection of riparian habitat.

6 56. “To decide whether a given project’s environmental effects are likely to be significant, the
7 agency must use some measure of the environment’s state absent the project, a measure sometimes
8 referred to as the ‘baseline’ for environmental analysis.” *Citizens for a Better Environment v. South*
9 *Coast Air Quality Management District* (2010) 48 Cal.4th 310, 315. Using the wrong baseline, such as
10 an “approach using hypothetical allowable conditions as the baseline[,] results in illusory comparisons
11 that can only mislead the public as to the reality of the impacts and subvert full consideration of the actual
12 environmental impacts, a result at direct odds with CEQA’s intent.” *Id.* at 322 (quotation omitted).

13 57. Here, the District’s use of the wrong baseline had precisely that pernicious effect. As the
14 FEIR states repeatedly, the Project’s *raison d’être* is to provide the District and its partners with the
15 ability to store excess CVP water that would otherwise be lost due to a shortage of storage capacity. For
16 example, on page 9-129, the FEIR states, “Increasing storage allows the Project Partners to accept water
17 when excess is available that would otherwise be lost due to a lack of means to store the water.” But the
18 FEIR expressly refuses to analyze whether the approval of the Project would impact the Delta by
19 increasing the amount of harmful pumping that occurs there, despite numerous requests for such a
20 discussion from the public and from state agencies. The FEIR’s stated justification is that the Project will
21 not affect the Delta or CVP or SWP operations because the CVP and SWP will continue to be operated
22 within the parameters of existing approvals.

23 58. But as our Supreme Court noted, using “maximum permitted operational levels as a
24 baseline,” as the FEIR does, “is not a realistic description of the existing conditions without the . . .
25 Project.” Put differently, under CEQA, it is irrelevant whether or not the increased pumping that the
26 Project will cause is within the maximum bounds of current CVP operations; what matters is whether
27 approval of the Project will cause a change in baseline conditions. And here, the answer is indisputably
28 yes: without the Project, some water portion of contracted water is “lost due to a lack of means to store

the water,” as the FEIR puts it, but if the Project is approved, this logistical barrier will be lifted. CEQA requires the District to consider the effects of this change.

The EIR’s Impact Analysis Is Legally Inadequate

59. The District’s review of the Project’s environmental impacts failed to proceed in the manner required by CEQA in the following respects, among others.

60. “An EIR must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project.” *Laurel Heights*, 47 Cal.3d at 405; *Sierra Club v. County of Fresno* (“*Sierra Club*”) (2018) 6 Cal.5th 502, 516.

61. CEQA requires agencies to quantify environmental impacts where it is possible to do so. Guidelines § 15144 (“an agency must use its best efforts to find out and disclose all that it reasonably can”); *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 735-36. “The fact that precision may not be possible . . . does not mean that no analysis is required.” *Laurel Heights*, 47 Cal.3d at 399.

62. Under CEQA, the EIR “must . . . disclos[e] the analytic route the agency traveled from evidence to action.” *Id.* at 404. Put differently, an “EIR must contain facts and analysis, not just the bare conclusions of a public agency. An agency’s opinion concerning matters within its expertise is of obvious value, but the public and decision-makers, for whom the EIR is prepared, should also have before them the basis for that opinion so as to enable them to make an independent, reasoned judgment.” *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal. App. 3d 818, 831.

63. Contrary to these commands, the EIR’s discussion of the Project’s environmental impacts is so incomplete as to preclude meaningful public review, which renders the EIR legally inadequate. *Sierra Club*, 6 Cal.5th at 514 (“whether a description of an environmental impact is insufficient because it lacks analysis or omits the magnitude of the impact is not a substantial evidence question”). For example, and for illustrative purposes only, the deficient discussions in the EIR relate to the following consequences of the Project, among others:

- a. Impacts to biological resources;
- b. Water quality impacts, impacts to the Delta, and other environmental impacts

related to hydrology;

- c. Impacts to recreation;
- d. Air quality and greenhouse gas emissions impacts;
- e. Interactions with the geology and soils surrounding the Project site;
- f. The hazard of dam failure and its public safety implications;
- g. Impacts to cultural resources;
- h. Aesthetic impacts;
- i. Impacts to energy use;
- j. Impacts to agricultural resources;
- k. Environmental justice impacts;
- l. Impacts related to traffic and transportation, including – but not limited to – new or worse safety hazards, and the cognizable environmental effects of additional traffic delays (such as increased fuel use and emergency access conflicts);
- m. The Project’s failure to comply with local land use plans, policies, or regulations;
- n. Impacts related to utility construction;
- o. Growth-inducing impacts; and
- p. The cumulative impact of these and other environmental impacts.

64. To further illustrate a single one of these examples, again without limitation, the deficiencies in the EIR’s analysis of just one of these topics, biological resources, include (but are not limited to):

- a. The FEIR *completely* omits an analysis of the Project’s impacts on “terrestrial” biological resources downstream of the Project, which will be affected by reduced flows in Del Puerto Creek. The “study area” for this portion of the FEIR, unlike the section concerning fish, includes *only* land that will be physically disturbed by Project construction. For example, and for illustrative purposes only, Least Bell’s vireo has been documented by DFW in Del Puerto Creek, but the FEIR states in response to comment that the reason the FEIR’s chapter on biological resources does not even mention that species is because supposedly “the likelihood that Least Bell’s vireo may nest *in the study area* is . . . considered to be low.” FEIR at 9-54 (emphasis added). *But the “study area” for “terrestrial” biological*

resources does not include *Del Puerto Creek downstream of the dam*. The same analytical failure is present for *every* species. This information is essential to a complete understanding of the Project's environmental impacts, yet the EIR does not even acknowledge, much less explain, its omission.

b. The FEIR's combination of poor or nonexistent surveys and undefined mitigation measures makes it impossible to even understand which species the Project is going to affect, much less to what degree. The timing of the FEIR's surveys seems almost deliberately designed to find as few protected species as possible. *No* wildlife surveys were conducted in the wet months, despite the Project's potential effects on amphibians. The *only* springtime plant surveys were conducted during a dry year. Grasslands surveys were inconclusive – and a reader of the FEIR must ferret out a report unlawfully “buried in an appendix” to find out that the reason the FEIR deems those surveys inadequate is that they, like the others, were improperly conducted in especially dry conditions. *Vineyard*, 40 Cal.4th at 442. Meanwhile, the formulation of mitigation plans for *all* of the species that *were* identified during these few surveys was deferred until after Project approval, as discussed below. The FEIR's combination of vague mitigation and poor surveys make it impossible for the public to discern how the most vulnerable species in our state will be affected by the Project.

c. Relying exclusively on an expressly non-exhaustive regulatory checklist of environmental impacts, the FEIR improperly refuses to fully analyze impacts on species that are not of a “special” status. Public agencies requested an analysis of the Project's impacts on Tule elk and the prairie falcon, but the FEIR refuses to provide a comprehensive analysis. The FEIR's excuse appears to stem from CEQA Guidelines Appendix G, the “environmental checklist form,” but Appendix G is only a *guideline* to the topics that should be covered by an EIR. The ultimate question is not how the agency's consultants should complete the checklist, but instead how the Project will affect the environment. *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1111. The mere fact that a potential impact on the environment is not listed in the checklist is an insufficient basis to refuse to fully analyze that impact.

65. Alternatively, the EIR's analyses of the environmental impacts listed two numbered paragraphs above are not supported by substantial evidence, as required. “Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly erroneous or inaccurate, or evidence of

1 social or economic impacts which do not contribute to or are not caused by physical impacts on the
2 environment does not constitute substantial evidence.” Guidelines § 15384(a).

3 **The EIR’s Mitigation Measures Are Inadequate**

4 66. CEQA requires that agencies mitigate the potentially significant adverse impacts of
5 projects through adoption of alternatives or mitigation measures. §§ 21002, 21002.1, 21081. The
6 Guidelines further explain that “significant, avoidable damage to the environment” must be avoided
7 through the use of feasible alternatives or mitigation measures. Guidelines § 15002(a)(3). Project
8 approval should be withheld where such measures or alternatives exist and are ignored. Guidelines §
9 15021(a)(2). An agency must make specific findings about the alternatives and mitigation measures
10 considered for each significant impact identified in the EIR. Guidelines § 15091(a)(1). And it also must
11 take specific action to adopt feasible alternatives and enforceable mitigation measures that would reduce
12 a project’s significant effects to insignificance. Guidelines § 15091(d).

13 67. An EIR’s discussion of proposed mitigation measures must be sufficiently specific to
14 enable the public to evaluate and comment about whether the mitigation measures are adequate and if
15 they will themselves have any environmental impacts. Mitigation measures must not be remote and
16 speculative, and they are inadequate where they are so undefined that it is impossible to gauge their
17 effectiveness. *Federation of Hillside & Canyon Ass’ns v City of Los Angeles* (2000) 83 CA4th 1252,
18 1260; *Preserve Wild Santee v City of Santee* (2012) 210 CA4th 260, 281. The formulation of mitigation
19 measures also cannot be postponed until later: “[R]equir[ing] . . . the . . . adopt[ion of] mitigation
20 measures recommended in a future study is in direct conflict with the guidelines implementing CEQA.”
21 *Sundstrom v. County of Mendocino* (1988) 202 Cal.App.3d 296, 306.

22 68. Contrary to these requirements, the FEIR is riddled with deferred mitigation measures.
23 For example, and for illustrative purposes only, unlawfully deferred mitigation measures in the FEIR
24 include, but are not limited to:

- 25 a. Future development of numerous plans to mitigate the Project’s impacts on
26 special-status species;
- 27 b. Future development of a construction traffic management plan intended to mitigate
28 the Project’s traffic impacts;

1 c. Future development of a plan to mitigate the Project's impacts on cultural
2 resources; and

3 d. Future development of air quality mitigation measures, which range from "on-site
4 measures" to reduce NOx emissions, to an alternative plan to instead create a Voluntary Emissions
5 Reduction Agreement, to the future development of an "Air Impact Assessment" for the local air quality
6 district.

7 69. Because it precludes public comment on the adequacy and environmental impacts of these
8 yet-to-be-developed mitigation measures, among others, the FEIR violates CEQA. *Preserve Wild Santee*,
9 210 Cal.App.4th at 281; *Sundstrom*, 202 Cal.App.3d at 306; *Communities for a Better Environment v.*
10 *City of Richmond* (2010) 184 Cal.App.4th 70, 92.

11 70. Mitigation measures must be "fully enforceable through permit conditions, agreements, or
12 other measures." § 21081.6(b). But the FEIR contains numerous mitigation measures that are entirely
13 unenforceable. For example, and for illustrative purposes only, the FEIR's primary mitigation measure
14 for the Project's greenhouse gas emissions is a vague promise to use renewable energy when feasible.
15 Similarly, and also for illustrative purposes only, the FEIR traffic analysis includes a vague and
16 unenforceable mitigation measure that will allow the City of Patterson and County of Stanislaus to decide
17 whether to "choose" to implement "temporary traffic signals during dam and roadway realignment
18 construction." These standardless mitigation measures cannot be enforced, and thus violate CEQA.

19 71. The FEIR further fails to either mitigate the Project's significant environmental impacts to
20 insignificance or explain why doing so is infeasible, contrary to sections 21002 and 21002.1(b). For
21 example, and for illustrative purposes only, although the FEIR concludes that the Project's greenhouse
22 gas emissions impacts would be significant, it *completely* fails to explain why, or if, it is impossible to
23 mitigate this impact by using exclusively clean energy to power the Project. It cannot be said that the
24 Project's increase in greenhouse gas emissions is "unavoidable" when such an obvious mitigation
25 measure was never even discussed.

26 **The EIR's Alternatives Analysis Is Inadequate**

27 72. CEQA requires EIRs to consider and discuss a reasonable range of feasible alternatives
28 that would reduce or avoid the Project's significant impacts. Guidelines § 15126.6(a), (e). An EIR also

1 must identify an environmentally superior alternative, which must be adopted unless it is infeasible. §§
2 21002, 21002.1(b), 21081; Guidelines §§ 15091(a), (b), 15092(b), 15093, 15126.6(e)(2). The discussion
3 of alternatives is “the core of an EIR.” *Citizens of Goleta Valley v. Board of Supervisors* (1990) 52
4 Cal.3d 553, 564.

5 73. “A lead agency may not give a project’s purpose an artificially narrow definition.” *North*
6 *Coast Rivers Alliance v. Kawamura* (2016) 243 Cal.App.4th 647, 668. The use of an improperly narrow
7 statement of project objectives enables the lead agency to skew the alternatives analysis process by
8 improperly “dismiss[ing] out of hand” all alternatives except the preferred one. *Id.*

9 74. The District’s FEIR violates CEQA because it uses an artificially narrow statement of the
10 Project’s objectives. *Id.* Rather than the actual goal of increasing the reliability of the District’s water
11 supplies, the FEIR states that the objective of the Project is to construct a dam with a capacity of at least
12 80,000 acre-feet. It uses this narrow objective to dismiss potentially feasible alternatives. And yet it is
13 not at all clear that an 80,000 acre-foot dam like the Project is either necessary or the optimal way to
14 achieve reliable water supplies – for instance, the FEIR identifies only 70,000 acre-feet of unmet demand
15 for storage; water cannot leave the reservoir during algal blooms; water is unlikely to be available during
16 unusually long droughts; the reservoir must be dewatered every five years; evaporation and seepage total
17 nearly 2,500 acre-feet annually; it is unknown whether the new reservoir capacity would actually be
18 available when it is needed; and it is unknown whether and how often the three parties sharing the
19 reservoir capacity actually require water storage simultaneously.

20 75. A broader set of objectives would have allowed the District to balance the various costs
21 and benefits of different ways of achieving a more reliable water supply, instead of simply excluding
22 everything except the predetermined outcome of a new 80,000 acre-foot dam. The 80,000 acre-foot
23 requirement was used as a justification for refusing to provide a detailed analysis of numerous
24 alternatives, including groundwater recharge. This artificially narrow analysis is contrary to CEQA.
25 *NCRA*, 243 Cal.App.4th at 668.

26 76. CEQA further requires agencies to consider a “reasonable range” of alternatives that can
27 reduce the Project’s environmental impacts, as determined by the “rule of reason.” Guidelines §
28 15126.6(a).

1 77. The FEIR fails this test. It analyzes only two alternative actions to the proposed Project,
2 both of which are similar to the Project, rather than the required reasonable range. The FEIR also
3 provides only conclusory assertions to support the dismissal of many other potentially feasible
4 alternatives. The FEIR's failure to consider the required "range of reasonable alternatives" that "would
5 avoid or substantially lessen" the Project's impacts (Guidelines § 15126.6(a)) is perhaps most
6 dramatically illustrated by the fact that the FEIR *concedes* that *none* of the alternatives it analyzed are
7 environmentally superior to the Project.

8 78. The brief analysis of alternatives that the FEIR does include likewise fails to satisfy
9 CEQA. The FEIR provides bare conclusions rather than facts and analysis, and fails to disclose the
10 analytic route traveled to reach those bare conclusions. But conclusory platitudes do not satisfy CEQA's
11 requirement of enabling the public to meaningfully understand the Project's environmental impacts.
12 *Laurel Heights*, 47 Cal.3d at 399.

13 **The EIR Fails to Satisfy CEQA's Consultation and Coordination Requirements**

14 79. CEQA requires the District, as the lead agency preparing the EIR, to "consult with, and
15 obtain comments from" a variety of other agencies, including "each responsible agency [and] trustee
16 agency," multiple times throughout the CEQA process. §§ 21080.3, 21080.4, 21153. The duty to *obtain*
17 comments is an affirmative duty placed upon the *lead* agency.

18 80. Here, the District failed to discharge this duty by erroneously failing to identify the City of
19 Patterson and County of Stanislaus as responsible agencies for the approval of the Project's electrical
20 transmission facilities. The FEIR claims that neither entity has a role in this regard because the District
21 has intergovernmental immunity from local land use controls – but this immunity, which is provided by
22 Government Code section 53091(d), expressly states that "zoning ordinances of a county or city *shall*
23 apply to the location or construction of facilities for the storage or transmission of electrical energy by a
24 local agency, if the zoning ordinances make provision for those facilities."

25 81. The Project includes the construction and relocation of electrical transmission facilities,
26 and the City of Patterson and County of Stanislaus have made provision for electrical transmission
27 facilities in zoning ordinances over which they possess approval and enforcement authority. As such, the
28 City of Patterson and County of Stanislaus are responsible agencies with respect to the approval of

1 electrical transmission facilities, and comments from these two entities should have been obtained and
2 considered but were not. This violates CEQA. § 21153.

3 82. The FEIR's misrepresentations about the legal authority other local governments have
4 over any power lines built by the District also precluded informed public review of the Project, and
5 thereby independently violate CEQA.

6 83. Under CEQA, each lead agency is responsible for producing an environmental document
7 that is sufficient for use by responsible and trustee agencies. *Habitat & Watershed Caretakers v. City of*
8 *Santa Cruz* (2013) 213 Cal. App. 4th 1277, 1305. The EIR must provide sufficient information to enable
9 the later agency to make an informed exercise of its discretion, and the EIR is inadequate if it does not do
10 so. *Id.*

11 84. Because the FEIR does not include information sufficient to inform the exercise of the
12 discretionary authority possessed by the City of Patterson and County of Stanislaus over the Project's
13 electrical transmission facilities, the FEIR is additionally inadequate under *Habitat & Watershed*
14 *Caretakers, supra*, 213 Cal. App. 4th at 1305.

15 85. The District further violated CEQA by failing to sufficiently consult and coordinate with
16 trustee agencies. The District *ignored* the SWRCB's scoping comments, as noted above. The District
17 also failed to meaningfully respond to the comments of trustee agencies about the FEIR's inadequacies,
18 as noted below, and made no pretense of accommodating those agencies' concerns.

19 86. Because the District failed to discharge its coordination and consultation obligations, and
20 because the FEIR does not contain sufficient information for the use of other agencies, the FEIR is
21 inadequate and the District's approval of the Project is unlawful. §§ 21080.3, 21080.4, 21153; *Habitat &*
22 *Watershed Caretakers, supra*, 213 Cal. App. 4th at 1305.

23 **The EIR Fails to Meaningfully Respond to Comments**

24 87. CEQA requires agencies to provide detailed responses to comments raising significant
25 environmental issues that are made prior to the end of the comment period on the draft EIR. Guidelines §
26 15088. The responses must show a "good faith, reasoned analysis," and must be supported by factual
27 information. *Id.*

28 88. If a comment raises significant environmental issues and the agency chooses not to accept

1 its suggestions, the agency must explain why. Guidelines § 15088(c); *Flanders Foundation v. City of*
2 *Carmel-by-the-Sea* (2012) 202 Cal.App.4th 603, 615. Meaningful agency response to public comment is
3 fundamental to CEQA’s informational purpose. For this reason, a failure to adequately respond to
4 comments renders an EIR “fatally defective.” *People v. County of Kern* (1974) 39 Cal.App.3d 830, 842.

5 89. For example, and for illustrative purposes only, the Draft EIR comments of the California
6 Department of Fish and Wildlife (“DFW”) reflect DFW’s serious concern about the adequacy of the
7 Project’s mitigation measures for biological resources. DFW made numerous specific suggested
8 improvements to those measures, but the FEIR does not meaningfully respond to any of them. In one
9 such instance, DFW requested quadrupling the size of the 600-foot construction buffer zone around
10 *active* hawk nests, but the FEIR responds by rejecting the request without any substantive explanation of
11 why or how a 600-foot buffer zone is sufficient to protect nests in active use. *Compare* FEIR Chapter 10,
12 Comment 5-3 (DFW states 600-foot buffer is insufficient and recommends a ½-mile buffer) *with* FEIR at
13 9-51 (600-foot buffer is appropriate in Project biologists’ professional judgment, and also was used once
14 before nearly a decade ago, in an unspecified project in a different county).

15 90. One additional illustrative example of the FEIR’s failure to respond to comment is its
16 response to the California Department of Water Resources (“DWR”). DWR manages the State Water
17 Project (“SWP”), a large state irrigation project that pumps water from the Delta. DWR commented that
18 because Del Puerto Creek is an indirect tributary of the Delta, the Project’s “diversions from [Del Puerto]
19 Creek contemplated in the DEIR could conflict with SWP[] operations, especially when DWR is
20 releasing supplemental SWP . . . water to meet water quality flow objectives and water quality standards
21 in the Delta, or diversions are limited to meet Endangered Species Act requirements.” FEIR Chapter 10,
22 Comment 3-2. DWR specifically requested “a more detailed analysis of the Project’s potential effects on
23 hydrology and water quality standards in the Delta.” *Id.* The FEIR’s response hardly even *acknowledges*
24 DWR’s concerns about whether Project approval could result in modifications to the current pumping
25 regimen that in turn could have significant environmental impacts, and certainly does not qualify as the
26 good-faith and meaningful response to comment required by CEQA.

27 91. This lack of substantive response typifies the FEIR’s responses to many other public
28 comments. By failing to give meaningful response to public comment, the District violated CEQA.

Guidelines § 15088.

The EIR Was Not Recirculated

92. CEQA requires recirculation of a draft EIR “when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under [CEQA Guidelines] Section 15087 but before certification.” Guidelines § 15088.5(a).

93. The Final EIR references and presents numerous examples of “significant new information” that was not contained within the draft EIR. For example, and for illustrative purposes only, this new and significant information includes, but is not limited to:

- a. new information about golden eagles in the vicinity of the Project (FEIR at 3.4-17);
- b. a new disclosure that pesticides may be present in the soil on the Project site (FEIR at 3.10-12);
- c. newly quantified information about the Project’s impacts on flows in Del Puerto Creek (FEIR at 3.11-25);
- d. information about new plant surveys, including photos and wholesale revisions to the species affected by the Project (FEIR at 3.4-7 to 3.4-10);
- e. a new invasive species control protocol (FEIR at 9-74);
- f. a new analysis of the environmental impacts of site alternatives (FEIR at 9-2 to 9-10); and
- g. an extended discussion of how the purported infeasibility of groundwater recharge supposedly rendered dismissing that alternative from consideration appropriate (FEIR at 9-11 to 9-13).

94. Each of these additions prevented the public from commenting on a significant environmental issue and thereby constitutes “significant new information” requiring recirculation. Guidelines § 15088.5. For example, it was impossible for the public to comment on the Project’s effects on downstream flows in Del Puerto Creek, because the draft EIR contained no quantified information about that issue at all. Similarly, the draft EIR omitted specific information about many plants due to a dearth of surveys; the FEIR does include one series of spring plant surveys, but the belated addition prevented the public from commenting about their adequacy, results, and significance. Likewise, the public was not given an opportunity to respond to the FEIR’s new information about alternatives.

1 Recirculation was accordingly required under Guidelines section 15088.5(a)(1)-(2).

2 95. Recirculation is also required, under Guidelines section 15088.5(a)(3), where the FEIR
3 declines to adopt suggested mitigation measures. Here, this criterion is met because the FEIR refused to
4 adopt numerous specific new mitigation measures, including but not limited to those requested by DFW
5 in its comments on the Draft EIR. *See* FEIR Chapter 10, Comments 5-2 to 5-10 & responses thereto.
6 The public's inability to comment on the FEIR's failure to adopt these different and feasible mitigation
7 measures warranted recirculation under Guidelines section 15088.5(a)(3).

8 96. Finally, recirculation is additionally required where the EIR is so fundamentally
9 inadequate and conclusory in nature that meaningful public review is precluded. Guidelines §
10 15088.5(a)(4). This criterion is met here because the EIR's analysis is deficient in the respects described
11 above.

12 97. The District's failure to recirculate the FEIR violated CEQA.

13 **The District's Findings and Statements of Overriding Considerations Are Inadequate**

14 98. If a project will have "significant environmental effects," CEQA requires the agency to
15 make "one or more written findings for each of those significant effects, accompanied by a brief
16 explanation of the rationale for each finding." Guidelines § 15091(a). There are three "possible findings:

- 17 (1) Changes or alterations have been required in, or incorporated into, the project which avoid
18 or substantially lessen the significant environmental effect
19 (2) Such changes or alterations are within the responsibility and jurisdiction of another public
20 agency and . . . have been adopted . . . or can and should be adopted by such other agency.
21 (3) Specific economic, legal, social, technological, or other considerations . . . make infeasible
22 the mitigation measures or project alternatives identified in the final EIR."

22 Guidelines § 15091(a); *see also* § 21081(a). The findings "shall be supported by substantial evidence in
23 the record." Guidelines § 15091(b). Where, as here, an agency approves a project that has significant
24 environmental effects that "are not avoided or substantially lessened," the agency must "state in writing
25 the specific reasons to support its action." Guidelines §§ 15093(b), 15096(h), 15064(a)(2). This
26 "statement of overriding considerations shall be supported by substantial evidence" (Guidelines §
27 15093(b)), and is to be made in addition to the findings required under section 15091. Guidelines §
28 15091(f).

99. CEQA's requirements of recorded findings and statements of overriding considerations ensure that agencies carefully and transparently consider the proposed action's environmental effects. The "intended effect is to facilitate orderly analysis and minimize the likelihood that the agency will randomly leap from evidence to conclusions." *Topanga Assn. for a Scenic Com. v. County of Los Angeles* (1974) 11 Cal.3d 506, 516-517. Because findings lay out the agency's rationale, they also help courts police agency compliance with CEQA's procedures. *Mira Mar Mobile Com. v. City of Oceanside* (2004) 119 Cal.App.4th 477, 496 ("findings must 'bridge the analytic gap between the raw evidence and ultimate decision,' so as to allow a reviewing court 'to trace and examine the agency's mode of analysis'").

100. To make the findings CEQA requires, the EIR must properly identify and fully analyze the Project's significant environmental impacts. As discussed at length above, the District's FEIR fails to do so in numerous respects. The District's findings and statements of overriding considerations flow out of the FEIR's deficient impacts analysis and are, in turn, necessarily defective themselves.

101. Additionally, the District's findings and statements of overriding considerations are not supported by substantial evidence, as required, and are defective for that reason as well. Guidelines § 15093(b).

SECOND CAUSE OF ACTION

(Writ of Mandate, Declaratory and Injunctive Relief to Set Aside

Project Approvals as Contrary to Code of Civil Procedure §§ 1085 and 1094.5)

102. The paragraphs set forth above and below this cause of action are realleged and incorporated herein by reference.

103. Respondent proceeded in excess of its jurisdiction and abused its discretion in purporting to approve the Project and certify its EIR because such approvals violate Code of Civil Procedure sections 1085 and 1094.5 in the following respects, among others:

- a. such approvals were not granted in accordance with procedures required by law;
- b. such approvals were not based on the findings required by law; and
- c. such approvals were not based on, or were contrary to, the evidence in the record.

104. Respondent failed to proceed in the manner required by law, in that the District violated

1 CEQA as alleged above.

2 105. The District's actions in approving the Project without complying with the procedures
3 required by Code of Civil Procedure sections 1085 and 1094.5 exceeded the District's jurisdiction and
4 constitute a prejudicial abuse of discretion, and therefore are invalid and must be set aside.

5 **PRAYER FOR RELIEF**

6 WHEREFORE, petitioners pray for the following relief:

7 1. This Court's alternative and peremptory writs of mandate, declaratory judgment, and
8 permanent injunction, setting aside and enjoining the District's actions purporting to (1) certify the
9 Project's EIR and (2) approve the Project, on the grounds that all such approvals and certification violate
10 CEQA;

11 2. This Court's temporary restraining order, stay order, preliminary injunction, and
12 alternative and peremptory writs of mandate, enjoining and restraining the District, and the District's
13 officials, agents, employees, representatives, and all persons acting in concert or participating with them,
14 from taking any action to implement the Project that could result in any change or alteration to the
15 physical environment pending the District's compliance with CEQA;

16 3. For attorney's fees under Code of Civil Procedure section 1021.5, in that petitioners'
17 successful prosecution of this proceeding confers a significant benefit on the public, and an award of its
18 attorney's fees is otherwise warranted and appropriate;

19 4. For costs of suit herein; and

20 5. For such other and further equitable or legal relief as the Court deems just and proper.

21 Dated: November 20, 2020

Respectfully submitted,

22 

23 DANIEL P. GARRETT-STEINMAN
24 Attorney for petitioners and plaintiffs
25 SIERRA CLUB, CALIFORNIA NATIVE PLANT
26 SOCIETY, CENTER FOR BIOLOGICAL
27 DIVERSITY, and FRIENDS OF THE RIVER
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I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that this Verification was executed in San Francisco, California, on November 20, 2020.

DANIEL P. GARRETT-STEINMAN

SITES PROJECT

Activity ID	Activity Name	Remaining Duration	Start	Finish	2021				2022				2023				2024				2025				2026				2027				2028				2029				Q3 20
					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1				
SITES PROJECT		2334	25-Mar-20 A	13-Dec-29																																	13				
MILESTONES		2299	19-Feb-21 A	13-Dec-29																																	13				
MS-002-LF	Local Funding (Go/No-go #2)	0		19-Feb-21	◆ Local Funding (Go/No-go #2)																																				
MS-011-DE	Release Revised Draft EIR/ Supplemental Draft EIS for Public I	0		29-Jul-21	◆ Release Revised Draft EIR/ Supplemental Draft EIS for Public Review																																				
MS-003-LF	Local Funding (Go/No-go #3)	0		22-Sep-21	◆ Local Funding (Go/No-go #3)																																				
MS-020-CS	WIIN Construction Start Date (12/16/21)	0		16-Dec-21	◆ WIIN Construction Start Date (12/16/21)																																				
MS-004-P2	Ph 2 Amendment 2	0		29-Dec-21*	◆ Ph 2 Amendment 2																																				
MS-006-Ph2-	Phase 2-2a Amendment Complete	0		31-Dec-21	◆ Phase 2-2a Amendment Complete																																				
MS-250-FE	Final EIR/EIS	0		03-May-22	◆ Final EIR/EIS																																				
MS-450-RD	ROD Signed	0		03-Oct-22	◆ ROD Signed																																				
MS-010-D	Final Design Complete	0		03-Jun-24	◆ Final Design Complete																																				
MS-500-CS	Construction Starts	0		03-Sep-24	◆ Construction Starts																																				
MS-510-CC	Construction Complete	0		05-Feb-29	◆ Construction C																																				
MS-600-PB	Public Beneficial Occupancy - Sites Program	0		13-Dec-29	◆ Pu																																				
OPERATIONS MODELING		879	15-Jun-20 A	16-May-24	16-May-24, OPERATIONS MODELING																																				
Full Operations Analysis		74	15-Jun-20 A	15-Apr-21	15-Apr-21, Full Operations Analysis																																				
EIR/EIS Appendices		38	04-Jan-21	26-Feb-21	26-Feb-21, EIR/EIS Appendices																																				
BA/ITP Documentation		104	01-Mar-21	27-Jul-21	27-Jul-21, BA/ITP Documentation																																				
Operations Plan, Ver 1		225	04-Jan-21	24-Nov-21	24-Nov-21, Operations Plan, Ver 1																																				
Operational Agreements		465	13-Jan-21	22-Nov-22	22-Nov-22, Operational Agreements																																				
Bridging Analysis for CWC/WSIP Benefits		71	13-Jan-21	26-Apr-21	26-Apr-21, Bridging Analysis for CWC/WSIP Benefits																																				
Final Sites-Reclamation Operating Agreement		613	02-Nov-20 A	10-May-23	10-May-23, Final Sites-Reclamation Operating Agreement																																				
Final Sites-DWR Operating Agreement		613	02-Nov-20 A	10-May-23	10-May-23, Final Sites-DWR Operating Agreement																																				
Final TCCA Facility Use Agreement		328	30-Jul-21	22-Nov-22	22-Nov-22, Final TCCA Facility Use Agreement																																				
Final GCID Facility Use Agreement		328	30-Jul-21	22-Nov-22	22-Nov-22, Final GCID Facility Use Agreement																																				
Final CBDA Facility Use Agreement		328	30-Jul-21	22-Nov-22	22-Nov-22, Final CBDA Facility Use Agreement																																				
Operations Plan, Version 2		370	30-Jul-21	29-Dec-22	29-Dec-22, Operations Plan, Version 2																																				
Annual Operating Plan Process and Procedures		519	06-Oct-21	02-Oct-23	02-Oct-23, Annual Operating Plan Process and Procedures																																				
Develop Organizational Operating Roles and Responsibilities		519	06-Oct-21	02-Oct-23	02-Oct-23, Develop Organizational Operating Roles and Responsibilities																																				
Member Portal/Accounting System		300	30-Dec-21	15-Mar-23	15-Mar-23, Member Portal/Accounting System																																				
Operations Support		715	20-Aug-21	16-May-24	16-May-24, Operations Support																																				
EIR/EIS		1026	22-Sep-20 A	09-Dec-24	09-Dec-24, EIR/EIS																																				
Project Description Chapter		37	22-Sep-20 A	25-Feb-21	25-Feb-21, Project Description Chapter																																				
Revised Draft EIR/Supplemental Draft EIS		144	10-Dec-20 A	29-Jul-21	29-Jul-21, Revised Draft EIR/Supplemental Draft EIS																																				
Public Review		41	30-Jul-21	26-Sep-21	26-Sep-21, Public Review																																				
Begin Preparation of the Admin Final EIR/EIS		29	07-Sep-21	19-Oct-21	19-Oct-21, Begin Preparation of the Admin Final EIR/EIS																																				
Environmental Feasibility Report For CWC		52	20-Sep-21	07-Dec-21	07-Dec-21, Environmental Feasibility Report For CWC																																				
Final EIR/Final EIS		150	06-Oct-21	03-May-22	03-May-22, Final EIR/Final EIS																																				
NOD, Findings of Fact, Statement of Overriding Considerations, Mitigation Monitoring		32	13-Apr-22	26-May-22	26-May-22, NOD, Findings of Fact, Statement of Overriding Considerations, Mitigation Monitoring Program																																				
Authority Certifies EIR and Approves Project and File NOD		1	26-May-22	27-May-22	27-May-22, Authority Certifies EIR and Approves Project and File NOD																																				
ROD		109	04-May-22	03-Oct-22	03-Oct-22, ROD																																				
Additional NEPA/CEQA Review, if needed		570	04-Oct-22	09-Dec-24	09-Dec-24, Additional NEPA/CEQA Review, if needed																																				
FEDERAL PERMITS AND AGREEMENTS		882	14-Apr-20 A	21-May-24	21-May-24, FEDERAL PERMITS AND AGREEMENTS																																				
Phase 1 Environmental Site Assessments		421	03-Jan-22	14-Aug-23	14-Aug-23, Phase 1 Environmental Site Assessments																																				
U.S. Army Corps of Engineers CWA 404, Rivers and Harbors Act Section 10		614	05-May-20 A	11-May-23	11-May-23, U.S. Army Corps of Engineers CWA 404, Rivers and Harbors Act Section 10																																				
U.S. Army Corps of Engineers Rivers and Harbors Act Section 14, Section 408		859	04-Feb-21	21-May-24	21-May-24, U.S. Army Corps of Engineers Rivers and Harbors Act Section 14, Secti																																				

 Critical Remaining Work
  Milestone
 Summary



SITES PROJECT

Date: 11-Jan-21

Activity ID	Activity Name	Remaining Duration	Start	Finish	2021				2022				2023				2024				2025				2026				2027				2028				2029				30
					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4					
	U.S. EPA and U.S. Army Corps of Engineers LEDPA Review	546	02-Nov-20 A	06-Feb-23	06-Feb-23, U.S. EPA and U.S. Army Corps of Engineers LEDPA Review																																				
	Advisory Council on Historic Preservation NHPA Section 106	273	01-Sep-20 A	19-Jan-22	19-Jan-22, Advisory Council on Historic Preservation NHPA Section 106																																				
	USFWS and NMFS ESA Section 7	283	14-Apr-20 A	03-Feb-22	03-Feb-22, USFWS and NMFS ESA Section 7																																				
	USFWS Bald Eagle Protection Act	610	01-Sep-20 A	13-Jun-23	13-Jun-23, USFWS Bald Eagle Protection Act																																				
	U.S. Coast Guard Navigability Determination	239	03-Jan-22	15-Dec-22	15-Dec-22, U.S. Coast Guard Navigability Determination																																				
	USBR Warren Act	356	03-May-21	03-Oct-22	03-Oct-22, USBR Warren Act																																				
	USBR - Land Agreement	445	02-Nov-20 A	13-Oct-22	13-Oct-22, USBR - Land Agreement																																				
STATE PERMITS AND AGREEMENTS		2232	01-Sep-20 A	24-Jul-29	24-Jul-29, STATE PERMITS AND AGREEMENTS																																				
	Caltrans Encroachment & Transportation	605	03-Jan-22	03-Jun-24	03-Jun-24, Caltrans Encroachment & Transportation																																				
	State Lands Commission/State Lands Lease, if needed	242	03-Jan-22	20-Dec-22	20-Dec-22, State Lands Commission/State Lands Lease, if needed																																				
	Central Valley Flood Protection Board Levee Encroachment	501	01-Sep-20 A	11-May-23	11-May-23, Central Valley Flood Protection Board Levee Encroachment																																				
	SWRCB Water Rights Permit	535	01-Sep-20 A	20-Jan-23	20-Jan-23, SWRCB Water Rights Permit																																				
	SWRCB NPDES and CWA Section 402 (Multiple permits based on construction packages)	1234	15-Aug-23	05-May-28	05-May-28, SWRCB NPDES and CWA Section 402 (Multiple permits based on construction packages)																																				
	SWRCB Waste Discharge Requirements (Multiple permits based on construction packages)	1234	15-Aug-23	05-May-28	05-May-28, SWRCB Waste Discharge Requirements (Multiple permits based on construction packages)																																				
	SWB CWA Section 401 Water Quality Certification	1227	15-Jan-21	29-Sep-25	29-Sep-25, SWB CWA Section 401 Water Quality Certification																																				
	DWR DSOD (Multiple permits based on construction packages and/or ROW access)	210	21-May-24	10-Mar-25	10-Mar-25, DWR DSOD (Multiple permits based on construction packages and/or ROW access)																																				
	Cal OSHA Permits (Multiple permits based on construction packages and/or ROW access)	1541	29-Aug-23	24-Jul-29	24-Jul-29, Cal OSHA Permits (Multiple permits based on construction packages and/or ROW access)																																				
	CDFW Streambed Alteration Agreements	591	30-Dec-21	04-Apr-24	04-Apr-24, CDFW Streambed Alteration Agreements																																				
	CDFW Incidental Take Permits	390	01-Sep-20 A	01-Jul-22	01-Jul-22, CDFW Incidental Take Permits																																				
	NAHC/Local Tribes AB 52 Consultation	315	01-Sep-20 A	08-Apr-22	08-Apr-22, NAHC/Local Tribes AB 52 Consultation																																				
	SMARA	126	06-Oct-21	12-Apr-22	12-Apr-22, SMARA																																				
LOCAL AGENCY PERMITS AND APPROVALS		400	03-Jan-22	14-Jul-23	14-Jul-23, LOCAL AGENCY PERMITS AND APPROVALS																																				
	Colusa County	400	03-Jan-22	14-Jul-23	14-Jul-23, Colusa County																																				
	Glenn County	400	03-Jan-22	14-Jul-23	14-Jul-23, Glenn County																																				
	Yolo County	400	03-Jan-22	14-Jul-23	14-Jul-23, Yolo County																																				
MITIGATION		2334	28-Aug-20 A	13-Dec-29	13-Dec-29, MITIGATION																																				
FEASIBILITY LEVEL GEOTECH		233	25-Mar-20 A	08-Dec-21	08-Dec-21, FEASIBILITY LEVEL GEOTECH																																				
	Geotechnical Permitting & Planning	19	25-Mar-20 A	29-Jan-21	29-Jan-21, Geotechnical Permitting & Planning																																				
	Field Investigations	79	04-Jan-21	27-Apr-21	27-Apr-21, Field Investigations																																				
	Data Evaluation and Reporting	233	30-Oct-20 A	08-Dec-21	08-Dec-21, Data Evaluation and Reporting																																				
FEASIBILITY ENGINEERING		1176	28-Aug-20 A	07-Jul-25	07-Jul-25, FEASIBILITY ENGINEERING																																				
PROP 1		949	30-Oct-20 A	22-Aug-24	22-Aug-24, PROP 1																																				
	CWC Feasibility Report	245	30-Oct-20 A	27-Dec-21	27-Dec-21, CWC Feasibility Report																																				
	CWC Feasibility Review	22	07-Dec-21	28-Dec-21	28-Dec-21, CWC Feasibility Review																																				
	CWC Review of Public Draft EIR/EIS	30	30-Jul-21	09-Sep-21	09-Sep-21, CWC Review of Public Draft EIR/EIS																																				
	CWC Determination of Feasibility	0	28-Dec-21	28-Dec-21	28-Dec-21, CWC Determination of Feasibility																																				
	CWC All Permits Acquired for Construction Funding	67	21-May-24	22-Aug-24	22-Aug-24, CWC All Permits Acquired for Construction Funding																																				
RIGHT OF WAY (ROW)		1427	15-Aug-23	31-Jan-29	31-Jan-29, RIGHT OF WAY (ROW)																																				
	Rights of Entry	218	15-Aug-23	27-Jun-24	27-Jun-24, Rights of Entry																																				
	Acquisitions (Phased)	298	15-Aug-23	17-Oct-24	17-Oct-24, Acquisitions (Phased)																																				
	Relocation Assistance, as needed	1119	18-Oct-24	31-Jan-29	31-Jan-29, Relocation Assistance, as needed																																				
	Acquistion Closeout and Transfer of Jurisdiction as needed	90	18-Oct-24	20-Feb-25	20-Feb-25, Acquistion Closeout and Transfer of Jurisdiction as needed																																				
DESIGN LEVEL GEOTECH & SURVEY		260	14-Jun-22	12-Jun-23	12-Jun-23, DESIGN LEVEL GEOTECH & SURVEY																																				
	Design Level Geotech	260	14-Jun-22	12-Jun-23	12-Jun-23, Design Level Geotech																																				
PRELIMINARY AND FINAL ENGINEERING		915	19-Jan-22	22-Jul-25	22-Jul-25, PRELIMINARY AND FINAL ENGINEERING																																				

 Critical Remaining Work
  Milestone
 Summary



SITES PROJECT

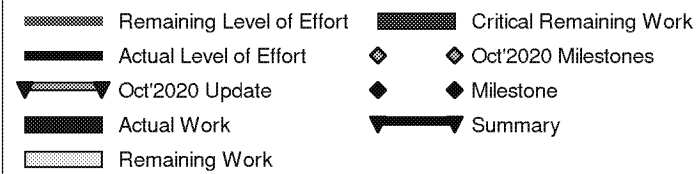
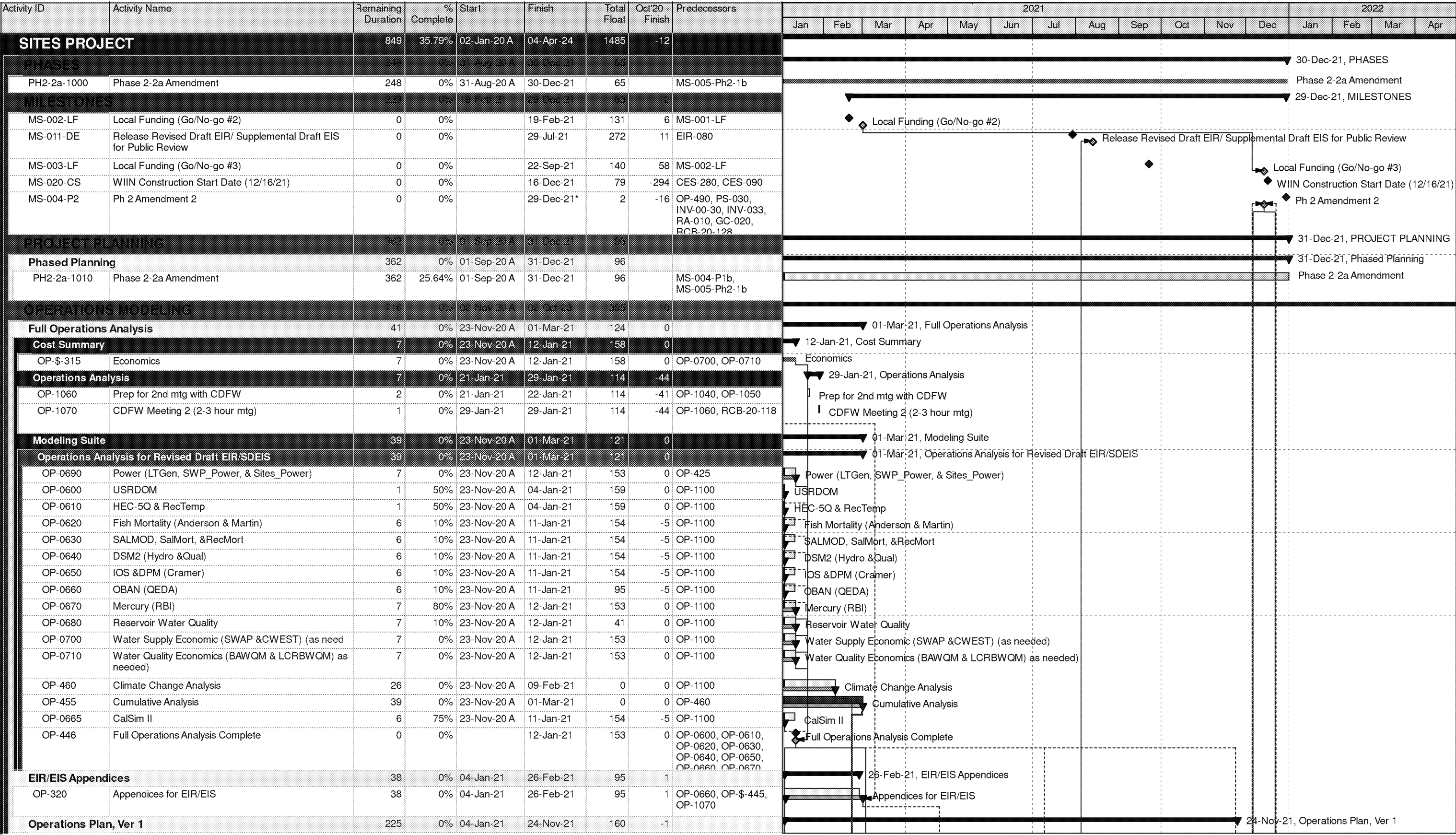
Date: 11-Jan-21

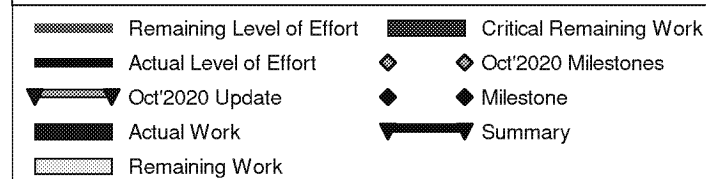
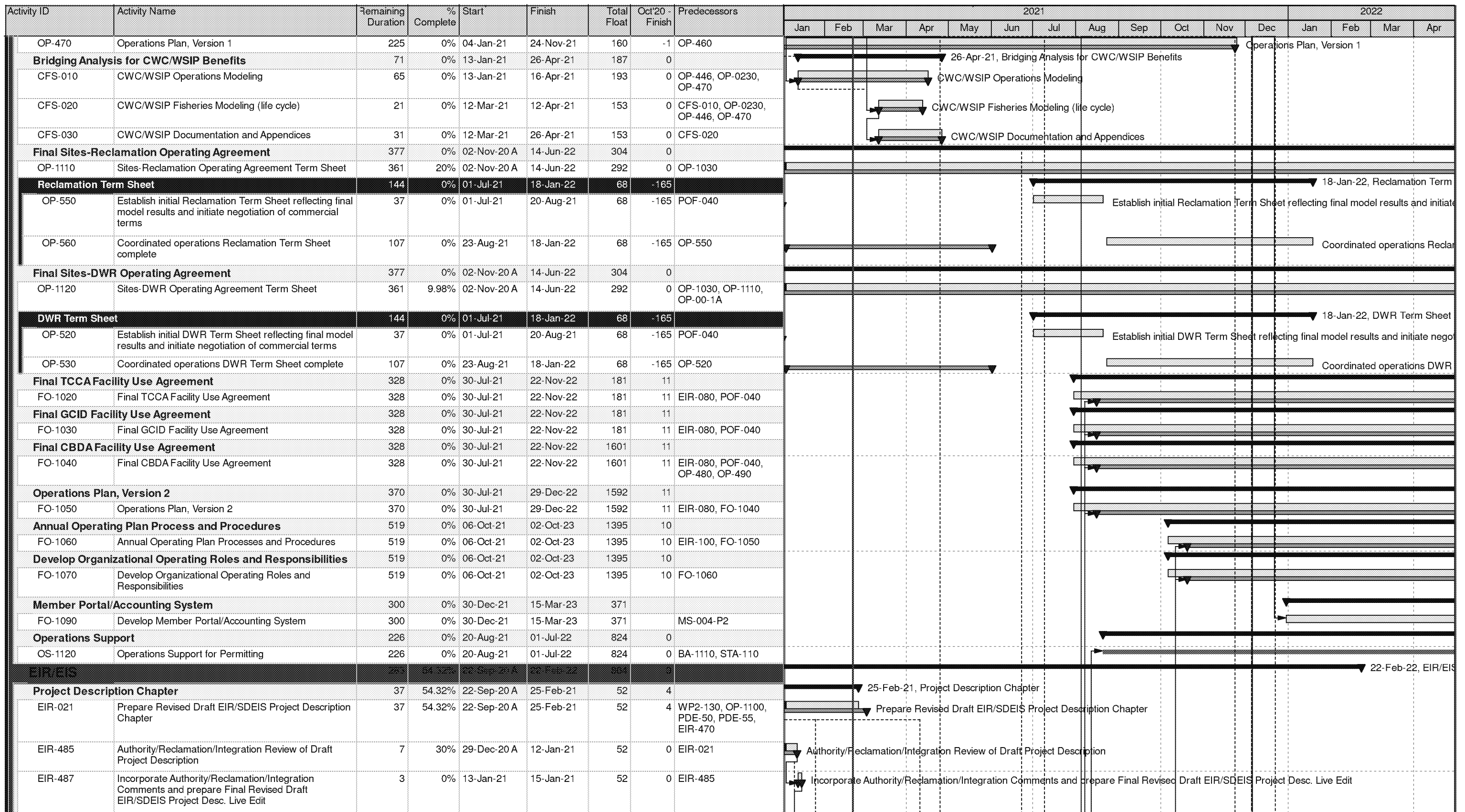
Activity ID	Activity Name	Remaining Duration	Start	Finish	2021				2022				2023				2024				2025				2026				2027				2028				2029				2030
					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1				
	Project Delivery Method (assumes mixed contracting)	118	19-Jan-22	01-Jul-22	01-Jul-22, Project Delivery Method (assumes mixed contracting)																																				
	Preliminary Engineering	195	15-Nov-22	14-Aug-23	14-Aug-23, Preliminary Engineering																																				
	Final Engineering	275	15-Aug-23	02-Sep-24	02-Sep-24, Final Engineering																																				
	Recreation Facilities Design/Engineering	506	15-Aug-23	22-Jul-25	22-Jul-25, Recreation Facilities Design/Engineering																																				
	CONSTRUCTION	1854	29-Dec-21	05-Feb-29	05-Feb-29, CO																																				
	Procurement Designers/Design Builders/Design Assist	119	29-Dec-21	13-Jun-22	13-Jun-22, Procurement Designers/Design Builders/Design Assist																																				
	Procurement - Contractors	639	21-Feb-24	03-Aug-26	03-Aug-26, Procurement - Contractors																																				
	Conveyance Features	1008	03-Sep-24	13-Jul-28	13-Jul-28, Conveyance																																				
	Reservoir Features	1155	03-Sep-24	05-Feb-29	05-Feb-29, Res																																				
	Recreational Features	520	04-Aug-26	31-Jul-28	31-Jul-28, Recreational																																				
	Roads & Bridges	650	15-Aug-23	09-Feb-26	09-Feb-26, Roads & Bridges																																				
	OPERATIONS	223	06-Feb-29	13-Dec-29	13																																				
	Early Operations (Commissioning)	222	06-Feb-29	12-Dec-29	12																																				
	Full Operations Begins	0	13-Dec-29	13-Dec-29	13																																				

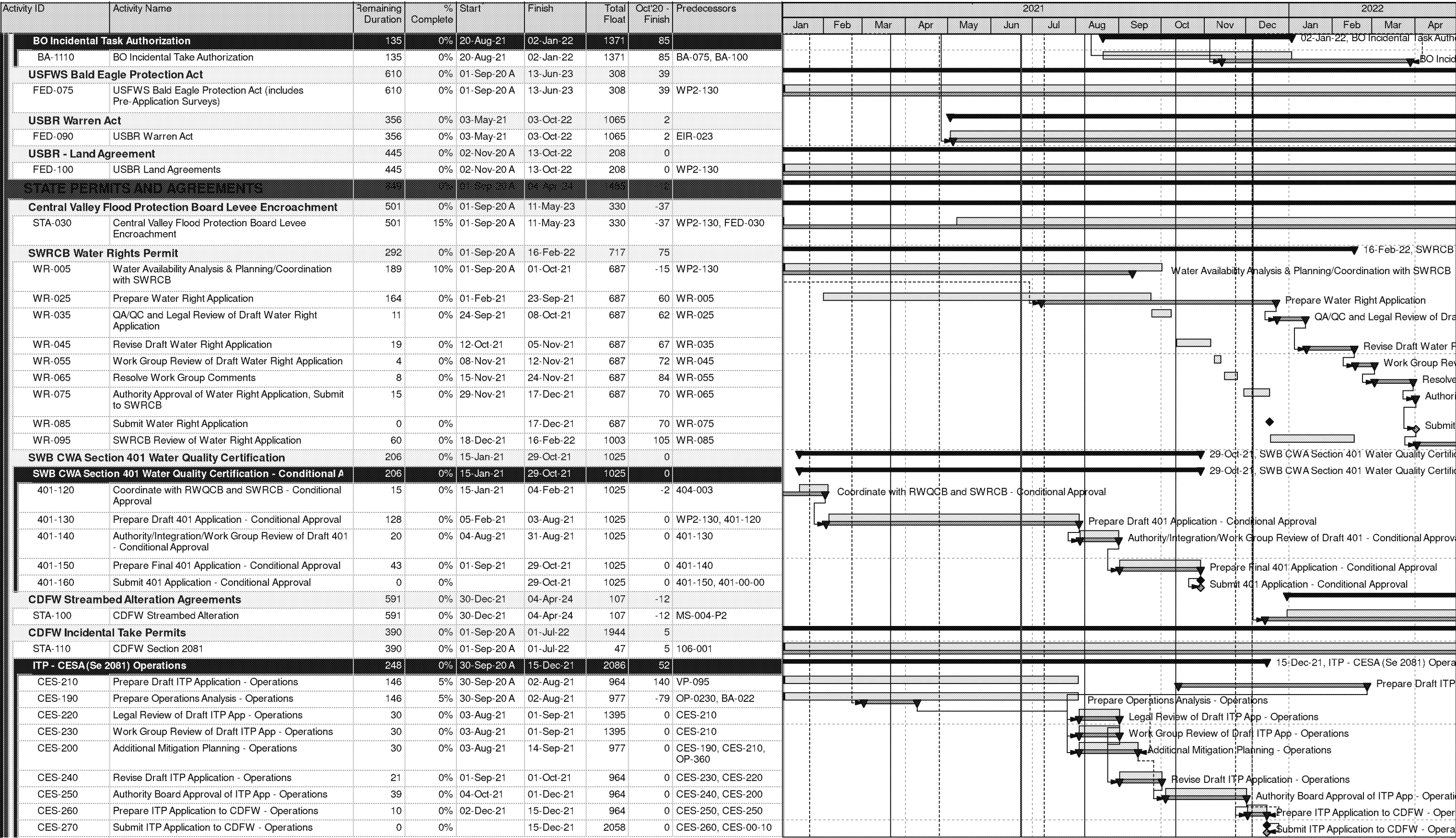
 Critical Remaining Work
  Milestone
 Summary



Activity ID	Activity Name	Remaining Duration	Start	Finish	2021				2022				2023				2024				2025				2026				2027				2028				2029				30
					Q	Q2	Q3	Q4	Q1	Q	Q3	Q4	Q1	Q2	Q3	Q4	Q	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q	Q2	Q3	Q4	Q1	Q	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q	Q3	Q4	
SITES PROJECT		2334	23-Nov-20	13-Dec-29																																	1				
OP-455	Cumulative Analysis	39	23-Nov-20	01-Mar-21	■ Cumulative Analysis																																				
EIR-027	Prepare Cumulative Section	32	02-Mar-21	15-Apr-21	■ Prepare Cumulative Section																																				
EIR-030	Complete Admin Revised Draft EIR/SDEIS	1	15-Apr-21	15-Apr-21	┆ Complete Admin Revised Draft EIR/SDEIS																																				
EIR-035	Authority/Reclamation/Integration/Authority Legal Review of Admin Revised Draft EIR/SDEIS	22	16-Apr-21	17-May-21	■ Authority/Reclamation/Integration/Authority Legal Review of Admin Revised Draft EIR/SDEIS																																				
EIR-590	Cooperating Agency Review	22	16-Apr-21	17-May-21	■ Cooperating Agency Review																																				
EIR-040	Incorporate comments/edits and prepare Public Revised Draft EIR/SDEIS	21	18-May-21	16-Jun-21	■ Incorporate comments/edits and prepare Public Revised Draft EIR/SDEIS																																				
EIR-050	Reclamation Backcheck edits and Finalize Revised Draft EIR/SDEIS	15	17-Jun-21	08-Jul-21	■ Reclamation Backcheck edits and Finalize Revised Draft EIR/SDEIS																																				
EIR-067	Final Editing, Formatting and Doc Production	10	09-Jul-21	22-Jul-21	┆ Final Editing, Formatting and Doc Production																																				
EIR-075	Coordination with Reclamation, Reclamation internal clearance, and public noticing	5	23-Jul-21	29-Jul-21	┆ Coordination with Reclamation, Reclamation internal clearance, and public noticing																																				
EIR-080	Authority Release Revised Draft EIR/SDEIS and Issue Public Notices	0		29-Jul-21	◆ Authority Release Revised Draft EIR/SDEIS and Issue Public Notices																																				
EIR-090	Public Review Period	59	30-Jul-21	26-Sep-21	■ Public Review Period																																				
EIR-110	Prepare Draft Environmental Feasibility Report for CWC	31	20-Sep-21	03-Nov-21	■ Prepare Draft Environmental Feasibility Report for CWC																																				
EIR-095	Categorize and Sort Comments by Topic	20	20-Sep-21	19-Oct-21	■ Categorize and Sort Comments by Topic																																				
EIR-540	Authority review of Draft Environmental Feasibility Report for CWC	8	03-Nov-21	16-Nov-21	┆ Authority review of Draft Environmental Feasibility Report for CWC																																				
EIR-115	Ad Hoc EPP Work Group Briefing on Draft Environmental Feasibility Report	5	16-Nov-21	23-Nov-21	┆ Ad Hoc EPP Work Group Briefing on Draft Environmental Feasibility Report																																				
EIR-560	Legal Review of Draft Environmental Feasibility Report for CWC	5	16-Nov-21	23-Nov-21	┆ Legal Review of Draft Environmental Feasibility Report for CWC																																				
EIR-550	Reservoir Committee Briefing on Draft Environmental Feasibility Report	1	22-Nov-21	23-Nov-21	┆ Reservoir Committee Briefing on Draft Environmental Feasibility Report																																				
EIR-117	Live Edit Meeting of Draft Environmental Feasibility Report for CWC	1	23-Nov-21	24-Nov-21	┆ Live Edit Meeting of Draft Environmental Feasibility Report for CWC																																				
EIR-580	Resolve Legal Comments and prepare Final Feasibility Report for CWC	7	24-Nov-21	07-Dec-21	■ Resolve Legal Comments and prepare Final Feasibility Report for CWC																																				
CWC-403	CWC Feasibility Review	22	07-Dec-21	28-Dec-21	■ CWC Feasibility Review																																				
CWC-500	CWC Determination of Feasibility	0		28-Dec-21*	◆ CWC Determination of Feasibility																																				
PDC-1000	Procurement - Designers, Design Builders & Design Assists (CMAR)	119	29-Dec-21	13-Jun-22	■ Procurement - Designers, Design Builders & Design Assists (CMAR)																																				
DLG-010	Design Level Geotech	130	14-Jun-22	12-Dec-22	■ Design Level Geotech																																				
PD-100	Preliminary Design	195	15-Nov-22	14-Aug-23	■ Preliminary Design																																				
FD-110	Final Design	210	15-Aug-23	03-Jun-24	■ Final Design																																				
FD-120	Procurement - Contractor - Dams & Reservoirs	65	04-Jun-24	02-Sep-24	■ Procurement - Contractor - Dams & Reservoirs																																				
FD-130	Procurement - Contractor - Conveyance Features	65	04-Jun-24	02-Sep-24	■ Procurement - Contractor - Conveyance Features																																				
CC-100	Final Conveyance Construction	1008	03-Sep-24	13-Jul-28	■ Final Conveyance Construction																																				
RC-100	Dams & Reservoir Construction	1155	03-Sep-24	05-Feb-29	■ Dams & Reservoir Construction																																				
OPR-110	Early Operations (Commissioning)	222	06-Feb-29	12-Dec-29	■ Early Operations (Commissioning)																																				
MIT-030	Post Construction Monitoring Begins	5	07-Dec-29	13-Dec-29	┆ Post Construction Monitoring Begins																																				
MS-600-PB	Public Beneficial Occupancy - Sites Program	0		13-Dec-29	◆ Public Beneficial Occupancy - Sites Program																																				
OPR-120	Full Operations Begins	0		13-Dec-29*	◆ Full Operations Begins																																				







Remaining Level of Effort

Actual Level of Effort

Oct'2020 Update

Actual Work

Remaining Work

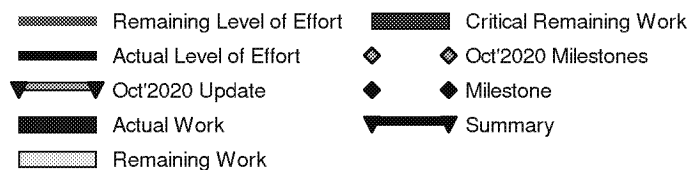
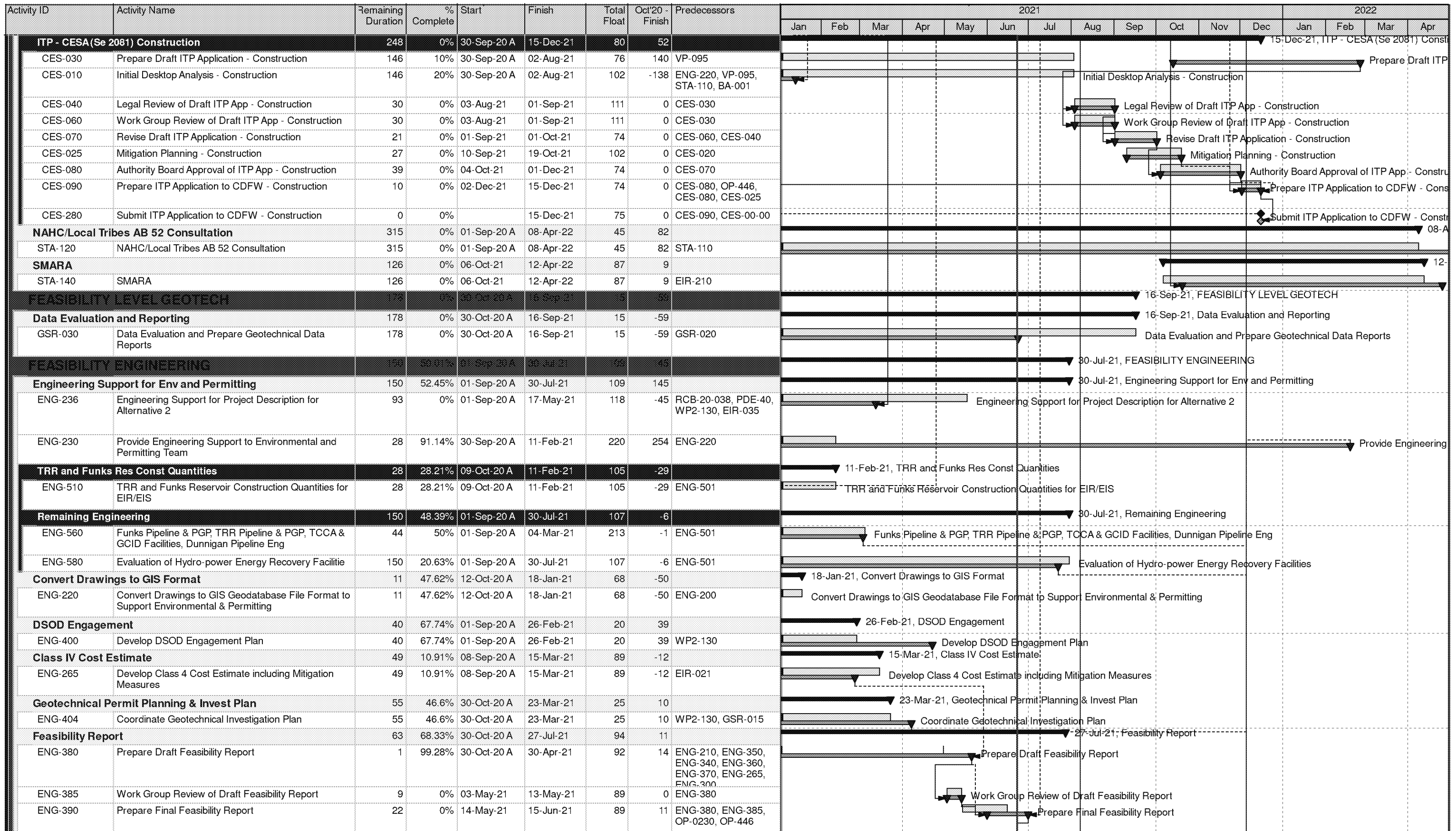
Critical Remaining Work

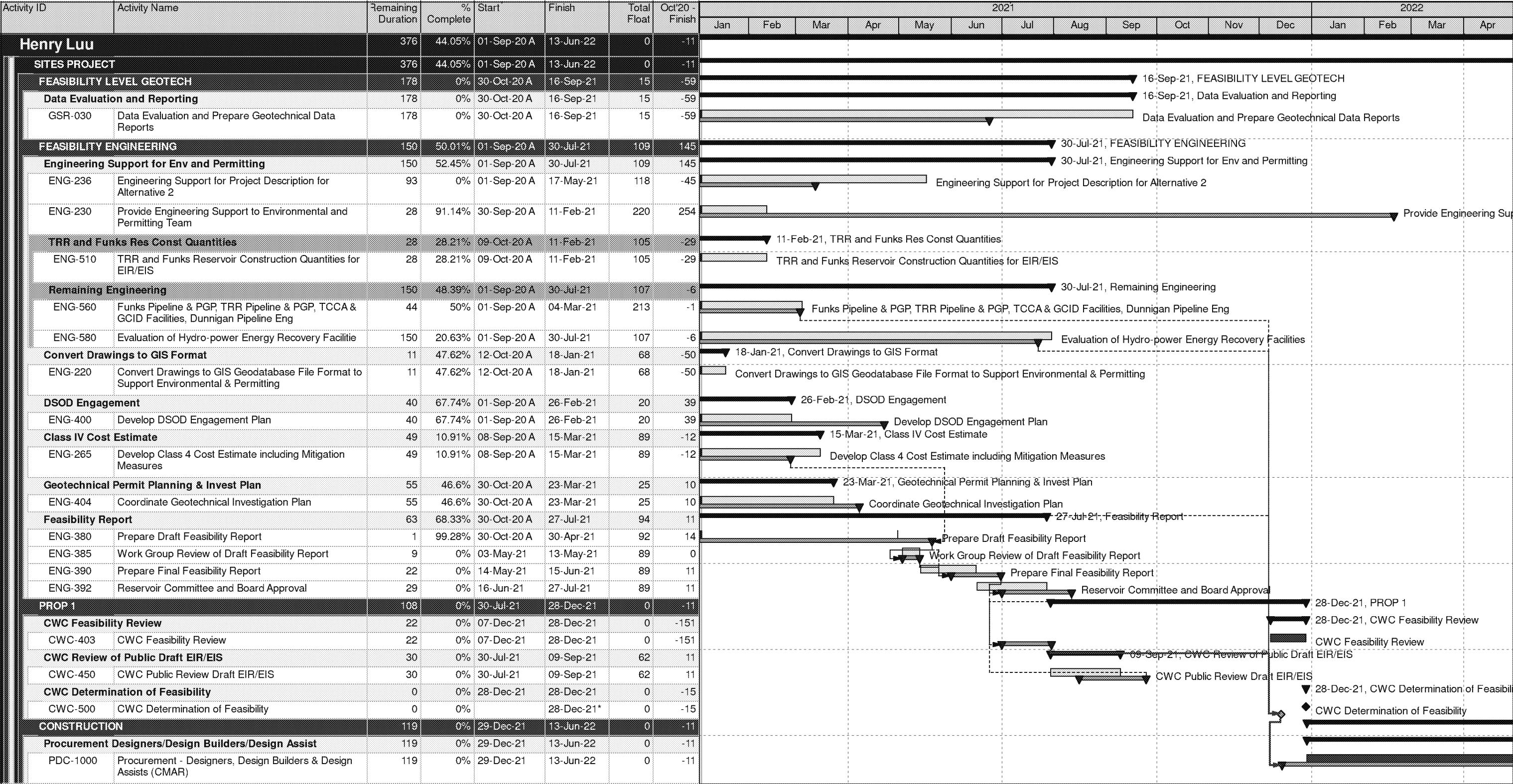
Oct'2020 Milestones

Milestone

Summary







Remaining Level of Effort

Actual Level of Effort

Oct'2020 Update

Actual Work

Remaining Work

Critical Remaining Work

Oct'2020 Milestones

Milestone

Summary



From: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Sent: 1/12/2021 12:55:00 PM
To: Kevin Spesert [kspesert@sitesproject.org]
CC: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: FW: Sites Jan 11 draft meeting minutes
Attachments: 2021_0111_Yocha Dehe_meeting minutes.docx

Hi Kevin,

Janis has provided the attached notes from the field visit with the Yocha Dehe. Please review and let me know if you have any changes.

Thank you,

Laurie

From: Janis Offermann [mailto:janis@horizonh2o.com]
Sent: Tuesday, January 12, 2021 12:01 PM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: RE: Sites Jan 11 draft meeting minutes

Hi, Laurie
Please use this version instead. I was able to get Eric's and Alex's last names from Laverne.
Thanks
janis

From: Janis Offermann <janis@horizonh2o.com>
Sent: Tuesday, January 12, 2021 9:57 AM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: Sites Jan 11 draft meeting minutes

Hi, Laurie
Attached are the notes from yesterday for your review.
Let me know if you have questions.
Thanks
janis

Janis Offermann

Cultural Resources Practice Leader
Horizon Water and Environment
400 Capitol Mall, Suite 2500
Sacramento, CA 95814
916.465.8076 – office
530.220.4918 – mobile

AB 52 Sites Reservoir Project Update Meeting Minutes



Sites Reservoir Project

Meeting Information:

Date: January 11, 2021 **Location:** Field review
Start Time: 9:00 a.m. **Finish Time:** 1:45 p.m.
Notes By: Janis Offermann **Reviewed By:** Laurie Warner Herson
Purpose: Quarterly Meeting and Site Visit with Yocha Dehe for Sites Reservoir

Meeting Participants (indicate absent invitees):

Laverne Bill, Yocha Dehe	Kevin Spesert, Authority	Name
Alex Cedano, Yocha Dehe	Laurie Warner Herson, Phenix	Name
Eric Hernandez, Yocha Dehe	Janis Offermann, Horizon	Name

Key Takeaways/Decisions/Action Items:

Takeaways: Yocha Dehe will start working more on this project in order to identify areas of concern and potential mitigation measures for tribal cultural resources.

Decisions: A video conference meeting will take place in about one month and a second field review will take place in March in order to visit Funks Reservoir and, possibly, areas of concern in the valley.

Action Items:

Action Item	Owner	Deadline	Notes
Review draft archaeological report and inform Laverne about whether there was any tribal involvement in the survey.	Janis	ASAP	
Produce a figure showing new preferred project alternative with survey coverage and site locations	Janis	ASAP	
Yocha Dehe to review project alternatives and resource location maps to provide Kevin with a map that identifies locations of concern.	Laverne	ASAP	Kevin will see about obtaining permission to enter from land owners for a field review of locations by YD.

Yocha Dehe to consider mitigation measures for TCRs.	Laverne	Next couple of months	
Schedule next meeting in about one month	Laverne	ASAP	

Agenda:

1. Review maps of project footprint
2. Conduct field review of TRR area and reservoir pool
6. Next Steps

Meeting Minutes (issues discussed and decisions made):

The group met at the Authority office in Maxwell at 9 a.m. Laurie provided maps of the most up-to-date project alternatives, including the new Alternative 3. These maps were reviewed, along with figures that depicted the areas previously surveyed for archaeological resources and the locations of recorded resources.

Laverne, Eric, Alex, Kevin, and Janis then caravanned to the location of the TRR, and then out to Antelope Valley where they made three stops to review the lay of the land and locations of some of the project facilities, such as dams, saddle dams, and recreation areas. During this time, Kevin provided a detailed description about how the reservoir would be operated. Laverne identified some general areas of concern and expressed an interest in accessing these areas for a field review.

Following the field review, the field team met back at the Authority's office where Kevin showed a map of and discussed the location of the Dunnigan Pipeline. He also showed some photographs that more clearly depicted the locations of the saddle dams at the north end of the reservoir pool.

The team then discussed next steps. Laverne would like to visit areas of concern in the reservoir footprint. Kevin noted that access is difficult due to the reluctance of property owners to allow access. However, he said he would try to get access if Laverne could provide a map showing which areas he is interested in visiting.

The team also discussed the need to develop mitigation measures for tribal cultural resources that could be impacted by the project, keeping in mind that the draft Revised Environmental Impact Report (DEIR) is scheduled to be released to the public in July 2021. Laverne will start devoting more time to the project and thinking about how to address the issue. Janis will work with Laverne to help draft the mitigation measures. [Note: the mitigation measures would be reviewed by Kevin prior to submittal to ICF for inclusion in the DEIR.]

It was decided that a teleconference meeting should take place in a month. Laverne will check his schedule and suggest some dates. Kevin also suggested conducting a field visit to the Funks Reservoir area in March. If possible, he will also arrange access to some of the sensitive areas identified by Yocha dehe.

From: Jerry Brown [jbrown@sitesproject.org]
Sent: 1/12/2021 4:22:13 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]
Subject: Re: Sites - Project Description Team

I'm not sure where we stand on deciding the Alt 3 25% Reclamation share operations. We just got off the phone with Reclamation Coor Mtg and I don't have a good feeling we'll be closing this issue out for next week's board meeting based on where we are right now.

They represented the "sharing with the state" as very conceptual, an idea that came up in the meeting yesterday. I asked them to explain the concept so I understood it better coming directly from them but they declined because it was too conceptual. When I mentioned we have NOD participants that have informally indicated a willingness to give up their share to reclamation and it shouldn't be an issue with local support they said that was new information that could change things for them.

I think we need to get back to them sooner than later that we don't think "sharing with the state" will work and we think the original gives us flexibility to continue to evaluating specific options but gives us environmental and operations coverage adequate for this point in time. Unless you guys really feel like the "sharing with the state" concept can work? Let me know.

From: Alicia Forsythe <aforsythe@sitesproject.org>
Date: Tuesday, January 12, 2021 at 3:01 PM
To: "laurie.warner.herson@phenixenv.com" <laurie.warner.herson@phenixenv.com>, Alicia Forsythe <aforsythe@sitesproject.org>, "Spranza, John" <john.spranza@hdrinc.com>, "Heydinger, Erin" <erin.heydinger@hdrinc.com>, "Arsenijevic, Jelica" <Jelica.Arsenijevic@hdrinc.com>, "Fisher, Linda" <Linda.Fisher@hdrinc.com>, "Henry.Luu@hdrinc.com" <Henry.Luu@hdrinc.com>, "Monique Briard (Monique.Briard@icf.com)" <Monique.Briard@icf.com>, "Lecky, Jim" <Jim.Lecky@icf.com>, "Williams, Nicole" <Nicole.Williams@icf.com>, "Rude, Pete/RDD" <Pete.Rude@jacobs.com>, "Boling, Robert M." <Robert.Boling@hdrinc.com>, "Forrest, Michael" <michael.forrest@aecom.com>, "jeff.herrin@aecom.com" <jeff.herrin@aecom.com>, "Berryman, Ellen" <Ellen.Berryman@icf.com>, "Unsworth, Ellen" <Ellen.Unsworth@icf.com>, Jerry Brown <jbrown@sitesproject.org>, Kevin Spesert <kspesert@sitesproject.org>, "conner@cmdwest.com" <conner@cmdwest.com>, "Smith, Jeff/SAC" <Jeff.Smith1@jacobs.com>, Marcia Kivett <MKivett@sitesproject.org>, "Alexander, Jeriann" <jalexander@fugro.com>, "connermcdonald@gmail.com" <connermcdonald@gmail.com>, "Leaf, Rob/SAC" <Rob.Leaf@jacobs.com>, "steve.micko@jacobs.com" <steve.micko@jacobs.com>, "Hendrick, Mike" <Mike.Hendrick@icf.com>, "Watkins, Hunter" <Hunter.Watkins@icf.com>
Subject: Sites - Project Description Team

Hi all – We are thinking about tomorrow's team meeting. Right now, we don't have a ton for an agenda. Please let me know just as soon as possible if you have any topics you'd like to discuss.

Thanks all!

Ali

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

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From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 1/12/2021 4:45:11 PM
To: Jerry Brown [jbrown@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Re: Sites - Project Description Team

I think this is partially an issue of Reclamation not talking internally. Derya has been pushing this for a couple of weeks now (the concept of pooling storage generally) and told me she has also discussed it with Kristin. I'm not sure they're running it up the pole on the planning side. That is also untrue that it was the first they heard about the CVP contractors. I have mentioned it before but it was met with skepticism on their end.

I agree I think we're in a bit of a tough spot. Partially because we haven't gotten any sort of formal "ask" from Reclamation. I think Derya is hoping Rob can quickly run this through the model (under their contract) to make sure it works for them before doing so.

Is there any way the three of us could chat briefly before the GCID meeting at 11?

Erin

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Tuesday, January 12, 2021 4:22:13 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Subject: Re: Sites - Project Description Team

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

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From: Alicia Forsythe <aforsythe@sitesproject.org>
Date: Tuesday, January 12, 2021 at 3:01 PM
To: "laurie.warner.herson@phenixenv.com" <laurie.warner.herson@phenixenv.com>, Alicia Forsythe <aforsythe@sitesproject.org>, "Spranza, John" <john.spranza@hdrinc.com>, "Heydinger, Erin" <erin.heydinger@hdrinc.com>, "Arsenijevic, Jelica" <Jelica.Arsenijevic@hdrinc.com>, "Fisher, Linda" <Linda.Fisher@hdrinc.com>, "Henry.Luu@hdrinc.com" <Henry.Luu@hdrinc.com>, "Monique Briard (Monique.Briard@icf.com)" <Monique.Briard@icf.com>, "Lecky, Jim" <Jim.Lecky@icf.com>, "Williams, Nicole" <Nicole.Williams@icf.com>, "Rude, Pete/RDD" <Pete.Rude@jacobs.com>, "Boling, Robert M." <Robert.Boling@hdrinc.com>, "Forrest, Michael" <michael.forrest@aecom.com>, "jeff.herrin@aecom.com"

<jeff.herrin@aecom.com>, "Berryman, Ellen" <Ellen.Berryman@icf.com>, "Unsworth, Ellen" <Ellen.Unsworth@icf.com>, Jerry Brown <jbrown@sitesproject.org>, Kevin Spesert <kspesert@sitesproject.org>, "conner@cmdwest.com" <conner@cmdwest.com>, "Smith, Jeff/SAC" <Jeff.Smith1@jacobs.com>, Marcia Kivett <MKivett@sitesproject.org>, "Alexander, Jeriann" <jalexander@fugro.com>, "connermcdonald@gmail.com" <connermcdonald@gmail.com>, "Leaf, Rob/SAC" <Rob.Lead@jacobs.com>, "steve.micko@jacobs.com" <steve.micko@jacobs.com>, "Hendrick, Mike" <Mike.Hendrick@icf.com>, "Watkins, Hunter" <Hunter.Watkins@icf.com>

Subject: Sites - Project Description Team

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Thanks all!

Ali

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

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From: Micko, Steve/SAC [Steve.Micko@jacobs.com]
Sent: 1/13/2021 2:15:22 PM
To: Williams, Nicole [Nicole.Williams@icf.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Leaf, Rob/SAC [Rob.Lead@jacobs.com]; Thayer, Reed/SAC [Reed.Thayer@jacobs.com]
Subject: Sites DEIR/EIS CalSim Model Results for NAA, ALT 1A, ALT 1B and ALT 2
Attachments: NODOS_Trend_Reporting_rev36dpcy_DV6_HistClim_CALSIM_NAA_ALT1A_011221_ALT1B_011221_ALT2_011221.xlsm; _Readme_20210113.pdf

Hi Nicole,

The attached CalSim II trend reporting spreadsheet contains model results for the following alternatives:

- No Action Alternative 011221
- Alternative 1A 011221
- Alternative 1B 011221
- Alternative 2 011221

Attached pdf describes modeled alternatives and a brief trend reporting spreadsheet user guide.

I will work with Erin to post the spreadsheet on SharePoint.

Please let me know if you have any questions.

Best,
Steve

Steve Micko, PE | Jacobs | Associate Water Resources Engineer
O:916.286.0358 | M:408.834.6614 | Steve.Micko@jacobs.com
2485 Natomas Park Drive Suite 600 | Sacramento, CA 95833

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File Provided Natively

CalSim Model Results for NAA, ALT 1A, ALT 1B and ALT 2

This deliverable includes modeling results, in trend reporting format, for the No Action Alternative, Alternative 1A, Alternative 1B and Alternative 2 for the Sites Project Administrative Draft EIR/EIS.

Scenarios Included

Scenarios provided in this deliverable are tabulated below.

Model Name	Label Name (as seen in spreadsheet)	Description
No Action Alternative 011221	NAA 011221	Baseline simulation (Reclamation 2020 Benchmark)
Alternative 1A 011221	ALT1A 011221	1.5 MAF Reservoir
Alternative 1B 011221	ALT1B 011221	1.5 MAF Reservoir with 91 TAF of Reclamation Investment
Alternative 2 011221	ALT2 011221	1.27 MAF Reservoir

Trend Reporting Spreadsheet

The Trend Reporting Spreadsheet, NODOS_Trend_Reporting_rev35dpcy_DV6_HistClim_CALSIM_NAA_ALT1A_011221_ALT1B_011221_ALT2_011221.xlsm, is designed to provide easy viewing of multiple scenarios. Please focus on the "Report - ALL (DASHBOARD)" tab. At this tab, you can select the parameter that you wish to evaluate, the type of statistic that you would like to view (e.g. averages, water-year type averages, dry periods), and the seasonal period (e.g. individual months, water year, CVP contract year, selected seasons). There is also an option to convert flow data in CFS to volume in TAF/month.

This tab presents data in the following formats:

- Results Table
- Bar chart of results
- Timeseries of selected statistic
- Exceedance plot (displays all data for the selected seasonal period; is not affected by "select statistic")
- Monthly Pattern (displays the selected statistic for each month; is not affected by "select seasonal period")
- Overall timeseries (includes entire timeseries, not affected by "select statistic" or "select seasonal period").

Not all statistics or seasonal periods should be used for all parameters. For example, seasonal averages or annual averages of reservoir storage do not provide value.

If reviewing results by water year type, please note that water year type averages are calculated based on calendar year, not water year.

From: Cooke, Robert@DWR [Robert.Cooke@water.ca.gov]
Sent: 1/18/2021 1:55:16 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]
CC: Jerry Brown [jbrown@sitesproject.org]
Subject: FW: WSIP CEQA
Attachments: State agency CEQA matrix.xlsx

Ali,

I've been asked to confirm question #3 below from David Okita. Can you please confirm for me? I'm assuming the answer is yes, DWR will be recognized as a Responsible Agency and the document will meet DWR's CEQA needs and will be routed through DWR for compliance type comments.

Rob-

Rob Cooke
Principal Engineer, PE, RA
Department of Water Resources
(916) 365-7915

From: Okita, David@DWR <David.Okita@water.ca.gov>
Sent: Thursday, January 14, 2021 8:21 AM
To: Tang, Hoan@DWR <Hoan.Tang@water.ca.gov>; Deaver, Katerina@DWR <Katerina.Deaver@water.ca.gov>; Gordon, David@DWR <David.Gordon@water.ca.gov>; Sandino, David@DWR <David.Sandino@water.ca.gov>; Kirkland, Marianne@DWR <Marianne.Kirkland@water.ca.gov>; Maroney, Jagruti@DWR <Jagruti.Maroney@water.ca.gov>; Cooke, Robert@DWR <Robert.Cooke@water.ca.gov>
Subject: WSIP CEQA

We are working on the scope of work for the Initial Study for State Agency actions for the WSIP projects. As part of this process we need to identify DWR actions we want covered in the IS.

We have a meeting with SWRCB, DFW and AECOM on 1/28 where we will go over the draft scope (under development) and ask them what actions they want covered in the IS.

Attached is a spreadsheet showing State actions I have identified associated with WSIP projects. I will be sending this out with the agenda for the 1/28 meeting, but wanted to give DWR a head start on this. We don't have to make a decision on 1/28, but we will in the next month or so to finalize the scope of work.

Based on earlier discussions with David Sandino, DWR will be issuing a Notice of Determination and CEQA Findings when we approve agreements/amendments for WSIP projects. Because each of the WSIP project have or will have their own CEQA documents, we need to determine if existing or future CEQA documents meet DWR needs for approvals - or if we need to cover it under the new State agency CEQA document. The IS will determine if a MND or EIR is necessary.

So... I have the following assignments and questions.

1. David Sandino - do the public benefit contracts that DWR is responsible for need CEQA coverage?
2. For Los Vaqueros Katerina is reviewing LVE FEIR/EIS to see if that document provides adequate coverage

3. For Sites I assume that when they revise EIR to reflect a smaller reservoir that DWR will be recognized as a Responsible Agency and make sure that document meeting all DWR CEQA needs for that project - Rob Cooke please confirm.
4. For 3 Pulse flow projects the Initial Study will need to address San Luis Reservoir and Oroville impacts. We will assume that local CEQA documents cover local impacts.
5. For Kern Fan - Marianne to work with Katerina to see if FEIR is adequate for new turnout agreement.
6. For Willow Springs - Marianne to work with Katerina to see if prior EIRs are adequate for new turnout agreement. Since This project is uncertain, just a cursory review at this time is needed and we can decide on coverage later.
7. Hoan - feel free to give this to AECOM so they can see what we are doing.

David Okita, PE
Department of Water Resources
530 902-7588

From: Micko, Steve/SAC [Steve.Micko@jacobs.com]
Sent: 1/18/2021 11:06:16 PM
To: Williams, Nicole [Nicole.Williams@icf.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]; Thayer, Reed/SAC [Reed.Thayer@jacobs.com]
Subject: Sites DEIR/EIS CalSim Model Results for NAA, ALT 1A, ALT 1B and ALT 2
Attachments: NODOS_Trend_Reporting_rev03cye_DV4_HistClim_HEC5Q_RecTemp__NAA_ALT1A_ALT1B_ALT2_011221.xlsm;
NODOS_Trend_Reporting_rev04cye_DV4_HistClim_DSM2__NAA_ALT1A_ALT1B_ALT2_011221.xlsm;
Sites_ModelResultsPackage_Jan18_2021.pdf

Hi Nicole,

The attached two trend reporting spreadsheets contain river water temperature and Delta water quality results:

- **River water temperature:**

NODOS_Trend_Reporting_rev03cye_DV4_HistClim_HEC5Q_RecTemp__NAA_ALT1A_ALT1B_ALT2_011221.xlsm

- **Delta water quality:**

NODOS_Trend_Reporting_rev04cye_DV4_HistClim_DSM2__NAA_ALT1A_ALT1B_ALT2_011221.xlsm

Each spreadsheet contains model results for the following alternatives:

- No Action Alternative 011221
- Alternative 1A 011221
- Alternative 1B 011221
- Alternative 2 011221

Attached pdf briefly describes modeled alternatives, models, and a trend reporting spreadsheet user guide.

Spreadsheets will be posted to SharePoint in the morning.

Please let me know if you have any questions.

Enjoy!

Steve

Steve Micko, PE | Jacobs | Associate Water Resources Engineer
O:916.286.0358 | M:408.834.6614 | Steve.Micko@jacobs.com
2485 Natomas Park Drive Suite 600 | Sacramento, CA 95833

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File Provided Natively

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2485 Natomas Park Drive, Suite 600
Sacramento, California 95833-2937
United States
T +1.916.920.0300
F +1.916.920.8463
www.jacobs.com

Project Name Sites Reservoir Project

Subject Model Results to Support the April 2021 Administrative Revised Draft EIR/SDEIS: No Action Alternative, Alternative 1A, Alternative 1B, and Alternative 2

Attention Ali Forsythe/Sites Project Authority Erin Heydinger/HDR
Nicole Williams/ICF

From Robert Leaf/JACOBS Steve Micko/JACOBS
Reed Thayer/JACOBS

Date January 18, 2021

1. Introduction

The Sites Reservoir Project team has developed model simulations to support quantitative analysis of Sites long-term operations as part of developing an Administrative Revised Draft EIR/SDEIS, for completion in April 2021.

The results of these model simulations are provided for informational and review purposes. If there are any questions regarding the results of these simulations, please contact the modeling team.

2. Modeled Scenarios

Model results are provided for the alternatives tabulated below.

Model Name	Label Name (as seen in spreadsheet)	Description
No Action Alternative 011221	NAA 011221	Baseline simulation (Reclamation 2020 Benchmark)
Alternative 1A 011221	ALT1A 011221	1.5 MAF Reservoir
Alternative 1B 011221	ALT1B 011221	1.5 MAF Reservoir with 91 TAF of Reclamation Investment
Alternative 2 011221	ALT2 011221	1.27 MAF Reservoir

The CalSim II model was used to simulate Sites Reservoir, CVP, and SWP water operations, including reservoir operations, river flows and diversions at key project-related locations.

The CalSim II models used were developed in coordination with and reviewed by Sites Project Authority (Authority), and revised according to direction provided by the Authority.

The HEC5Q (Trinity, Sacramento, and American River models) and Reclamation Temperature Model (Feather River model) models were used to simulate reservoir and riverine temperature conditions based on the results of the CalSim II models mentioned above.

The DSM2 model (Hydro and Qual components) was used to simulate Delta hydrodynamics and salinity conditions based on the results of the CalSim II models mentioned above.

These models (CalSim II, HEC5Q and Reclamation Temperature Model and DSM2) have been jointly developed by Reclamation and the California Department of Water Resources (DWR) over many years. These models are useful so long as the results are interpreted consistent with the model limitations.

3. Model Simulations for Modeled Scenarios

3.1 CalSim II Simulations

A Trend Reporting spreadsheet, NODOS_Trend_Reporting_rev36dpcy_DV6_HistClim_CALSIM_NAA_ALT1A_011221_ALT1B_011221_ALT2_011221.xlsm, was provided on January 13th, 2021.

3.2 HEC5Q Simulations

A Trend Reporting spreadsheet, NODOS_Trend_Reporting_rev03cye_DV4_HistClim_HEC5Q_RecTemp__NAA_ALT1A_ALT1B_ALT2_011221.xlsm, is provided.

Note that this trend reporting spreadsheet does not include HEC5Q storage, nor flow results. Some storage and flow locations in HEC5Q may coincide with storage and flow locations available in CalSim II. For consistency, please observe storage and flows from CalSim II at boundary condition or controlled flow locations.

3.3 Reclamation Temperature Model Simulations

A Trend Reporting spreadsheet, NODOS_Trend_Reporting_rev03cye_DV4_HistClim_HEC5Q_RecTemp__NAA_ALT1A_ALT1B_ALT2_011221.xlsm, is provided.

Note that this trend reporting spreadsheet does not include Reclamation Temperature Model storage, nor flow results. Some storage and flow locations in Reclamation Temperature Model may coincide with storage and flow locations available in CalSim II. For consistency, please observe storage and flows from CalSim II at boundary condition or controlled flow locations.

3.4 DSM2 Simulations

A Trend Reporting spreadsheet, NODOS_Trend_Reporting_rev04cye_DV4_HistClim_DSM2___NAA_ALT1A_ALT1B_ALT2_011221.xlsm, is provided.

Note that this trend reporting spreadsheet does not include DSM2 flow results. Some flow locations in DSM2 may coincide with flow locations available in CalSim II. For consistency, please observe flows from CalSim II at boundary condition or controlled flow locations.

4. Trend Reporting Spreadsheet

The trend reporting spreadsheet is designed to provide easy viewing of multiple scenarios. Please focus on the “Report - ALL (DASHBOARD)” tab. At this tab, you can select the parameter that you wish to evaluate, the type of statistic that you would like to view (e.g. averages, water-year type averages, dry periods), and the seasonal period (e.g. individual months, water year, CVP contract year, selected seasons). There is also an option to convert flow data in CFS to volume in TAF/month.

This tab presents data in the following formats:

- Results Table
- Bar chart of results
- Timeseries of selected statistic
- Exceedance plot (displays all data for the selected seasonal period; is not affected by “select statistic”)
- Monthly Pattern (displays the selected statistic for each month; is not affected by “select seasonal period”)
- Overall timeseries (includes entire timeseries, not affected by “select statistic” or “select seasonal period”).

Not all statistics or seasonal periods should be used for all parameters. For example, seasonal averages or annual averages of reservoir storage do not provide value.

If reviewing results by water year type, please note that water year type averages are calculated based on calendar year, not water year.

From: Micko, Steve/SAC [Steve.Micko@jacobs.com]
Sent: 1/19/2021 10:06:18 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Spranza, John [john.spranza@hdrinc.com]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Monique Briard (monique.briard@icf.com) [monique.briard@icf.com]; Hendrick, Mike [mike.hendrick@icf.com]; Hassrick, Jason [jason.hassrick@icf.com]; Chris Fitzer [cfitzer@esassoc.com]; Lecky, Jim [jim.lecky@icf.com]
CC: Thomas, Jeremy/SAC [Jeremy.Thomas@jacobs.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]; Whittington, Chad/SAC [Chad.Whittington@jacobs.com]
Subject: RE: Sutter Bypass Suitable Habitat Analysis
Attachments: Sites_Sutter_FloodplainHab_Results_01.14.21.pdf; Task3A_TM_11.03.17.pdf; Subtask_2.2_Off-Channel_Habitats_Final_Report.pdf

Hi all,

In following up on action items from last week's meeting, the following documents are attached:

- Presentation slides from meeting: Sites_Sutter_FloodplainHab_Results_01.14.21.pdf
- 2017 CH2M TM: Task3A_TM_11.03.17.pdf
- 2017 TNC TM: Subtask_2.2_Off-Channel_Habitats_Final_Report.pdf

Let me know if I'm missing anything, or if you have any questions.

Best,
Steve

-----Original Appointment-----

From: Micko, Steve/SAC
Sent: Friday, January 8, 2021 7:49 PM
To: Micko, Steve/SAC; Alicia Forsythe; Spranza, John; Heydinger, Erin; Monique Briard (monique.briard@icf.com); Hendrick, Mike; Hassrick, Jason; Chris Fitzer; Thomas, Jeremy/SAC; Leaf, Rob/SAC; Whittington, Chad/SAC; Lecky, Jim
Subject: Sutter Bypass Suitable Habitat Analysis
When: Thursday, January 14, 2021 1:00 PM-2:00 PM (UTC-08:00) Pacific Time (US & Canada).
Where: Microsoft Teams Meeting

Hi all,

Based on Doodle Poll results, let's meet at 1 PM on Thursday, January 14th to review findings from the Sutter Bypass suitable habitat analysis.

Agenda to be provided in coming days.

Let me know if this date/time no longer works with your schedule.

Best,
Steve

Microsoft Teams meeting

Join on your computer or mobile app

[Click here to join the meeting](#)

Join with a video conferencing device

493366865@t.plcm.vc

Video Conference ID: 117 998 030 9

[Alternate VTC dialing instructions](#)

Or call in (audio only)

[+1 323-886-6924,,787173013#](#) United States, Los Angeles

Phone Conference ID: 787 173 013#

[Find a local number](#) | [Reset PIN](#)

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Sutter Bypass Floodplain Habitat Evaluations

Supporting Sites Reservoir Project Planning
and Scenario Development

01/14/2020

Jeremy Thomas, Steve Micko / Jacobs

Outline

1. Objectives and Background

2. Approach

- Bypass Floodplain Rearing Criteria
- Modeling Assumptions

3. Scenarios and Hydrologic Relationships

4. Preliminary Results

5. Trends

Objectives and Background

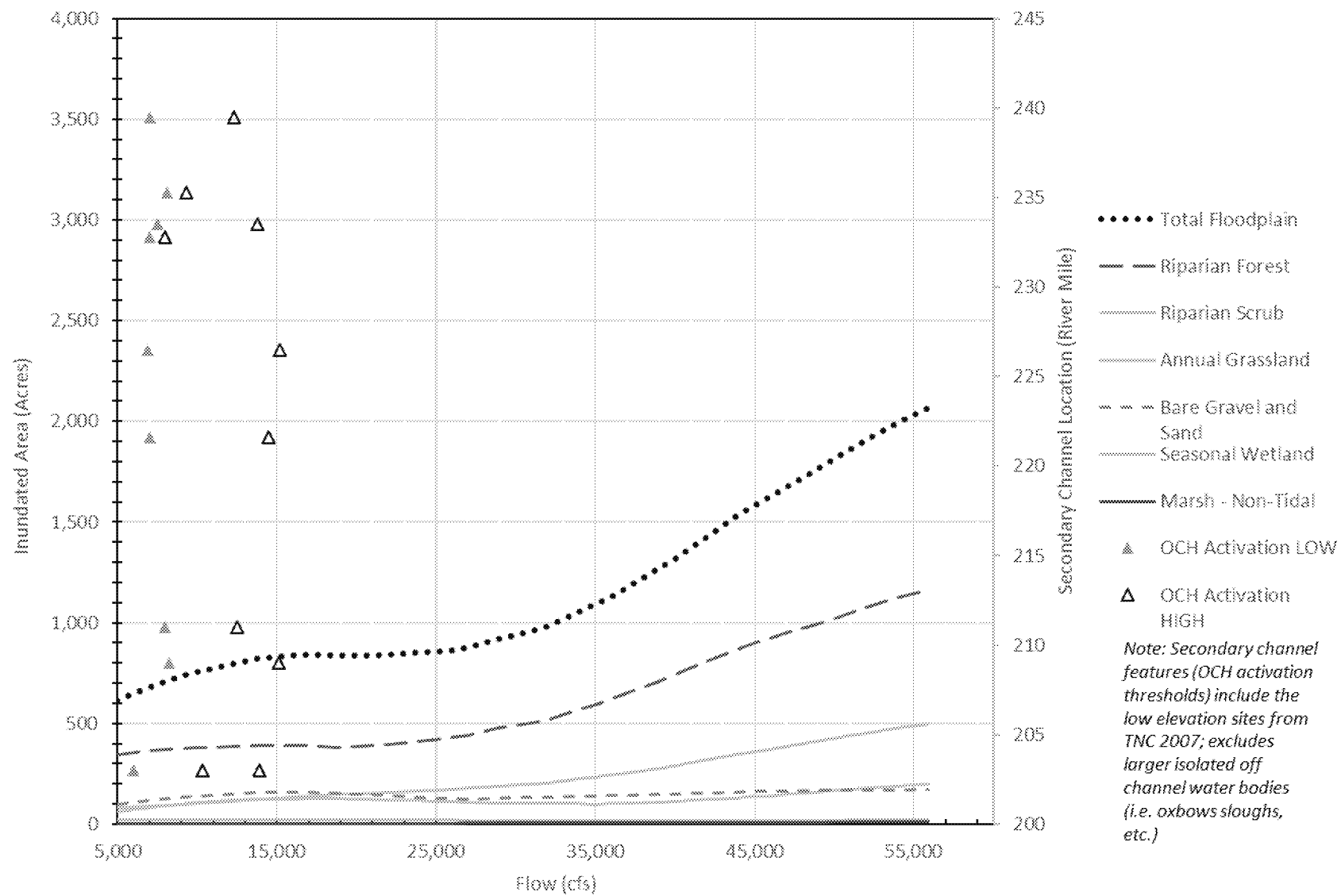
Objectives

- Identify suitable salmonid rearing habitat on existing floodplains along three primary segments of the Sacramento River:
 - Mainstem channel from Bend Bridge to Freeport
 - Sutter Bypass
 - Yolo Bypass
- Compare changes in floodplain inundation between existing conditions and potential future conditions associated with diversions and releases of water for Sites Reservoir
- Identify potential impacts or benefits to floodplain rearing habitats that could be attained from the operation of Sites Reservoir

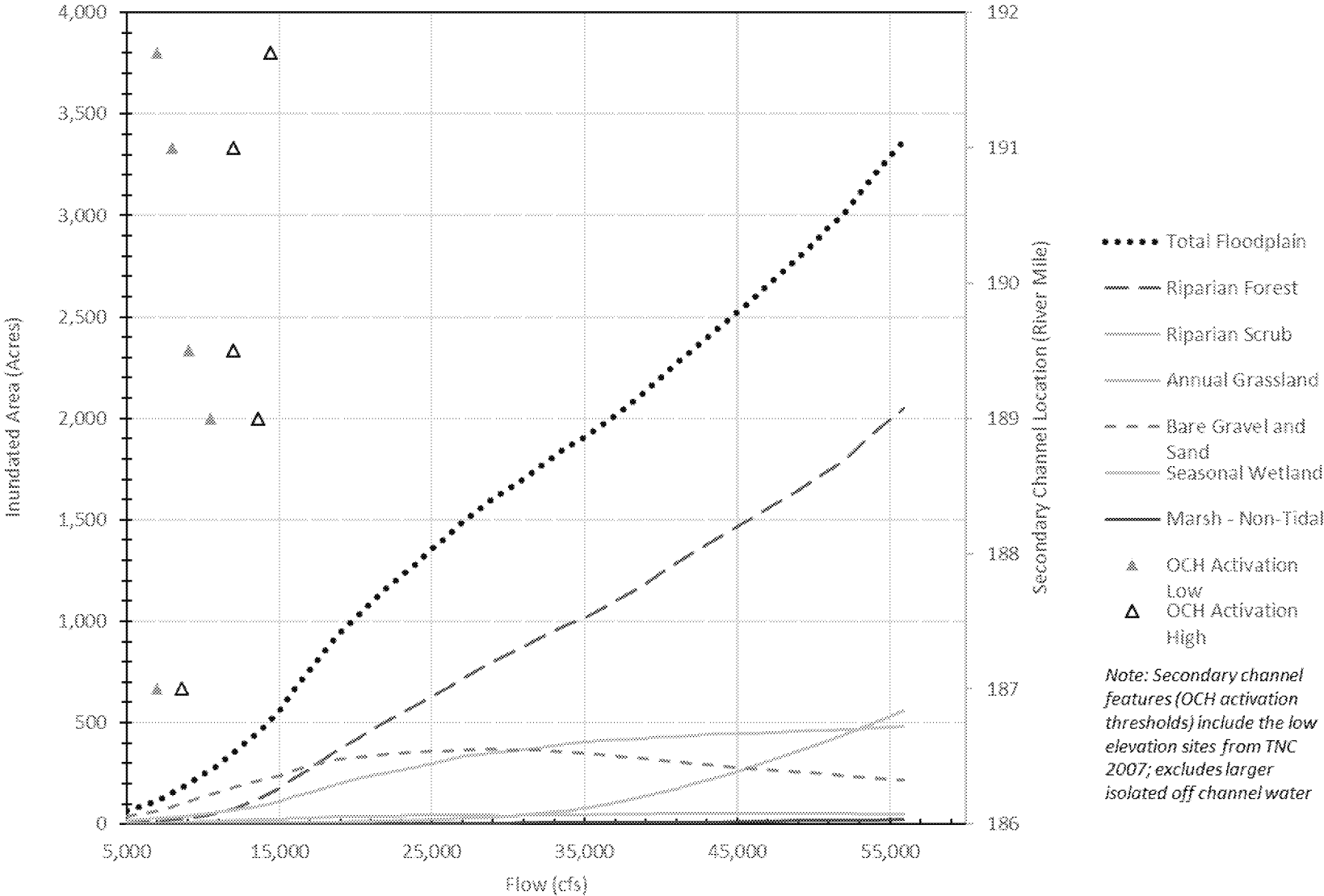
Previous Sites Reservoir Floodplain Inundation Study

- Summarized in a November 2017 TM
 - Evaluated floodplain habitat along mainstem from Bend Bridge → Knight's Landing
 - Used floodplain depth criteria of less than 5 feet, and incorporated frequency and duration criteria
 - Incorporated identification and activation of secondary channel features from a previous study (TNC)
 - Results provided for 3 main reaches of channel
 - Preliminary comparison of Sites diversion criteria (at the time) to determine potential impacts and benefits
- Current study extends and builds upon this work
 - Includes the Sutter and Yolo Bypasses
 - Incorporates additional criteria (velocity)
 - Evaluates the current Sites Reservoir operations being considered

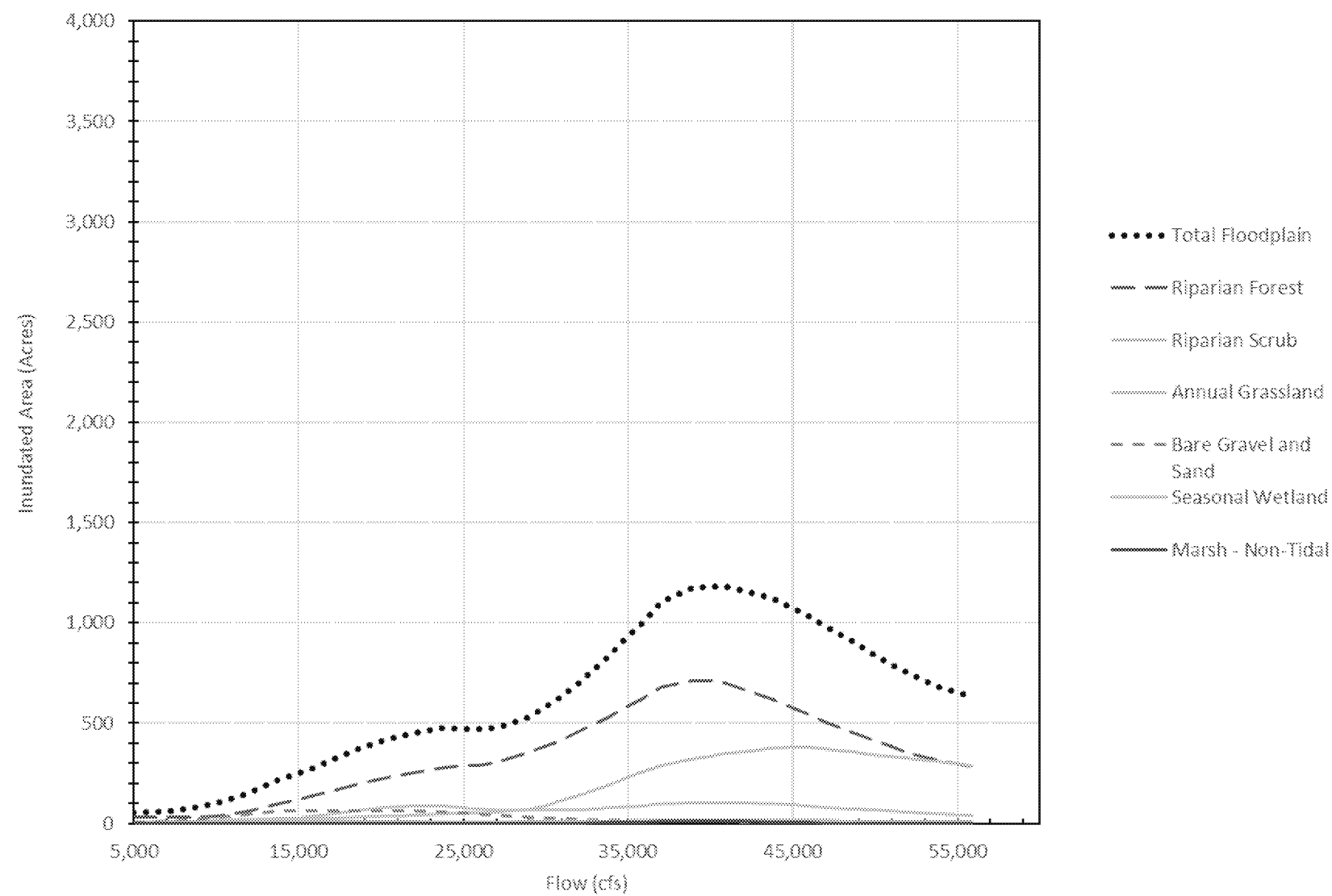
Reach 1 – Bend Bridge to Hamilton City



Reach 2 – Hamilton City to Delevan



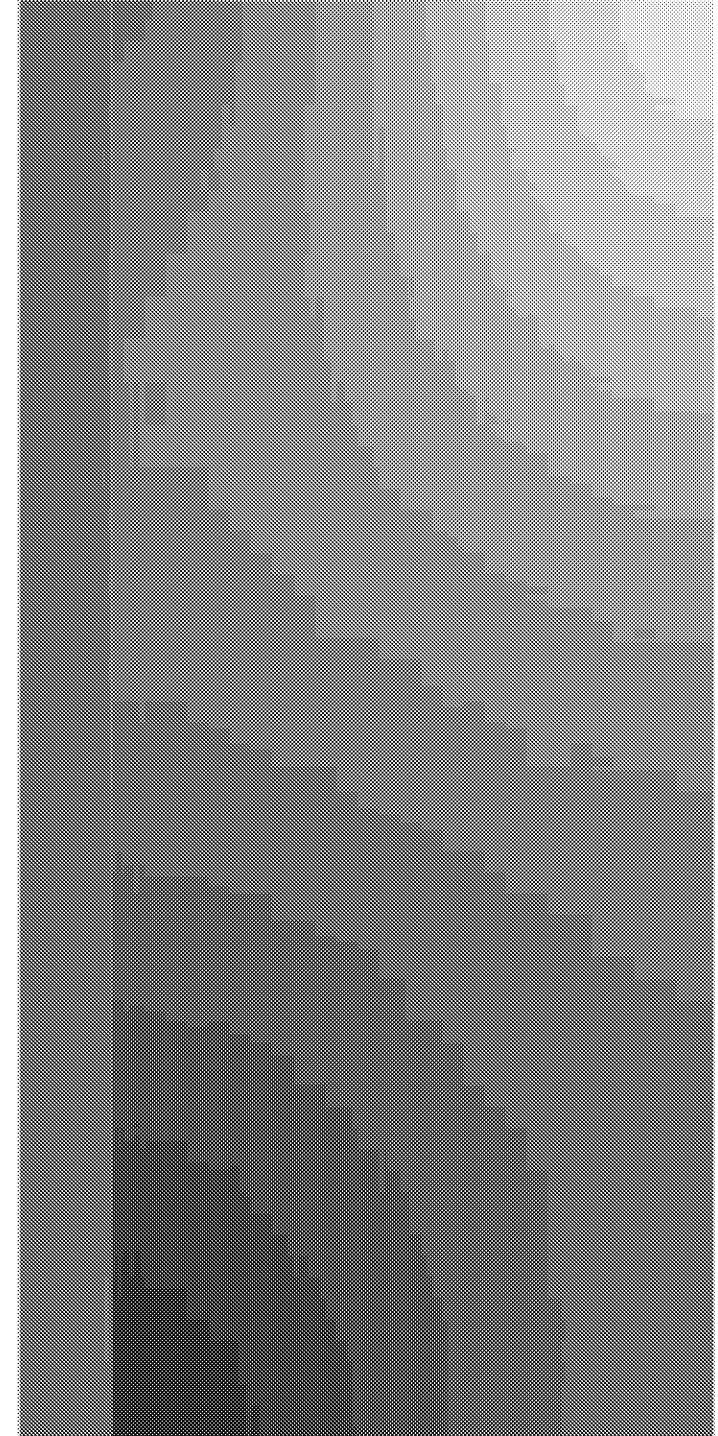
Reach 3 – Delevan to Knight's Landing



Current Status

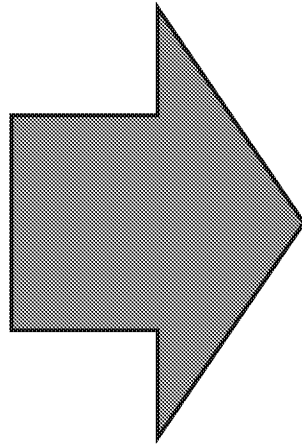
- Preliminary results have been developed for the Sutter Bypass – identifies existing trends, no comparative results (yet)
- Yolo Bypass and mainstem channel evaluations in progress
- Diversion scenarios in progress
- Cramer Fish Sciences will provide input on the biological response, impacts, and benefits

Approach – Sutter Bypass Floodplain Evaluation



Sutter Bypass Floodplain Rearing Criteria

- Water Depths $\leq$ 1 meter
- Water Velocities $\leq$ 1.5 ft/s
- Land Cover Types:
 - Agriculture
 - Seasonal Wetlands
 - Non-tidal Marsh
 - Riparian Forest
 - Riparian Scrub
 - Gravel Bar
 - Open Water



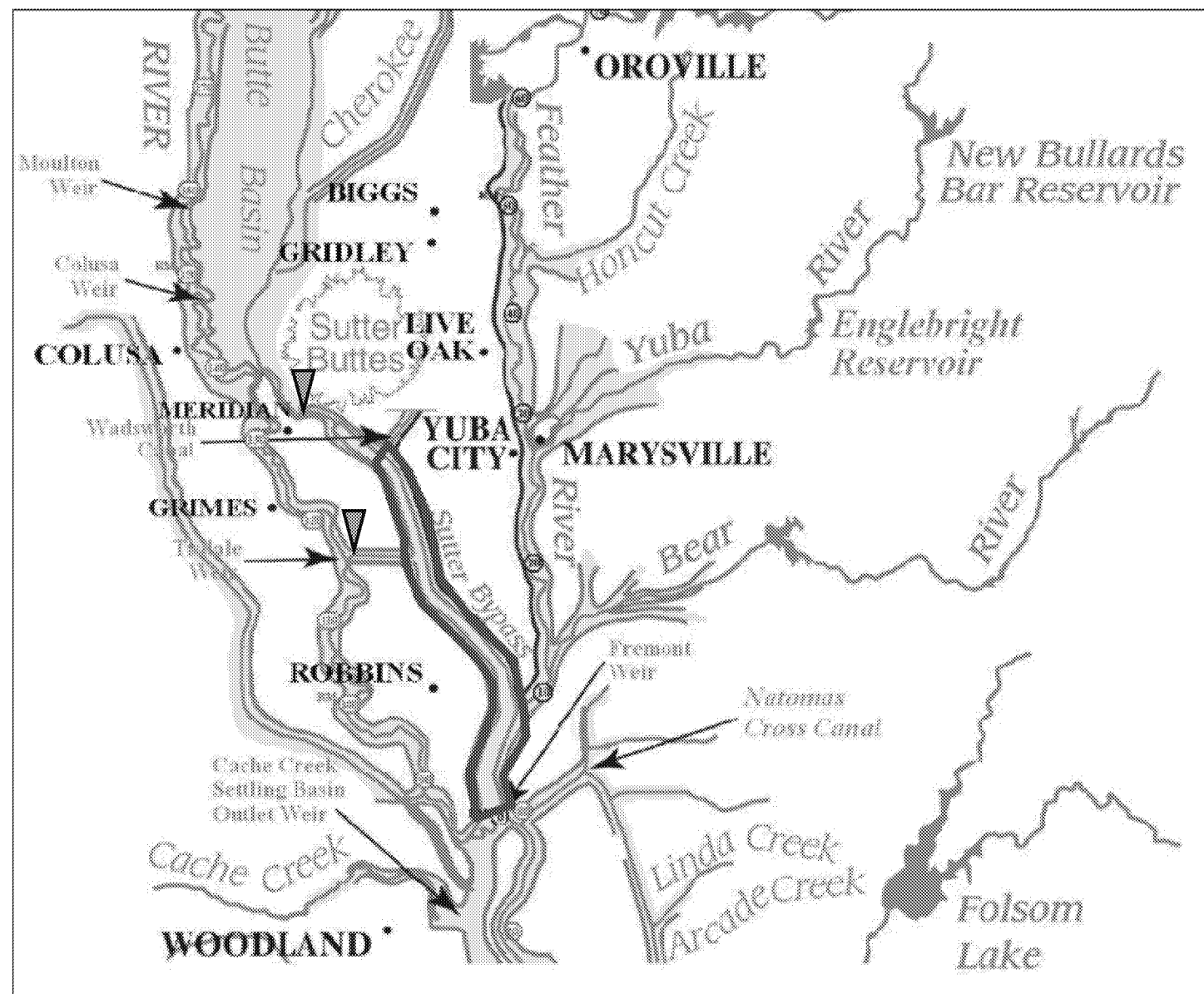
Developed from existing habitat suitability research / models, in consultation with Dave Vogel, including:

- 2019 Chinook Salmon Habitat Quantification Tool (i.e. Salmon HQT)
- Empirical studies on Trinity River restoration sites (1997)
- USFWS habitat suitability models
- CVFPP Conservation Strategy and appendices

Modeling Assumptions

- Boundary Conditions, Flow Periods, and Models Used

Parameter	Period	Source
Tisdale Weir Spill (Divertible & Storable Flow Tool)	10/1/2008 – 5/31/2018	Daily Divertible & Storable Flow Tool (using USRDOM outputs & curves)
Tisdale Weir Spill (CalSim)	10/1/1921 – 9/30/2003	CalSim (NAA 091720)
Sacramento River flow above Hamilton City	10/1/2008 – 5/31/2018	Daily Divertible & Storable Flow Tool (using USDROM outputs & curves)
Butte Slough Flow near Meridian	10/1/2008 – 5/31/2018	Daily Divertible & Storable Flow Tool (using USDROM outputs & curves)
Feather River flow above Sacramento River Confluence	10/1/1921 – 9/30/2003	CalSim (NAA 091720)
American River flow above Sacramento River Confluence	10/1/1921 – 9/30/2003	CalSim (NAA 091720)

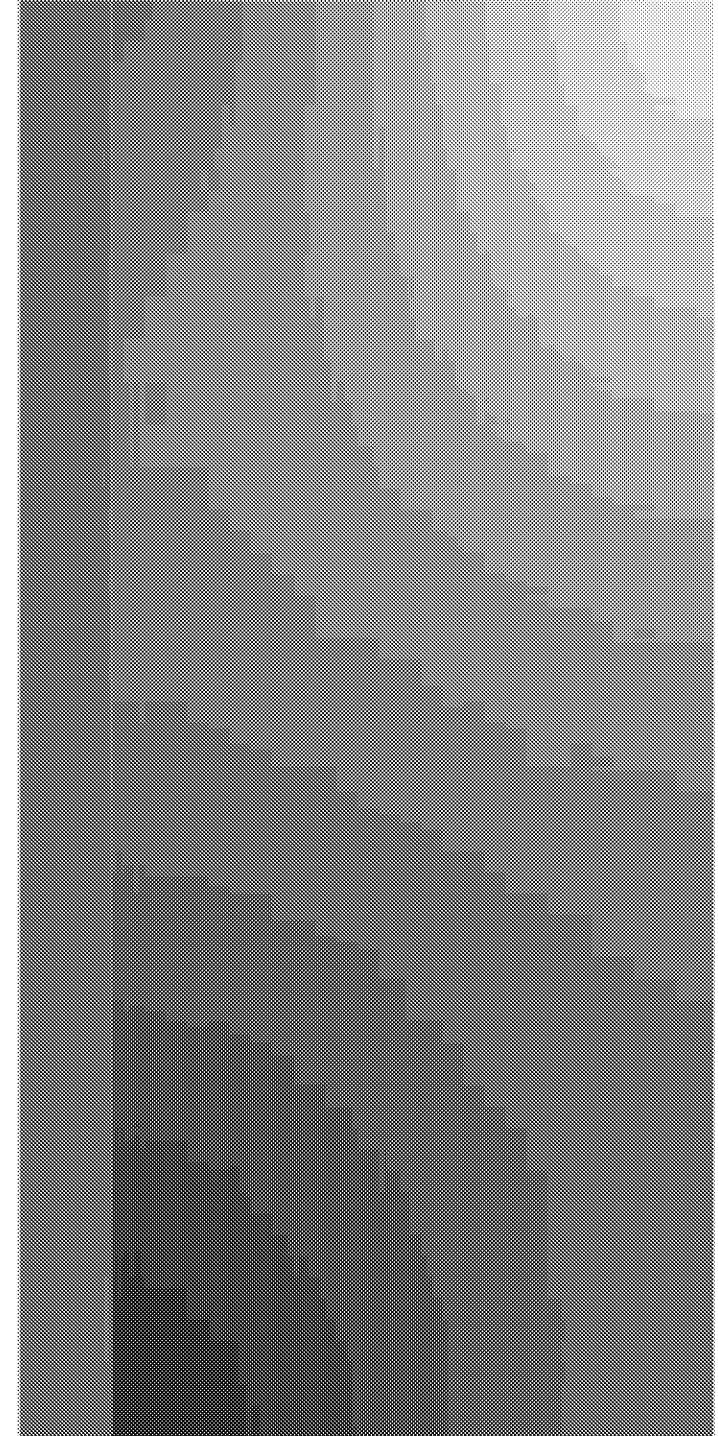


Modeling Methods

- Sensitivity analyses performed for various Sutter Bypass flows determining which flows through Butte Slough and Tisdale Weir satisfy biological criteria (velocity and depth)
- 14 scenarios developed that bracket the range of events that satisfy both criteria, with the following range of inflows and total flows
- Maps developed showing total acreage of inundation for each land cover type for each scenario

Tisdale Weir (cfs)	Butte Slough (cfs)	Total Sutter Bypass (cfs)
500-1,000	1,500 – 7,000	2,000 – 8,000

Scenarios & Hydrologic Relationships



Modeling Scenarios

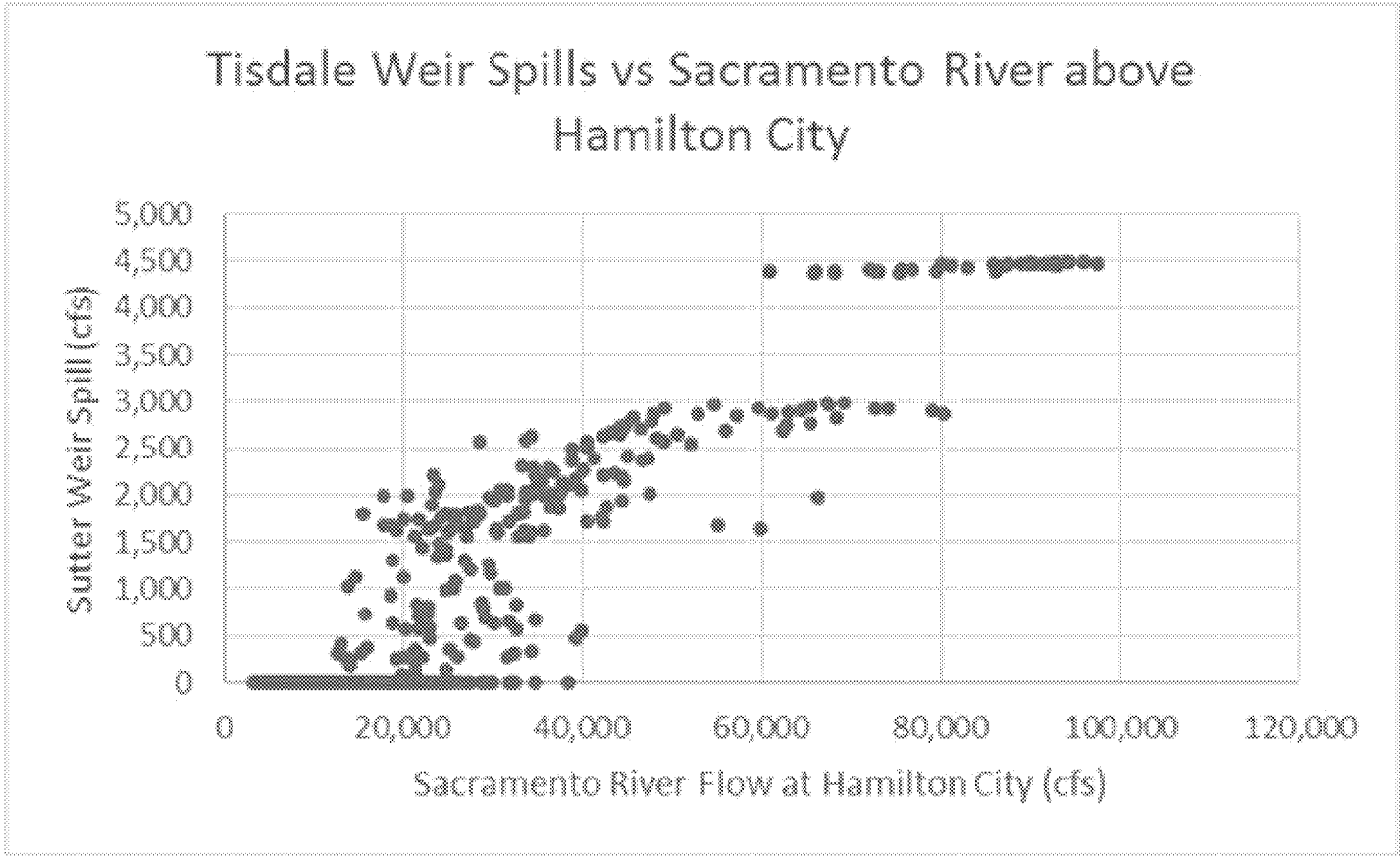
Scenario	Tisdale Weir Spill (cfs)	Butte Slough Flow (cfs)	Computed Total Sutter Bypass Flow (cfs)
1	500	1,500	2,000
2	500	2,000	2,500
3	500	2,500	3,000
4	500	3,000	3,500
5	500	3,500	4,000
6	500	4,000	4,500
7	500	4,500	5,000
8	1,000	4,000	5,000
9	1,000	4,500	5,500
10	1,000	5,000	6,000
11	1,000	5,500	6,500
12	1,000	6,000	7,000
13	1,000	6,500	7,500
14	1,000	7,000	8,000

Hydrologic Relationships –Tisdale Weir Initiation

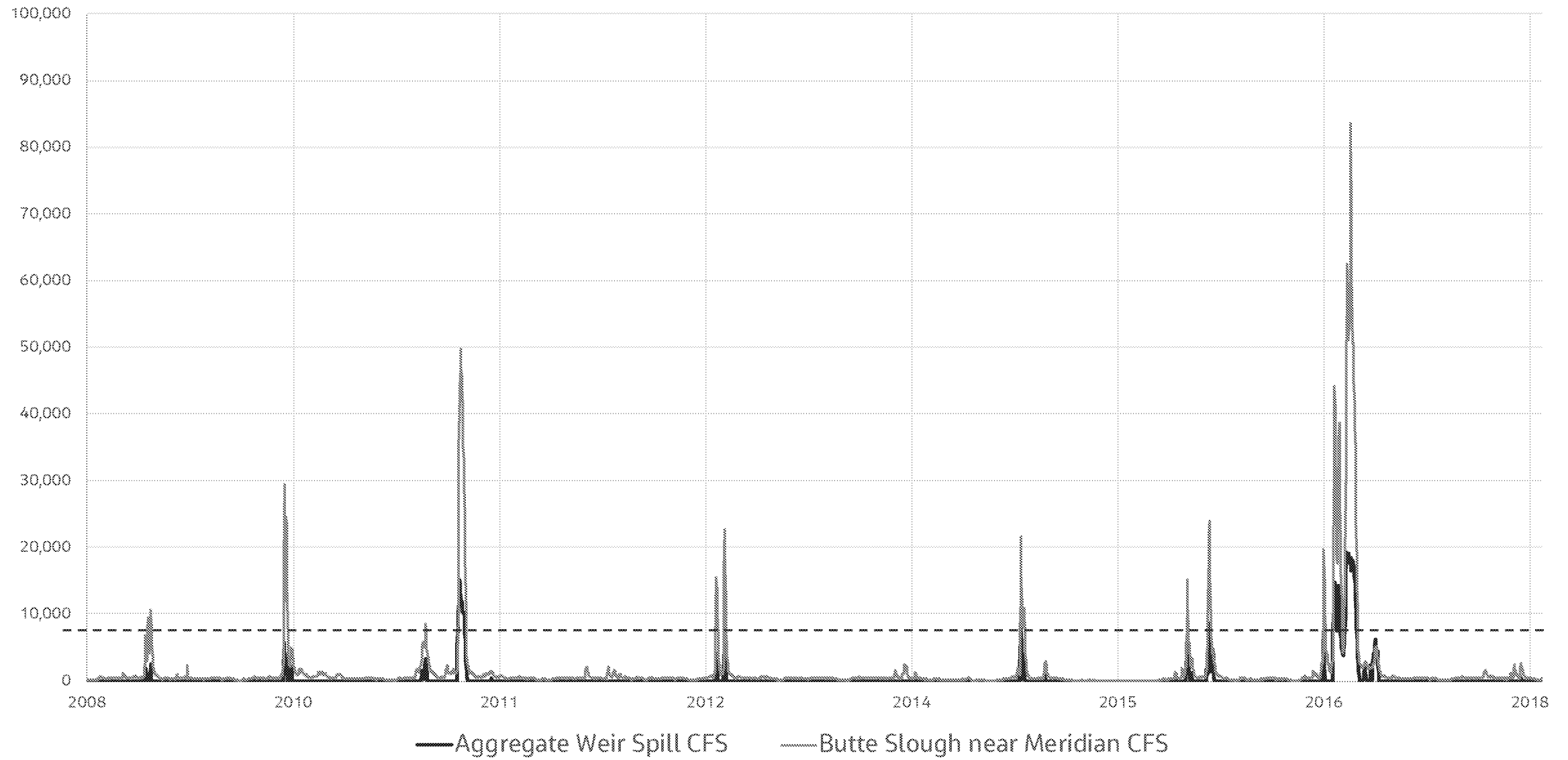
- Means and Standard Deviations of River Flows Corresponding to Tisdale Weir Spills of 0 – 300 cfs

River Flow Parameter	Mean Flow Correlated to Low Spills over Tisdale Weir(cfs)	Standard Deviation of Flow Correlated to Low Spills over Tisdale Weir (cfs)
Sacramento River above Hamilton City	20,537	5,216
Butte Slough near Meridian	4,725	530
Feather River above Sacramento River Confluence	14,887	9,782
American River above Sacramento River Confluence	4,670	2,491

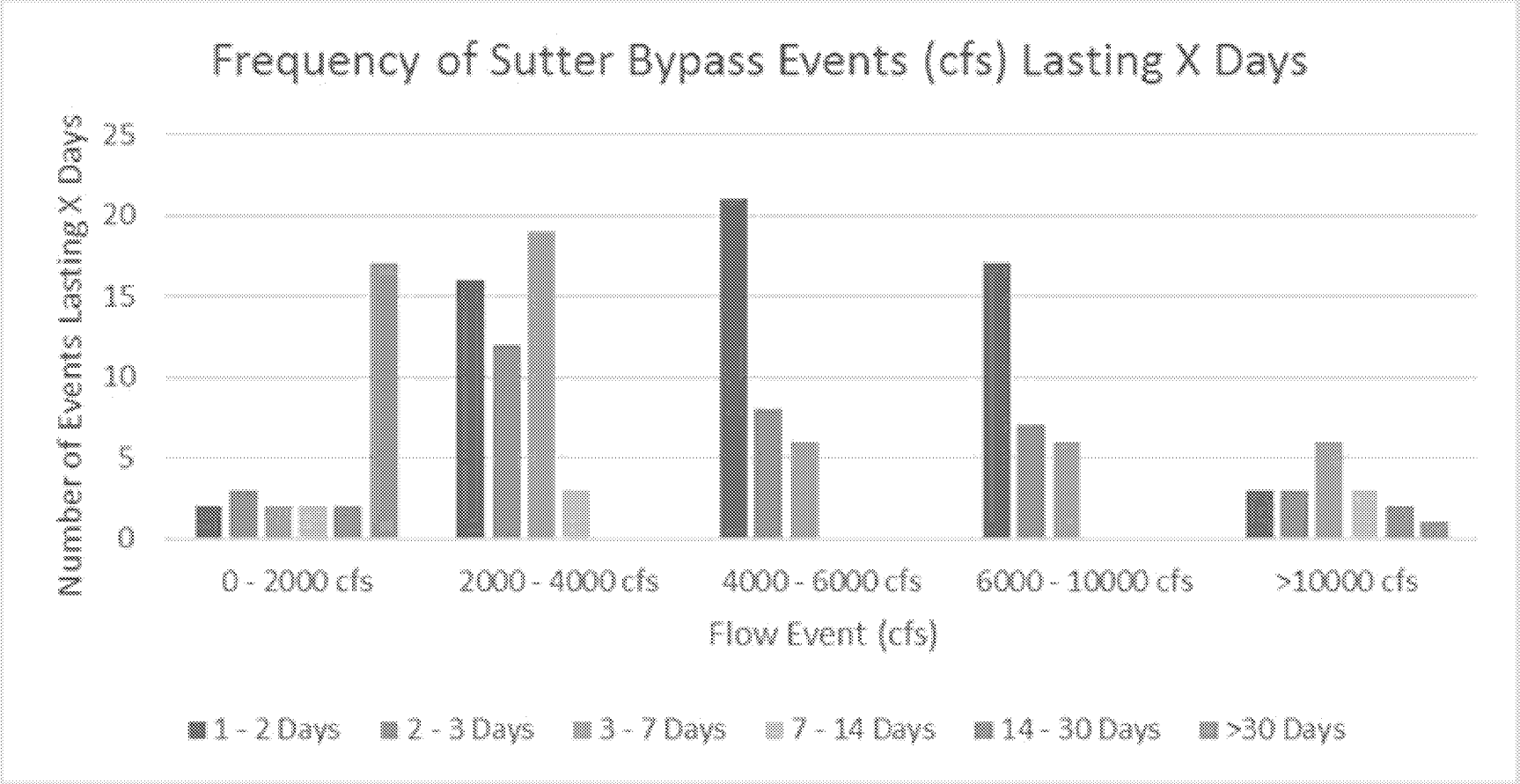
Hydrologic Relationships –Tisdale Weir vs Sacramento River



Butte Slough Flows vs Fremont Weir Spill based on Daily Modeling Tool

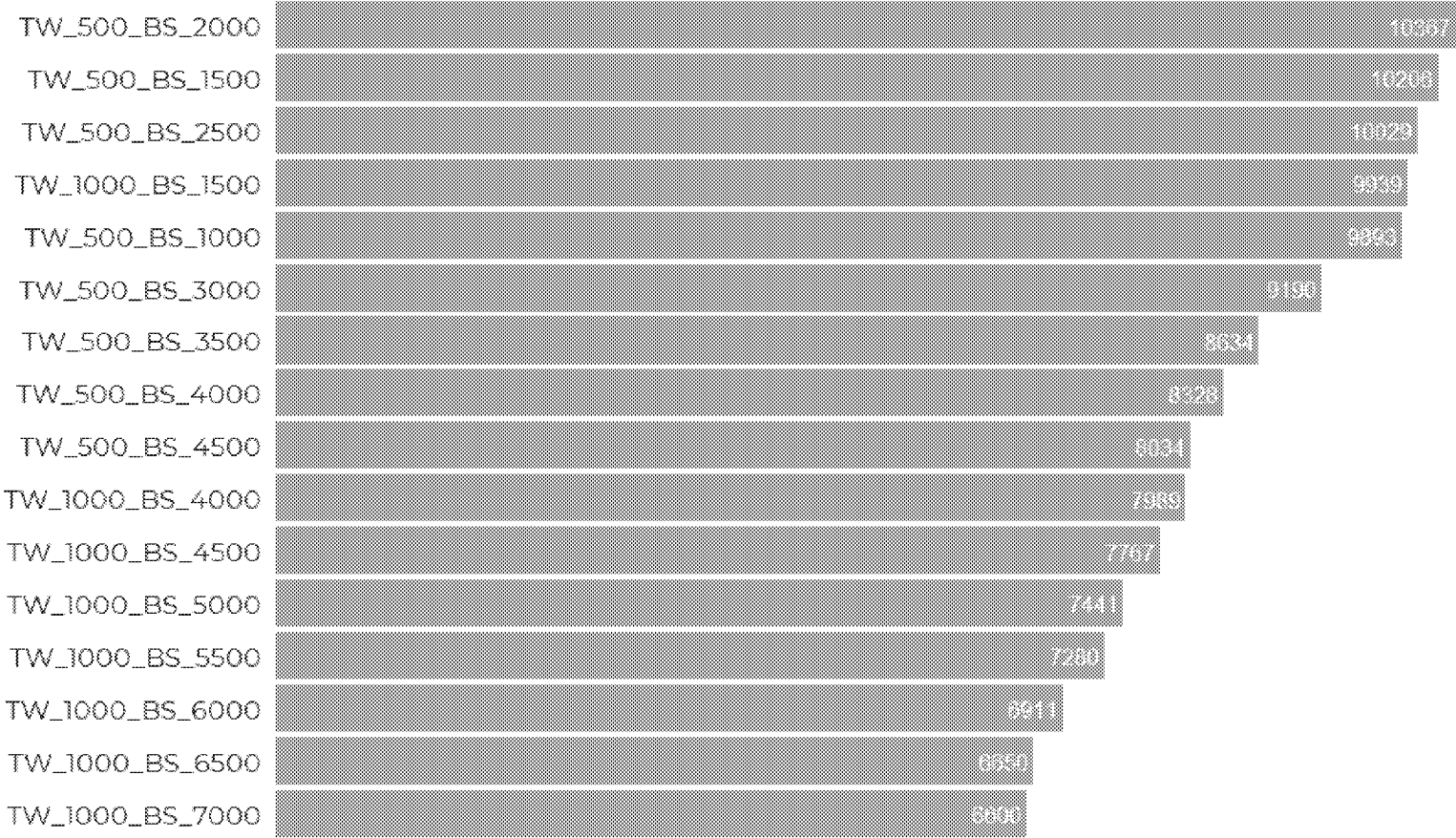


Hydrologic Relationships – Frequency and Duration of Flow Events 2008-2018



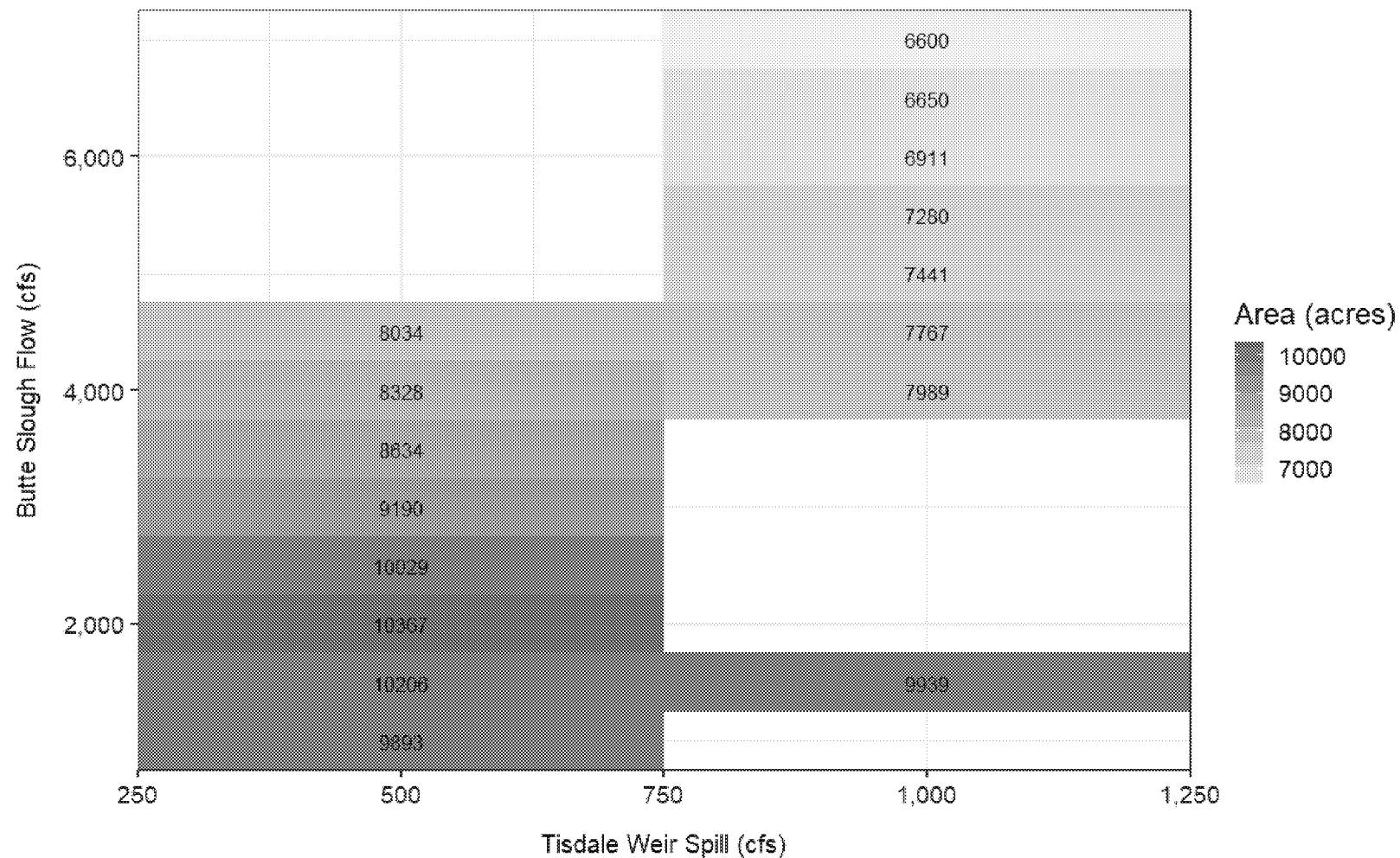
Preliminary Results

Total Inundation Area for Each Scenario that Meets Criteria



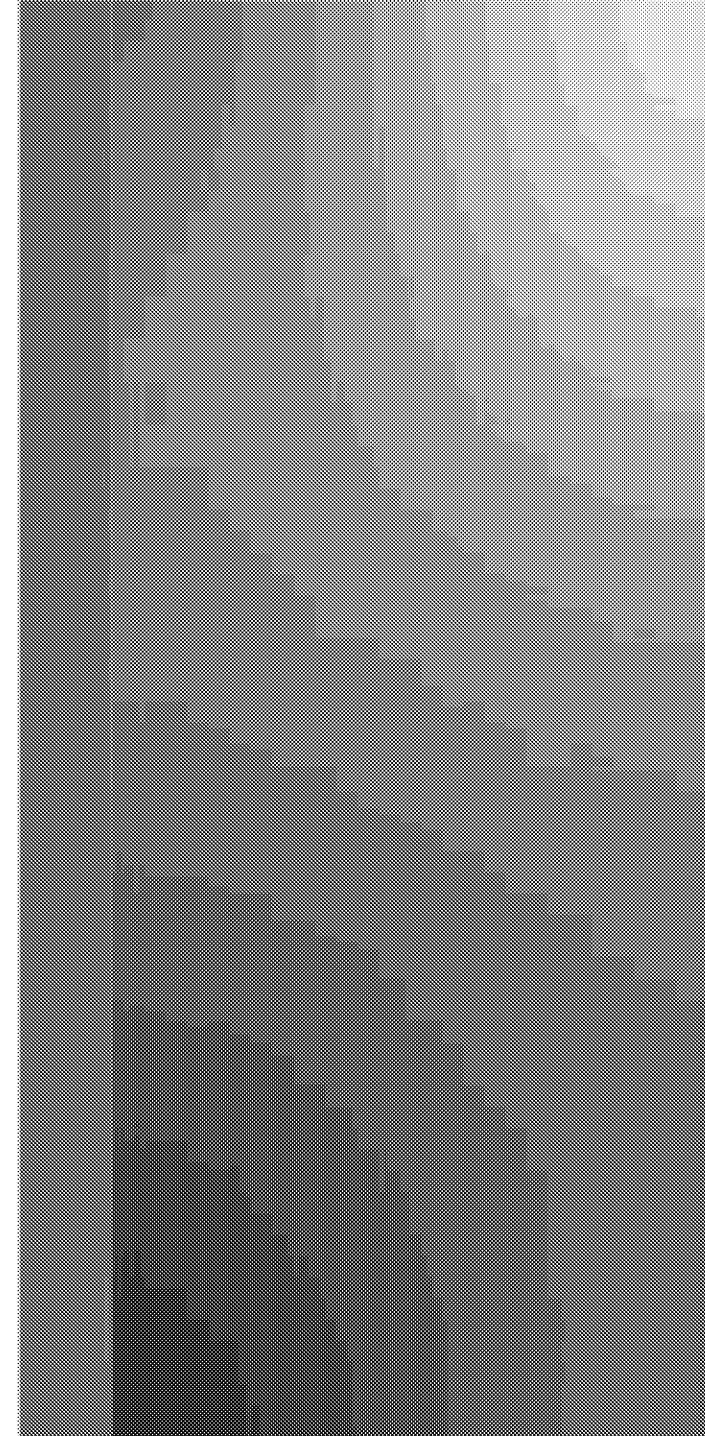
TW: Tisdale Weir Spill | BS: Butte Slough Flow

Total Inundation Area for Each Scenario that Meets Criteria

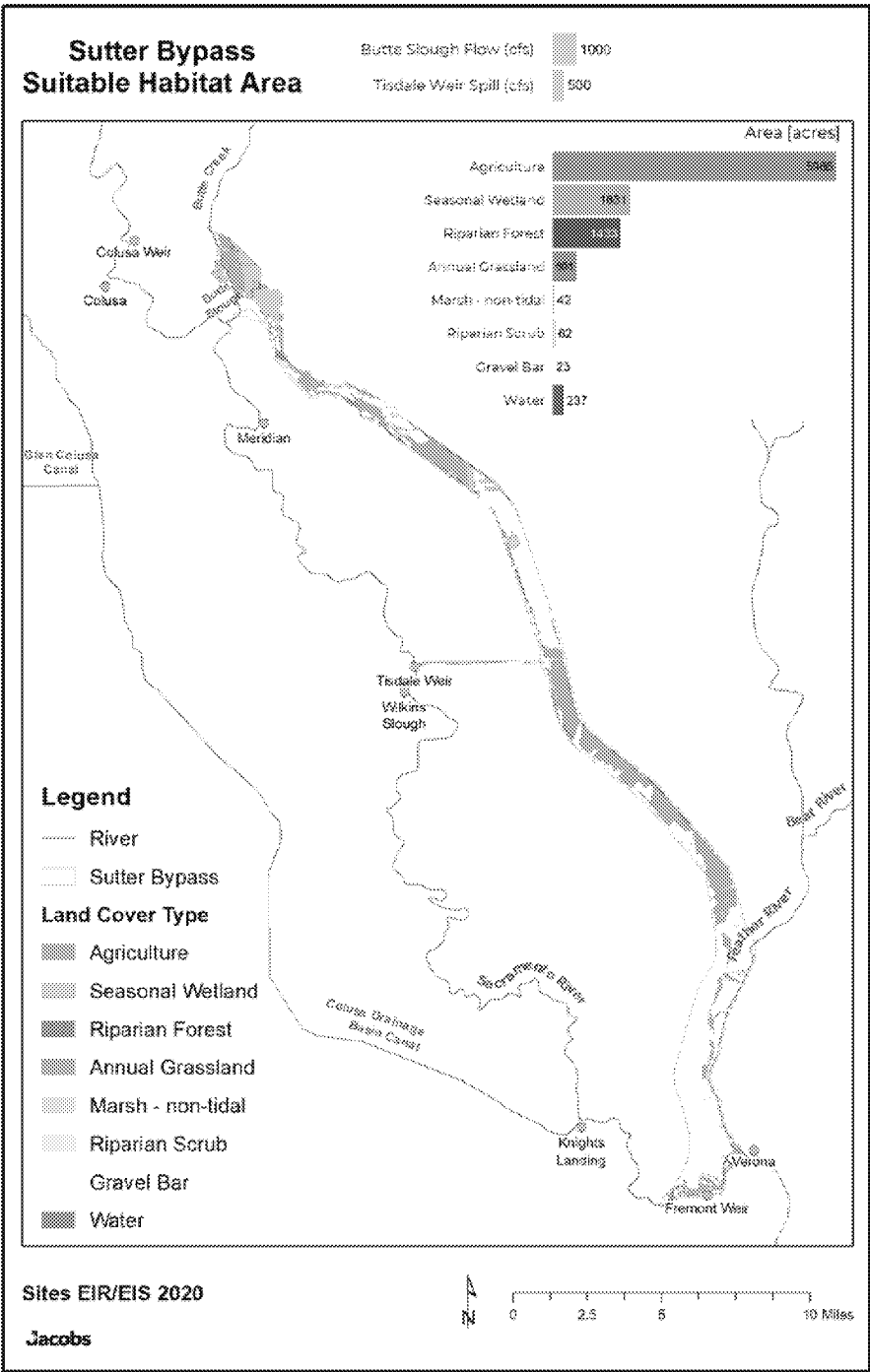


Habitat Inundation Maps

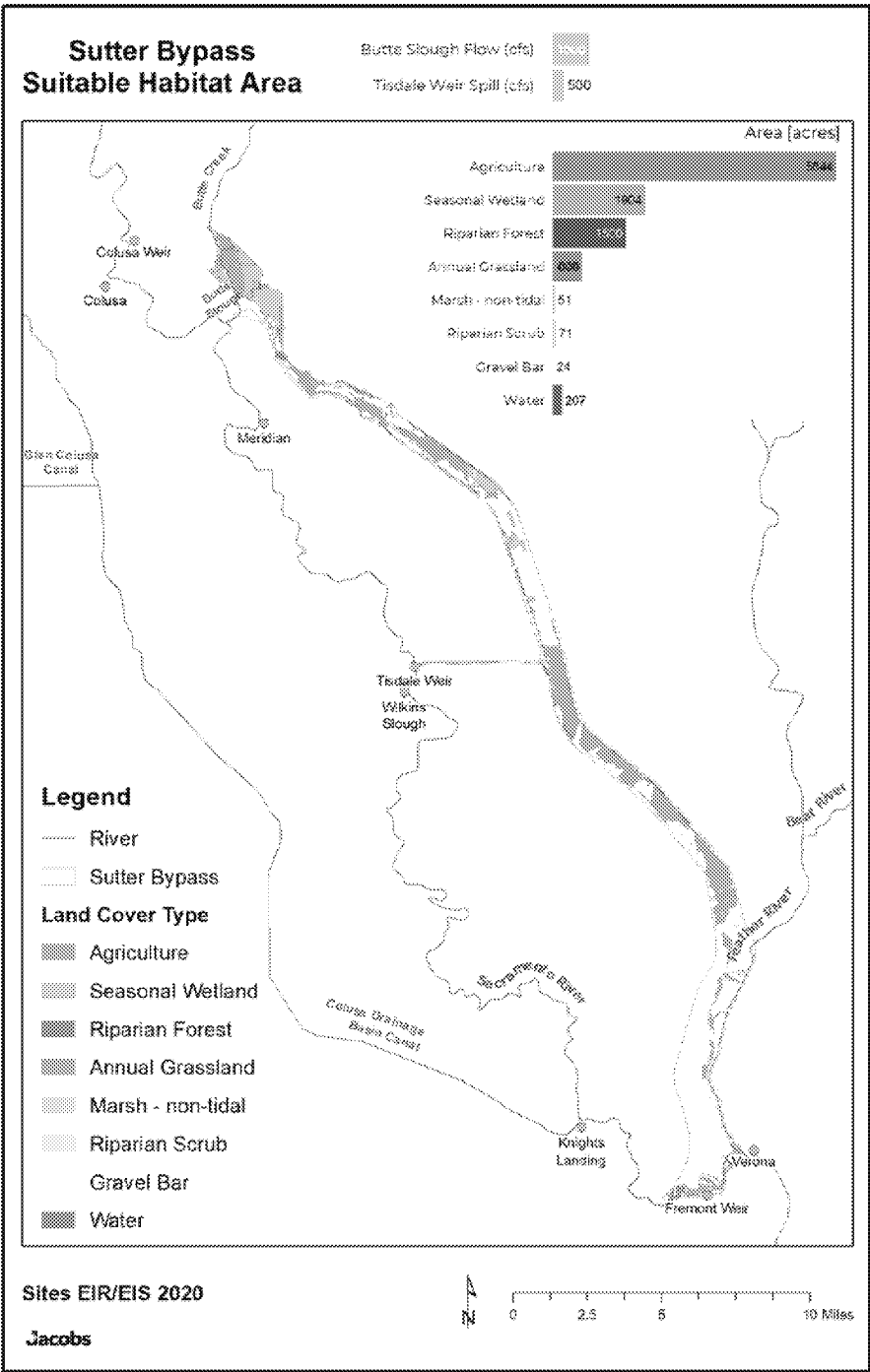
Tisdale Weir Spill = 500 cfs



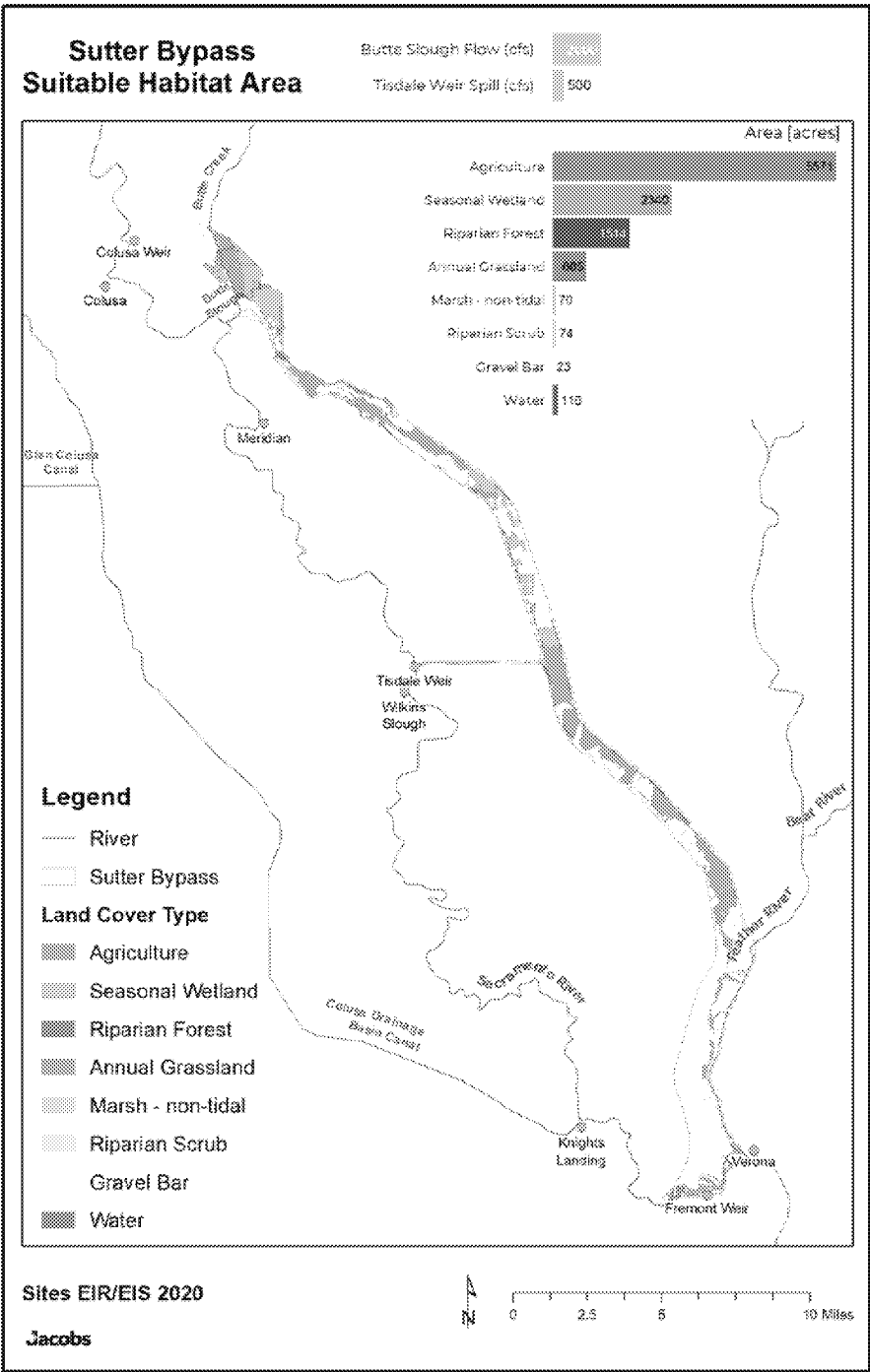
Inundation Maps



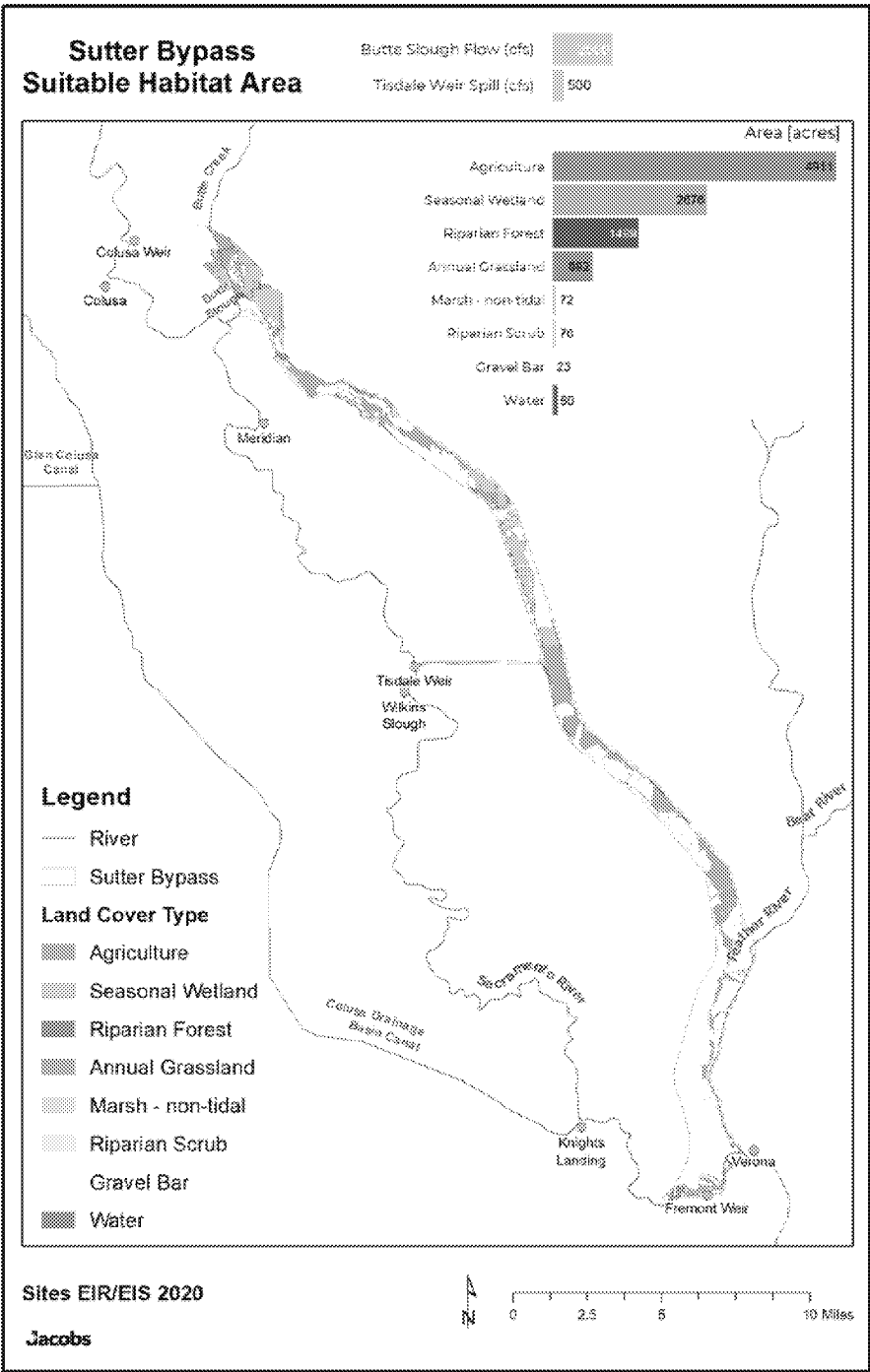
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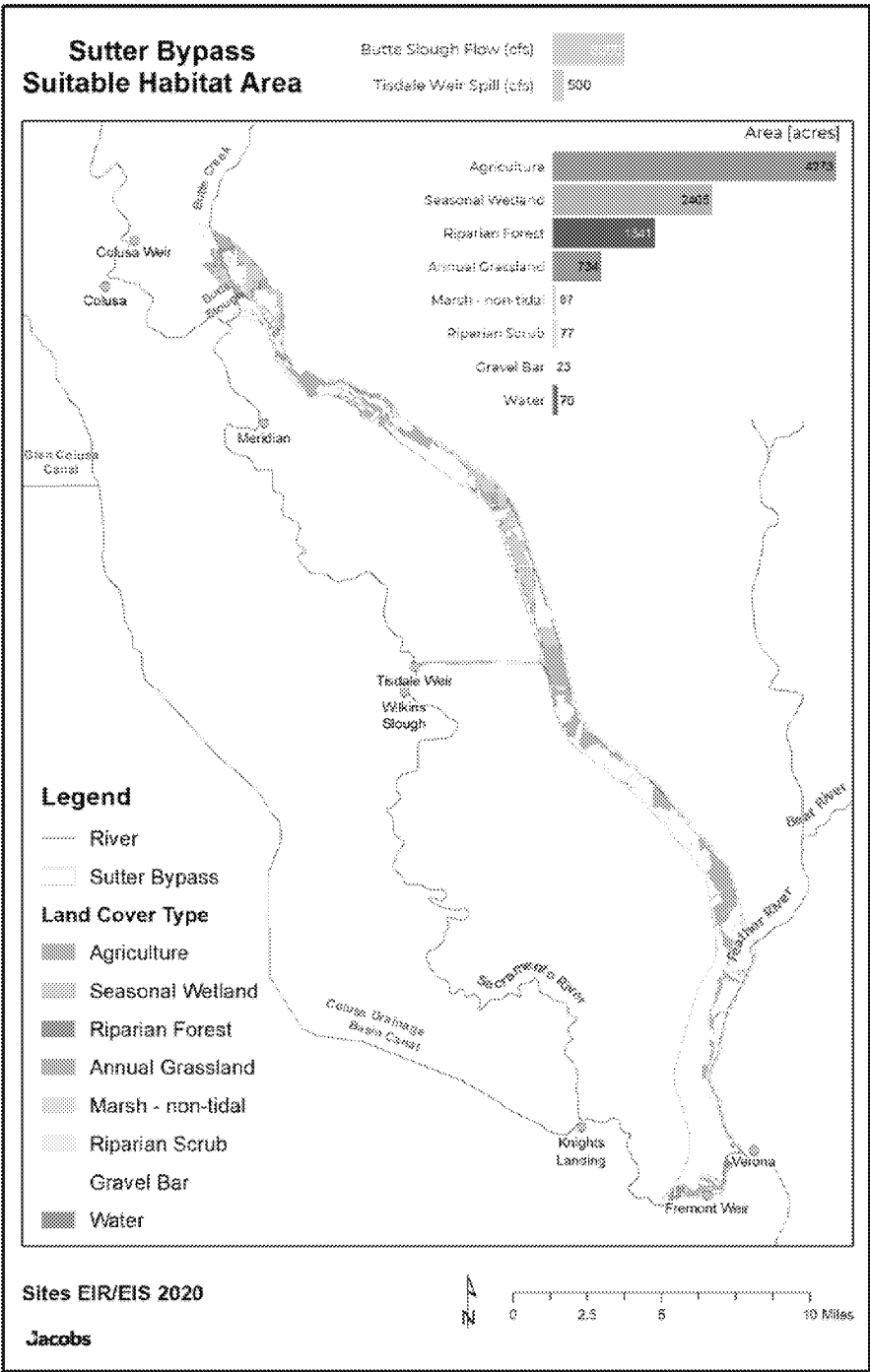
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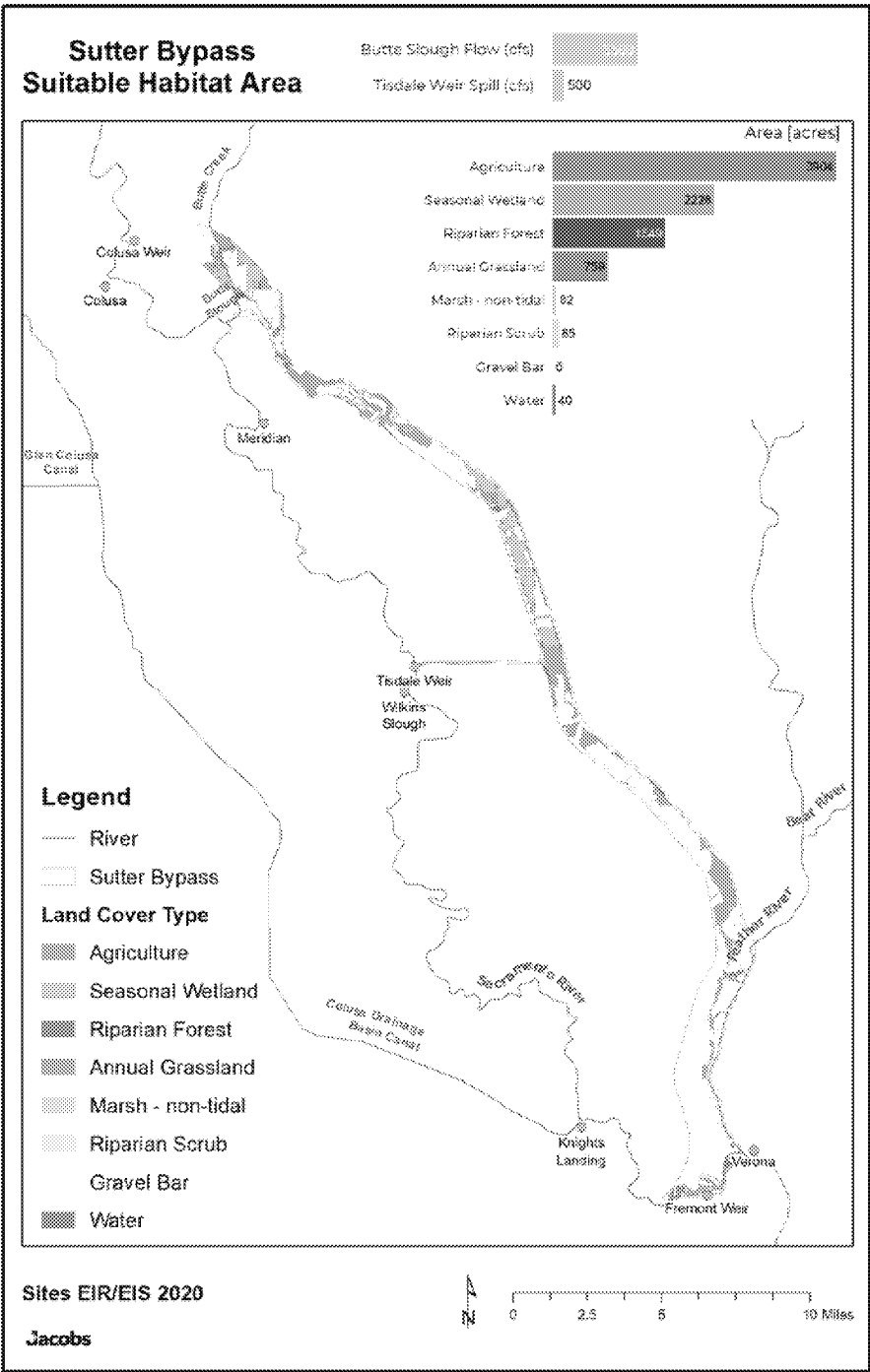
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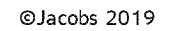
Inundation Maps



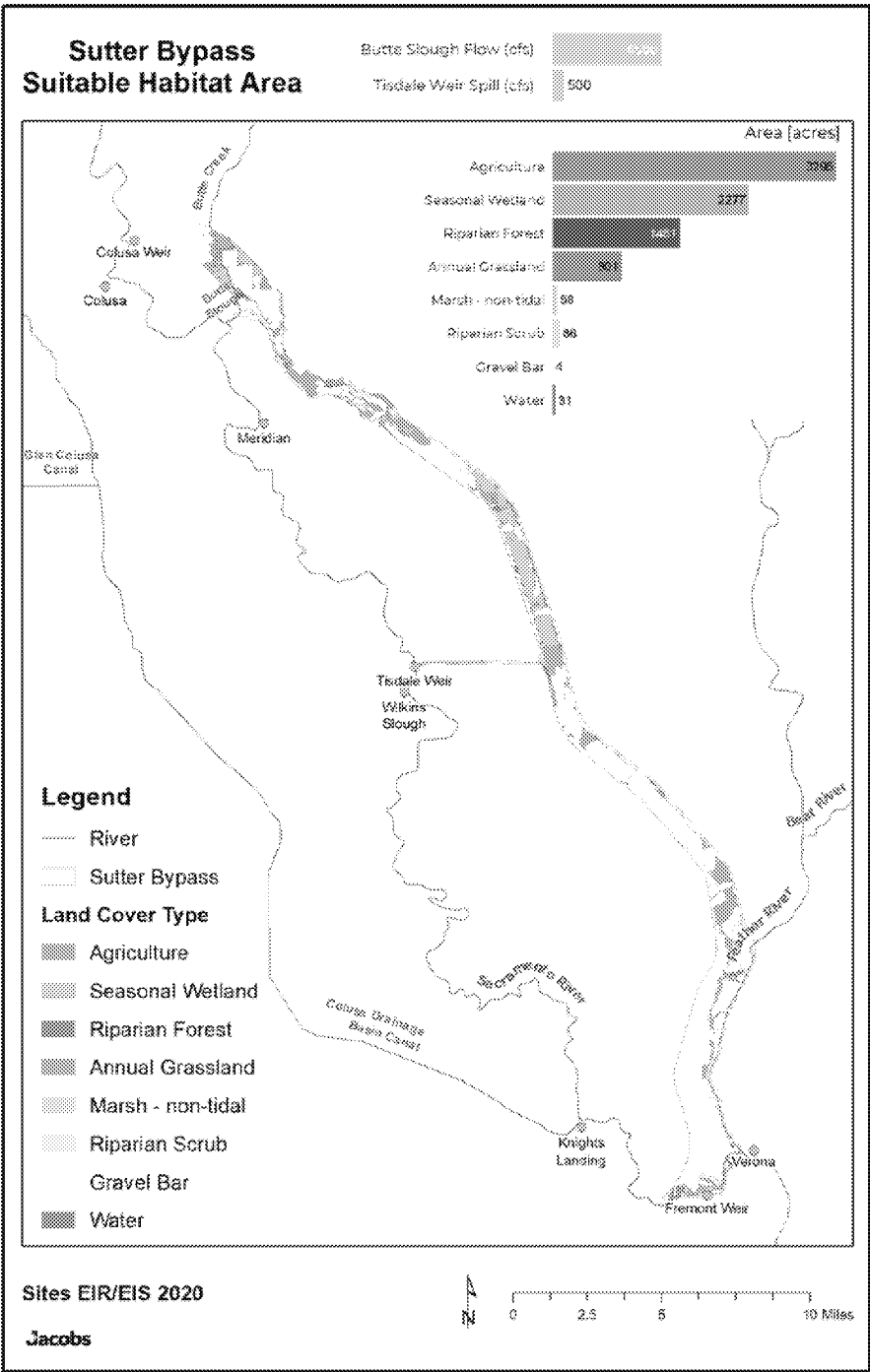
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31

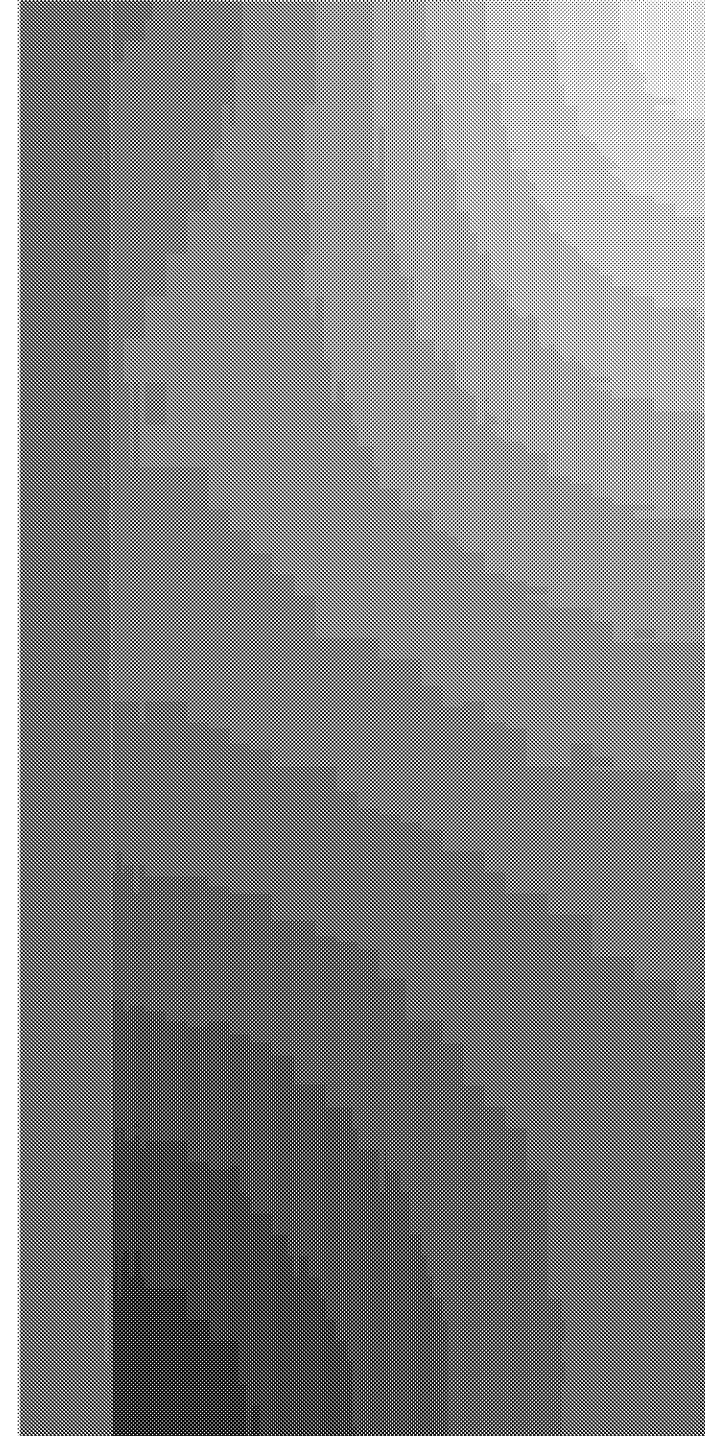


Inundation Maps

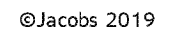


Habitat Inundation Maps

Tisdale Weir Spill = 1000 cfs

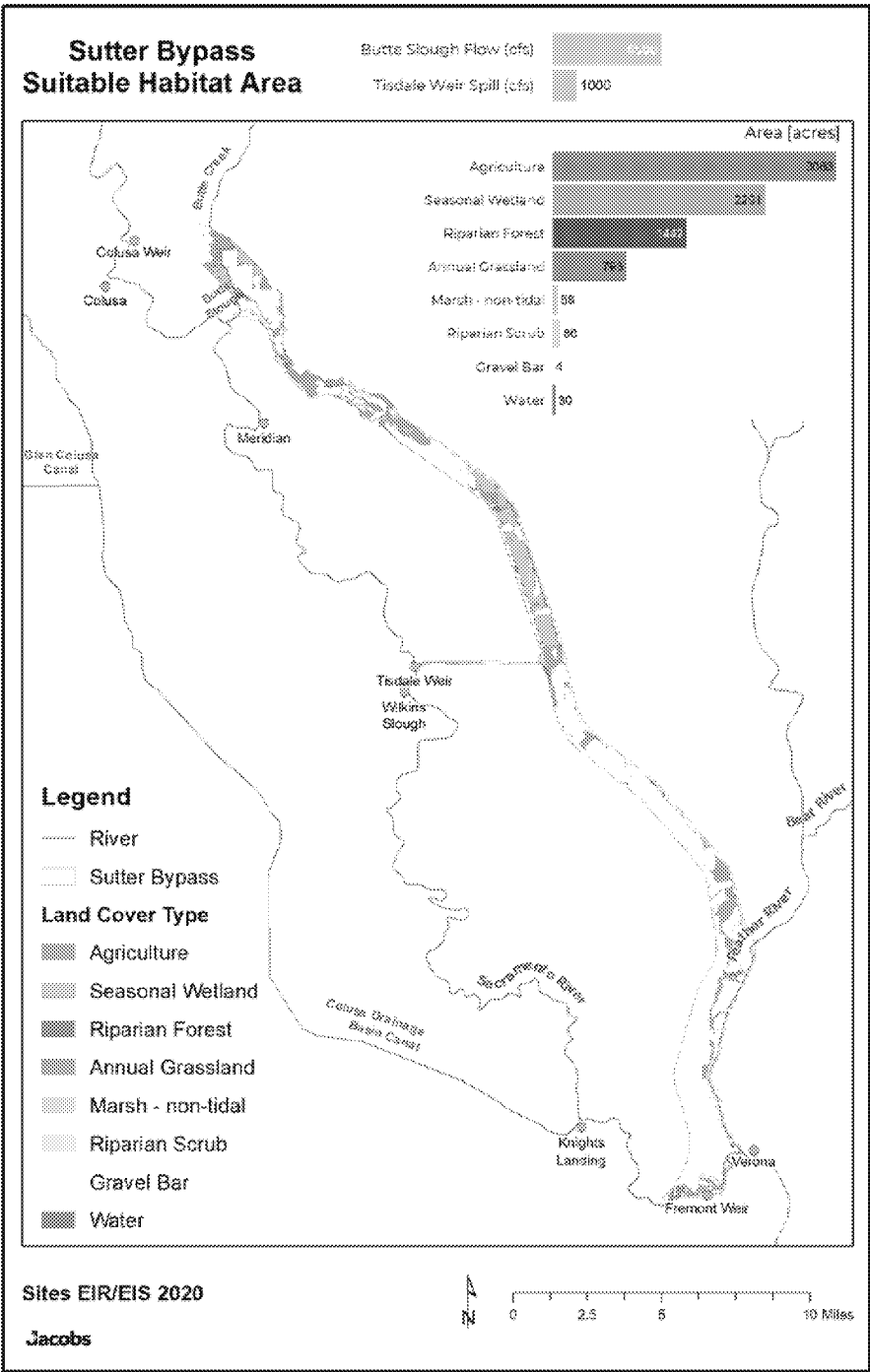


34

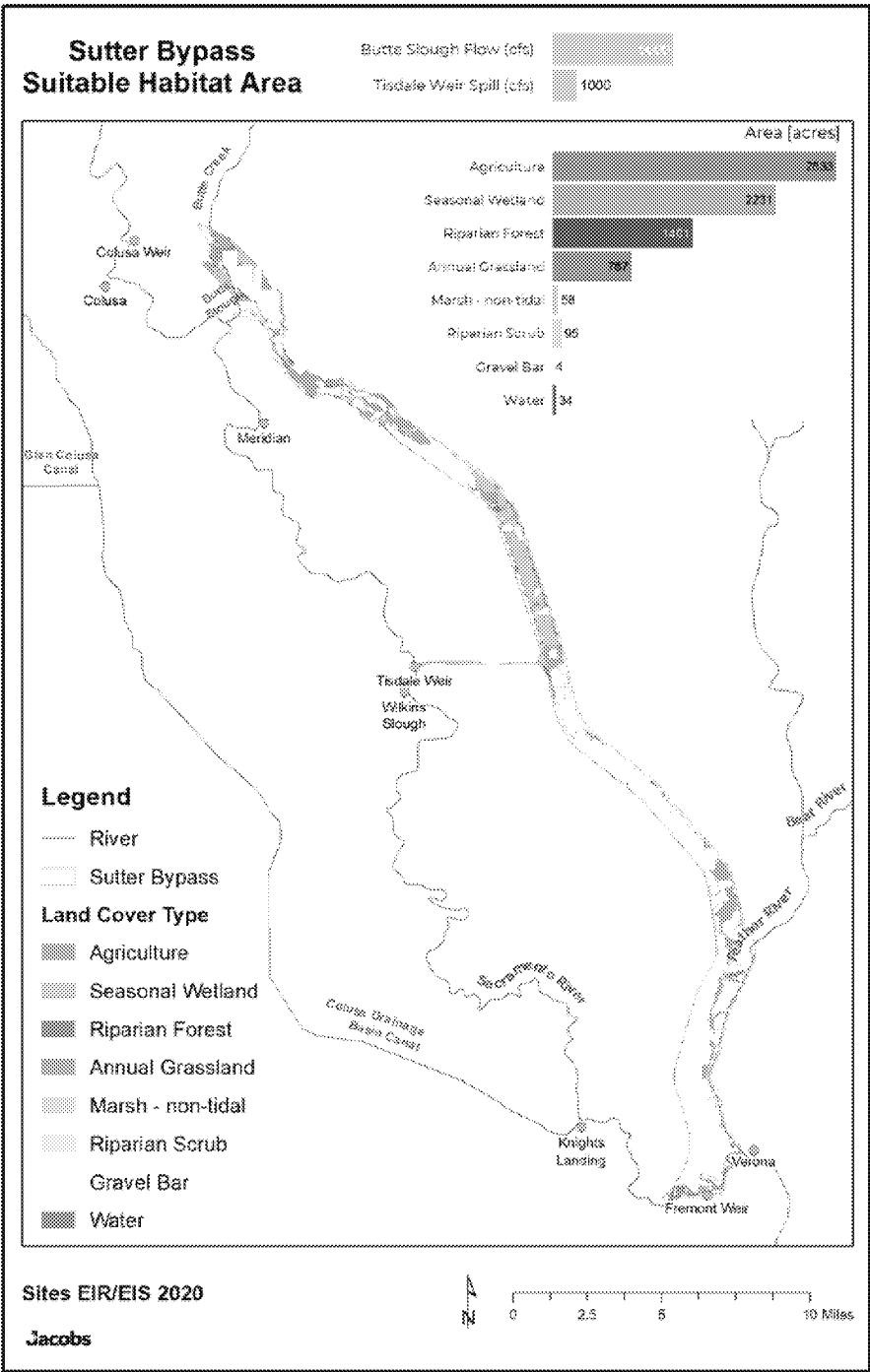
**Sites EIR/EIS 2020**

Jacobs

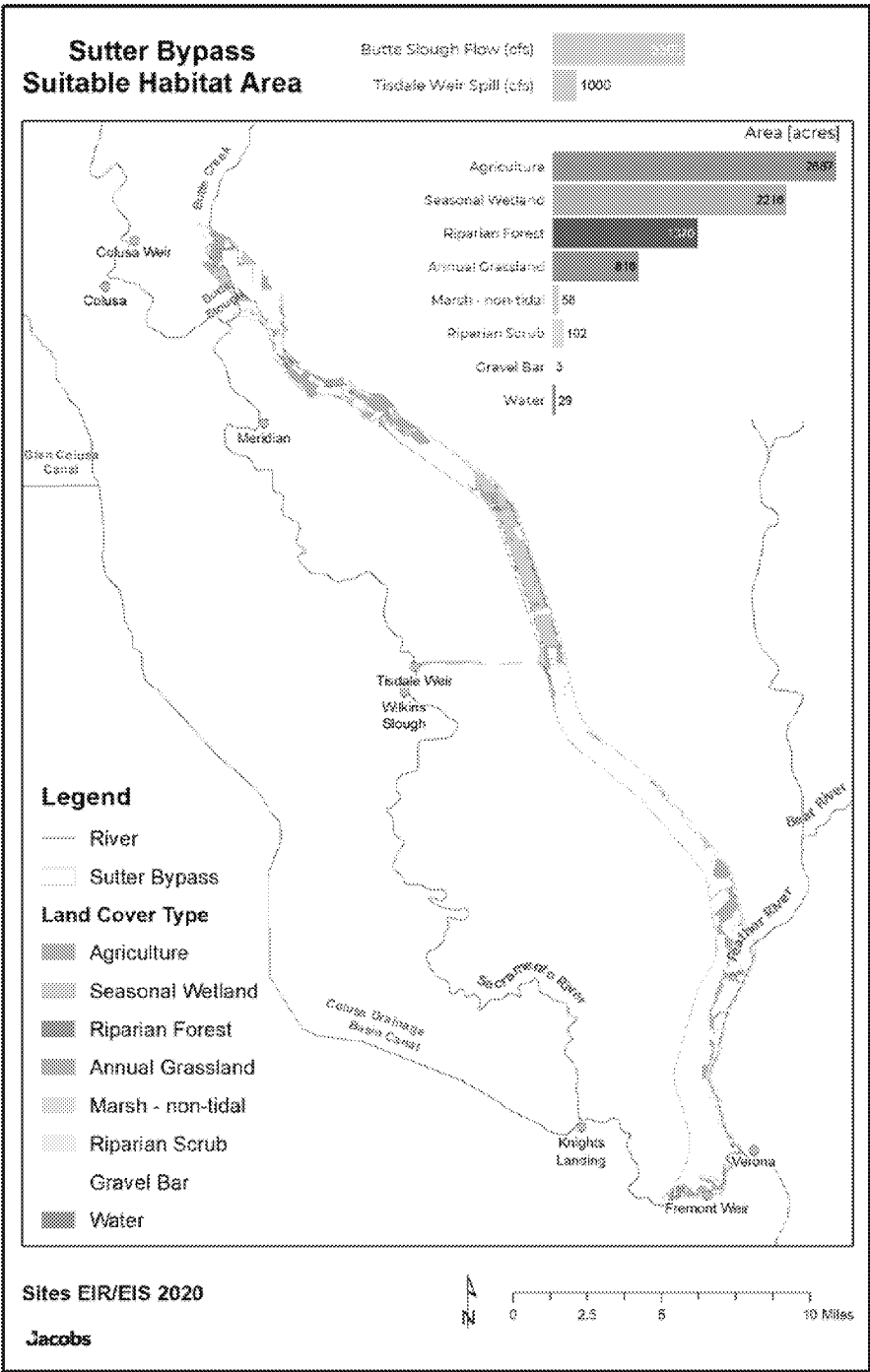
Inundation Maps



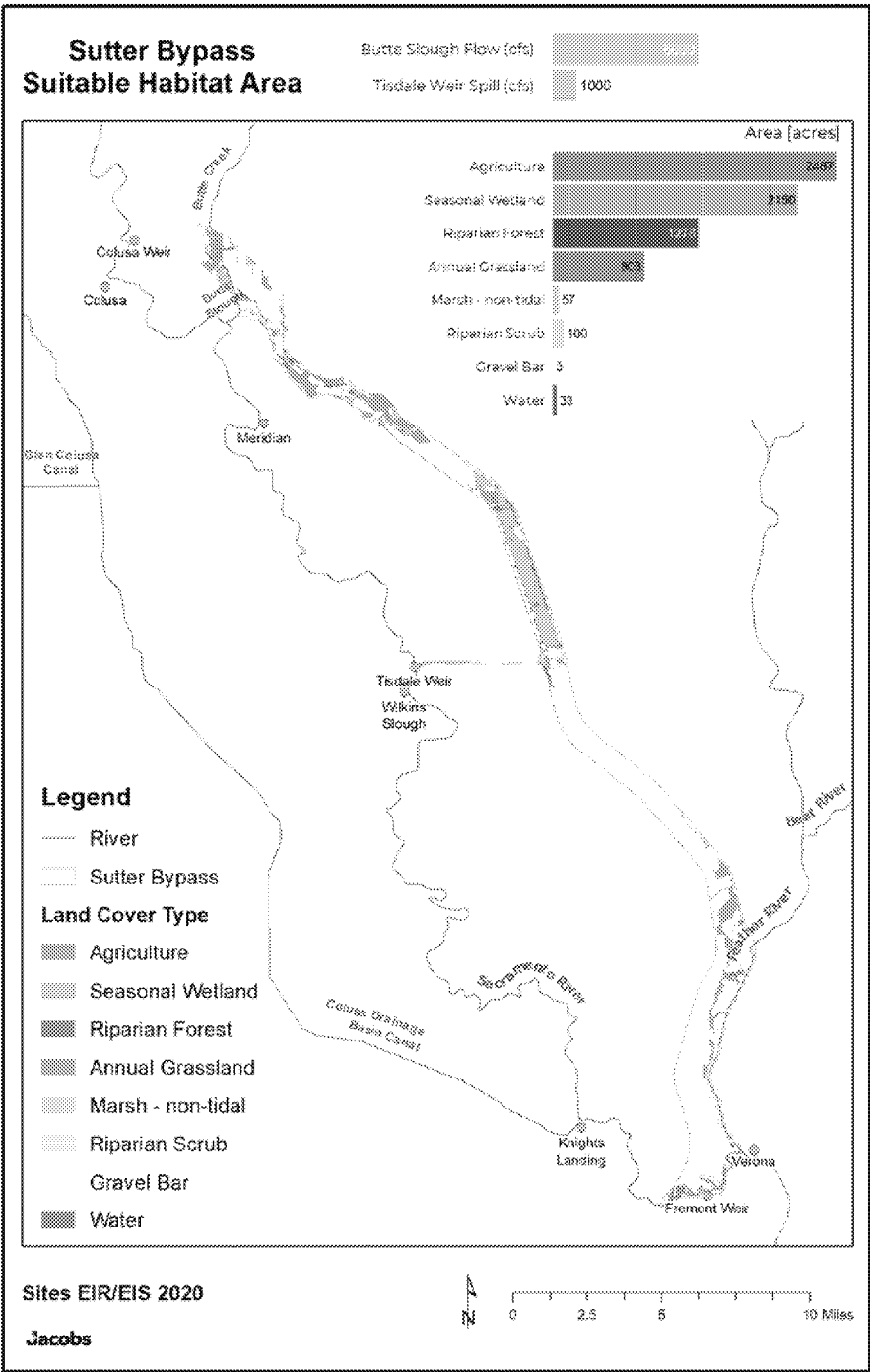
Inundation Maps



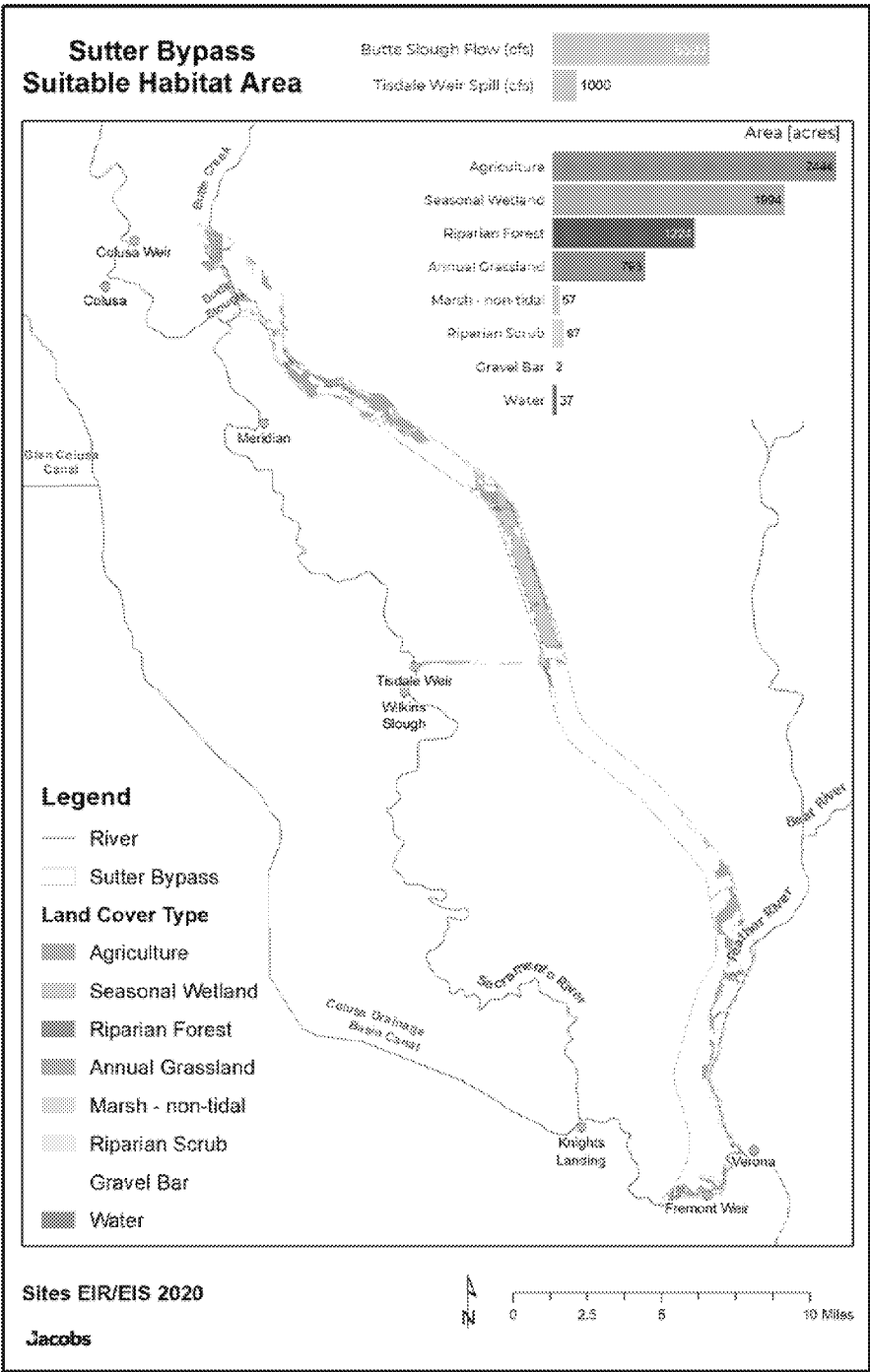
Inundation Maps



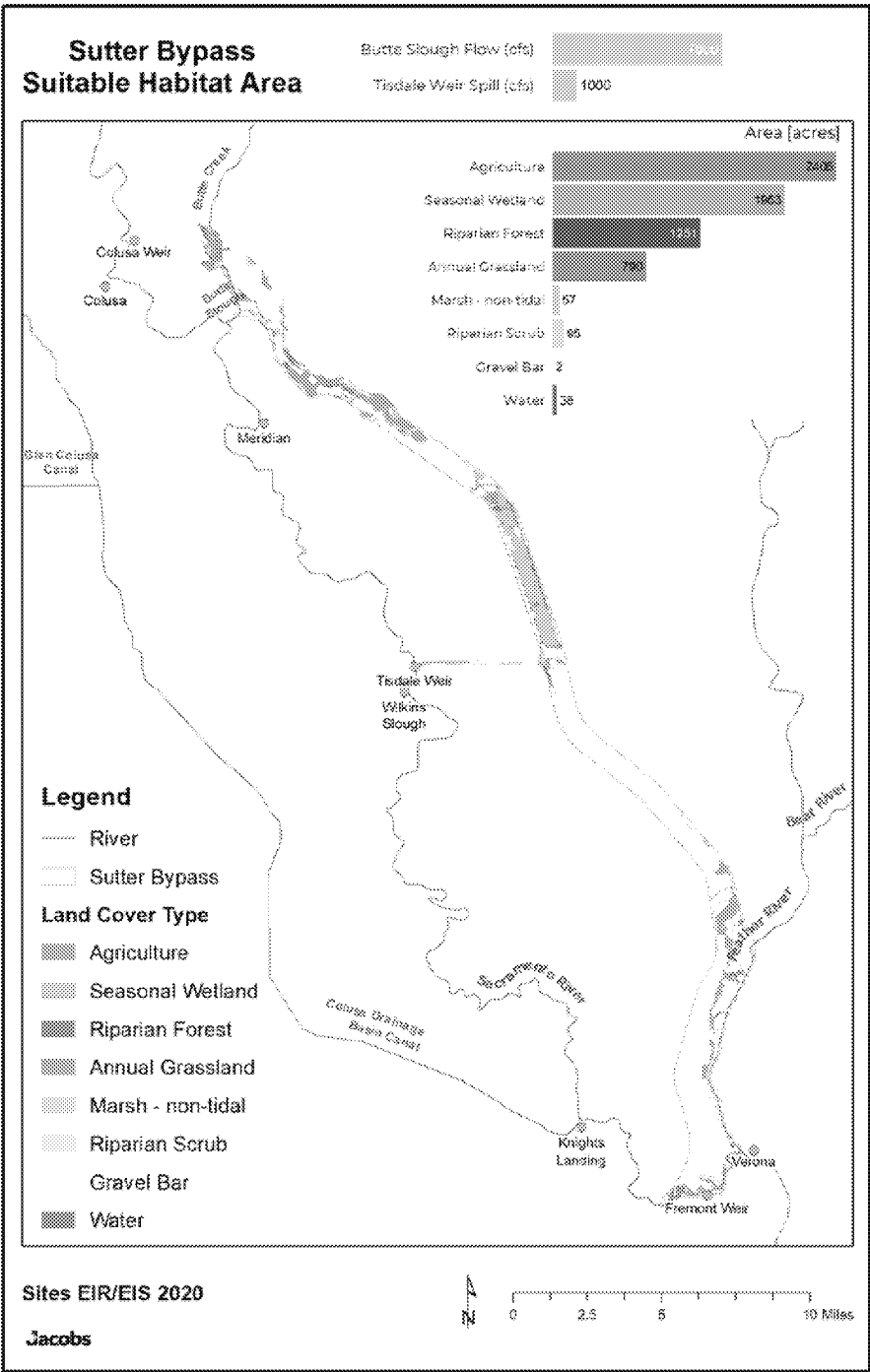
Inundation Maps



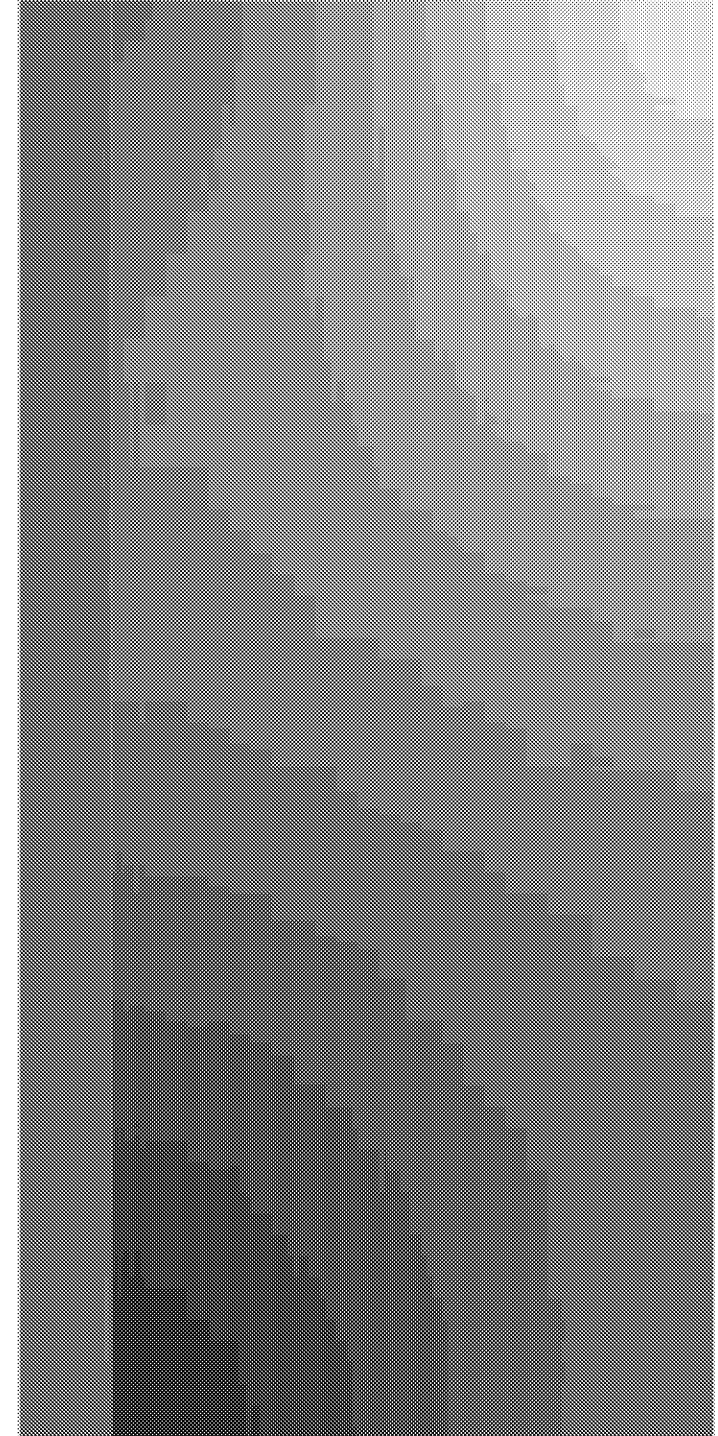
Inundation Maps



Inundation Maps



Preliminary Trends



Preliminary Observations and Trends – Floodplain Inundation Areas

- At lowest flows (Tisdale = 500 cfs, Butte Slough = 1,000 cfs)
 - Floodplain habitat occurs in primarily agricultural areas in southern portion of bypass, and some in northern areas
- As flows increase, habitat occurs more in the mid to upper reaches of bypass, and tends to occur in more seasonal wetland and riparian land covers
- Largest amount of usable habitat areas occurs at lower flows through Tisdale Weir, and Butte Slough flows of around 2,000 cfs

Preliminary Observations and Trends - Hydrology

- Sutter Bypass flows tend to be very flashy, and do not necessarily occur with the frequency (floodplain inundation every 2-3 years) and duration (minimum 7 days) to satisfy salmonid rearing criteria.
- Flows that meet the critical depth and velocity criteria tend to occur on the rising or falling limb of these larger events

Preliminary Observations and Trends - Recommendations

- Sites operations may be able to increase the quality and quantity of floodplain habitat areas in the Sutter Bypass by:
 - Targeting diversions / releases that optimize floodplain activation flows in the Bypass
 - Trying to increase the frequency and duration of those optimal flows in the Bypass
- In general, Sacramento River flows of 20,000 – 25,000 cfs at Hamilton City appear to be critical for initiating and optimizing floodplain rearing habitat in the Sutter Bypass

Identification of Floodplain and Off-Channel Habitats and Inundation Areas on the Sacramento River

1.0 Introduction

The Sites Project operations plan prepared for the Water Storage Investment Program application considered potential requirements regarding the amount of flow that could be diverted to fill the project (the bypass criteria). Flows are an important factor in the distribution, availability, and quality of aquatic, floodplain, wetland, riparian, and terrestrial habitats along the Sacramento River, and the geomorphic processes that support habitat development. More information is needed to determine the potential effects of Sites Reservoir diversions on Sacramento River flows, and potential impacts to habitat forming and sustaining processes, including:

- Hydrologic connectivity onto floodplains, seasonal wetlands, and riparian areas
- Geomorphic processes such as bank scour, channel avulsion, bar formation, and secondary channel formation
- Activation of existing side-channel and back-channel features

The purpose of this analysis is to evaluate potential effects of Sites Reservoir diversions on Sacramento River ecologically-important riverine habitats and features, including riparian, seasonal wetlands, and floodplain habitats, as well as side-channel and back-channel areas. This is a screening level evaluation of:

- 1) The species that utilize these floodplain habitats, and their critical habitats, processes, and hydraulic dependencies
- 2) The distribution and total area of natural habitat features along the Sacramento River corridor
- 3) The amount of floodplain inundation that occurs at specific flow profiles
- 4) The ranges of flows that activate and inundate secondary channel features

This document provides the methods used for this evaluation, preliminary results, and a brief discussion of relevant considerations for the design and operation of the Sites Project.

2.0 Methods

This evaluation was performed in the following sequence:

- 1) Development of a “framework” that identifies the key species and habitats along the Sacramento River channel corridor, and determination of the hydraulic dependencies, ecological processes, and criteria for these identified species and habitats.

- 2) Identification of the distribution and areas of natural habitat features.
- 3) Using hydraulic modeling output, development flow -area relationships that identify the amount of floodplain inundation that occurs for a given flow profile.
- 4) Development of flow- area – depth relationships that integrates salmonid floodplain rearing habitat depth criteria.

The study area was divided into three reaches:

- 1) Bend Bridge (location of USGS stream gage 11377100) to Hamilton City¹
- 2) Hamilton City to Delevan
- 3) Delevan to Knight's Landing (including the Sutter Bypass)

Three reaches of the Sacramento River were identified to determine the regional hydraulic effects of potential diversion locations being considered for the Sites Project; at the Tehama Colusa Canal intake (at the Red Bluff Diversion Dam), the Glenn Colusa Irrigation District Canal intake (at Hamilton City), and a potential new intake by Delevan Pipeline.

2.1 Ecological Framework

The Sacramento River channel between Bend Bridge and Knights Landing is a sinuous, meandering river that supports a complex, inter-connected mosaic of dynamic floodplain habitats. Off-channel habitat features are formed by active geomorphic processes such as channel migration, chute-cutoff, and avulsion resulting from successive sequences of scour, deposition, and vegetation colonization and succession. These areas provide important rearing habitat for juvenile salmon including the runs of Chinook salmon (*Oncorhynchus tshawytscha*) that occur in the Sacramento River basin (Bjornn and Reiser 1991, Sommer et al. 2001, Limm and Marchetti 2003, Jeffres et al. 2008, Limm and Marchetti 2009). These areas also provide habitat for Western Pond Turtle (*Clemmys marmorata*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychochelilus grandis*), and California roach (*Hesperoleucus symmetricus*), as well as non-native species, such as largemouth bass, bullfrogs, and red-eared sliders (Kondolf and Stillwater Sciences, 2007). Recent research on environmental factors that are influential in determining outmigration success for Chinook salmon on the Sacramento River found that off-channel habitat availability was positively correlated to survival, but to a lesser extent than flow in the main channel (Iglesias et al. 2017).

A preliminary “ecological framework” was developed to identify the key species, habitats, processes, and hydraulic dependencies and criteria of the off-channel floodplain and near-bank areas along the Sacramento River corridor, with an emphasis on conditions that are preferential for salmonid rearing. It is important to note that the in-channel areas (defined by the permanently-wetted radius of the Sacramento River channel), are being considered and evaluated in a parallel analysis of the relative sensitivities of four focal fish species (Sacramento River ESU winter-run Chinook salmon, Central Valley ESU spring-run Chinook salmon, California Central Valley DPS steelhead, and southern DPS green sturgeon) to changes in Sacramento River flows at and below Red Bluff. The fundamental premise for this framework is that maintaining connectivity between the main channel and floodplain habitats

¹ For the habitat area mapping, Bend Bridge was used as the upstream boundary for the study reach to capture any effects on the habitat upstream of Red Bluff due to the diversions at the Red Bluff intake.

sustains multiple geomorphic and ecological processes that improve rearing conditions and benefit juvenile salmonids (Ahearn et al. 2006; Jeffres et al. 2008).

The ecological framework was used to identify the key hydrologic and hydraulic parameters affecting ecological conditions along the channel corridor, and guide further evaluations of the potential effects of Sites Reservoir diversions on Sacramento River flows and habitat forming and sustaining processes.

2.2 Habitat Feature Identification and Mapping

Habitat features identified in the ecological framework were quantified and mapped using recent GIS data developed for the California Department of Water Resources (DWR) to assist with the development of the Central Valley Flood Protection Plan (CVFPP). The *Fine-Scale Riparian Vegetation Mapping of the Central Valley Flood Protection Plan Area* dataset was developed by DWR in collaboration with the California Department of Fish and Wildlife (CDFW), the Geographical Information Center (GIC) at California State University, Chico, and the California Native Plant Society (CNPS). The data consists of a highly detailed vegetation classification system and a fine-scale vegetation map of the Central Valley, including the study area used in this analysis. This dataset maps vegetation communities to the National Vegetation Classification Standard (NVCS) Alliance Level, and is based on 2009 NAIP satellite imagery and field reconnaissance. As part of the development of the CVFPP, these vegetation alliances were “lumped” into various habitat units.

For the purposed of this analysis, the following habitat units were utilized:

- Bare sand and gravel
- Non-tidal marsh
- Seasonal wetland
- Riparian scrub
- Riparian forest
- Annual grassland

The CVFPP Conservation Strategy Appendix F (DWR, 2017) describes the processes and assumptions used in the development of these habitat units from the Fine Scale Vegetation Mapping dataset.

Emphasis was placed on identifying, quantifying, and mapping natural habitats that could potentially support the species and processes identified in the ecological framework, or that could be influenced by the hydraulic effects of the diversions being considered by the Sites Project. All other areas, including upland forests, developed lands, agricultural lands, and areas dominated by invasive species (such as *Arundo donax* (giant reed) and *Rubus armeniacus* (Himalayan blackberry)) were excluded from the mapped areas.

Areas of the mapped habitat units were quantified. A total area of potentially available floodplain habitat (represented by the total sum of all of the natural habitat units along the channel corridor) was also calculated.

For this analysis, secondary channels and off-channel shallow water habitat features were identified and mapped according to research done in a 2007 report for The Nature Conservancy (TNC) by G. Mathias Kondolf (UC Berkeley) and Stillwater Sciences entitled *Sacramento River Ecological Flows Study: Off-Channel Habitat Study*. This study identified and mapped 44 off-channel features such as oxbow lakes,

sloughs, side channels, and secondary channels along the Sacramento River corridor (within Reaches 1 and 2 of this analysis), and estimated the discharge magnitudes required to inundate 17 different low-elevation secondary channel features (scour channels on point bars) to create seasonal, shallow-water habitat.

The data presented in the Kondolf and Stillwater Sciences, 2007 study was used to determine the locations of these low-elevation secondary channel features, the flows at which those features begin to become activated (inundated), and the flows at which those features become fully connected (contiguous) to the main channel (allowing fish to move freely between the interior portions of the secondary channel features and the main Sacramento River channel).

2.3 Flow- Inundation Area Analyses

Using output from the HEC-RAS 1D hydraulic model coupled with the LiDAR terrain model described in Appendix C, inundation areas were calculated for 40 steady-state flow profiles from 5,000 cfs to 55,900 cfs along the three study reaches. These inundation areas were then overlaid onto the habitat areas derived from the *Fine-Scale Riparian Vegetation Mapping* dataset, and intersected to calculate the total amount of inundated habitat within each study reach for a given flow profile. This analysis provided an initial estimate of the relationship between flow and area of inundated floodplain habitat along the Sacramento River channel corridor.

Several studies have correlated water depths and water velocities with the utilization of floodplain habitats by salmonids. For example, in the Trinity River, a U.S. Fish and Wildlife (USFWS) study found that floodplain utilization for chinook salmon and steelhead fry and juveniles decreased when water depths were greater than about 5 feet, and velocities exceeded about 2 feet/second (Hampton et al, 1997). To get a more refined understanding of the potential utilization of these floodplain habitat areas by outmigrating salmonids, the depth criteria from the Trinity River study was incorporated into the analysis. Using the HEC-RAS 1D hydraulic model, the flow-inundation area analyses were reevaluated *excluding* all inundated areas greater than or equal to 5 feet in depth.

Off-channel habitat units along the main channel corridor within all 3 reaches were included in the flow-inundation area analyses. However, although the bypasses (including the Sutter Bypass and the northern end of the Yolo Bypass) are within the Reach 3 study area boundary, they were *excluded* from these preliminary flow- inundation area analyses. It is anticipated that in subsequent iterations of these analyses, the bypasses will be included and integrated into the Reach 3 results.

3.0 Results and Discussion

3.1 Ecological Framework

The ecological framework developed for this analysis was intended to provide an initial understanding of the species that could potentially be affected by changes in the hydrology of the Sacramento River that could impact the off-channel floodplain areas as a result of the Sites Project diversion. These species were identified using a variety of datasets, including the Sites Reservoir Project EIR/EIS (SPA and Reclamation, 2017), the Sacramento River Ecological Flows Tool (Sac EFT) (TNC and ESSA, 2012;

Alexander et al., 2014), the CVFPP Conservation Strategy, especially Appendix G: Identification of Target Species and Focused Conservation Plans (DWR 2107a; DWR 2017b), and the CVFPP Sacramento River Basinwide Feasibility Study, especially Appendix I-E: Yolo Bypass Ecosystem Concept Development and Modeling (DWR 2017c). These references provided a wealth of information about these potentially affected species (in this case, potentially affected by changes to the hydrology of Sacramento River that could alter hydraulic connectivity between the channel and floodplain areas), including the geomorphic, hydrologic, and ecological processes that are critical for their survival, their habitat usage, and their specific hydrologic dependencies (criteria).

This information was summarized into a preliminary matrix (Table 3-1). This list was not intended to be exhaustive, and many potentially affected species were originally included and then discarded because their usage of these off-channel habitat areas were either poorly understood or unverified, or the potential affects to the species as a result of changes to floodplain inundation hydrology were determined to be insignificant. Due to the rapid nature and limited scope of this study, and because the primary focus of this phase of the evaluation is on floodplain rearing habitat for salmonids, many of the species on Table 3-1 were not directly addressed in the preliminary analysis. These species are indicated by the gray shading in their respective rows. However, subsequent phases of this study may further evaluate off-channel utilization by these other species, and potential impacts as a result of hydrologic changes resulting from the Sites Project.

Floodplain inundation timing, duration, and frequency are critical variables that influence the functionality and usability of floodplains as rearing habitat by salmonids (Jeffres et al., 2009; Matella and Jagt, 2014). Table 3-2 displays the floodplain timing, duration, and frequency variables that were used to determine floodplain habitat suitability for salmonid rearing as part of the CVFPP Basinwide Feasibility Studies. In this preliminary evaluation, flow-inundation area analyses were developed using steady-state flows (i.e. not incorporating hydrologic parameters including timing, duration, and frequency), thus the results included in this analysis should only be utilized to determine the physical relationships between flow and inundated floodplain habitat areas, and not the relative biological importance of those relationships to priority fish species.

Table 3-1. Preliminary Ecological Matrix for Sacramento River Off-Channel Areas

Species	Life Stage / Habitat Use	Critical Processes	Off-Channel / Floodplain Habitat Features					Critical Hydrologic Dependencies						Potential Occurrence Location		
			Active Geomorphic Features / Secondary Channels / Point Bars	Meander Bends / Exposed Banks	Riparian Woodland and Scrub	Permanent and Seasonal Wetlands	Other Natural	Inundation Timing (month / day)	Inundation Duration (days)	Inundation Frequency (recurrence interval)	Water Depth (feet)	Velocity (ft/s)	Depth to Ground-water (ft)	Red Bluff to Hamilton City	Hamilton City to Delevan	Delevan to Knights Landing
Chinook Salmon and Steelhead	Juvenile rearing and outmigration	Floodplain activation /area, stranding, geomorphic processes	x		x	x	x	See table 3-2	Min 10 days	2 years	< 5 ft	< 2ft / s	n/a	x	x	x
	Adult migration and holding	[same as above]	x		x	x	x	See table 3-2	Min 10 days	2 years	< 5 ft	< 2ft / s	n/a	x	x	x
Fremont Cottonwood & Native Willow	Recruitment and establishment	Fine sediment deposition / seed dispersal / flow recession & GW depth / post-germination scour	x					Spring	??	timing to seed dispersal and declining stage	??	??	critical depth for soil moisture to match root growth	x	x	x
Western Pond Turtle	All	Access to secondary channel areas for foraging, nesting on terrestrial uplands	x		x	x	x	Unknown	Unknown	Unknown	n/a	Unknown	n/a	x	x	x
Bank Swallow	Nesting	Meander / scour of banks		x				n/a	n/a	n/a	n/a	??	n/a	x	x	x
	Foraging	Access to foraging habitats			x	x	x	n/a	n/a	n/a	n/a	n/a	n/a	x	x	x
Giant Garter Snake	All	Habitat availability				x		n/a	n/a	n/a	n/a	n/a	n/a		x	x
Valley Elderberry Longhorn Beetle	All	Habitat availability			x			n/a	n/a	n/a	n/a	n/a	n/a	x	x	x
Least Bell's Vireo	Foraging and nesting	Habitat availability	x		x			n/a	n/a	n/a	n/a	n/a	n/a	x	x	x
Swainson's Hawk	Nesting	Habitat availability			x			n/a	n/a	n/a	n/a	n/a	n/a	x	x	x
Western Yellow Billed Cuckoo	Foraging and nesting	Habitat availability			x			n/a	n/a	n/a	n/a	n/a	n/a	x	x	x

Table 3-2. Inundation Timing, Duration, and Frequency Criteria for Floodplain Utilization by Salmonids

Species	Juvenile Rearing			Adult Immigration	Notes
	Timing	Minimum Duration	Frequency	Timing	
Chinook salmon, Central Valley spring-run ESU	Oct ¹ to early Dec ² , and late April ²	7 to 10 days ³	2 years ⁴	Jan ¹ through July ² , peaking April through May ² in Sacramento River Jan to mid-May in Yolo Bypass ²	Benefits primarily juveniles, but also yearling migrants.
Chinook salmon, Sacramento River winter-run ESU	Aug to early Dec ² , and late April ²	7 to 10 days ³	2 years ⁴	Dec through July, peaking in March in Sacramento River ² Nov through May in Yolo Bypass ²	
Steelhead, California Central Valley DPS	Feb through March to avoid warm temperatures in bypasses ²	7 to 10 days ³	2 years ⁴	Aug through March, with peak in Jan through Feb ²	Rear 1 to 3 years in freshwater. May realize fewer growth benefits from floodplain habitat since California Central Valley steelhead rear mainly in cool streams. Outmigrants peak in Delta in March through April ² . Juveniles observed at Knights Landing as early as Nov ¹ .
Chinook salmon, Central Valley fall-run ESU	Late Nov to early Dec, and late April ²	7 to 10 days ³	2 years ⁴	June through Dec, peaking Sept through Oct ²	
Chinook salmon, Central Valley late fall-run ESU	Late Oct ⁵ to early Dec ² , and late April ²	7 to 10 days ³	2 years ⁴	Oct through April, peaking in Dec; Nov. through May (adult passage in Yolo) ²	Yearling fish near Knights Landing in late Oct are less likely to benefit from floodplain rearing than are smaller fish showing up in late winter/spring.

Key:

DPS = Distinct Population Segment

ESU = Evolutionarily Significant Unit

Notes:

1 National Marine Fisheries Service, 2009.

2 DWR, 2017.

3 Conrad and Sommer, 2015. CVFPP Conservation Strategy (DWR, 2017) recommends 14 to 21 days.

4 Jackson, 2015; 2 years is consistent with U.S. Fish and Wildlife Service recommendations for Anadromous Fish Restoration Program projects.

5 Roberts et al., 2013.

3.2 Habitat Feature Identification and Mapping

Appendix A displays maps of the habitat areas along the Sacramento River corridor for all three study reaches. The low-elevation secondary channel features (scour channels on point bars) identified in the TNC Off-Channel Habitat Study are also indicated.

The largest patches of floodplain habitats tend to concentrate around tributary confluences, point bars, sloughs, cut-off channels, and oxbow features. Riparian forest habitat is the dominant habitat unit along the mainstem channel for all reaches, although in Reach 3 the Sutter Bypass includes large patches of seasonal wetland habitat. Annual grassland and riparian shrub habitats are interspersed with riparian forest along a broad topographic gradient on the channel banks (occurring in low-elevation near-shore areas, as well as on the higher-elevation floodplain terraces), while bare sand and gravel, seasonal wetlands, and non-tidal wetlands tend to occur in lower elevation areas adjacent to the channel (except in the bypass, as noted previously). The bare sand and gravel habitat unit is correlated with areas that are subject to frequent erosion, scour, and deposition. The off-channel secondary channel features identified in the TNC Off-Channel Habitat Study tend to occur on the downstream end of point bars on both sides of the main channel throughout Reach 1 and the northern half of Reach 2; these features are also strongly correlated with the bare sand and gravel habitat features.

Along the mainstem channel, Reach 2 has the greatest amount of floodplain habitat overall, and Reach 3 has the least. This is due to the much more sinuous, broad, unconfined channel corridor between Red Bluff and Delevan, and the confined, less sinuous nature of the channel in Reach 3 between Delevan and Knight's Landing, where levees and other flood control infrastructure have reduced the extent of available off-channel habitat areas and secondary channel features.

Further evaluations of the potential occurrence and relative habitat value of secondary channel features (especially South of Colusa in Reach 3, which was outside of the TNC Off-Channel Habitat Study area boundary) is necessary, and is recommended as a next step in this analysis.

3.3 Flow- Inundation Area and Secondary Channel Activation Relationships

The results of the flow- inundation area analyses include:

1. Tables 3-4, 3-5, and 3-6, which provide the area (in acres) of inundated habitat less than 5 feet in depth for each reach.
2. Flow-inundation area curves (Figure 3-1 to 3-3) that describe the relationship between flow and inundated habitat areas less than 5 feet in depth for each reach. Trends within each reach are summarized as follows:
 - In Reach 1, the total available inundated floodplain habitat less than 5 feet in depth increases with flow up to about 15,000 cfs, then levels off between 15,000 cfs and 25,000 cfs, and then begins to increase again at flows above 25,000 cfs. The inundated area less than 5 feet in depth of the bare sand and gravel habitat unit, which is strongly correlated with the presence of secondary channel features, does not appreciably change above 15,000 cfs.

- In Reach 2, the total available inundated floodplain habitat less than 5 feet in depth increases with flow in a linear trend between 5,000 cfs and 56,000 cfs. However, the inundated area less than 5 feet in depth of the bare sand and gravel habitat unit (again, which is strongly correlated with the presence of secondary channel features) does not appreciably change above 25,000 cfs, and begins to decline as flows increase above 30,000 cfs as water depths begin to exceed 5 feet with the larger flows.
 - In Reach 3, the total available inundated floodplain habitat less than 5 feet in depth increases with flow in a non-linear trend between 5,000 cfs and 40,000 cfs, and then begins to decline as water depths begin to exceed 5 feet with the larger flows. This trend demonstrates the influence of a narrower, confined channel in this reach of the river; as flows increase, water depths begin to exceed 5 feet across all available areas of floodplain habitat, leading to a decrease in available habitat. It is important to note that these results for Reach 3 *do not include* the Sutter or Yolo Bypasses. Inclusion of those areas would likely change these results significantly, as the bypasses support large areas of potentially available floodplain habitat.
3. Maps that indicate the inundated habitat areas less than 5 feet in depth at three flow profiles: 5,000 cfs, 30,000 cfs, and 50,000 cfs (Appendix B). Comparison of these maps provides an understanding of the floodplain habitats area that are inundated at those flows.

The relationship of flow to the activation of secondary channel features is described in Table 3-3, which was developed based on the data in the TNC Off-Channel Habitat Study (Kondolf and Stillwater, 2007) report. Activation thresholds (the point and which the secondary channel features become initially activated, and then fully hydraulically connected to the mainstem channel) are also represented in Figures 3-1 to 3-3. The secondary channel features activate and become fully hydraulically connected between flows of approximately 6,000 cfs and 15,000 cfs in Reaches 1 and 2; this is a critical flow range for establishing and maintaining access to these important habitat features.

Table 3-3. Secondary Channel Activation Relative to Flows in the Sacramento River (from Kondolf and Stillwater, 2007)

Site ID	River Mile	Right or Left Bank	Sac River Discharge (cfs) 2/22/07-3/6/07			Ponded During Disconnection	Connected Below Measured Discharge	Notes
			Activation Low	Activation High	Lowest Measured			
Gage flow at Ord Ferry RM 184.5 (Sites Habitat Reach 2)								
13	187.0	R	7,000	8,600	7,500	Y	Y	50% connected at 7,500; other 50% at 8,500
14	189.0	R	10,500	13,600	8,600	y	Y	Same as above
15	189.5	L	9,100	12,000	7,600	Y	N	50% connected at 7,500; other 50% at 8,500
16	191.0	L	8,000	12,000	7,600	Y	Y	50% connected at 8,500; other 50% above 14,400
17	191.7	R	7,000	14,400	7,600	Y	Y	50% connected at 7,600; other 50% at 8,500
Gage flow at Hamilton City RM 199.2 (Sites Habitat Reach 1)								
22	203.0	R	6,000	13,900	7,600	Y	Y	50% connected at 7,600; other 50% at 8,500
23	203.0	L	6,000	10,300	7,100	Y	Y	Downstream connection isolated at 7,100
Gage Flow at Vina Woodson Bridge RM 218.3 (Sites Habitat Reach 1)								
25	209.0	L	8,200	15,100	8,000	Y	Y	50% isolated at 7,900
27	211.0	L	8,000	12,500	7,900	Y	Y	
33	221.6	R	7,000	14,500	8,000	Y	Y	30% connected at 7,300; 70% at 8,100
35	226.5	L	6,900	15,200	6,900	N	Y	50% at 7,100; 100% at 14,900
39	232.8	L	7,000	8,000	7,000	N	Y	40% connected at 7,800; 100% at 8,900
40	233.5	R	7,500	13,800	7,900	Y	N	10% connected at 8,900; 100% connected at 13,500
41	235.3	R	8,100	9,300	8,100	N	Y	30% connected at 7,300; 70% at 8,100; 90% at 9,300; 100% at 13,500
44	239.5	R	7,000	12,300	7,700	Y	Y	80% connected at 7,700 and 9,500; 100% at 11,300

Table 3-4. Inundated Habitats Less Than 5' in Depth – Reach 1

Flow (cfs)	Inundated Habitat Areas ≤ 5' Depth (acres)						
	Annual Grassland	Bare Gravel and Sand	Marsh - Non-Tidal	Riparian Forest	Riparian Scrub	Seasonal Wetland	Total Floodplain
5,000	84.3	99.2	2.2	343.9	64.4	19.7	613.7
7,000	89.4	119.2	3.3	365.0	83.8	21.9	682.4
8,800	97.6	131.7	3.3	374.2	99.5	22.0	728.3
10,000	103.9	138.4	3.4	379.6	107.1	22.5	754.8
10,900	108.0	142.9	3.4	382.6	112.1	23.2	772.1
12,000	113.4	147.8	3.4	387.3	116.3	23.6	791.9
13,800	123.1	156.1	3.5	391.5	121.7	24.3	820.2
15,000	129.6	159.8	3.5	390.8	122.9	24.1	830.6
15,900	134.5	160.5	3.5	389.4	124.5	23.7	836.1
17,000	140.0	160.0	3.6	388.6	127.5	23.5	843.2
18,800	145.9	155.0	3.9	382.4	126.8	23.4	837.3
20,000	148.2	149.1	4.0	386.2	124.6	22.8	835.0
20,900	151.6	146.7	4.0	390.6	122.6	22.5	838.0
22,000	156.0	143.2	4.0	397.1	120.0	22.2	842.6
23,800	163.8	135.2	3.9	410.2	116.4	21.0	850.5
25,000	168.2	128.3	4.0	420.4	114.3	20.3	855.5
25,900	172.3	125.5	4.1	429.1	111.5	19.7	862.2
27,000	176.8	124.2	4.8	442.5	107.6	18.5	874.5
28,800	186.2	130.3	6.3	474.9	104.1	17.0	918.8
30,000	193.3	131.9	6.1	489.6	102.4	16.1	939.5
30,900	198.8	133.0	6.1	501.8	101.9	15.7	957.2
32,000	205.8	134.1	6.0	518.6	101.7	15.2	981.5
33,800	224.4	137.2	6.3	565.2	100.5	14.7	1,048.5
35,000	235.9	140.3	6.5	594.1	100.0	14.5	1,091.4
35,900	244.0	142.4	6.6	615.2	101.0	14.5	1,123.7
37,000	255.1	144.4	6.8	650.6	103.5	14.7	1,175.1
38,800	275.6	147.1	7.0	705.0	108.0	15.5	1,258.2
40,000	291.3	149.2	7.1	742.0	112.3	16.0	1,317.8
40,900	304.1	151.7	7.2	771.8	116.6	16.1	1,367.6
42,000	320.3	154.5	7.3	806.9	121.3	16.4	1,426.7
43,800	346.0	158.4	7.7	865.8	130.0	17.2	1,524.9
45,000	361.1	161.1	8.3	899.7	135.7	17.8	1,583.7
45,900	372.5	162.9	8.2	921.2	139.6	18.2	1,622.4
47,000	386.8	165.5	8.0	949.8	145.6	18.7	1,674.4
48,800	412.3	167.4	8.6	990.8	157.0	19.4	1,755.6
50,000	427.7	168.2	9.5	1,022.0	165.8	19.4	1,812.6
50,900	439.3	168.1	10.3	1,044.9	171.3	19.6	1,853.6
52,000	452.8	168.2	11.2	1,073.9	177.2	20.0	1,903.3
53,800	475.9	170.7	12.6	1,121.1	186.5	20.6	1,987.2
55,900	497.1	173.3	14.2	1,162.0	197.7	21.2	2,065.6

Table 3-5. Inundated Habitats Less Than 5' in Depth – Reach 2

Flow (cfs)	Inundated Habitat Areas ≤ 5' Depth (acres)						
	Annual Grassland	Bare Gravel and Sand	Marsh - Non-Tidal	Riparian Forest	Riparian Scrub	Seasonal Wetland	Total Floodplain
5,000	1.0	37.4	0.0	9.8	17.5	1.4	67.1
7,000	1.0	62.2	0.0	15.5	27.9	4.9	111.5
8,800	2.4	106.8	0.0	27.3	40.4	10.5	187.4
10,000	4.1	137.4	0.0	40.8	49.5	13.2	245.1
10,900	4.6	157.0	0.0	52.9	57.5	15.7	287.7
12,000	5.2	180.9	0.0	77.1	69.5	18.1	350.8
13,800	6.4	215.8	0.0	128.6	92.5	21.8	465.2
15,000	7.2	239.2	0.0	176.2	112.9	26.4	561.9
15,900	8.0	262.0	0.1	224.7	133.8	28.6	657.0
17,000	9.1	288.5	0.2	276.1	156.6	30.7	761.2
18,800	11.0	317.6	0.4	367.1	198.0	40.1	934.1
20,000	12.2	330.2	0.6	417.7	220.3	38.9	1,020.0
20,900	13.6	336.6	0.9	458.8	235.9	38.6	1,084.4
22,000	14.6	345.5	1.1	507.0	253.9	39.3	1,161.2
23,800	18.5	355.1	1.6	580.1	279.4	42.3	1,276.9
25,000	22.1	359.6	2.0	629.6	298.5	42.7	1,354.5
25,900	24.8	361.8	2.4	668.4	313.6	43.4	1,414.4
27,000	28.5	364.8	3.0	715.5	332.9	44.5	1,489.2
28,800	36.1	368.6	4.5	790.9	351.1	42.5	1,593.7
30,000	41.6	367.8	5.4	838.7	358.7	41.5	1,653.7
30,900	46.2	366.8	6.2	872.3	365.9	42.5	1,699.9
32,000	52.9	363.7	7.5	914.7	377.4	44.3	1,760.6
33,800	67.1	356.8	8.5	981.3	393.8	46.1	1,853.7
35,000	78.3	350.3	9.0	1,017.7	404.8	46.5	1,906.6
35,900	88.6	344.7	9.2	1,052.1	411.1	47.2	1,952.9
37,000	103.9	337.0	9.5	1,100.7	415.7	48.3	2,015.0
38,800	133.5	324.2	9.8	1,177.0	422.1	51.6	2,118.3
40,000	156.2	315.5	10.0	1,235.7	429.3	53.3	2,200.1
40,900	173.5	309.6	10.1	1,280.8	432.9	54.1	2,261.0
42,000	194.7	301.1	10.3	1,334.5	437.6	54.1	2,332.3
43,800	232.0	289.0	11.1	1,416.1	446.2	53.4	2,447.7
45,000	260.6	280.9	12.1	1,467.4	449.0	54.0	2,524.1
45,900	282.7	274.7	13.0	1,505.8	449.1	54.7	2,580.1
47,000	309.3	267.7	14.2	1,555.2	451.9	55.5	2,653.8
48,800	355.2	257.9	16.5	1,635.9	456.1	55.3	2,776.9
50,000	388.1	250.8	18.2	1,693.9	460.1	54.3	2,865.3
50,900	412.6	246.3	19.2	1,739.2	463.5	53.6	2,934.4
52,000	440.3	239.8	20.1	1,789.8	466.0	52.7	3,008.7
53,800	492.9	229.1	21.4	1,917.8	474.5	50.7	3,186.5
55,900	556.4	215.4	22.7	2,044.6	480.7	48.6	3,368.5

Table 3-6. Inundated Habitats Less Than 5' in Depth – Reach 3

Flow (cfs)	Inundated Habitat Areas ≤ 5' Depth (acres)						
	Annual Grassland	Bare Gravel and Sand	Marsh - Non-Tidal	Riparian Forest	Riparian Scrub	Seasonal Wetland	Total Floodplain
5,000	7.7	6.3	0.0	31.0	4.4	2.7	52.1
7,000	9.8	8.4	0.0	31.1	4.9	3.6	57.8
8,800	11.5	20.8	0.0	32.8	7.7	4.8	77.7
10,000	13.3	30.2	0.1	38.6	10.0	6.1	98.2
10,900	15.4	38.1	0.1	45.7	12.6	6.9	118.7
12,000	18.5	48.2	0.1	61.6	17.1	8.6	154.1
13,800	22.7	62.9	0.2	98.7	23.5	11.0	218.9
15,000	25.2	62.8	0.2	121.0	27.7	12.1	248.9
15,900	26.6	63.5	0.2	138.5	36.0	12.8	277.6
17,000	27.9	63.5	0.2	162.2	49.1	12.8	315.6
18,800	31.2	62.4	0.2	203.3	69.4	11.7	378.3
20,000	34.7	61.7	0.2	222.9	79.0	10.8	409.1
20,900	36.7	61.9	0.2	237.2	83.1	9.7	428.8
22,000	39.2	61.7	0.3	254.2	88.1	8.8	452.3
23,800	45.9	55.8	0.6	276.9	87.4	7.2	473.8
25,000	49.7	50.2	0.7	286.5	76.4	6.8	470.3
25,900	52.6	45.6	0.9	290.8	72.2	6.5	468.6
27,000	56.4	40.3	1.1	305.2	67.8	6.2	477.2
28,800	69.0	30.7	1.2	349.2	65.1	9.4	524.7
30,000	89.5	26.4	1.2	384.1	65.7	10.2	577.0
30,900	112.2	23.7	1.1	414.4	66.3	10.9	628.7
32,000	141.1	19.7	1.9	455.8	69.6	11.5	699.6
33,800	192.3	15.3	5.0	528.6	77.0	12.4	830.6
35,000	232.8	13.6	5.2	586.7	83.5	13.0	934.8
35,900	258.1	12.7	7.9	620.6	89.0	14.0	1,002.3
37,000	290.4	11.8	10.2	679.4	97.5	15.5	1,104.7
38,800	320.7	10.9	10.2	711.8	103.8	16.0	1,173.4
40,000	334.0	10.0	10.2	709.5	103.8	14.0	1,181.6
40,900	347.8	9.2	10.2	698.1	104.3	13.8	1,183.2
42,000	355.9	7.9	10.0	671.2	102.3	13.3	1,160.6
43,800	377.2	6.6	6.7	616.7	96.5	13.7	1,117.4
45,000	383.1	6.2	3.9	577.7	91.0	13.5	1,075.4
45,900	381.2	5.9	3.0	546.0	86.0	13.5	1,035.7
47,000	373.2	5.6	2.2	506.6	78.4	13.3	979.4
48,800	356.3	5.3	1.0	449.9	74.0	12.5	898.9
50,000	342.3	4.9	0.6	411.1	66.1	11.0	836.0
50,900	334.2	4.6	0.4	384.3	60.6	10.1	794.2
52,000	325.6	4.3	0.2	352.3	56.1	9.3	747.8
53,800	309.2	3.6	0.2	312.3	48.5	8.1	682.0
55,900	286.2	2.5	0.1	284.9	42.5	12.1	628.3

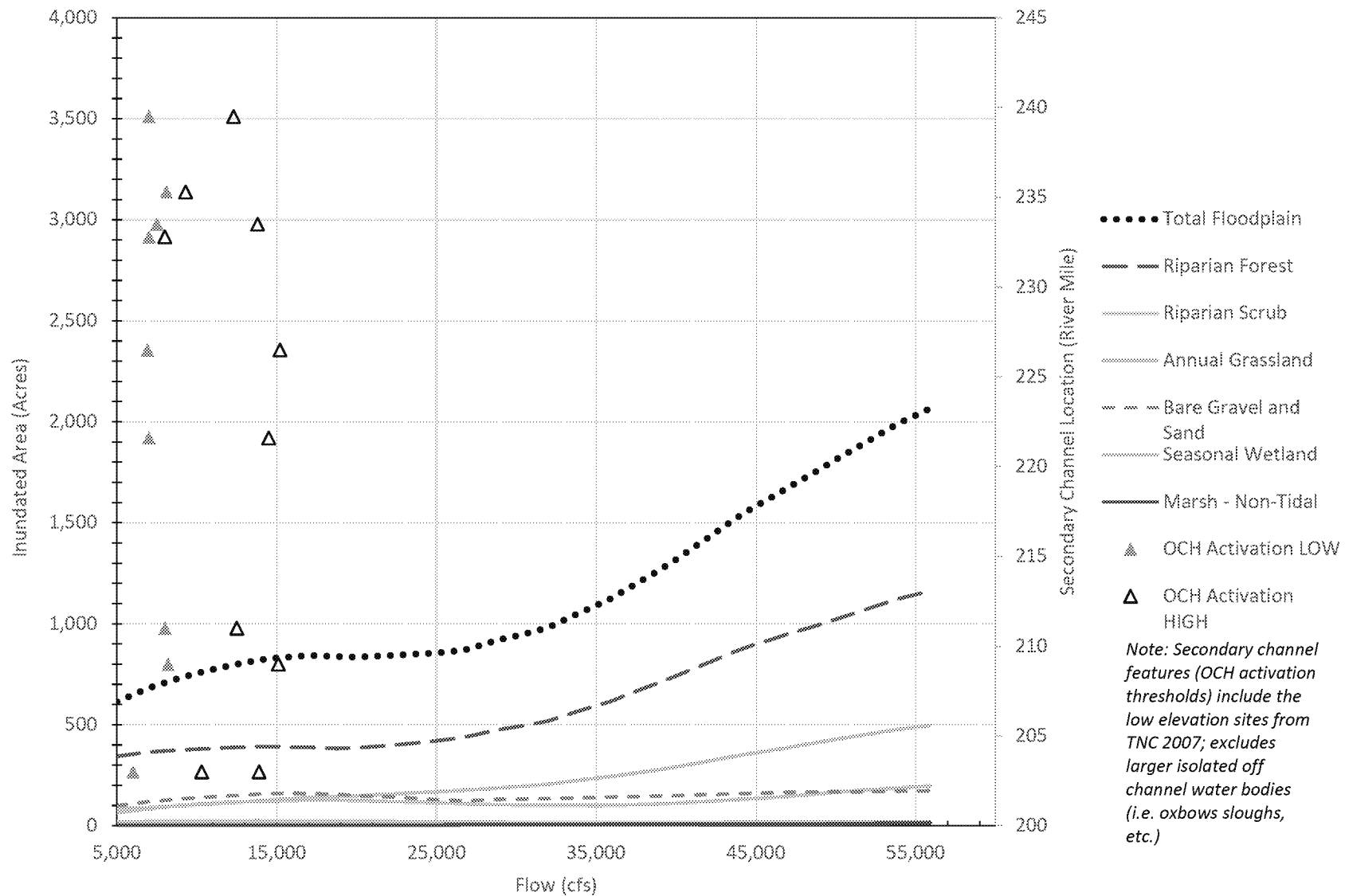


Figure 3-1. Reach 1 Secondary Channel Activation and Flow- Habitat Inundation Area Curves for Water Depths ≤ 5 Feet

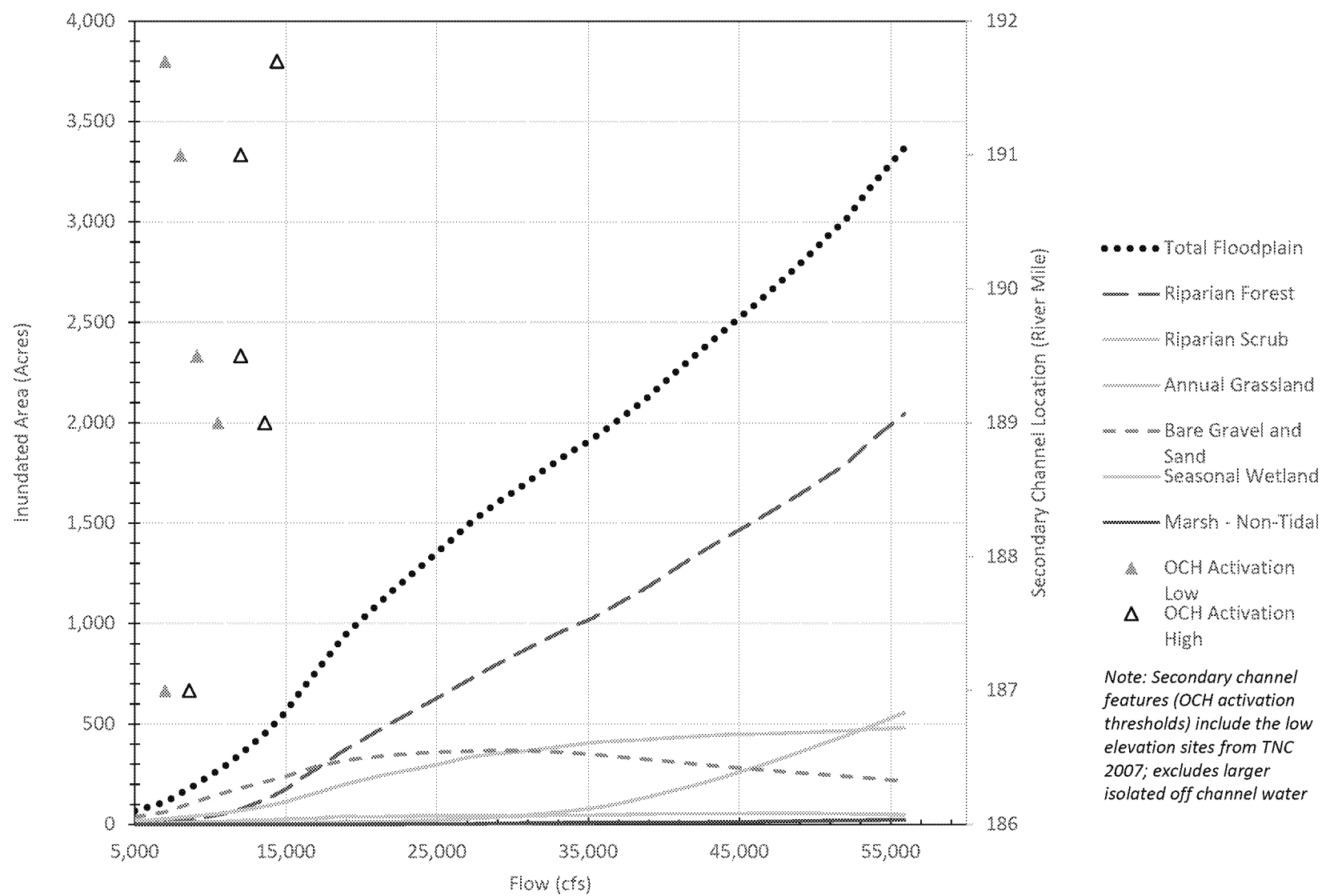


Figure 3-2. Reach 2 Secondary Channel Activation and Flow- Habitat Inundation Area Curves for Water Depths ≤ 5 Feet

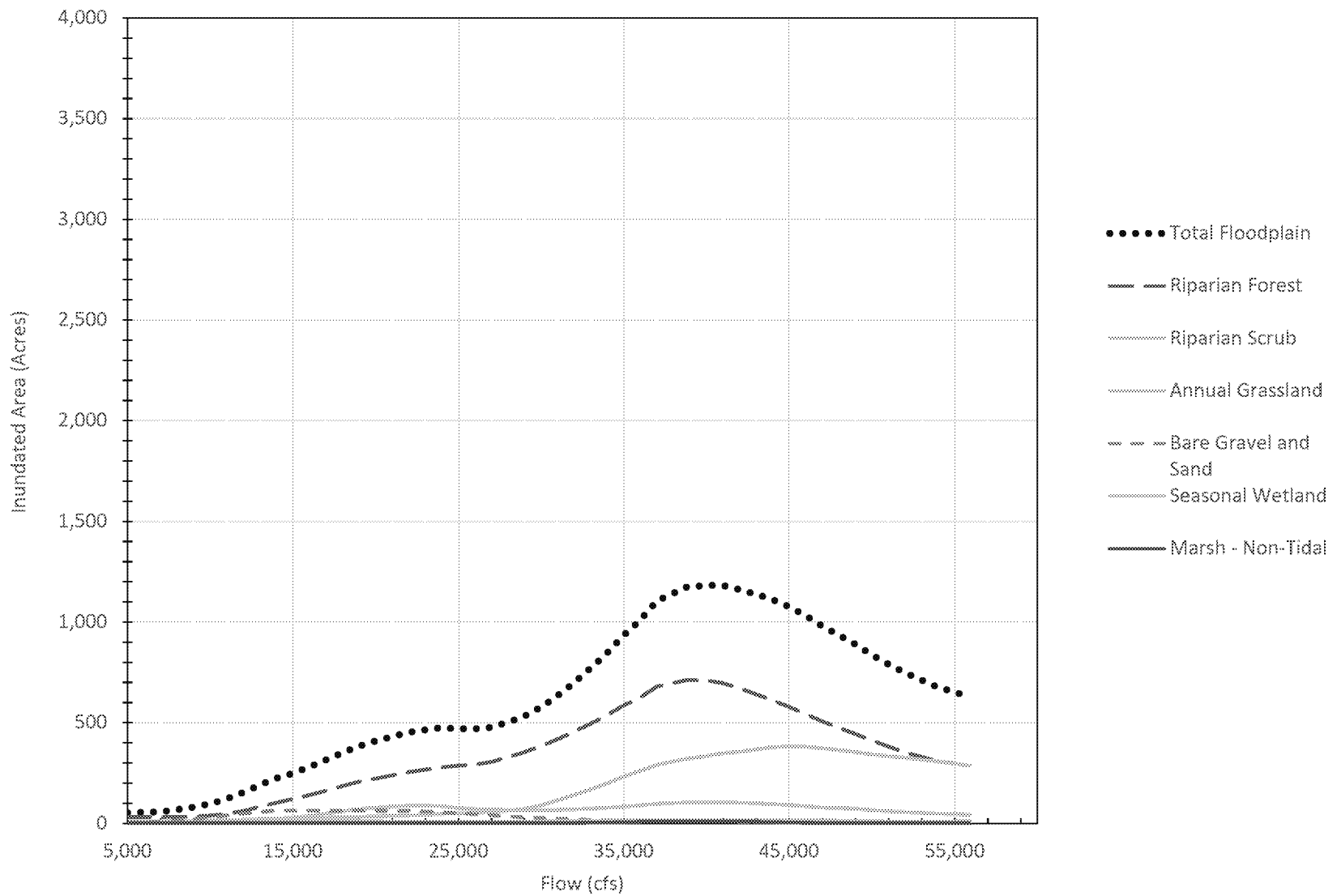


Figure 3-3. Reach 3 Flow- Habitat Inundation Area Curves for Water Depths $\leq$ 5 Feet

4.0 Conclusion

This analysis demonstrates that overall, there is significant quantity of hydraulically connected floodplain and off-channel habitat between Red Bluff and Delevan. However, these habitats become more limited south of Delevan due to changes in channel geometry (channel confinement and decrease in sinuosity) largely as a result of levees and other flood management infrastructure.

Overall, there is a strong correlation between the amount of flow and the connectivity and availability of potential floodplain habitat. However, in Reach 3, as flows exceed 5 feet in depth, available inundated habitat begins to decline.

The secondary channel features identified in this evaluation are highly sensitive to changes in flow below 15,000 cfs.

As previously described, in this preliminary evaluation flow-inundation area analyses were developed using steady-state flows that do not incorporate ecologically-important hydrologic parameters including the timing, duration, and frequency of inundation, thus the results included in this analysis should only be utilized to understand the physical relationships between flow and inundated floodplain habitat areas, and not the relative biological importance of those relationships to priority fish species.

It is recommended that future phases of this study should include:

- Evaluations of floodplain inundation using dynamic, unsteady flow conditions.
- Better integration of the timing, duration, and frequency criteria from Table 3-2 into the floodplain inundation analyses.
- Inclusion of other criteria from the ecological framework (Table 3-1) into the off-channel habitat analysis to understand the potential effects of Sites Project diversions on a wider range of species.
- Inclusion of the Sutter Bypass and northern Yolo Bypass (the Elkhorn Basin) into the flow-inundation area analyses in Reach 3.
- Mapping and integration of secondary channel features south of Colusa.

5.0 References

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Appendix A – Habitat Maps

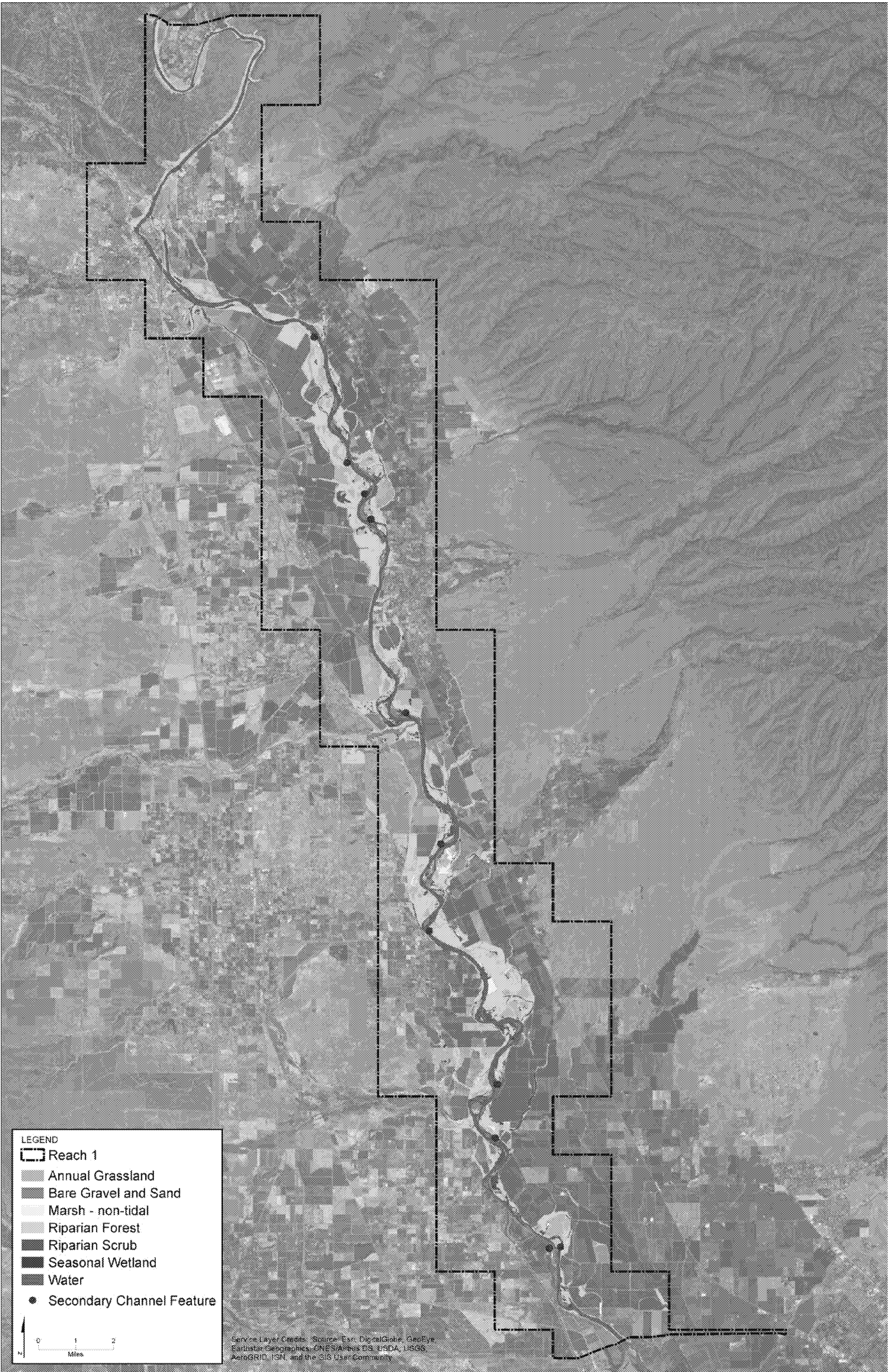


Figure A-1. Habitat and Secondary Channel Features Along Sacramento River Corridor – REACH 1



Figure A-2. Habitat and Secondary Channel Features Along Sacramento River Corridor – REACH 2

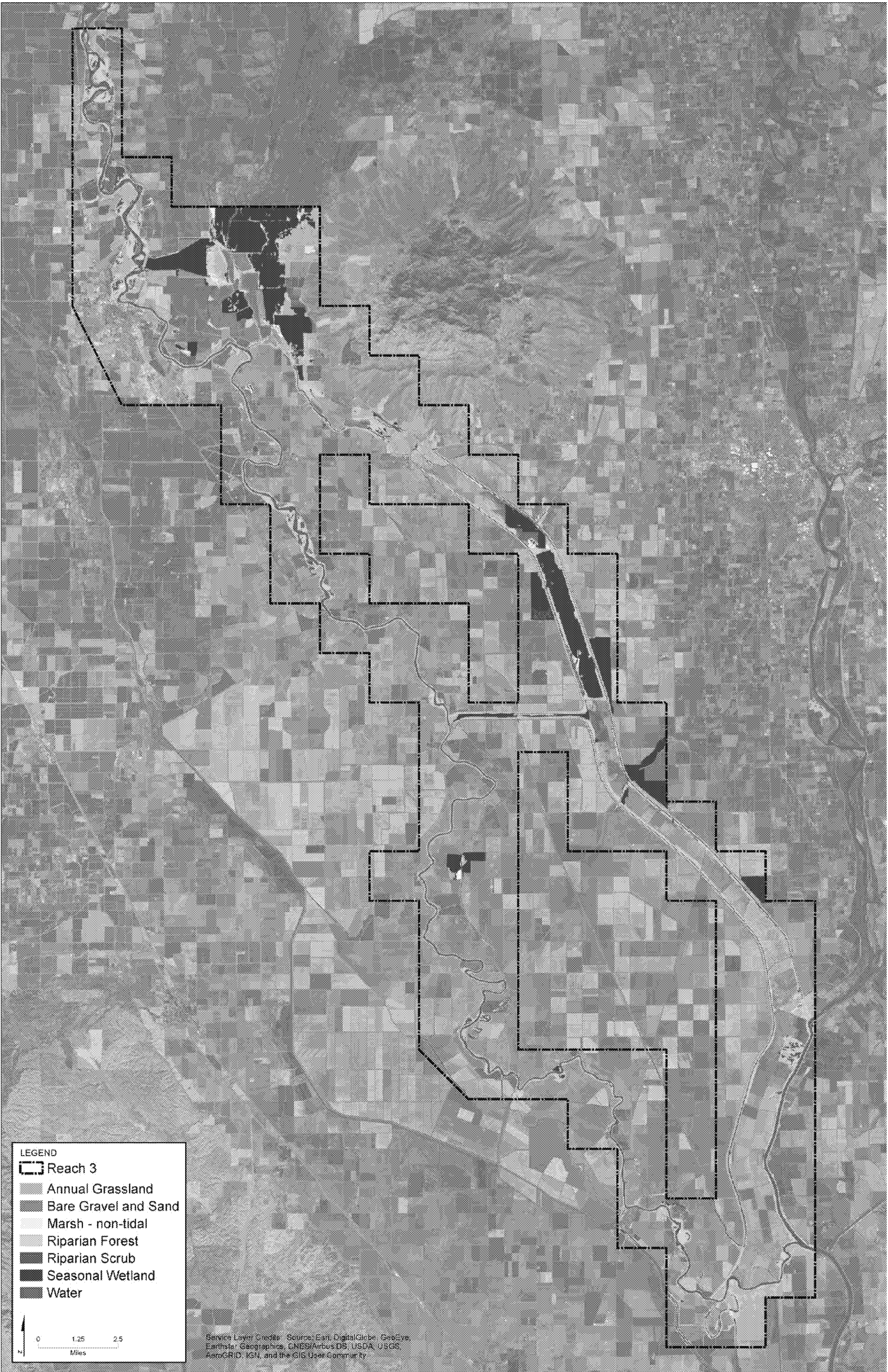


Figure A-1. Habitat Features Along Sacramento River Corridor – REACH 3

Appendix B – Flow- Inundation Area Maps

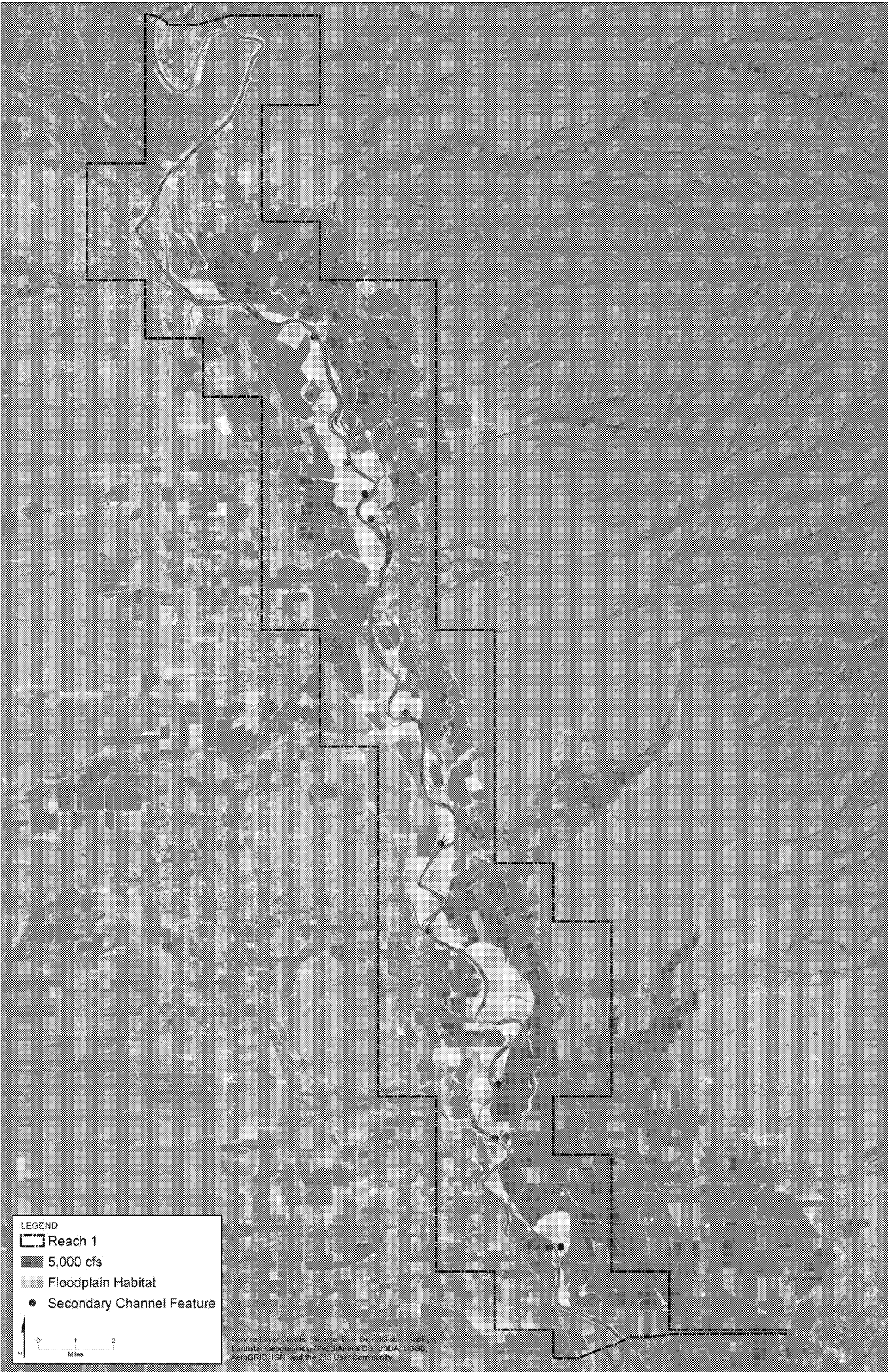


Figure B-1. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 5,000 cfs – REACH 1

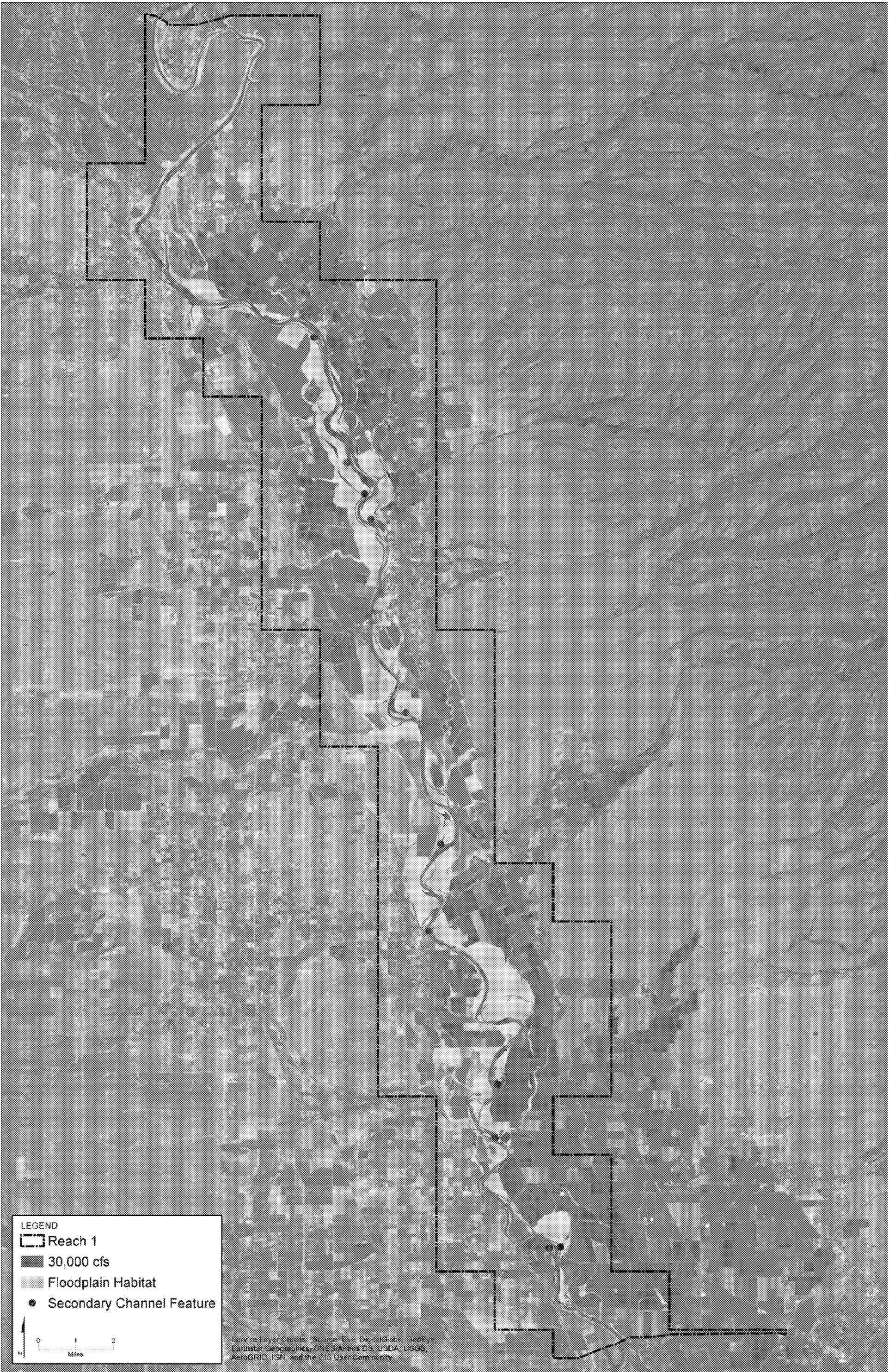


Figure B-2. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 30,000 cfs – REACH 1

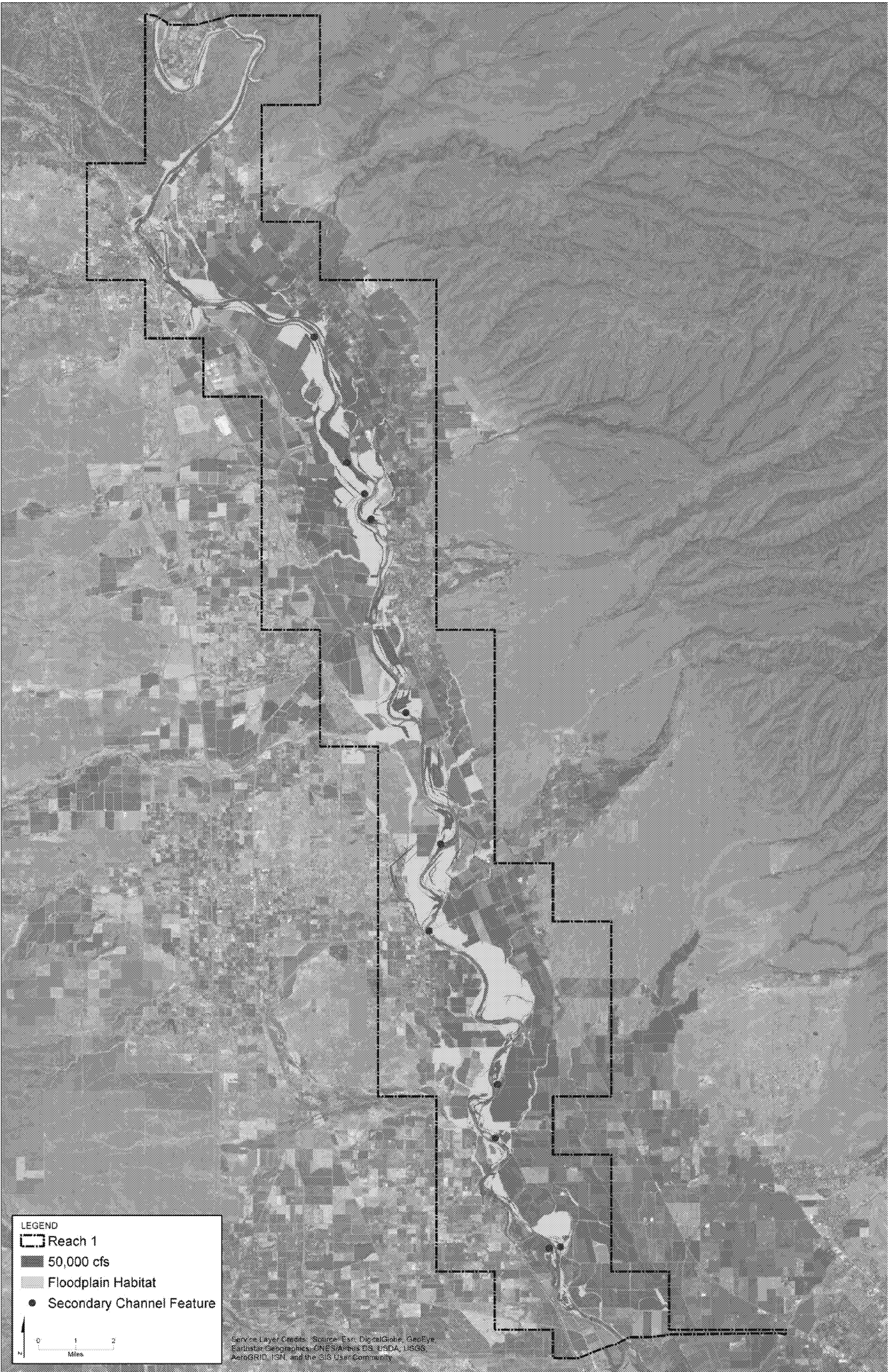


Figure B-3. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 50,000 cfs – REACH 1

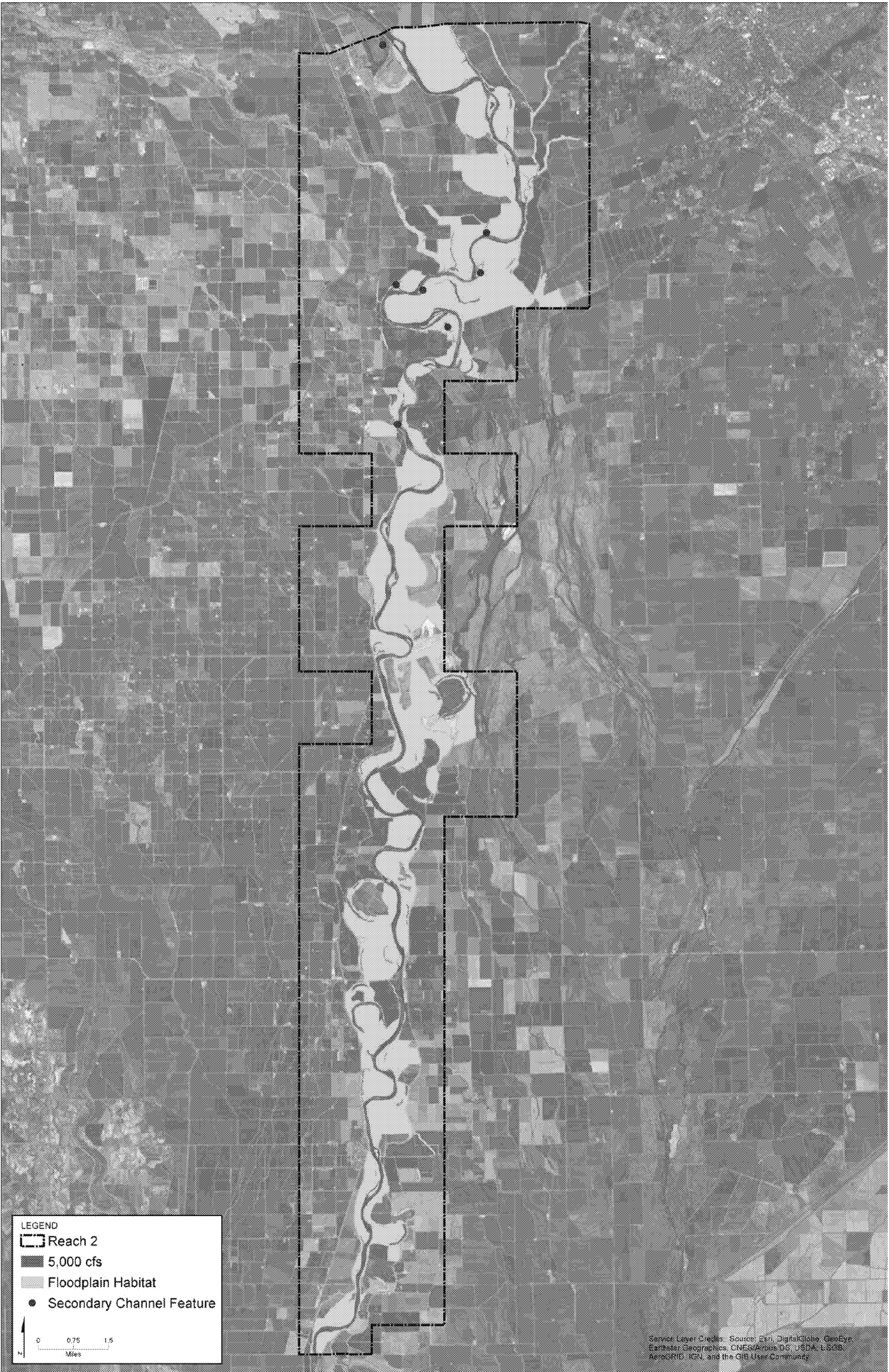


Figure B-4. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 5,000 cfs – REACH 2

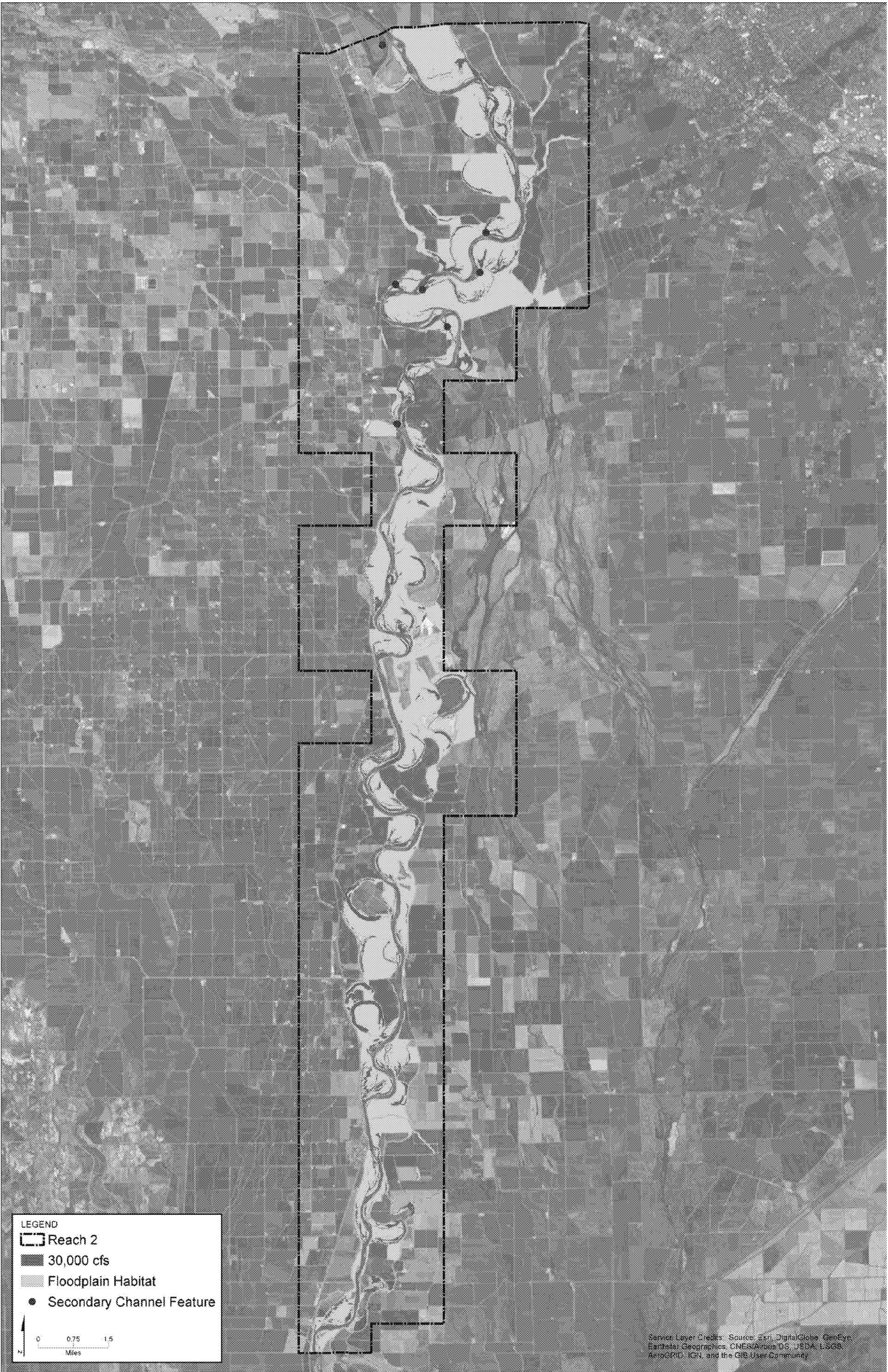


Figure B-5. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 30,000 cfs – REACH 2



Figure B-6. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 50,000 cfs – REACH 2

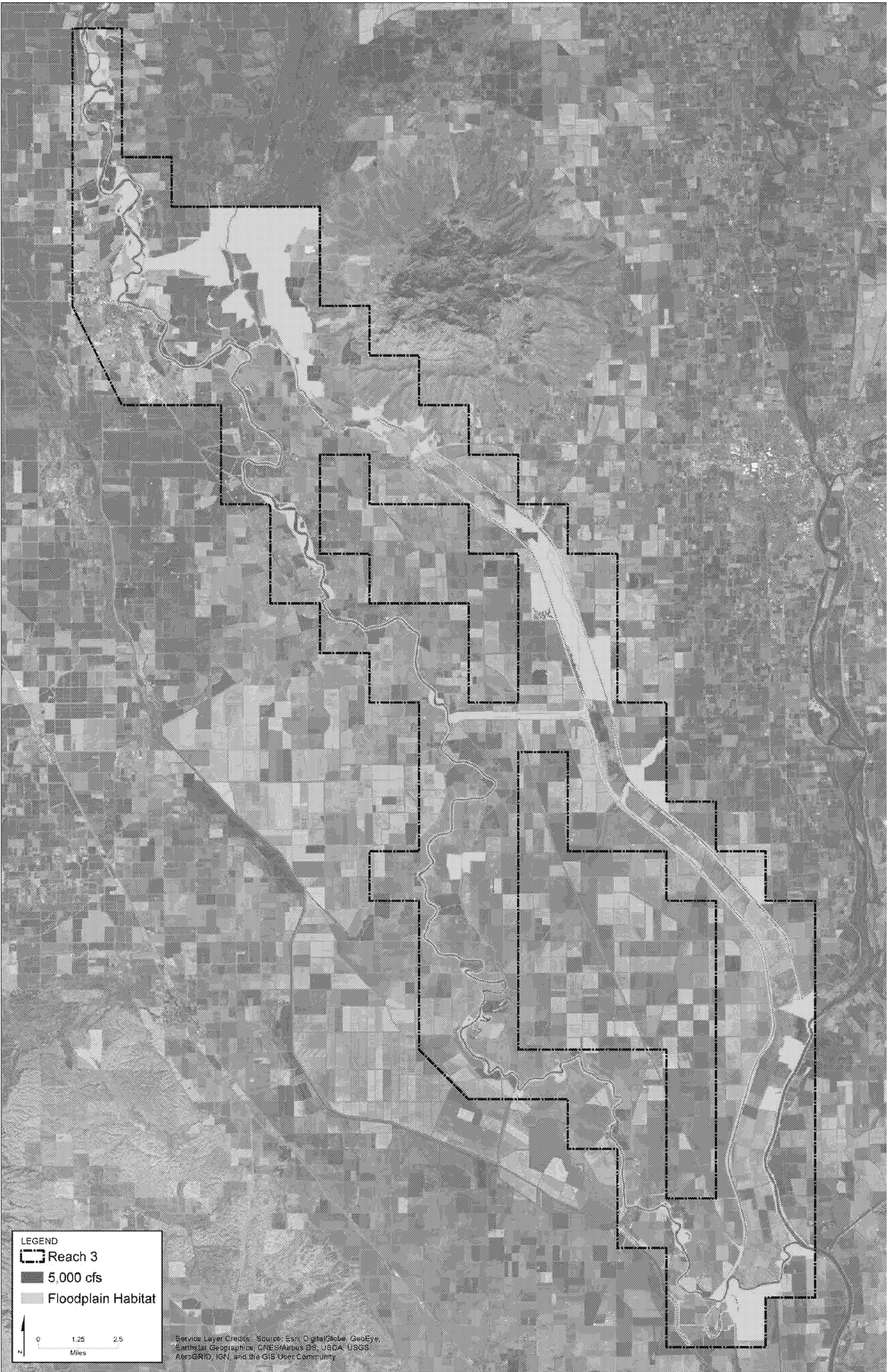


Figure B-7. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 5,000 cfs – REACH 3

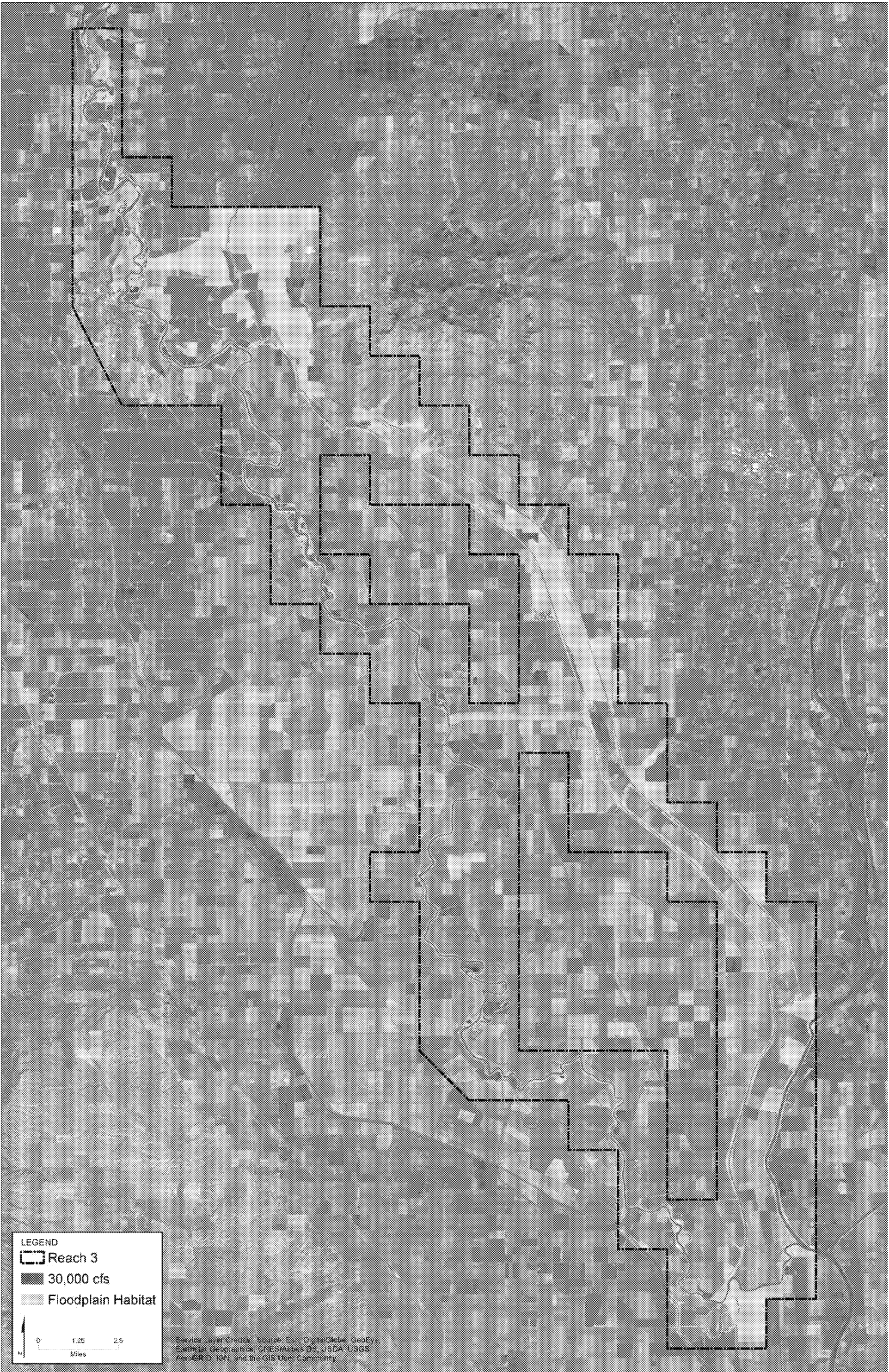


Figure B-8. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 30,000 cfs – REACH 3

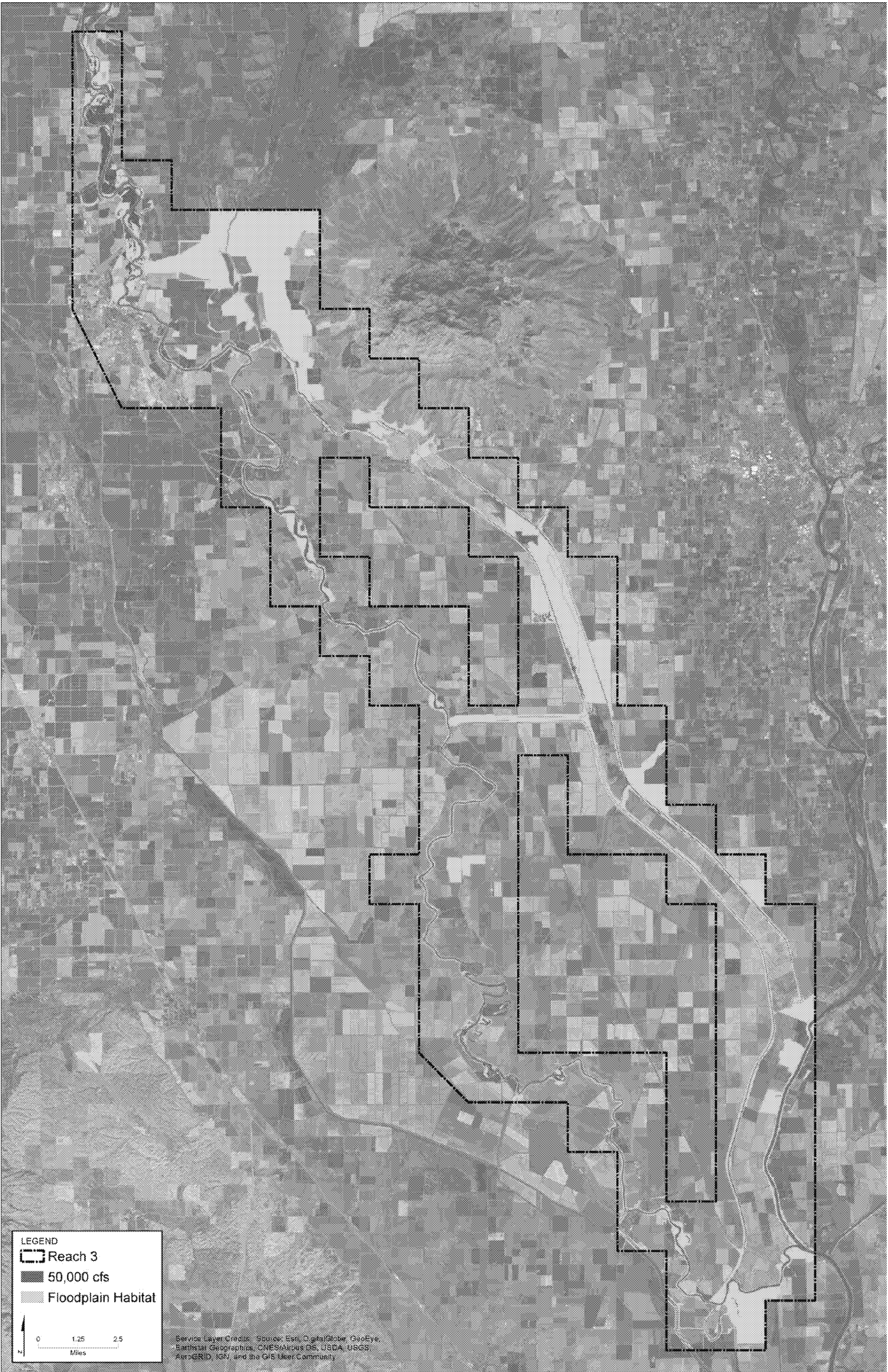


Figure B-9. Inundated Floodplain Habitats at Depths of Less than 5 Feet at Flows of 50,000 cfs – REACH 3

Appendix C – Hydraulic Modeling Approach

HEC-RAS Modeling of Sacramento River

Inundation polygons were generated from Sacramento River HEC-RAS 5.0 steady-state simulation results at various levels of flow. The Sacramento River HEC-RAS model is a section of the Sacramento River Routing (SRR) model. Model outputs were validated against gage data from the California Data Exchange Center (CDEC).

A Riverine Model of Sacramento River

A HEC-RAS 5.0 model was utilized to identify inundation areas along the Sacramento River between Red Bluff and Knights Landing. This model is a section of the SRR model, which was developed, calibrated, and validated in 2014 for Central Valley Floodplain Evaluation and Delineation (CVFED) (Wood Rogers, 2014). The SRR model included all major rivers in the Sacramento Valley.

Except for the upper Sacramento River (the area of interest), all rivers were clipped from the SRR model. Then the model was converted from HEC-RAS 4.1 to 5.0. This model extends along the Sacramento River from Keswick Dam to Knights Landing. The steady-state simulations were performed at various flows to quantify inundation area between 5,000 to 55,900 cfs.

Validation of Model

Since steady-state simulations do not replicate events, model results were validated with rating curves (plots of flow versus stage). Rating curves based on HEC-RAS and CDEC data (DWR) were created at the following locations:

- Sacramento River at Butte City
- Sacramento River at Colusa
- Sacramento River at Wilkins Slough

Since CDEC datums do not match HEC-RAS datums, HEC-RAS rating curves were adjusted with a constant value. Difference in stage between HEC-RAS and CDEC at the lowest flow (typically 5,000 cfs) represents the constant at each CDEC station. This constant is added/subtracted to all values in the rating curve. Adjustments are provided in Table C-1, below. Figure C-1 includes original and adjusted HEC-RAS ratings curves. Original HEC-RAS rating curves are not provided in remaining figures.

Table C-1. Station Locations and Adjustment Factors

Location	CDEC Station Name	Adjustment (feet)
Sacramento River at Butte City	BTC	-1.54
Sacramento River at Colusa	COL	-2.14
Sacramento River at Wilkins Slough	WLK	-0.27

HEC-RAS and CDEC rating curves for Sacramento River at Butte City, Sacramento River at Colusa, and Sacramento River at Wilkins Slough are provided in Figures C-1, C-2, and C-3, respectively. HEC-RAS rating curves match CDEC rating curves well. In examining all locations, the maximum relative difference in stage for a given flow is 5%. This ensures reliability in steady-state inundation area results within this flow range.

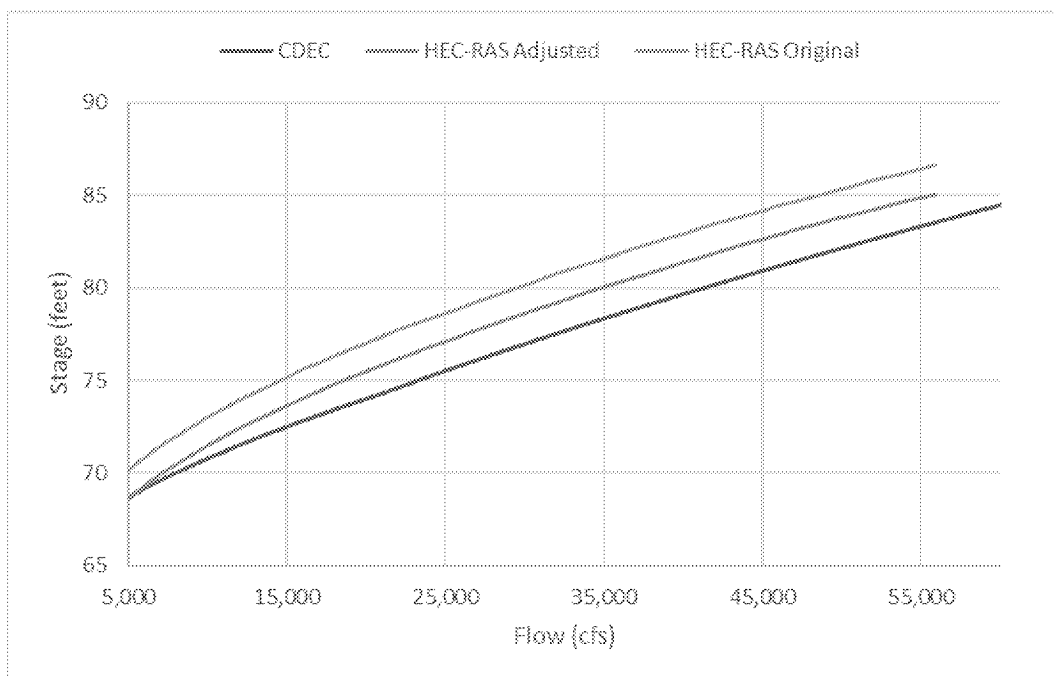


Figure C-1. Rating Curves for Sacramento River at Butte City (BTC)

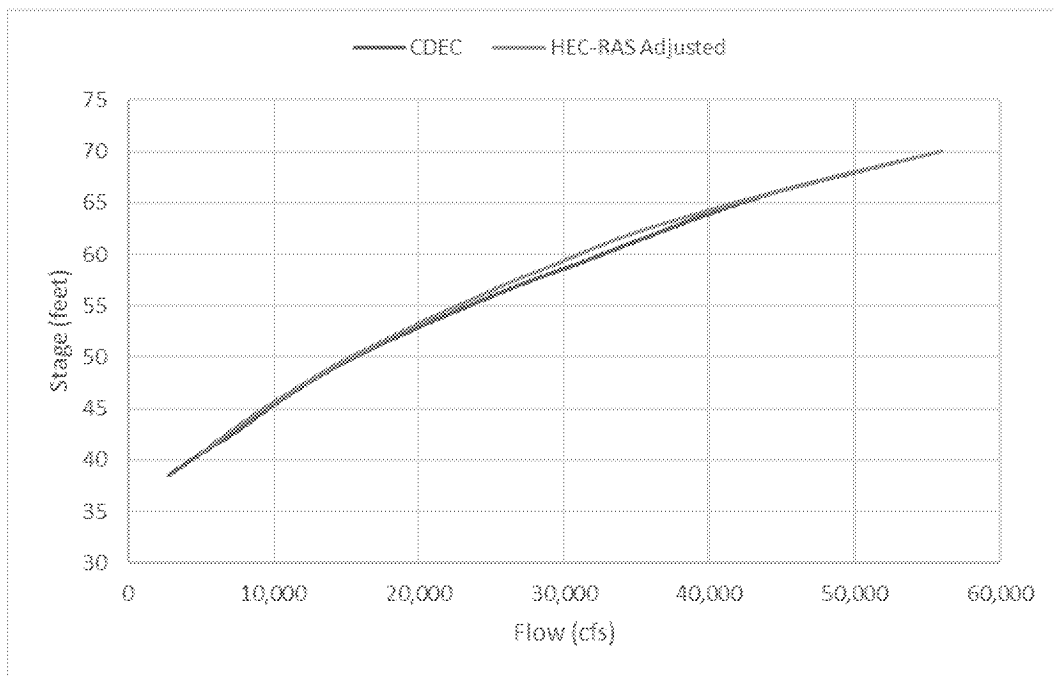


Figure C-2. Rating Curves for Sacramento River at Colusa (COL)

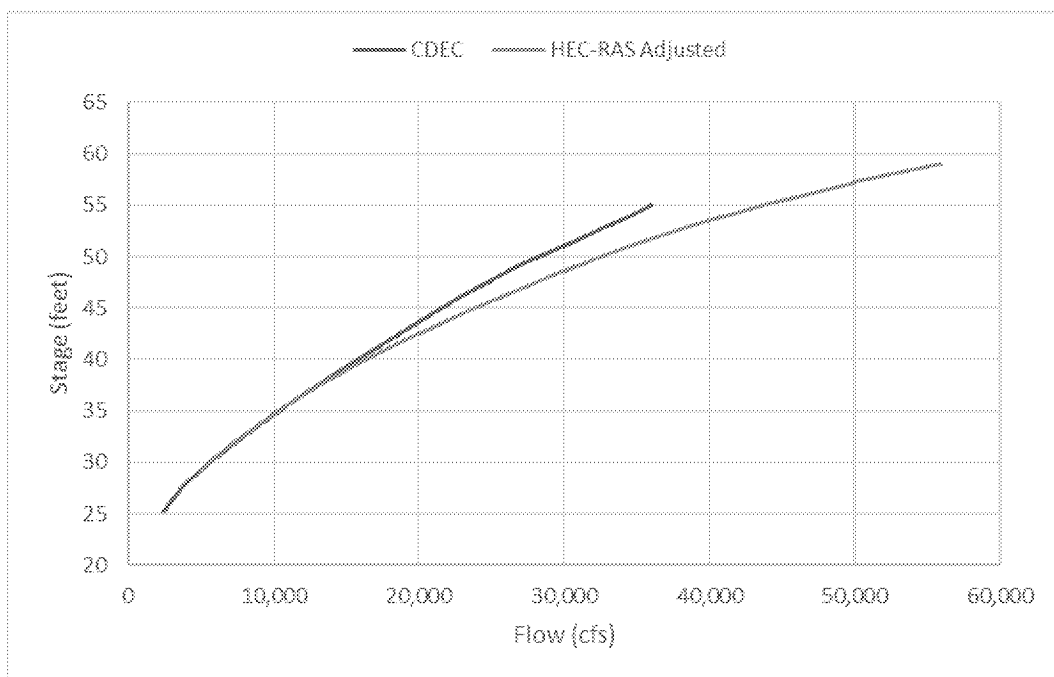


Figure C-3. Rating Curves for Sacramento River at Wilkins Slough (WLK)

Model Application

Steady-state simulations were performed at several flows between 5,000 and 55,900 cfs. This flow range was selected based on its ecological importance. All steady-state simulations are provided in Table C-2, below.

Table C-2. HEC-RAS Steady-State Simulations

Steady-State Simulations, Titled by Input Flow (cfs)			
5000	7000	8800	10000
10900	12000	13800	15000
15900	17000	18800	20000
20900	22000	23800	25000
25900	27000	28800	30000
30900	32000	33800	35000
35900	37000	38800	40000
40900	42000	43800	45000
45900	47000	48800	49900
50000	52000	53800	55900

Model Results

For each simulation, inundation areas for depths less than or equal to 5 feet were calculated. Ras Mapper, a module in HEC-RAS 5.0, provides inundation area greater than or equal to a depth threshold. Therefore, two inundation outputs were generated for each steady-state simulation: greater than or equal to 0 and greater than or equal to 5 feet. To identify inundation area at depths less than 5 feet, the

inundation area for depths greater than or equal to 5 feet was subtracted by the inundation area for depths greater than or equal to 0 feet. A visual of these inundation areas is provided in Figure C-4.



LEGEND
 Inundation Area - Depth ≥ 0 ft - 15,000cfs
 Inundation Area - Depth ≥ 5 ft - 15,000cfs
 Inundation Area - Depth < 5 ft - 15,000cfs

Service Layer Credits: Sources: Esri, DeLorme, USGS, NPS
 Sources: Esri, USGS, NOAA
 Sources: Esri, DeLorme, GeoEye, Earthstar Geographics,
 CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS

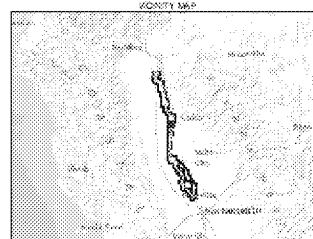
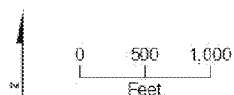


Figure C-4. Output Inundation Areas - 15,000 cfs

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Sacramento River Ecological Flows Study: Off-Channel Habitat StudyFinal Report

Prepared for



Sacramento River Project
500 Main St.
Chico, CA 95928

Prepared by

G. Mathias Kondolf
2241 Ward Ave
Berkeley, CA 94705

And

Stillwater Sciences
2855 Telegraph Ave, Suite 400
Berkeley, CA, 94705

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1 INTRODUCTION

Geomorphic processes such as channel migration, chute-cutoff, and avulsion are crucial to the formation of oxbow lakes, sloughs, and side channels and other off-channel habitats on actively meandering rivers. In this report, we refer to off-channel habitats collectively as off-channel water bodies (OCWBs). OCWBs evolve over time as a function of sediment deposition and scour, vegetation colonization and succession, and the buildup of organic detritus from aquatic vegetation. A variety of riverine species depend on OCWBs for habitat. For example, in the Sacramento River corridor, OCWBs provide critical habitat for Western Pond Turtle (*Clemmys marmorata*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychochelilus grandis*), California roach (*Hesperoleucus symmetricus*) and Chinook salmon (*Oncorhynchus tshawytscha*). They also harbor several non-native species, such as largemouth bass (*Micropterus salmoides*), bullfrogs (*Rana catesbeiana*), and red-eared sliders (*Trachemys scripta*).

Geomorphic processes also help maintain channel complexity, which often includes shallow-water, seasonally inundated habitats on channel margins. These habitats are generated as a function of overbank flows (e.g., floodplains), point bar dynamics (e.g., scour channels on point bars and edge habitat), and inundation of former main channel positions. Shallow-water areas provide important rearing habitat for juvenile salmon (Lister and Genoe 1970, Bjornn and Reiser 1991), including the runs of Chinook salmon that occur in the Sacramento River basin (Sommer et al. 2001).

As with most aquatic riverine habitats, the formation and maintenance of secondary channels is a function of flow and sediment dynamics, both of which have been altered dramatically in the Sacramento River by the construction and operation of water storage and delivery systems and the installation of rock revetment along the river's banks. Flow regulation often reduces the frequency and magnitude of high flow events that drive the fundamental processes of bank erosion and meander migration, which are essential for creating OCWBs. Bank armoring activities are designed specifically to halt bank erosion and meander migration, thus preventing the creation of new OCWBs. However, other human activities may promote meander migration and concomitant channel cutoff, such as clearing of riparian vegetation within the river corridor.

Similarly, human activities influence the seasonal inundation of shallow-water habitat in the Sacramento River basin. For example, flow regulation has reduced the magnitude and frequency of high flow events, and levees have isolated the channel from its floodplains, thereby reducing the frequency, extent, and duration of floodplain inundation.

Understanding the processes controlling the evolution of off-channel water bodies (OCWBs) and seasonally inundated habitats within the bankfull channel is prerequisite to developing effective conservation and restoration strategies for these important habitat types in the Sacramento River. For example, the rate at which a former channel evolves from fully aquatic to terrestrial determines its persistence as aquatic habitat and its value to different species. Within the Sacramento River corridor, some oxbow lakes, such as Packer Lake and Old Packer Lake (Figure 1a), remain as open-water habitat for at least a century. Other oxbow lakes, such as Hartley Island (Figure 1b), are completely filled in within decades of their formation. Determining the factors that influence the evolution of OCWBs helps to inform the definition of management interventions to maintain existing units or to create new ones.

In the same way, it is important to understand what flow magnitudes are required to inundate shallow-water habitats that occur within the bankfull channel and thus provide habitat that supports multiple life history stages of different fish species. This study focuses on one type of shallow-water habitat—scour channels that form on point bars—to estimate the discharge magnitudes that inundate these features.

This technical report presents the results of a multi-disciplinary, multi-institutional, multi-year study that has combined funding from several different sources to optimize the amount and quality of data collected and analyzed. Funding sources include a CALFED grant administered by The Nature Conservancy (TNC), the Fulbright Alumni Incentives Award program administered by the Council for International Exchange of Scholars, and the French National Center for Scientific Research (CNRS). Appendix A displays investigators and their institutional affiliations.

2 STUDY OBJECTIVES AND SITES

2.1 Study Objectives

This study was guided by three objectives:

1. **Estimate the lifespan of existing OCWBs by estimating their rates of terrestrialization.**

It is unclear how human changes have influenced the lifespan of OCWBs in the Sacramento River. Flow regulation has generally reduced the frequency and magnitude of flood events that connect OCWBs with the mainstem channel, which in turn has reduced the frequency of events that either deposit or scour sediment in OCWBs. Also, changes in land use within the Sacramento River corridor have displaced riparian vegetation, substituting land uses such as agriculture, which contribute to higher rates of soil erosion (e.g., agriculture). As a result, fine sediment loading may be higher than occurred historically, thus increasing potential filling rates of OCWBs even if inundation occurs less frequently. By estimating the lifespan of existing OCWBs, we provide an indicator of how important it is to create new OCWBs (e.g., removal of bank armor coupled with high flow events) or preserve existing OCWBs (e.g., dredging OCWBs to increase their lifespan).

2. **Assess habitat conditions in OCWBs by monitoring water quality and mapping aquatic macrophytes.**

OCWBs vary in the type of species that they support, generally as a function of habitat characteristics that are influenced by the process of terrestrialization. For example, deeper OCWBs with open water habitat appear to provide better habitat for juvenile salmonids. In contrast, shallower OCWBs often support dense areas of aquatic vegetation (e.g., *Ludwigia*), which is more advantageous to a species like largemouth bass that can tolerate lower rates of dissolved oxygen and, as an ambush predator, can use the vegetation for concealment from prey. Habitat quality in OCWBs is also influenced by human activities such as agricultural runoff that can affect water quality. By monitoring water quality and mapping aquatic vegetation in existing OCWBs, we can make a coarse assessment of habitat conditions in them.

3. **Estimate the discharge magnitudes required to inundate scour channels on point bars to create seasonal, shallow-water habitat.**

The Sacramento River used to flood the Sacramento Valley extensively and frequently (Kelley 1989), creating an “inland sea” of shallow-water habitat that benefited multiple fish and avian species. However, flow regulation and levee construction have generally reduced the extent and frequency of floodplain inundation. Periodic flooding in the Yolo and Sutter bypasses provides vast increases in shallow-water habitat; however, these bypasses are located in the lower Sacramento River valley. In contrast, the middle Sacramento River, between Red Bluff (RM 243) and Colusa (RM 143), generally does not provide the same type of periodic expansion of shallow-water habitat. The middle Sacramento River is an important migratory corridor for juvenile salmonids, and shallow-water habitat provides important growth opportunities for salmonid fry. Faster growth can promote higher rates of survival for juvenile salmonids. As a result, it is important to identify ways to increase shallow-water habitat in the middle Sacramento River. This is especially true for the endangered winter-run Chinook salmon, because the seasonality of

inundation in the Yolo and Sutter bypasses generally does coincide with the fry dispersal period between August and December. There are several forms of shallow-water habitat that occur within the Sacramento River, often in association with point bars. Scour channels that form on point bars provides one type of seasonally inundated, shallow-water habitat within the bankfull channel (Figure 2). These shallow-water areas appear to provide rearing habitat for salmonid fry when they are inundated, but they can pose a stranding risk when they become disconnected from the channel (M. Limm, personal communication, May 1, 2005). Estimating the discharges that inundate these habitats and connect them with the mainstem channel can inform the definition of flow pulses to expand shallow-water habitat while simultaneously reducing stranding risk.

By pursuing these objectives, this study aims to inform the definition of management measures (e.g., flow releases, dredging) that create and maintain OCWBs and seasonally inundated, shallow-water habitat on point bars.

2.2 Study Sites

We sampled two different types of habitats: OCWBs and scour channels on point bars. As a result, the process used to select study sites differed for the two different habitat types.

2.2.1 Off-channel water bodies

An analysis of aerial photographs reveals that there are more than 70 OCWBs in the Sacramento River between Red Bluff (RM 243) and Colusa (RM 143). By necessity, the initial selection criterion was site access. OCWBs are not part of the navigable waterway, so access requires permission from landowners. We focused on OCWBs for which permission was likely to be granted, either because of public ownership or existing relationships with private landowners. Many of the selected study sites are within the Sacramento River National Wildlife Refuge, administered by the U.S. Fish and Wildlife Service and the Sacramento River Wildlife Area, administered by the California Department of Fish and Game. We conducted a reconnaissance-level field examination of candidate study sites. The selected study sites represent a wide range of OCWBs in terms of side-channel connectivity, age, and degree of terrestrialization. Our sample of 30 OCWBs between RM 236.8 and RM 161.2 represented the full range of OCWB types except for the very old, fully terrestrialized end member, and the very young cutoff channel that has not developed an alluvial plug at either end (Table 1).

Table 1. Ownership and parameters measured at off-channel water body study sites.*

Name	RM	Ownership	Sediment Depth (including date if sampled)		Sediment Sample	Macrophyte Survey	WSE	Water Quality (including date if sampled)		Water level changes during the receding of the March 06 flood + Sediment sampling	Cross-section survey
La Barranca	R 236.8	USFWS	X	08/13/05	X	X	X	X	11/05/05	X	
Ohm Right	R 234.8	USFWS	X	08/14/05				DRY		X	
Ohm Left	L 234	USFWS	X	10/16/05	X	X		DRY			
Kopta Slough North	R 221.7	TNC	X	09/02/05			X	X	11/10/05	X	
Kopta Slough Backwater	R 221.6	None	X	09/15/05	X	X		X	11/10/05	X	
Kopta Slough Main	R 218.4	State Parks	X	09/27/05	X	X		X	11/05/05	X	X
N/A	R 212	None	X	09/15/05	X	X		X	10/23/05		
Merrills Landing	L 212.7	DFG	X	08/15/05	X	X	X	X	11/11/05	X	
N/A	L 211	None	X	09/15/05	X	X		X	10/23/05		
Wilson Landing	L 203 205	DFG	X	09/24/05		X	X	X	11/05/05	X	
N/A	L 203	None	X	09/15/05	X	X		X	10/23/05		
Pine Creek Backwater	L 196	DFG	X	09/18/04							
Indian Fisheries	L 195	State Parks	X	08/16/05	X	X	X	X	11/05/05	X	
Jenny Lind Bend	R 195	DFG	X	09/19/04			X	DRY		X	X
N/A	R 194.3	TNC	X	09/13/05	X	X		X	11/07/05	X	
Capay	R 193.5	USFWS	X	08/31/05	X	X		X	11/08/05	X	X
N/A	R 192	USFWS	X	09/19/04				DRY		X	
Sam's Slough	R 190	USFWS	X					X	11/08/05	Phelan	Phelan
N/A	R 189	Private	X	09/13/05	X	X		X	11/05/05	X	
Lagoon	L 182.5	Llano Seco	X	10/19/05				DRY		X	
Duck Lake	L 180.8	Llano Seco	X	08/17/05				DRY		X	

Name	RM	Ownership	Sediment Depth (including date if sampled)		Sediment Sample	Macrophyte Survey	WSE	Water Quality (including date if sampled)		Water level changes during the receding of the March 06 flood + Sediment sampling	Cross-section survey
Jacinto	R 179.2	Llano Seco	X	08/22/05	X	X	X	X	10/08/05	X	X
N/A	R 178	None	X	10/18/05	X	X		X	11/08/05	X	
N/A	R 174	Private	X	09/24/05	X	X		X	11/08/05	X	
Beehive Bend	R 170	DFG	X	11/14/05	X	X	X	X	11/06/05	X	
Rasor Slough	R 168.9	USFWS	X	11/17/05		X		DRY		X	X
Young Rasor Slough	R 168.8	USFWS	X	09/25/05	X	X		DRY		X	X
Old Packer Lake	R 168.4	USFWS	X	09/25/05	X	X	X	X	11/06/05		
Packer Lake	R 167.2	USFWS	X	11/12/05		X	X	X	11/06/05	X	
Boggs Bend	L 161.2	DFG	X						11/06/05	X	

*Designation of "X" indicates that sampling of the indicated parameter(s) was conducted at the site.

2.2.2 Scour channels on point bars

We identified 44 candidate scour channel study sites using air-photo images from 1999, 2004, and 2005 to determine how channel planform location (i.e., curvature and wetted width), point bar dimensions, and vegetation patterns changed in recent time and at varying flow levels. Our air-photo analysis suggested that the processes and geomorphic conditions of the candidate study sites can be grouped into three general categories (Figure 3):

- **Type 1:** Channels that have been scoured behind active point bars, typically along the bank (i.e., within the bankfull channel at the edge of Sacramento River floodplain), with longitudinal axes oriented parallel to the mainstem. Some are supplemented laterally at high flow via point-bar spanning channels with planform morphology similar to what is seen on braided bars. The scour channels are generally perched above the main channel so that they are disconnected at both the inlet and outlet at low flows (Figure 4a). Scour holes within the scour channel often maintain residual pools after cessation of direct mainstem flow input, either from groundwater flow or simply via retention of water after connectivity with the mainstem is lost. In some sites, inlets are no longer distinct because of vegetation establishment and/or sediment deposition and shifts in the mainstem channel position that reduce the frequency of high flows breaching the point bar at the inlet.
- **Type 2:** Abandoned mainstem channels (or flow scars) on the insides of meander bends. Abandonment results from shifts in planform location, as a meander bend erodes its outer bank. These channels may alternatively be remnant channels from previous episodes of meander migration. Inlets are generally disconnected from the mainstem due to blockage by sediment deposits. In contrast, outlets are typically better connected with the mainstem because they are nearly at-grade with the channel bed. These Type 2 units differ from Type 1 scour channels with blocked inlets because they are not always within the bankfull channel, they have larger channel dimensions, and they have outlets that are not typically perched above the main channel. Mainstem inundation occurs via groundwater flow along the longitudinal axis and backwater flow from the outlet. Type 2 units are similar to sloughs, but they are generally smaller and they occur within the bankfull channel rather than the floodplain.
- **Type 3:** Former mainstem channels on the outsides of meander bends that have become ephemerally connected to the mainstem and are separated by small islands or perennially vegetated bars. Island formation differs from a full-blown meander bend cutoff event in that the mainstem cuts behind an active point bar, rather than across the river's floodplain. Inlets tend to be nearly at-grade with the mainstem channel bed, making them better connected than inlets of Type 1 and Type 2 units (Figure 4b). Outlets also tend to be nearly at-grade with the mainstem channel bed, such that outlet connectivity is similar to that of Type 2 units and greater than that of Type 1 units. Type 3 units resemble oxbow lakes, though they are smaller and they occur within the bankfull channel, rather than across the floodplain.

During a five-day field reconnaissance, we visited 32 of the 44 potential study sites. A subset of 17 sites was selected for monitoring of inundation and inlet and outlet connectivity (Table 2). The 17 sites were selected to span the range of morphologic types, while optimizing accessibility and estimated likelihood of capturing a range of inundation conditions for mainstem flows that were expected to occur during the study period (i.e., from 6,000 to 20,000 cfs).

Table 2. Summary of 17 seasonally inundated, shallow-water study sites selected for sampling in the Sacramento River between RM 243 and 184.

Site Number	RM	Bank	Number of Thermographs Installed	Number of Thermographs Recovered	Morphologic Type ¹
13	187	West	2	0	2
14	189	West	1	1	2
15	189.5	East	8	8	1
16	191	East	2	2	3
17	191.7	West	4	3	1 & 2 ²
22	203	West	7	7	1
23	203	East	2	2	3
25	208.9	East	8	8	1
27	211	East	2	2	3
30	219.9	East	3	0	1
31	220.4	East	4	1	1
33	221.6	West	5	5	1 & 2 ²
35	226.5	East	5	4	1
39	232.8	East	2	2	1
40	233.3	West	4	4	1
41	235.3	West	4	4	3
44	239.5	West	4	4	1

¹ See Figure 3 for illustration of morphologic types.

² In some cases, type 1 and type 2 channels coexist at a bend, joining together at the downstream end of the point bar, where the outlet of the abandoned channel intersects with the probe channel. At those sites, we focused our sampling along the probe channels and studied the connection between the abandoned channels and the probe channels.

3 METHODS

3.1 Analysis of Aerial Photographs and Historical Flow Data

We examined historical aerial photographs and historical flow data to estimate the age of OCWB study sites. We scanned, rectified, and analyzed aerial photographs of the middle Sacramento River (RM 243–143) dating from 1942, 1962, 1985, and 1999. We selected these photosets because they were flown during similar seasons and at similar discharges, which facilitates a time-series analysis of their evolution. Each photo was scanned at a resolution of 600–800 dpi. By analyzing a time series of aerial photographs, we were able to bracket the timeframe when a channel was cutoff from the mainstem channel. We then analyzed historical discharge records from intervening years between the aerial photo series to identify the high flow events that likely caused the channel to cutoff and an OCWB to form. In this manner, we were able to estimate the year in which an OCWB study site was formed for 12 of the 14 sampled sites.

We also used the aerial photographs to map the distribution and extent of OCWBs between RM 243 to RM 143, delineating the extent of open water, emergent aquatic vegetation, and riparian vegetation in each photo. We measured and tabulated basic descriptive data such as length, width, water surface area, vegetated surface, etc. We conducted a principal component analysis on the geometric characteristics of the OCWBs we measured from the 1999 aerial photos: surface area of the water body, sinuosity of the channel, length of the wetted former channels, length of the upstream plug, length of the downstream plug, and distance from the channel.

3.2 Survey of Sediment and Water Depths

We collected water and sediment depths in OCWB study sites. The depth of fine sediment in each study site, coupled with the estimated age of each site yielded by the analysis of aerial photos, allowed us to make an estimate of the sedimentation rate at each site.

We determined fine sediment depths by collecting sediment cores using a hand auger with a screw bit that penetrated fine-grained sediment quickly, but encountered resistance when it hit gravel. We assumed that the gravel surface defined the former channel bed at the time of cutoff. However, OCWBs with acute angles to the mainstem may have filled partially with gravel after the site was cut off from the mainstem channel, especially near their upstream ends. We considered this caveat when interpreting our results.

At the selected sampling sites, we collected at least three sediment cores—at an upstream, midpoint, and downstream location along the axis of each secondary channel. OCWBs that were inundated during the time of sampling were cored from a boat when flow magnitudes were sufficient to facilitate navigation. Access to OCWBs that were dry was by foot. All coring depths were ≤ 20 feet due to equipment limitations.

For inundated study sites, we measured water depth using a stadia rod.

3.3 Radiometric Dating

In collaboration with Dr. Rolf Aalto of the University of Washington, we conducted a ^{210}Pb analysis of an 80-cm long sediment core taken from the Packer Lake OCWB (RM 167.2). The radioisotope ^{210}Pb has been used with great success to measure rates of sedimentation in alluvial environments (Stokes and Walling 2003).

3.4 Water Surface Elevations and Flow Velocities

A flood event in March, 2006 inundated many of the study sites. We surveyed water-surface elevations (WSE) in study sites during the recession limb over the course of a week, recording WSEs for a wide range of discharge. At each sampled site, we established benchmarks to which WSEs could be related, and the California Department of Water Resources surveyed the benchmarks using a survey-grade GPS in a subsequent field effort. We also estimated flow velocities and direction in inundated OCWB study sites by tracking the movement of objects (e.g., oranges) placed in the water.

3.5 Cross-Section Surveys

We surveyed channel cross sections of seven OCWB study sites, as shown in Appendix A. We conducted the surveys using inflatable boats. Water depths were collected using a stadia rod. Where possible, we extended tapes across the channel for the survey, but in wider units we used stadia intercepts. We used the water surface only as a datum from which to develop channel bathymetry, but the water surface elevation itself was of no importance as the flows at which we surveyed different channels differed and were arbitrary.

3.6 Water Quality Sampling

We used a Hydrolab Minisonde (Hach, Loveland, Colorado) to monitor pH, water temperature, electrical conductivity, salinity, total dissolved solids (TDS) and dissolved oxygen in the OCWB study sites. To the extent possible, we sampled water quality in those OCWBs in which sediment coring and macrophyte mapping was conducted (Table 1). However, not all OCWB study sites were inundated during each sampling period, which prevented the collection of water quality data at some sites. To the extent possible, we also selected study sites to match those that were surveyed by a previous investigation conducted by Bornette and Morken in 2002. Water quality data included for analysis in this study were collected on the following occasions: June 2002, September 2004, October-November 2005, March 2006, November 2006, and April 2007.

3.7 Macrophyte Mapping

We mapped aquatic macrophytes in 21 OCWBs to better understand the composition and density of aquatic vegetation in these habitats (Table 1). The surveys identified the spatially dominant species of aquatic vegetation and estimated the percentage cover for each species. To the extent possible, we sampled aquatic macrophytes at sites surveyed during a prior investigation conducted in 2002 by Bornette and Morken.

3.8 Thermograph Deployment in Scour Channels on Point Bars

To identify periods of inundation in scour channels that form on point bars, we deployed data-logger thermographs (Stowaway Thermograph, Onset Computer Corporation, Bourne, MA) to continuously record temperatures at 15-minute intervals (Table 2). Previous research (Stillwater Sciences and Dietrich 2002) indicated that when the temperature recorders are exposed to the open air, diurnal fluctuations are more pronounced than when the recorders are inundated (Figure 5).

3.8.1 Thermograph set-up and calibration

Following the manufacturer's specifications, temperature was recorded in 0.16°C increments. Prior to installation, we calibrated the thermographs in tap-water and ice-water baths, to confirm the manufacturer-specified accuracy ($\pm 0.2^\circ\text{C}$), using United States National Institute of Standards and Technology (NIST) certified thermographs. Only thermographs passing an initial calibration check were deployed.

3.8.2 Field study implementation

Thermographs were deployed between 2/15/2007 and 2/21/2007. A total of 67 thermographs (47 dry and 20 wet) were placed at 17 point bar study sites; the number of thermographs deployed at each study site varied, ranging from 1 to 8 (Table 2). Thermographs were placed at a variety of morphologically significant points across the study sites, including: (i) points that would identify the initiation of water-surface connection between the mainstem and the study site inlets and outlets; (ii) points that would indicate longitudinal connectivity along the scour channel on the point bar (i.e., when isolated pools become connected with other portions of the study site and subsequently the mainstem); and (iii) points that would aid in quantifying lateral connectivity, and thus identify changes in wetted width and water depth within the study site. At some study sites, multiple thermographs were placed in a line oriented perpendicular to flow (i.e., in a cross-sectional array). Although the basic rationale for thermograph placement was consistent from site to site, there were places where deployment was precluded due to site-specific conditions. For example, at some sites the outlet was at or below grade with the mainstem channel bed, so that it was unlikely to disconnect during any of the flow magnitudes expected during the study period. Professional judgment was required to optimize the deployed array of thermographs according to the level of effort required, the number of thermographs available, and the data needs of the study.

At each temperature monitoring point, a steel stake was pounded into the channel or bank, and a thermograph was secured to the stake about 2 cm above the substrate with plastic cable ties. Each thermograph was given a unique numeric ID that matched the study site. UTM coordinates of thermographs were established using differential GPS (DGPS). At 10 of the sites, elevation control was also obtained, with 2-cm precision, by establishing benchmarks with the DGPS on dual-frequency carrier phase lock for a minimum of 60 minutes. Thermograph elevations were tied to the benchmark elevations using an auto-level. For cross-sectional arrays of thermographs, topographic cross-sections were also surveyed with the auto-level. At the seven sites that lacked monumented benchmarks, only 1 to 2 thermographs were installed. Relative elevations of those thermographs and water surface elevations were established using a hand-level in concert with the DGPS. The relative elevations are sufficient to establish the change in water surface stage required for local inundation or aerial exposure (depending on whether the thermograph was dry or wet at the time of deployment).

Several additional physical and biological parameters were inventoried at each study site during thermograph installation. The wetted area of each study site was mapped onto 2005 NAIP aerial photographs (which are 1-m orthophotos) printed at a scale of 1:3,000. Lengths and widths of both wetted and dry (i.e., that could potentially become wet) areas were measured using an Impulse Laser Range Finder (with 0.01-m manufacture-specified resolution). Water depths were measured in several locations with a stadia rod to determine the maximum and average depths at the time of thermograph deployment. At each site, we also estimated the percent coverage of the surface by the five major sediment grain size classes (i.e., silt/clay, sand, gravel, cobble, and boulder). Vegetation species growing in the wetted areas of the study sites were identified where possible, and visual estimates of the percent of the study site covered in submerged, floating, and emergent vegetation were also made. Fish observations were conducted from the banks or wetted edges of the inundated portion of study sites, and for deeper sites with good water clarity, a mask and snorkel were used. Observations of fish included the species, frequency, and size class where possible. Turbidity was qualitatively assessed based on a visual scale of 0–4 (i.e., 0 = clear, 4 = no visibility).

Thermographs were removed on 4/25/2007 and 4/26/2007 following 65 to 70 days of deployment. We recovered 57 of the 67 installed thermographs (Table 2). All of the missing thermographs are assumed stolen because: 1) the precision of the DGPS supported a high recovery rate of most thermographs, allowing us to reoccupy installation locations within 0.5 m, including one thermograph that was buried in sediment; 2) the majority were lost at three sites where the missing rate was 100%, suggesting systematic removal of the thermographs; and 3) thermographs disappeared from relatively high elevation points which had relatively low risk of scour and/or deposition and higher risk of being found by human traffic. During thermograph removal, wetted areas were mapped for a second time on 1-m 2005 NAIP imagery. For study sites where the mainstem was at a similar discharge during removal and installation, mapping during removal amounted to a ground truthing of the original mapping.

3.8.3 Data QA/QC and analysis

3.8.3.1 Post-recovery thermograph calibration

Prior to downloading data, all recovered thermographs were subjected to a post-recovery calibration check following methods described above. Following the post-recovery calibration check against NIST certified thermographs, 51 of the 57 recovered thermographs were found within the manufacturer's specified accuracy; 5 of the 6 thermographs that did not pass were just outside the specified accuracy range and had to be adjusted 0.1 to 0.3°C following the methods described by Wagner et al. (2000). One thermograph (thermograph ID #15-6) was further out of range and had to be adjusted 1.3°C. Although the precision of thermograph #15-6 would be too low for some applications, its temperature trends coincide with the temperature trends of the other 7 thermographs deployed at study site 15. This implies that it reliably depicts the timing of inundation and aerial exposure, making it sufficient for the purposes of this study.

3.8.3.2 Determination of inundation vs. aerial exposure

The calibrated temperature record for each thermograph was converted into a time series of alternating inundated and sub-aerial exposure records. Dry thermographs exhibit larger magnitude diurnal temperature variations and correspondingly faster rates of temperature change relative to wet thermographs, due to the higher heat capacity of water relative to air (Figure 5). Additional evidence was used to help delineate wet and dry conditions including:

- Air and water temperature records from Red Bluff Diversion Dam and air temperature and precipitation records from Chico were used to characterize the general temperature and storm patterns for the region during the study period.
- Direct observations of the status (i.e., wet vs. dry) of each thermograph at two discharges, during installation and removal. We were able to couple these observations with surveyed elevation differences among thermographs at some sites, to establish whether the inundation (or sub-aerial exposure) of one thermograph implies inundation (or sub-aerial exposure) of others.
- Comparative analyses using thermographs with known, constant status. Based on site layout, thermograph elevations, thermograph records, and the flows that occurred during the study period, we determined that some thermographs never became wet or dry within the study period. Temperatures recorded on these thermographs were used to determine when other thermographs were wet or dry. For example, inundation would be clearly indicated if a thermograph's temperature pattern first matched the pattern of a known dry thermograph and then rapidly deviated from it.
- Observations of lagged temperature responses for shallowly submerged sites (usually disconnected from the mainstem at the inlet), where the magnitude of diurnal temperature fluctuations can be similar to those observed in dry thermographs, due to the lack of incoming water and disconnection from the mainstem. Our observations indicate that the temperature response in shallow water lags 3 to 4 hours behind what we observe at sub-aerially exposed sites, particularly during the evening when temperature cooling in shallow pools occurs later and at a slower rate than dry sites, but may nevertheless approach or equal dry site temperatures by early morning.
- Correlation with other inundated and sub-aerially exposed events. The majority of thermographs were installed dry. If they became inundated, it typically occurred three times during short duration peak flows, separated by 2.5 days in the first half of the monitoring period. This helped establish a consistent relationship between discharge and inundation, which could be used to help identify the threshold discharge if the temperature signal was not definitive for one of the three peak flow events, as was the case with the second peak flow which deviated from the typical diurnal temperature pattern due to a concurrent storm event.

3.8.3.3 Flow data

Data from 4 CDWR flow gauges were analyzed for comparison with the thermograph temperature data (Table 3). Peak flow for the study period ranged from 14,724 to 17,040 cfs across the gauges, whereas minimum flow ranged from 6,150 to 7,123 cfs. In comparison, bankfull discharge on the mainstem Sacramento River is estimated at 88,300 cfs post Shasta Dam construction (Thomas 2000).

Table 3. CDWR flow gauges on the Sacramento River used for thermograph analysis from 2/15/2007 to 4/26/2007.

Gauge	RM	Max flow (cfs)	Min flow (cfs)
Bend Bridge	261.4	15,100	6,150
Vina Woodson Bridge	218.2	17,040	6,918
Hamilton City	199.3	14,724	6,202
Ord Ferry	184	15,577	7,123

The three highest flows at the gauges occurred between 2/22/07 and 3/1/07 and were characterized as three distinct peaks separated by about 2.5 days that had relatively quick rising and recessional limbs (Figure 6). A lower magnitude peak flow occurred near the end of the monitoring period, on 4/22/2007, following a brief spring storm. Flows were relatively low between mid-March and the late April storm, with the extreme lows for the study period occurring from 3/24 to 3/26/2007.

Because some deployed thermographs were located as far as 20 miles from the nearest flow gauge, it was necessary to adjust the time stamp of the flow data for comparison with the temperature data. To estimate a reasonable time-stamp adjustment for the comparative analysis, we calculated lag times for the arrival of flow peaks at the gauges for each of the three peak flows during the 2/22/07 to 3/1/07 interval. When coupled with the distance between the gauges, the lag times can be used to estimate the speed of flow peaks, which in this case averaged 4.5 mi/hr (± 0.5 mi/hr, $n=15$). We used this speed to adjust the time stamps of the flow data of the relevant gauge to each site. For example study site 14 is located at RM 189, which is about 5 miles upstream of the Ord Ferry Gauge. For site 14, 1 hour was subtracted from flow data time stamps at Ord Ferry, so that a flow occurring at 8:00 AM at Ord Ferry was considered to be the local flow condition at 7:00 AM at site 14.

This adjustment should be reasonable, given that the majority of inundation and subsequent dry cycles at our study sites occurred during the three late February peak flows and 4.5 mi/hr rate is calculated specifically from these events. Once time stamps were adjusted, we were able to estimate local flow conditions during thermograph installation and removal and also at the time of inundation and subsequent sub-aerial exposure, based on temperature data from the thermographs (Table 4). Flow at the threshold of inundation was consistent for most thermographs, suggesting that the method of adjusting flow time stamps worked well. Nevertheless, some error is expected in matching gauge discharge with thermograph records due to separation distance. The amount of error associated with adjusting the time stamp of flow gauges is unknown, but the relatively consistent agreement between threshold flows for inundation during three peaks storms (with different sloped hydrographs during both rising and recessional limbs) suggests the method of time adjustment was reasonable. Discharges reported in this study are rounded to the nearest 100 cfs, in part, to reflect this uncertainty.

Table 4. Study site locations and flows during thermograph installation and removal.

Study site	River mile	Corresponding flow gauge	Flow ¹ during (cfs):	
			installation	removal
13	187	Ord Ferry	8,600	7,600
14	189	Ord Ferry	8,600	7,600
15	189.5	Ord Ferry	8,600	7,600
16	191	Ord Ferry	8,500	7,600
17	191.7	Ord Ferry	8,500	7,600
22	203	Hamilton City	7,600	6,700
23	203	Hamilton City	7,600	6,700
25	208.9	Vina Woodson	7,900	8,800
27	211	Vina Woodson	7,900	8,800
33	221.5	Vina Woodson Bridge	8,100	8,900
35	226.5	Vina Woodson Bridge	8,900	8,900
39	232.8	Vina Woodson Bridge	8,900	9,000
40	233.3	Vina Woodson Bridge	8,900	8,900
41	235.3	Vina Woodson Bridge	9,300	8,900
44	239.5	Bend Bridge	9,500	8,900

¹ All flows are based on data from nearest gauge after adjusting for time lag of 4.5 mi/hr (see Section 3.8.3.3).

The assumed 4.5 mi/hr travel time for flow is not expected to be representative of all peak flow events, because storm patterns, tributary and reservoir discharges, and ground saturation levels are likely to vary and affect the travel time. 4.5 mi/hr is also likely not representative of travel times for the low flow period of the study. However, given that stage tends to change slowly during non-storm periods, with discharges often remaining stable for several hours during low flow periods, using the 4.5 mi/hr time adjustment is assumed to be reasonable for our study purposes.

3.8.3.4 GIS analysis

Wetted areas were mapped by hand onto aerial photographs during thermograph deployment and retrieval and were digitized and projected into UTM NAD 1983, Zone 10N using ArcMap 9.2 software. These wetted area polygons were calibrated in the office by comparing the dimension of the digitized polygons with length and width measurements taken with the Laser Range Finder. Areas (m²) were calculated for each wetted polygon and divided into wetted polygons that are either connected to (by inlet and/or outlet) or disconnected from the mainstem.

After determining the discharges required to inundate (or expose to air) the thermographs, we identified the likely boundaries of inundated areas at different discharges, based on observed hydraulics, connectivity, survey data, and field sketches of features and slope breaks at elevations similar to those of the thermographs. For example, at one site, a thermograph was installed dry on an elevated bench (i.e., a terrace within the active channel) outside the wetted channel. We mapped the back edge of the bench onto air photos as the assumed boundary of inundation, should the thermograph installed on bench ever become inundated. When it eventually became

inundated, we assumed that the entire trace of the bench was wet when digitizing new polygons for the elevated flow levels. Key assumptions of this approach include: (i) surveyed cross-sections are often assumed to be representative of the adjoining channel up to several hundred meters, (ii) effects of channel slope within a study site are often disregarded (i.e., slope is assumed to be zero), and (iii) field judgment used to place thermographs at hydraulic control points is assumed to be accurate. These assumptions introduce significant, but difficult-to-quantify, uncertainties in our calculations of inundation areas.

4 RESULTS

4.1 Analysis of Aerial Photographs and Historical Flow Data

By examining a time series of aerial photographs, coupled with discharge data, we were able to estimate the age of several OCWBs in the Middle Sacramento River corridor (Table 5)

Table 5. Estimated age of off-channel water bodies in the Middle Sacramento River.

Name	River Mile	Date of cutoff		Age as of 2007
		beginning	end	
La Barranca	R 236.8	1991	1997	11
Ohm right side	R 234.8	1964	1969	38.5
Ohm left side	L 234	1991	1997	11
Kopta Slough North	R 221.7	1964	1969	38.5
Kopta Slough Backwater	R 221.6	1964	1969	38.5
Kopta Slough Main	R 218.4	1937	1946	63.5
Merrills Landing	L 212.7	1991	1997	11
N/A	R 212	1991	1997	11
N/A	L 211	1991	1997	11
Wilson's Landing	L 203-205	1976	1981	26.5
N/A	L 203	1976	1981	26.5
Pine Creek Backwater	L 196	1976	1981	26.5
Indian Fisheries	L 195	1937	1946	63.5
Jenny Lind Bend	R 195	1937	1946	63.5
N/A	R 194.3	1964	1969	38.5
Capay	R 193.5	1964	1969	38.5
N/A	R 192	1976	1969	32.5
Sam's Slough	R 190	1870	1870	135
N/A	R 189	1964	1969	38.5
Lagoon	L 182.5	1896	1908	103
Duck Lake	L 180.8	1870	1870	135
Jacinto	R 179.2	1960	1964	43
N/A	R 178	1991	1997	11
N/A	R 174	1991	1997	11
Beehive Bend	R 170	1923	1935	76
Rasor Slough	R 168.9	1870	1870	135
Young Rasor Slough	R 168.8	1960	1964	43
Old Packer Lake	R 168.4	1870	1870	135
Packer Lake	R 167.2	1870	1870	135
Boggs Bend	L 161.2	1937	1946	63.5

Based on cluster (ordination) analyses performed on principal components derived from a principal component analysis of the geometric characteristics of the former channels visible on 1999 air photos (Figure 7), we distinguish four distinct geometric types as a function of their straightness and proximity/hydrologic connection to the main channel:

- S1 = straight former channels close to the main channel
- S2 = straight former channels with a strong downstream connection
- M1 = meander former channels (long, sinuous and with a high surface area) far from the main channel
- M2 = meander former channels (long, sinuous and with a high surface area) close to the channel on its downstream entrance

4.2 Survey of Sediment and Water Depths

Our preliminary data show a range of sedimentation rates, ranging from 0 m to more than 5 m. The most commonly encountered sediment thickness is about 2 m (Figure 8). When we look at sedimentation rates as a function of age of the cut-off channel, we find a greater spread in rates among the recently cut-off channels (ranging from zero to 18 cm/year for cutoffs approximately a decade old) than in older cutoffs (ranging from 1 to 5 cm/y for 130-y-old cutoffs) (Table 6), Figure 9). Older OCWBs may have more consistent sedimentation rates because of the tendency for year-to-year variations in sedimentation rates to even out over time. OCWBs that initially fill rapidly will more quickly reach higher elevations, which require larger (and thus less frequent floods) to be inundated. Thus, their sedimentation rates will decrease over time. Channels that begin with slower sedimentation rates will remain at a lower elevation and thus continue to receive sediment over a longer time period than channels that fill rapidly and thus achieve elevations above the elevation of frequent inundation.

Table 6. Sedimentologic characteristics of OCWB study sites in the Middle Sacramento River.

Name	River Mile	Ownership	Age of cut-off (years)	Number of cores	Average sedimentation depth (cm)	Average sedimentation rate (cm/year)
La Barranca	R 236.8	USFWS	11	9	81.9	7.4
Ohm left side	L 234	USFWS	38.5	1	155.0	4.0
Ohm right side	R 234.8	USFWS	11	5	199.6	18.1
Kopta Slough North	R 221.7	TNC	38.5	8	201.4	5.2
Kopta Slough Backwater	R 221.6	None	38.5	5	76.2	2.0
Kopta Slough Main	R 218.4	State Parks	63.5	5	22.8	0.4
Merrills Landing	L 212.7	DFG	11	7	173.8	15.8
N/A	R 212	None	11	2	41.0	3.7
N/A	L 211	None	11	5	73.7	6.7
Wilson Landing	L 203-205	DFG	26.5	4	171.0	6.5
N/A	L 203	None	26.5	4	107.5	4.1
Pine Creek Back Water	L 196	DFG	26.5	5	274.6	10.4
Indian Fisheries	L 195	State Parks	63.5	4	339.7	5.3
Jenny Lind Bend	R 195	DFG	63.5	8	250.2	3.9
N/A	R 194.3	TNC	38.5	9	25.4	0.7
Capay	R 193.5	USFWS	38.5	5	151.6	3.9
N/A	R 192	USFWS	32.5	5	383.8	11.8
Sam's Slough	R 190	USFWS	135	2	268.5	2.0
N/A	R 189	Private	38.5	9	29.6	0.8

Name	River Mile	Ownership	Age of cut-off (years)	Number of cores	Average sedimentation depth (cm)	Average sedimentation rate (cm/year)
Lagoon	L 182.5	Llano Seco	103	1	296.0	2.9
Duke Lake	L 180.8	Llano Seco	135	2	453.0	3.4
Jacinto	R 179.2	Llano Seco	43	10	166.5	3.9
N/A	R 178	None	11	5	200.2	18.2
N/A	R 174	Private	11	7	0.0	0.0
Beehive Bend	R 170	DFG	76	6	232.8	3.1
Rasor Slough	R 168.9	USFWS	135	1	545.0	4.0
Young Rasor Slough	R 168.8	USFWS	43	5	149.8	3.5
Old Packer Lake	R 168.4	USFWS	135	1	467.0	3.5
Packer Lake	R 167.2	USFWS	135	4	249.5	1.8
Boggs Bend	L 161.2	DFG	63.5	3	175.0	2.8

Water depths (measured at various times during the year) varied among former channels. Some had consistently shallow depths of less than 1 m (e.g., 221.7 RM), while others had depths exceeding 3 to 4 m (Figure 8).

4.3 Radiometric Dating of Former Channel Sediments

Figure 10 illustrates the preliminary results from the ^{210}Pb analysis of the sediment core collected from Packer Lake (RM 167.2). The upper fill of the lake consists entirely of fines, signifying that the sediment core contains only material delivered by suspended load. The lack of significant peaks in the activity of ^{210}Pb implies that rates of sedimentation have been uniform through the recent past at Packer Lake. Converting the decay units of the ^{210}Pb data into units of sedimentation indicates an average overbank sedimentation rate in Packer Lake of 0.42 cm/yr.

4.4 Water Surface Elevations and Velocities

4.4.1 Water surface elevations

Analysis of stage data show some interesting differences among study sites, reflecting differences in hydrologic connectivity. For example, some sites remained well-connected to the mainstem, and experienced fluctuations that mimicked mainstem stage changes, while in others the fluctuations were muted, though in the same sense as the mainstem stage changes, reflecting the influence of floodplain water table changes, rather than a direct surface-water connection to the main channel. Stage-discharge relations during recession limb of the March 2006, with 0 stage set at the highest flow we measured at each site, are shown for the mainstem at Woodson Bridge and Hamilton City, and for five OCWBs, in Figure 11. For each site shown, the point along the zero line at the top of the figure represents the highest reading (at the beginning of our period of measurement during the flood's recession limb). The later observations are along the line descending to the left. The mainstem lines show linear declines. The OCWBs with straight lines reflect good connection between side channel and mainstem, while the non-linear traces reflect poor connection to the main channel.

4.4.2 Surface velocities

Surface velocity measurements during the recession limb of the March 2006 flood for each OCWB are presented in Figures 12a and 12b. The x-axis is labeled with the name of the OCWB for each velocity measurement. If the velocity was zero, no bar is visible. If velocity was negative (i.e., water flow in the upstream direction), the bar extends downward from the zero line. If velocity was positive (i.e., downstream), the bar extends upward. So that the figures are readable, we present the data for the complete set in two figures: Figure 12a presents data for Beehive Bend, Boggs Bend, Capay, Duck Lake, Indisan Fisheries, Jacinto, Jenny Lind Bend, Kopta Main, Kopta Backwater, Kopta North, and La Barranca. Figure 12b presents data for Lagoon, Merrills Landing, Old Razor Slough, Packer Lake, Phelan Island, R174, R178, R189, R192, R194, Wilson Landing, and Young Rasor Slough.

From the plots in Figures 12a and 12b, we can identify some distinctive groups of OCWBs:

1. Those with active velocity whatever the discharge (e.g., R194, R174)
2. Those with active velocity but strong decrease in velocity with increasing discharge (e.g., R189, Phelan)
3. Those whose velocity decreased slowly with increasing discharge (e.g., Capay, Jacinto, Merril Landing, Lagoon, Wilson Landing, Indian Fisheries),
4. Those with no velocity whatever the discharge (e.g., Beehive, Duke, Jenny, Kopta main, Kopta North, Kopta Backwater, La Barranca, Ohm Right, Young Rasor, Old Rasor, Packer Lake), and
5. One with negative velocity with increasing discharge (R178).

These velocity observations provide clear evidence of the differing degrees of hydrologic connectivity with the mainstem Sacramento River among the OCWBs studied. For example, R178, R189, and R194 are all S2-type OCWBs and function as connected secondary channels, with relatively high velocities in the downstream direction. Some others were connected only at their maximum stage (roughly a Q5), such as the S-1 type OCWBs Jacinto, Kopta North, Lagoon, and Phelan, the M-1-type OCWB Merrills Landing, and the M-2 type OCWBs Wilson Landing and Indian Fisheries. Capay was unique as an S-2 connected with positive velocities for our first two observations at the beginning of the flood, but whose connection was severed as the stage declined. Finally, we measured no velocity in some OCWBs, such as the M-1 type OCWBs Beehive Bend, Boggs Bend, and Packer Lake, the M-2 type OCWBs Duck Lake, Old Rasor, and Jenny Lind Bend, the S-1 type OCWBs Kopta Main and Ohm Right, and—surprisingly given their plan geometry—the S-2 type OCWBs Kopta Backwater and Young Rasor Slough.

4.5 Cross Section Surveys

Figures 13-19 show cross sections of OCWB study sites in the Sacramento River surveyed in March 2006 (with follow-up surveys at lower flows as needed). The x-axis is horizontal distance (m) across the channel (left bank to right bank unless otherwise noted) and the y-axis is elevation (m) above an arbitrary datum. Note that some of the legends use French terms: *terrain* is ground surface, *eau* is water surface elevation, *niveau fin* is the base of the fine-grained sediment accumulated over the former channel gravel, and *arbustes immerges* is bushes submerged by water. These cross sections demonstrate the narrowing that has occurred post-cutoff. The main channel width is roughly 100 m, but the abandoned channels have narrowed, most to around 60 m (Capay to about 30 m). The depth of fine sediment shown for Phelan (Figure 13) is consistently about 3 m across this channel.

4.6 Water Quality and Aquatic Macrophyte Survey

Preliminary results of vegetative transect surveys to date are presented in Table 7. We seek to better understand the distribution of *Ludwigia* as a function of hydrologic connectivity, water quality (as influenced by surrounding land uses, groundwater exchange, etc.), and other factors.

Table 7. Occurrence of vascular plant species during surveys of off-channel water bodies.

Species	Location (RM)							R					R				R	-195		-205	L	L	R	-214		R		braided	braided	meander
		G4	G5	G7	G6	G8		D12 bis	D13	D12	G10		G11	G11	G13 bis		D26	G15 bis	D29				D33	G26		G34	G33v	G33	G33m	
<i>Azolla mexicana</i>		0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	
<i>Ceratophyllum demersum</i>		1	0	1	0	0	1	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	
<i>Echinochloa muricata</i>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Egeria densa</i>		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	1	1	0	0	0	
<i>Elodea canadensis</i>		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	1	0	
<i>Elodea nuttallii</i>		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	1	
<i>Hibiscus californicus</i>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Juncus effusus</i>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Leersia oryzoides</i>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Lemna minor</i>		0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	
<i>Lemna minuscula</i>		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Lemna minuta</i>		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Limnobium spongia</i>		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Ludwigia peploides</i> ssp. <i>montevidensis</i>		1	0	1	0	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	1	1	1	1	1	1	1	1	
<i>Myriophyllum aquaticum</i>		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	1	
<i>Myriophyllum spicatum</i>		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	1	0	0	1	1	
<i>Nymphaea odorata</i>		0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Phalaris</i> sp.		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Polygonum hydropiperoides</i>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Polygonum punctatum</i>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Potamogeton crispus</i>		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	

Table 8. Average water quality measurements for OCWB sites.

Site Name	RM	Number of Samples (n)	Temp. (°C)	Dissolved Oxygen (%)	Conductivity (µS/cm)	Salinity (g/L)	TDS (g/L)	pH
Bogg's Bend	161.5L	1	11.09	93.50	109.50	0.04	0.07	8.02
Packer Lake	167.2R	5	17.21	50.20	167.18	0.08	0.11	7.79
Old Packer Lake	168.4R	3	23.93	96.23	266.47	0.13	0.17	8.14
Young Razor	168.6R	4	22.69	112.30	249.31	0.12	0.16	8.39
Old Razor Slough	168.8R	4	24.79	71.88	319.33	0.16	0.21	7.95
Beehive Bend	170R	5	18.04	48.82	349.10	0.17	0.22	7.70
N/A	174R	2	11.04	107.15	132.50	0.06	0.08	8.35
N/A	178R	4	17.72	58.38	190.98	0.09	0.12	7.88
Jacinto	179.2R	5	16.40	65.78	301.26	0.15	0.19	8.14
Duck Lake	180.8L	1	13.32	53.20	146.80	0.06	0.09	7.65
Lagoon	182.5L	1	11.09	108.90	126.40	0.05	0.08	7.97
N/A	189R	2	13.39	156.25	522.20	0.27	0.33	8.17
Sam's Slough / Phelan Island	190R	3	19.69	64.00	1211.93	0.64	0.78	8.01
N/A	192R	2	18.41	22.48	426.25	0.22	0.27	7.98
Capay	193.5R	2	16.58	41.95	590.20	0.31	0.38	7.92
Jenny Lind Bend	194.5R	1	31.92	99.13	168.60	0.07	0.11	8.19
N/A	194.3R	3	16.36	89.67	129.44	0.05	0.08	8.27
Indian Fisheries	195L	5	20.65	87.85	563.37	0.29	0.42	8.54
N/A	203L	1	19.75	153.30	241.80	0.11	0.15	7.73
Wilson's Landing	203-204L	4	20.63	127.12	647.45	0.33	0.41	7.71
N/A	211L	1	17.04	54.60	130.30	0.05	0.08	7.64
N/A	212L	1	18.22	24.00	152.10	0.07	0.10	7.58
Merrills Landing	213-214L	4	17.98	25.77	324.35	0.18	0.21	7.57
Kopta Main	218.4R	4	17.47	91.29	172.92	0.08	0.11	7.58
Kopta Slough Backwater	221.6R	1	15.62	49.40	219.50	0.10	0.14	7.80
Kopta North	221.7R	1	15.44	69.40	252.50	0.12	0.16	7.49
Ohm	234.8R	2	28.66	107.62	369.78	0.18	0.24	7.76
La Barranca	236.8R	4	17.53	40.40	231.79	0.15	0.15	7.87
Sacramento River	Hamilton City Bridge	2	16.37	75.95	115.25	0.05	0.07	8.08

Average percent dissolved oxygen saturation rates at the sites ranged from 22.48% to 156.25%. The average percent dissolved oxygen was over 90% for approximately 40% (11) of the sites. Average conductivity measurements ranged from 109.50 to 1211.93 $\mu\text{S}/\text{cm}$, average salinity rates ranged from 0.04 to 0.64 g/L, and average TDS rates ranged from 0.07 to 0.78 g/L. Since conductivity, salinity, and TDS measurements all relate to the concentration of particles in the water, the low measurements for these parameters all occurred at the same site (Bogg's Bend) and the high measurements also all occurred at the same site (Sam's Slough/Phelan Island). Average pH measurements ranged from 7.49 to 8.54.

In Figure 20, conductivity measurements are shown for seven different OCWB sites taken at three different discharge rates of the Sacramento River. For all of the sites but one (Giesbrecht North), conductivity decreased as river discharge increased. In comparing conductivity measurements taken at various river discharges, preliminary results suggest that the greater the river discharge and thus the greater the hydrological connection to the main channel, the lower the conductivity measurements of the OCWB.

4.7 Scour Channels on Point Bars

Results from the habitat surveys are summarized for the 15 sites where thermographs were recovered. A majority of study sites (11 out of 15) were dominated by substrates finer than 2 mm (i.e., clay, silt, and sand) (Table 9). A majority of sites (13 out of 15) also have *Ludwigia* growing within their wetted areas (Table 9; Photo 1). *Ludwigia* is an invasive plant often found in OCWBs and other slack-water areas. The maximum water depth was 1.8 m whereas average water depth ranged from 0.2 to 0.7 m across the sites. Fish were observed at 6 of the 15 sites. With the exception of the adult green sunfish (*Lepomis cyanellus*) observed at site 13, all fish were of juvenile age class. Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) were observed at four of the sites, with estimated number observed ranging from 50 to 320. Juvenile Sacramento Sucker (*Catostomus occidentalis*) and Sacramento pike minnow (*Ptychocheilus grandis*) were also observed.

Table 9. Summary of habitat data from 15 scour channels on point bar study sites on the Sacramento River.

Study Site	RM	Avg. Water Depth (m)	Max. Water Depth (m)	Dominant Substrate	Vegetation Surveys				Fish Species Observed		
					<i>Ludwigia</i> present	% emergent	% submerged	% floating	Species ¹	Count	Length Class (mm)
13	187		0.05	Gravel	No	5	0	0	LECY	50-100	150-220
14	189	0.46	0.58	Silt/ Sand/ Clay	Yes	5	1	0	None		
15	189.5	0.57	1.31	Silt/ Sand/ Clay	Yes	30	15	30	ONTS CAOC PTGR	100 75 465	40-80 40-80 40-80
16	191	N/A	N/A	Silt/ Sand/ Clay	Yes	5	5	5	None		
17	191.7	0.55	1.10	Silt/ Sand/ Clay	Yes	30	10	20	None		
22	203	0.4	1.37	Gravel	Yes	NA	NA	NA	ONTS RUTI	50 10	40-60 60-80
23	203	0.18	0.37	Gravel	No	0	0	0	None		
25	209	0.39	1.10	Silt/ Sand/ Clay	Yes	0	5	5	ONTS	130	40-60
27	211	0.69	1.28	Silt/ Sand/ Clay	Yes	0	2	0	None		
33	221.6	0.52	0.64	Silt/ Sand/ Clay	Yes	10	20	25	None		
35	226.5	0.7	0.73	Silt/ Sand/ Clay	Yes	1	15	0	None		
39	232.8	0.3	1.83	Silt/ Sand/ Clay	Yes	0	10	0	PTGR	50	20-60
40	233.3	0.4	0.98	Silt/ Sand/ Clay	Yes	1	40	2.5	None		
41	235.3	0.5	1.34	Silt/ Sand/ Clay	Yes	1	1	1	None		
44	239.5	0.69	0.99	Gravel	Yes	1	1	1	ONTS CAOC	320 5	20-80 40-60

¹ ONTS- Chinook salmon, CAOC- Sacramento sucker, PTGR Sacramento pike minnow, LECY-Green sunfish

Results from our analysis of threshold flows, maximum water temperatures, and inundation area at different discharges are summarized in Tables 10 and 11 along with references to relevant figures for each thermograph and study site. We present detailed results from four study sites: 15 (RM 189.5), 22 (RM 203), 25 (RM 209), and 44 (RM 239.5) in the sub-sections below. These sites were some of the more complex sites we monitored with a wide array of thermographs, and were also the four sites where juvenile Chinook salmon (*Oncorhynchus tshawytscha*) were observed. Detailed descriptions of the results for the remaining sites can be found in Appendix A.

Table 10. Thermograph installation and monitoring summary.

Thermograph ID	Wet vs. dry @ install	Inferred threshold flow ¹ (cfs)	Number of inundation cycles during study period	Max temp when wet (°C)	Relevant Figure #'s
13-1	Wet	NA	not recovered	NA	21
13-2	Dry	NA	not recovered	NA	21
14-1	Dry	13,400	3	14.0	22-23
15-1	Dry	12,200	3	11.8	24-25
15-2	Dry	9,800	1	13.0	24-25
15-3	Dry	12,200	3	13.8	24-25
15-4	Dry	14,700	1	15.5	24-25
15-5	Dry	12,000	3	14.6	24-25
15-6	Dry	12,200	3	12.7	24-25
15-7	Dry	NA	always dry	NA	24-25
15-8	Wet	NA	always wet	28.8	24-25
16-1	Wet	8,000	4	18.1	26-27
16-2	Dry	12,000	2	10.7	26-27
17-1	Dry	NA	always dry	NA	28-29
17-2	Dry	14,400	2	15.2	28-29
17-3	Dry	NA	not recovered	NA	28-29
17-4	Dry	13,800	2	16.6	28-29
22-1	Dry	12,300	3	19.2	30-31
22-2	Dry	NA	always dry	NA	30-31
22-3	Dry	NA	always dry	NA	30-31
22-4	Dry	12,300	3	19.8	30-31
22-5	Dry	10,200	3	16.0	30-31
22-6	Wet	NA	always wet	23.2	30-31
22-7	Wet	NA	always wet	21.6	30-31
23-1	Wet	7,100	4	27.4	32-33
23-2	Dry	10,900	3	14.6	32-33
25-1	Wet	NA	always wet	18.7	34-36
25-2	Dry	10,100	2	15.9	34-36
25-3	Dry	14,800	2	16.1	34-36
25-4	Wet	NA	buried in sediment		34-36
25-5	Wet	NA	always wet	18.4	34-36
25-6	Dry	8,700	7	20.1	34-36
25-7	Dry	12,000	3	13.3	34-36
25-8	Dry	NA	always dry	NA	34-36
27-1	Wet	NA	always wet	16.2	37-38
27-2	Dry	12,400	3	12.3	37-38
33-1	Dry	14,700	2	15.0	39-41
33-2	Dry	NA	always dry	NA	39-41
33-3	Wet	7,300	1	24.9	39-41
33-4	Dry	NA	always dry	NA	39-41
33-5	Dry	12,000	3	15.8	39-41
35-1	Wet	NA	always wet	21.3	42-44
35-2	Wet	7,100	1	20.4	42-44

Thermograph ID	Wet vs. dry @ install	Inferred threshold flow¹ (cfs)	Number of inundation cycles during study period	Max temp when wet (°C)	Relevant Figure #'s
35-3	Wet	NA	always wet	20.8	42-44
35-4	Dry	14,900	2	18.0	42-44
35-5	Dry	NA	not recovered	NA	42-44
39-1	Wet	7,800	1	30.1	45-46
39-2	Dry	NA	always dry	NA	45-46
40-1	Dry	13,500	2	14.3	47-48
40-2	Wet	NA	always wet	26.2	47-48
40-3	Dry	NA	always dry	NA	47-48
40-4	Dry	NA	always dry	NA	47-48
41-1	Wet	8,100	3	26.3	49-51
41-2	Dry	13,300	4	30.3	49-51
41-3	Dry		always dry	NA	49-51
41-4	Wet	8,100	1	18.3	49-51
44-1	Wet		always wet	22.5	52-53
44-2	Wet		always wet	20.0	52-53
44-3	Wet	7,700	1	29.4	52-53
44-4	Dry	11,300	5	25.0	52-53

¹ All flows are based on data from nearest gauge after adjusting for time lag of 4.5 mi/hr (see text).

Table 11. Summary of flows and estimated inundated areas.

Site	RM	Type of measurement	Discharge ¹ (cfs)	Connected inundated area (m ²)	Disconnected inundated area (m ²)	Total inundated area (m ²)	Relevant Figure #’s
13	187	direct observation	7,600	4,770	14,950	19,720	21a
		direct observation	8,600	23,660		23,660	21b
14	189	direct observation	10,500	2,770	6,410	9,180	22a
		thermograph	13,400	9,300		9,300	22b
15	189.5	direct observation	7,600		1,270	1,270	24a
		direct observation	8,600		3,890	3,890	24b
		thermograph	10,600		9,230	9,230	24c
		thermograph	12,200	14,370		14,370	24d
16	191	direct observation	7,600	6,190		6,190	26a
		direct observation	8,500	10,830		10,830	26b
		thermograph	12,000	28,950		28,950	26c
17	191.7	direct observation	7,600	910		910	28a
		direct observation	8,500	3,040	1,890	4,930	28b
		thermograph	14,400	6,010	2,830	8,840	28c
22	203	direct observation	7,600	34,160	990	35,150	30a
		thermograph	10,200	36,330	1,320	37,650	30b
		thermograph	12,300	54,030		54,030	30c
23	203	direct observation	7,100	36,290	620	36,910	32a
		direct observation	7,600	38,100		38,100	32b
		thermograph	10,900	55,610		55,610	32c
25	209	direct observation	7,900	4,970	2,340	7,310	34a
		direct observation	8,700	5,570	2,170	7,740	34b
		thermograph	12,000	6,806	1,630	8,436	34c
		thermograph	14,800	11,400	1,630	13,030	34d
27	211	direct observation	7,900	21,710		21,710	37a
		thermograph	12,400	31,820		31,820	37b
33	221.6	thermograph	7,300	1,800	6,890	8,690	39a
		direct observation	8,100	3,480	6,890	10,370	39b
		thermograph	12,000	10,530		10,530	39c
		thermograph	14,700	13,600		13,600	39d

Site	RM	Type of measurement	Discharge ¹ (cfs)	Connected inundated area (m ²)	Disconnected inundated area (m ²)	Total inundated area (m ²)	Relevant Figure #'s
35	226.5	thermograph	7,100	9,940		9,940	42a
		direct observation	8,900	15,000		15,000	42b
		thermograph	14,900	20,040		20,040	42c
39	232.8	thermograph	7,800	970		970	45a
		direct observation	8,900	3,690		3,690	45b
40	233.3	direct observation	8,900	460	1,770	2,230	47a
		thermograph	13,500	7,770		7,770	47b
41	235.3	thermograph	8,100	3,730		4,346	49a
		direct observation	9,300	11,900		11,900	49b
		thermograph	13,300	18,270		16,676	49c
44	239.5	thermograph	7,700	5,260		5,260	52a
		direct observation	9,500	5,770	350	6,120	52b
		thermograph	11,300	8,090		8,090	52c

¹ All flows are based on data from nearest gauge after adjusting for time lag of 4.5 mi/hr (see text).

4.7.1 River Mile 189.5L

Study site 15 is located on the east bank at RM 189.5L. Site 15 is a probe channel eroding behind an active point bar (Figure 24a). Under the classification scheme outlined in Section 2.2.2, site 15 is a type 1 unit, which we expect should generally exhibit poor hydraulic connectivity at both the inlet and outlet. Thermographs were installed on 2/21/2007, when flow was 8,600 cfs. Both the inlet and outlet were disconnected from the mainstem (Figure 24b). An array of eight thermographs was installed to investigate (i) the timing of connection to the mainstem, (ii) longitudinal connectivity within the site, and (iii) the timing of connection between Murphy Slough and the study site. Eight thermographs were recovered on 4/26/2007 when flow was 7,600 cfs.

During thermograph installation, Chinook salmon (*Oncorhynchus tshawytscha*), Sacramento Sucker (*Catostomus occidentalis*), and Sacramento pike minnow (*Ptychocheilus grandis*) were observed in isolated shallow pools near the disconnected inlet of the OCWB. Little vegetative canopy cover was located near the pools, and the substrate consisted largely of sand (75%) and gravel (25%). At 8,600 cfs, during installation of the thermographs, 6 disconnected pools were observed (Figure 24b). The pool located near thermograph 15-8 was deepest, with a maximum depth of 1.3 m. On average, pool depth was 0.4 m across the site.

Thermograph data indicates that the threshold flow for mainstem connection of all the pools along site 15's longitudinal axis is about 12,200 cfs (Figure 24d). However, the discharge for inlet connection varied from 11,900 to 12,800 (median of 12,200 cfs) during the three storm peaks (Figure 25); this variability may be attributed to local stage effects associated with Stony Creek which enters the Sacramento on the opposite bank just upstream from Site 15's inlet. These local stage effects may not be consistently reflected at the same flow level at the Ord Ferry

gauge. With the exception of thermograph 15-7, all of the thermographs became inundated during the three peaks of the 2/22/07–3/1/07 storm event (Figures 25a and 25b). Thermograph 15-2 became inundated at 9,800 cfs, prior to connection with the inlet, implying that pools within the study site received groundwater in response to a water table rise in the mainstem. Data from thermographs 15-3 (Figure 25a) and 15-6 (Figure 25b) suggest there was a 6 to 8 hour time lag for inundation following inlet connectivity after the arrival of the first peak at the site. Yet they became inundated rapidly following inlet inundation in the subsequent storm events, probably due to antecedent ground saturation and elevated water levels in previously isolated pools. The inlet and outlet appear to become inundated at roughly the same time, with a few exceptions; in some instances the outlet became inundated just prior to inundation of the inlet, suggesting the outlet connects to the mainstem from backwater in the eddy near the outlet prior to inlet connection at a flow of about 12,000 cfs. The peak flow during the study period (15,600 cfs) was insufficient to expand the wetted width out of the low flow channel to a higher elevation bench (about 0.5 m above the thalweg at thermograph 15-7) in the largest pool within the study site. During thermograph removal, at 7,600 cfs, the pool near the outlet was dry and several of the other pools had contracted in size relative to what was observed at 8,600 cfs (Figure 24a and Photo 3). We speculate that the remaining pools would eventually become dry if flow remained at or below 7,600 cfs.

Murphy Slough (RM 190) is located just upstream of site 15, and was nearly connected to site 15 during thermograph installation. The downstream end of Murphy Slough first connected to site 15 at a flow of about 14,700 cfs. Yet Murphy Slough remained connected to site 15 throughout the receding limbs of the triple-peaked storm in late February, until flows in the mainstem dropped to 9,100, 5 days after the last storm peak. We suspect that there may be a time lag between changing flows in the mainstem and water levels in Murphy Slough due to time delays associated with water table rises. This would imply that Murphy Slough connects to site 15 at a discharge lower than Ord Ferry gauge value that matched with the time of inundation for thermograph 15-4 and 14,700 cfs should be viewed as the maximum estimated discharge for connection to site 15.

4.7.2 River Mile 203R

Study site 22 is located on the west bank at RM 203R of the Sacramento River. Site 22 is type 1 unit as described in Section 2.2.2, which we expect should generally exhibit poor hydraulic connectivity at both the inlet and outlet (Figure 30a). Thermographs were installed on 2/20/2007 at a flow of 7,600 cfs (Figure 30a) at which time the inlet was disconnected and the outlet pool was connected to the mainstem. A few small isolated pools were present during the installation. Seven thermographs were installed in an array to investigate the timing at which the inlet became connected to the mainstem and the longitudinal and lateral connectivity within the site. Seven thermographs were recovered on 4/26/2007 at a flow of 6,700 cfs.

Chinook salmon and California Roach (*Lavinia symmetricus*) were observed in the isolated pools at this site. Small gravel and sand compose the majority of the substrate at site 22. *Ludwigia* is abundant in the small pools and throughout the site.

At a flow of about 12,300 cfs the inlet to site 22 becomes connected (Figure 30c), and within 2 hours the downstream thermographs became inundated (although the corresponding discharge with the time of inundation for further downstream thermographs is higher, it is assumed that the inlet connection provides the requisite flow and there is a time lag) (Figure 31). Following inlet disconnection, pools on along the longitudinal axis begin to isolate from the outlet at about

10,200 cfs (Figure 30b). A narrow channel (3 m wide) along the outer edge of the study site and an isolated pool remained submerged throughout the study period; water temperatures in these two areas reached maximums of 21 and 23°C, respectively.

4.7.3 River Mile 209L

Study site 25 is located on the east bank at RM 209L of the Sacramento River. Site 25 is a probe channel located at the downstream end of an active point bar complex that is currently being eroded away due to a shift in the upstream meander bend position. Thermographs were installed on 2/20/2007 at a flow of 7,900 cfs at which time the inlet was disconnected and the outlet connected to the mainstem (Figure 34a). Eight thermographs were installed in an array to investigate (i) inlet connectivity, (ii) lateral channel width expansion, and (iii) longitudinal connection of pools in a split high flow channel that extends upstream of the inlet and does not have a defined surface flow inlet connection with the mainstem. Eight thermographs were recovered on 4/26/2007 at a flow of 8,800 cfs and the inlet was connected (Figure 34b).

Two isolated pools located at site 25 provided habitat for a total of 130 juvenile Chinook salmon. Little cover was available in the small, shallow pools and the dominant substrate consisted of sand (75%) and gravel (20%). Fish observations were hampered throughout the rest of the site due to high turbidities. *Ludwigia* was sparsely distributed throughout the site.

The inlet to site 25 becomes connected at approximately 8,700 cfs (Figure 34b). The most downstream pool of the bifurcated high flow channel becomes connected to the study site and the mainstem at about 12,000 cfs (Figure 34c); however, a thermograph between pools further upstream in the bifurcated channel did not become inundated which suggests the lower pool was connected through backwater in the study site. By 14,800 cfs, flow depth within the site exceeded 1.3 m (4.1 ft), thermographs at the outer edge of site 15 became inundated and nearly the entire study site was submerged while likely receiving mainstem flow from multiple connection points (Figures 34d and 35). The stage discharge relationship recorded at a cross-section with the study site indicated that the rate of stage change relative to mainstem discharge was 0.1 m (0.34 ft) per 1,000 cfs change in discharge (Figure 35).

4.7.4 River Mile 239.5R

Study site 44 is a type 1 channel located on the west side of the Sacramento River at river mile 239.5R. Four thermographs were installed on 2/15/2007 at a flow of 9,500 cfs. At 9,500 cfs the inlet was disconnected and the outlet was connected (Figure 52b). The thermographs were installed in an array to investigate when the inlet and outlet were connected and the longitudinal connectivity within the site. All four thermographs were recovered on 4/25/2007 at a flow of 8,900 cfs.

The dominant substrate in the site is gravel that is intermixed with sand and cobble. *Ludwigia* was sparsely located throughout the site, with its most abundant location at the outlet. A relatively large number of juvenile Chinook salmon as well as five Sacramento sucker were observed in multiple pools that were marginally connected to the mainstem (Photo 5); Chinook and Sacramento sucker were also observed during thermograph retrieval in late April. Beaver activity was noted in site 44 in two locations, with one beaver dam influencing the channel hydraulics.

The inlet to study site 44 connected and disconnected 5 times during the study period, at approximately 11,300 cfs (Figures 52c and 53). Thermographs at the outlet and at a shallow riffle that represented a connection point between pools along the longitudinal axis did not go dry during the study period although they exhibited high water temperatures (maximum temperatures of 20 and 22.5°C) when the inlet was disconnected. Pools near the inlet that were disconnected from both the inlet and outlet during installation did go dry around 7,700 cfs (Figure 52a).

5 DISCUSSION AND SYNTHESIS

5.1 Sedimentation Rates

Our results show that sedimentation rates tend to even out over time, with slower-filling OCWBs (which are less connected hydrologically to the main channel) tending to catch up to faster-filling OCWBs over a period of decades (though with different granulometry, based on our data). Sedimentation rates did not appear to be related to geometric form of the former channel, but we found a strong relation between diversion angle and the evolutionary path (i.e., infill history) of oxbows in the Sacramento River. The diversion angle determines the extent to which gravel makes up the sedimentary fill of oxbows and the rate that oxbows are converted into terrestrial habitat. Oxbows with diversion angles $\leq 50^\circ$ fill in at least 5 times faster than those with diversion angles $> 70^\circ$. Lakes with high diversion angles function as long-term sinks for fine-grained sediment in the floodplain and may serve as storage sites for pollutants in the fluvial system.

5.1.1 Patterns of sedimentation observed in oxbow lakes of the Sacramento River

Our analyses of sediment collected at off-channel water bodies provide information on the precise nature of the fill and fine-scale temporal variability in sedimentation rates. Using standard granulometric methods, we analyzed sediment from seven off-channel water bodies. We hypothesized that the diversion angle is the primary control on the evolutionary pattern of the Sacramento River's oxbow lakes. Engineers have recognized that the diversion angle, or the angle between the main channel and the entrance to a diversion channel, is an important control on the division of the flow's momentum, and thus also on the ability of flow in the diversion to transport bed material (e.g., Law and Reynolds, 1966; Hager, 1984). Results from flume experiments revealed that discharge in the diversion is progressively reduced with increases in the diversion angle above 50° (Vanoni, 1975).

Sediment cores taken from four oxbow lakes with varying diversion angles reveal distinct granulometric profiles with depth. The profiles of cores from Duck Lake and Jenny Lind Bend (Figures 54 and 55), both with diversion angles greater than 75° , are dominated almost entirely by silt and clay above gravel bases. The profiles of cores from Rio Vista and La Barranca (Figures 56 and 57), both with diversion angles of about 50° , fine upwards from a gravel base, grading from mostly sand to mostly silt and clay near the surface.

Our interpretation of the granulometric data was that the profiles reflect the rate at which sediment plugs develop. Flow in an oxbow with a low diversion angle ($\leq 50^\circ$) is more able to transmit bed material, and thus the aggradation of bed material at the entrance is slowed or prevented. Such an oxbow remains hydraulically connected to the main channel at low flow-stages and receives bed material from the main channel over a greater duration of its history. Flow in an oxbow with a high diversion angle is less able to transmit bed material, which thus promotes the development of a sediment plug at the oxbow's entrance. This kind of oxbow is disconnected from the main channel soon after its formation and experiences sedimentation only during overbank-flow conditions.

Given that oxbows with low diversion angles progressively fill with gravel for some time after their formation, we devised a method of estimating their original depths because we were unable to core through coarse material. Using 1997 bathymetric data from the U.S. Army Corps of Engineers and similarly dated aerial photos of the study reach, we described a statistically significant linear regression between the average bankfull depth of a meander and its average radius of curvature (Figure 58). We used the equation that described the regression to estimate the average original depths relative to the outer banks of 14 oxbows, whose average radius of curvature we measured using 2004 aerial photos.

In the field, we measured the elevation difference between the outer bank of an oxbow and its water surface, water depth, and the fine-sedimentary (sand, silt, and clay) thickness. With an estimate of its original depth, we were then able to estimate the average gravel thickness within the oxbow. The results reveal a statistically significant and negative correlation between the average gravel thickness and diversion angle (Figure 59). We also found a significant and positive correlation between the amount that an oxbow has been filled and its average gravel thickness (Figure 60), reflecting the fact that the sedimentation rates are most rapid immediately following the cutoff when the channel is still flowing—and thus low diversion angles would have greater total sediment accumulation and higher gravel content. Infilling by finer-grained sediment would occur more slowly in subsequent years.

Using historical aerial photos of the reach, we were able to date the time of formation for 12 of the 14 studied oxbows. This allowed us to estimate average infilling rates, measured as the total thickness of sedimentary fill (gravel, sand, silt, and clay) divided by the number of years since cutoff. Consistent with our hypothesis, we found a significant and negative correlation between average infilling rates and the diversion angle (Figure 61).

We then examined sedimentation rate (cm/yr), measured in the field from our coring and probing, as a function of geometric channel type, as distinguished from our aerial photo analysis (Figure 62).

Our comparison of sedimentation rate among the four geometric channel types did not show any clear trends (Figure 62). When we distinguished points in the plot of sedimentation rate against the age of the former channels (Figure 9) by channel type, no differences were evident for M1, M2 and S1 types (Figure 63). However, S2 channel types, with more dynamic hydraulic conditions, tended to have somewhat lower sedimentation rates (Figure 63). We then developed a log-log regression model relating sedimentation rate, y , to the age of the unit, x (Figure 64). The regression equation, explaining 37 percent of the variance, is:

$$\text{Log } y = 1.82 - 0.7 \log x \quad r^2 = 0.37$$

Kopta Slough is clearly an outlier, with almost no fine sediment. This may be explained by past dredging for a boat launch.

5.2 Water Quality

The water quality parameters measured at the sites can provide information on the hydrological connectivity to the main channel, a general indication of habitat quality for aquatic species, and information on potential water pollutant sources. Some sites require more sampling to provide adequate data for analysis. However, the results provide preliminary information on overall water quality at the OCWB sites.

Dissolved oxygen in water is critical for supporting respiration of most aquatic organisms. Those OCWB sites with relatively low percent dissolved oxygen rates (i.e., less than 90%) may not provide suitable habitat for aquatic life. As stated in the results section, 11 of the 28 sites in Table 8 show an average % dissolved oxygen rate of over 90%. Many sites fall just below 90%, but some sites appear to have alarmingly low % dissolved oxygen rates of 50% or less. Dissolved oxygen may be a limiting factor in habitat quality for aquatic organisms at these sites.

Conductivity is a measure of water's ability to conduct electrical current and can also provide a general indication of water quality. Polluted runoff into an OCWB can affect conductivity rates, especially if the pollutants include inorganic dissolved solids such as bicarbonate, sulfate, chloride, calcium, magnesium, sodium, potassium, and phosphate ions. High conductivity in an OCWB adjacent to agricultural land may indicate that agricultural runoff is entering the water body since agricultural runoff typically has high levels of dissolved salts. According to the Environmental Protection Agency (EPA), streams supporting good mixed fisheries have conductivity measurements ranging from 150 to 500 $\mu\text{mhos/cm}$ (EPA 2006). Five OCWB sites have average conductivity measurements greater than 500 $\mu\text{mhos/cm}$, and five have average conductivity measurements of less than 150 $\mu\text{mhos/cm}$. Conductivity measurements at these sites indicate that water quality may limit species diversity of aquatic organisms. Water temperature also affects conductivity measurements.

To understand the effects of water quality on overall habitat quality of the OCWB sites, we also recommend that on-going water quality data collection occur in order to assess data, for example, at a range of river discharges. As Figure 20 indicates, water quality parameters such as conductivity can vary according to the discharge of the main channel. Thus, water quality may change seasonally within OCWB sites, responding to main channel flows.

5.3 Inundation of Scour Channels on Point Bars

5.3.1 Inundated area

This study was designed to identify the flows that connect scour channels on point bars with the mainstem and quantify how the extent of inundated habitat varies with flow. The left panels of Figures 65 to 68 depict how cumulative inundated area varies with discharge for sites associated with each flow gauge (Figure 65 to 67), and for all sites combined (Figure 68). The right panels of Figures 65 to 68 show the same relationships for the average normalized area of inundation, where normalized area is calculated for each site by dividing the observed inundated area by the total area available for inundation (see Section 3.8.3.4). This helps produce an average that gives equal weight to each study site, irrespective of site-to-site differences in total potentially inundated area. This makes for comparisons that are unaffected by the potentially confounding influence of study sites with large areas.

The five sites associated with the Ord Ferry gauge indicate there are two ranges of discharge that are important for changes in inundated area: 7,600–8,600 cfs and 12,000–14,000 cfs (Figure 65). Below 8,600 cfs, inundated areas of scour channels are contracting, isolated pools are drying up, inlets are disconnecting from the mainstem in type 3 channels (i.e., on the outsides of meander bends), and disconnected perennial pools are multiplying as riffles and gravel bars are becoming sub-aerially exposed. In contrast, 12,000 cfs appears to be a threshold for significant expansion in connected wetted area, with inlets to type 1 channels (i.e., probe channels that cross point bars)

beginning to connect, and water levels in type 2 channels (i.e., sloughs) beginning to rise and eventually providing connections among previously isolated pools.

The two sites associated with the Hamilton City gauge show a similar two-step change in undated area as a function of discharge (Figure 66). Inundated area declines sharply below 7,600 cfs and increases substantially between 10,900 and 12,300 cfs. Only 2 sites are associated with the Hamilton City gauge. Discharges of interest are 7,600 cfs, when the inlet disconnects from the mainstem at site 23 (a type 2 channel) and 12,300 cfs, when the inlet connects to the mainstem of site 22 (a type 1 probe channel). Areas that are inundated but disconnected are minimal, because the majority of the axial length of the study sites was connected to the mainstem at the outlet for all flows observed in this study (Figure 66).

Study sites associated with the Vina Woodson Bridge gauge also appear to have two flow ranges where changes in inundated areas are most substantial. Study sites begin to go dry (i.e., show a substantial decrease in inundated area) at about 9,000 cfs. Further declines occur below 8,000 cfs, when inlets begin to disconnect (e.g., at sites 25 and 41) and pools show significant contraction. Once flow levels reach about 12,000 cfs, the study sites begin to show significant expansion, with a decreasing percentage of area that is inundated but disconnected from the channel, and increasing connectivity of type 1 inlets to the mainstem (e.g., at site 44).

The area-flow relationship for all sites combined highlights an additional potentially important flow threshold. When flow drops in the range of 8,600 to 7,600 cfs, inlets appear to become disconnected from the mainstem, and pools contract and become increasingly isolated (Figure 68).

During thermograph retrieval on 4/25 and 4/26/2007, pools were contracting and the mainstem was becoming disconnected from inlets at sites associated with the Hamilton City and Ord Ferry gauges, downstream of RM 206, where substantial flow was being diverted for irrigation at GCID. In contrast, at study sites upstream of RM 206 (i.e., those associated with the Vina Woodson gauge), pool water levels were stable. A contracting pool can generally be identified in the field from evidence of changes in water levels; observed water level is typically several centimeters below recently wetted water lines in the surrounding sediment (see Photo 4). In contrast, former water lines are not present in stable or expanding pools. Gauging station records indicate that average discharge on 4/25 and 4/26 was 8,800 at Vina Woodson Bridges (RM 218), 6,800 at Hamilton City (RM 199), and 7,700 cfs at Ord Ferry (RM 184). The average GCID (RM 206) diversion was 2,200 cfs over the same 2-day period. The concurrence of pronounced losses in inundated area and relatively lower flows downstream of GCID is suggestive of a cause-effect relationship; the diversion at GCID appears to have been sufficient to push the downstream study sites below their lower thresholds for inundation. Diversion-related losses in inundated area would presumably be more pronounced during spring months in relatively dry years, when GCID begins diverting at near maximum capacity, even though releases from Shasta-Keswick (the primary source of flow after the winter, in the absence of storm events) remain relatively low and steady, before being ramped up for summer irrigation releases. Further data on the relationship between discharge and inundation area will be necessary to verify whether this is the case.

5.3.2 Inlet connection flows

The morphology of scour channels on point bars appears to be an important regulator of the threshold for connectivity between inlets and the mainstem. Connectivity with the mainstem requires higher flows for Type 1 (probe channels) inlets than it does for Type 3 (outside of

meander bends) inlets. This probably reflects the fact that probe channels are typically perched well above low flow channel, whereas the inlets of scour channels on point bars on the outsides of meander bends tend to be more at grade with the mainstem channel (Figure 4). None of the Type 2 scour channel on point bar inlets connected to the mainstem via surface flow during the study period. This probably reflects the fact that Type 2 channel inlets are plugged with sediment. Type 2 did nevertheless exhibit water level fluctuations due to influxes of groundwater from elevated water tables and peak flow events. Inlets to prototypical probe channels (e.g., at sites 15, 22, and 44) have inlet channels that are easily discernible due to annual scour. They connected to the mainstem at discharges ranging from 11,300 to 12,200 cfs. Where probe channel inlets were less well-defined, due to vegetative growth or sediment deposition (e.g., sites 17, 39, and 40), connection with the mainstem did not occur during the study period. Inlets to the three Type 3 channels (at sites 16, 23, and 41) all became disconnected from the mainstem at similar discharges, ranging from 7,600 to 8,100 cfs.

In addition to affecting inundated area, inlet connectivity is an important regulator of water temperature in scour channels on point bars. Water temperatures were higher within units that lacked inlet connectivity than they were at those that had inlet connectivity, irrespective of whether the outlet was connected to the mainstem at the time of the measurement. For all 55 days analyzed, the average maximum water temperature for thermographs in study sites that lacked inlet connectivity was higher (by 1.6 to 6.4°C; average = 4.6°C) than it was for those that were connected at their inlets to the mainstem (Figure 69). We focused specifically on variations in maximum daily water temperatures because they are a readily assessable proxy for thermal stress on the aquatic species of interest. Study sites with persistently disconnected inlets were, in most cases, connected to the mainstem at their outlets throughout the monitoring period. This indicates that the cooling effects of mainstem flow are minimal, unless there is a direct connection to the study site at its inlet; for outlet-connected study sites, flow-related effects on temperature are probably limited to the immediate vicinity of the outlet. Also evidenced in Figure 69, is the strong affect of air temperature on the maximum daily water temperatures in the scour channels on point bars, which is presumable more pronounced in these shallower water bodies than the mainstem.

Temperature is a primary limiting factor for juvenile Chinook salmon, which strongly affects growth and survival. For Central Valley fall-run Chinook fry, optimal temperatures for growth and survival are 13 to 18°C, and around 22 to 23°C major mortality is expected (Moyle 2002). During the study period, 7 out of the 13 thermographs with disconnected inlets exceeded 22°C, and 12 of 13 exceeded 20°C while inundated. In contrast, none of the inundated thermographs with connected inlets exceeded 22°C, and only 1 of 6 exceeded 20°C while inundated. Although our data illustrate that temperatures were warmer in sites without inlet connection, the cumulative effect of the warmer temperatures on growth and survival for juvenile Chinook salmon is inconclusive. Sommer et al. (2001) found higher growth and survival rates for juvenile Chinook salmon in the warmer Yolo Bypass than the mainstem Sacramento, largely due to significantly higher prey consumption and food availability in the bypass that exceeded the increased metabolic costs of rearing in the significantly warmer floodplain. For our study sites that were warmer water at sites with inlet disconnection, the temperature effects may not have deleterious to for juvenile Chinook salmon as long as the outlet of the water bodies remained connected and fish could escape to the mainstem as temperatures approached survival thresholds around 22 to 23°C. Additional data evaluating food production would be necessary in order to fully evaluate the benefits and costs of the higher water temperatures on growth and survival for juvenile Chinook salmon.

Temperature strongly affects growth and survival of juvenile Chinook salmon. For Central Valley fall-run Chinook fry, optimal temperatures for growth and survival range from 13 to 18°C, and at around 22 to 23°C mortality is expected to occur (Moyle 2002). During the study period, water temperatures at 7 out of the 13 thermographs with disconnected inlets exceeded 22°C, and temperatures at 12 of 13 exceeded 20°C. In contrast, water temperatures never exceeded 22°C at connected inlets, and exceeded 20°C at only 1 of 6 connected inlets. Although our data illustrate that temperatures were warmer in sites without inlet connection, the cumulative effect of warmer temperatures on growth and survival for juvenile Chinook salmon is inconclusive. Sommer et al. (2001) found higher growth and survival rates for juvenile Chinook salmon in the warmer Yolo Bypass than the mainstem Sacramento, largely due to significantly higher prey consumption and food availability in the bypass that exceeded the increased metabolic costs of rearing in the significantly warmer floodplain. For our study sites with inlet disconnection, warmer temperatures may not be deleterious to juvenile Chinook salmon as long as the outlet of the water bodies remains connected and fish can escape to the mainstem if temperatures approach survival thresholds around 22 to 23°C. Additional data evaluating food production would be necessary in order to fully evaluate the benefits and costs of the higher water temperatures in sites with disconnected inlets on growth and survival for juvenile Chinook salmon.

5.3.3 Stage-discharge relationships in scour channels on point bars

Quantifying how water depth (i.e., stage) changes as a function of discharge in the mainstem is important for evaluating aquatic habitat within the study sites at varying flow levels. To construct stage-discharge relationships for our study sites, we used our thermograph observations to identify when points of known elevation (i.e., stage) at surveyed cross-sections became wet (or dry) due to changes in discharge on the mainstem. We were able to develop stage-discharge relationships with 3 or more observations for three sites (Figures 35, 40, and 50). The slopes of the stage-discharge relationships are consistent at these sites, at about 0.10 m (0.34 ft) of stage change per 1,000 cfs change in discharge (Figures 35, 40, and 50).

We collected stage-discharge observations at surveyed cross-sections other than those depicted in Figures 35, 40, and 50. However, we were not able to gather more than two observations at these other sites, because some thermographs never became inundated and/or some thermographs never became dry. Figure 43 shows an example stage-discharge plot from such a site. Although the slopes of the stage-discharge relationships are not as well constrained as they are at sites with 3 or more observations, data from plots such as Figure 43 still provide insight into how stage changes with mainstem discharge across our sites. Utilizing all available stage-discharge observations, we grouped the stage discharge slopes by study unit type and plotted them as a function of River Mile in Figure 70. Slopes were not calculated for changes in discharge <1,000 cfs when discharges errors on the order of 100 cfs will substantially alter the calculated stage-discharge slope, due to uncertainties associated with determining discharges (which require extrapolation across multiple river miles from nearby gauges). Eighty percent (16 out of 20) of stage-discharge slopes in Figure 70 are based on changes in discharge >3,300 cfs. We suggest that errors associated with extrapolating changes in discharges of this magnitude from nearby flow gauge data are minimal.

The mean rate of change in stage per 1,000 cfs change in discharge was 0.10 m (0.32 ft) (Figure 70). The range of stage changes one standard deviation from the mean are between 0.13 m (0.42 ft) and 0.07 m (0.22 ft) change in stage per 1,000 cfs (Figure 70). The mean for the 20 slopes analyzed is very similar to the slopes from the three sites with 3 or more observations. Figure 70 shows that stage-discharge slope shows no clear trend with distance downstream from RM 240 to

187 ($R^2 = 0.01$ for a linear fit comparing rates with distance). Nor do any clear correlations emerge when the data are grouped by study unit type; this could be due, in part, to the small number of observations for type 2 and 3 channels. Stage-discharge slopes presented herein were sampled during discharges ranging from 7,000 to 15,000 cfs in the mainstem Sacramento. Extrapolating them outside the 7,000 to 15,000 cfs range would result in significant uncertainty. They are more likely to be applicable when the study sites remain a distinct feature separated from the mainstem by a sediment deposit or landform, and less likely to be applicable during higher flows when the study sites and their separating landforms are completely submerged (such that the study sites function as the edge of the mainstem channel).

5.3.4 Data uncertainty

In this study, we used indirect methods and assumptions to determine when points of interest became wet (or dry), to estimate local flow conditions, and to quantify inundated areas. We also made direct observations of inundated area during thermograph deployment and retrieval. The accuracy of the temperature readings of the thermographs ($\pm 0.2^\circ\text{C}$) was more than adequate for the study needs. Determining whether a thermograph was submerged or aerially exposed drew upon several lines of evidence, including patterns (see Section 3.8.3.2) that were anticipated during study inception, as well as some that were determined after analyzing several thermograph records. In general, we were able to develop a high level of confidence about when thermographs became wet (or dry) because we (i) deployed arrays of thermographs in areas with both wet and dry conditions, (ii) sampled a period that included multiple cycles of inundation and aerial exposure, and (iii) in many cases had several independent methods for deducing whether thermographs were wet or dry at any given time. Uncertainties were generally greater for thermographs that were installed wet and became dry during low flow periods (i.e., flows $< 8,500$ cfs). This was because many of the thermographs in question were located in pools that were not receiving flow inputs from the inlet. As the pools shrank, their water temperatures approached ambient air temperatures, making it relatively difficult precisely identify the timing of complete sub-aerial exposure and errors are estimated as high as 4 hours for determining desiccation (see Section 3.8.3.2 for details on how these instances were resolved). Errors of order ± 4 hours on the arrival of flows should have minimal implications for our estimated flow thresholds during these low flow periods of relatively stable hydrographs, because we report them to the nearest 100 cfs, and because stage and flows fluctuated at slow rates during low flow periods. We calculated that 30 cfs is about the average change of discharge over a 4 hour window at the Vina Woodson Bridge gauge during low flow periods of this study.

To correlate thermograph data with flow data from the nearest, most appropriate gauging station, we had to adjust the time stamp of the flow data to account for the distance between the gauge and the study site. We used an average speed of 4.5 mi/hr (± 0.5 mi/hr, $n = 15$), based on the time lag for the arrival of flow peaks for each of the three peak flows during the 2/22/07 to 3/1/07 interval. This adjustment speed is not expected to be universally applicable to flow data series on the middle Sacramento River, because the watershed is large enough and storm patterns are variable enough that the timing of tributary inputs is likely to vary from storm to storm. When this is considered along with the likely variability in antecedent ground saturation conditions, and variations in reservoir and diversion operations, it seems clear that the speed of flow peaks is likely to vary considerably on the river. In this case, however, the 4.5 mi/hr is specific to 2/22/07 to 3/1/07, which was also the period when sub-aerially installed thermographs became inundated during our study as all high flows occurred during this time period. We can therefore be reasonably certain that the adjustment is approximately correct over the short timescale of the study. Nevertheless, the further a given study site is from a gauge, the larger is the adjustment

and degree of uncertainty in the adjustments of the flow time stamps. We expect that adjustments for sites within 9 miles of a flow gauge (i.e., with a ≤ 2 hour time stamp adjustment) should be reliable. Study sites 39, 40, 41, and 44 are located between RM 233 and 240 (Table 4); this makes them the only sites that are >9 miles from a gauge (Vina-Woodson Bridge is at RM 218). Site 44 was the farthest from its gauge, requiring a 4.75 hour time-stamp offset. Although the time-stamp offsets for sites 39, 40, 41 and 44 are substantial, we can be reasonably certain that they did not introduce significant errors into our analysis, because, for each thermograph, the timing of submersion consistently matches a similar flow magnitude when the average 4.5 mi/hr offset speed is used to adjust the flow timing. The consistency from flow to flow (at a given thermograph) justifies the use of a constant average speed over the brief timescale of the study. Although the Red Bluff Diversion Dam gauge (RM 243) could have provided a better discharge association for these sites, it currently only provides stage data and is not rated for flow and therefore could not provide the data needed for our study.

We made a series of assumptions to estimate inundated areas for discharges other than those observed during field visits (see Section 3.8.3.4 for assumptions). This introduced the most significant, but difficult to quantify uncertainties in this study. In light of these uncertainties, data presented in Figures 65–68 should be viewed as depicting general inundation patterns rather than precise inundated areas. In Figures 65–68, the right panel depicts how the inundation changes with flow for normalized areas, in which each study site is given equal weight regardless of aerial extent. This makes it perhaps the most robust indicator of how inundation changes with flow, because it would not be overly distorted if a few areas were in error due to flaws in the assumptions in Section 3.8.3.4. In contrast, in the left panel, errors at larger sites will have a much greater effect on the overall relationship than errors at small sites.

6 MANAGEMENT IMPLICATIONS/CONCLUSIONS

6.1 Off-Channel Water Bodies

- Long-term conservation and restoration strategies for former channels must consider evolutionary trends, such as the pattern and rate of infilling/terrestrialization, depth of fine sediment deposited, and likely long-term future sedimentation rates.
- If in the future it is determined that it would be worthwhile to take steps to prevent or slow terrestrialization by deepening a partially-filled oxbow lake (or to restore hyporheic connectivity by excavating down to the channel gravel layer), any such effort should be informed by the history and pattern of sedimentation, notably the thickness of fine-grained material to remove, as well as the probable rate of future infilling and expected caliber of sediment.
- At a larger scale, we must consider not only the processes of how former channels evolve once they form (our study) but also the processes of meander cut-off, and the rate at which new cutoffs occur. Cutoff rates are being addressed in parallel studies, but one fundamental threat to maintaining a diverse assemblage of former channel habitats is the progressive decrease in sinuosity of the system (Micheli and Larsen, in prep.). As more and more outside bends are stabilized with riprap, fewer sites will have the potential to cut off.

6.2 Scour Channels on Point Bars

- Mainstem Sacramento River discharges $\geq 12,000$ cfs appear to provide substantial increase in inundated areas and connection to the mainstem for scour channels on point bars. Approximately 12,000 cfs is also the threshold discharge for inlet connection of Type 1 scour channels on point bars (Figure 3a).
- Mainstem Sacramento River discharges $\leq 8,500$ cfs appear to define another flow of concern: inlets of scour channels on point bars near grade with the edge of the mainstem disconnect (Figure 3b) and isolated pools within all scour channels on point bars show significant contraction and/or complete desiccation.
- For mainstem flows in the range of 7,000 to 15,000 cfs, stage-discharge slope within scour channels on point bars is 0.10 m (0.34 ft) of stage change per 1,000 cfs change in mainstem discharge.
- Water temperatures in scour channels on point bars without inlet connection to the mainstem are significantly higher than those with inlet connection. During this study period, the average difference between inlet connected and disconnected max daily temperatures was 4.6°C (range 1.6 to 6.4°C). During the study period, 7 out of the 13 thermographs with disconnected inlets exceeded 22°C (22 to 23°C is the threshold for major mortality in Central Valley fall-run Chinook fry [Moyle 2002]); in contrast, none of the inundated thermographs with connected inlets exceeded 22°C. Overall effects of the increased temperatures on growth and survival of juvenile Chinook salmon are inconclusive.

6.3 Future Research Needs

- Develop better relationships between OCWB water quality and such factors as surrounding land use, drainage pathways, and connectivity of the OCWB with the mainstem, so that we can better understand the factors limiting ecological potential in OCWBs.
- Collect sediment cores to document sedimentation history in greater detail and to analyze samples for radiometric dating. These data would refine our understanding of sedimentation history, especially for OCWBs that become cut off prior to our earliest map record in the late 19th century.
- Improve the gauging network, in both the mainstem and OCWBs, to document hydrologic interactions between OCWBs and mainstem.
- Inventory and analyze the length of rocked vs. unprotected bank (i.e., open to channel migration) on the mainstem Sacramento River, in order to assess future potential for meander bend cutoff (and thus a generation of new OCWBs).

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Figures

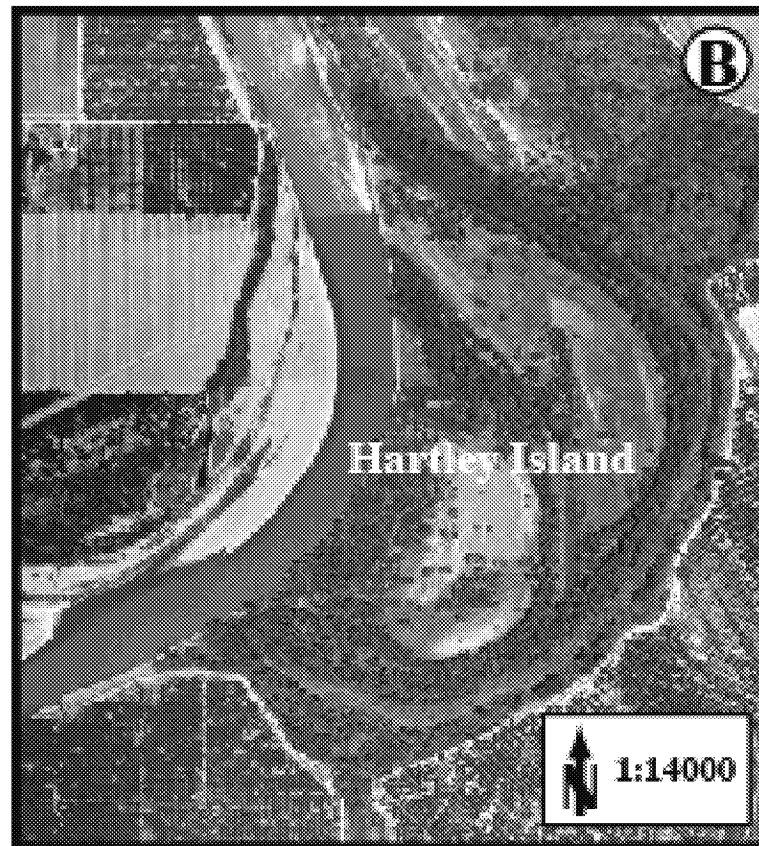
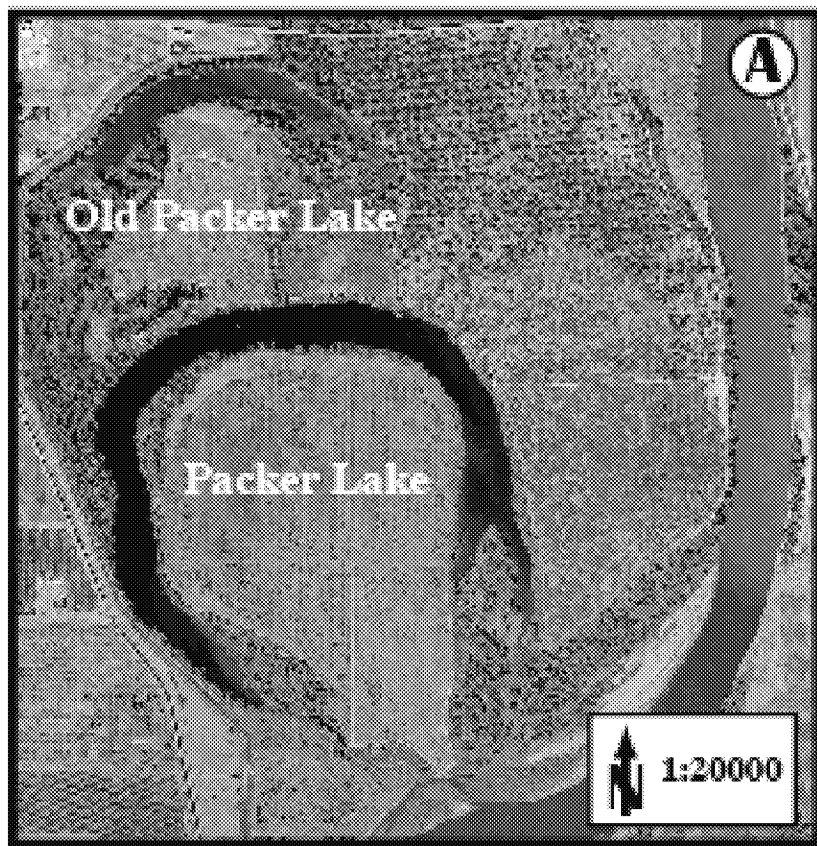


Figure 1. (A) Aerial photo of floodplain near river mile 167 taken in 2004. Based on radiocarbon data, Old Packer Lake is estimated to have formed over 800 years ago (Sullivan 1982). Historical maps of the vicinity show the formation of Packer Lake in 1874. (B) Aerial photo of floodplain near river mile 175 taken in 1997. Historical aerial photos show that Hartley Island formed in the late 1950's.



Figure 2. Example of a scour channel that forms on the downstream end of a point bar, providing seasonally inundated, shallow-water habitat that can support rearing of salmonid fry. (Photo Source: CDWR 1999)

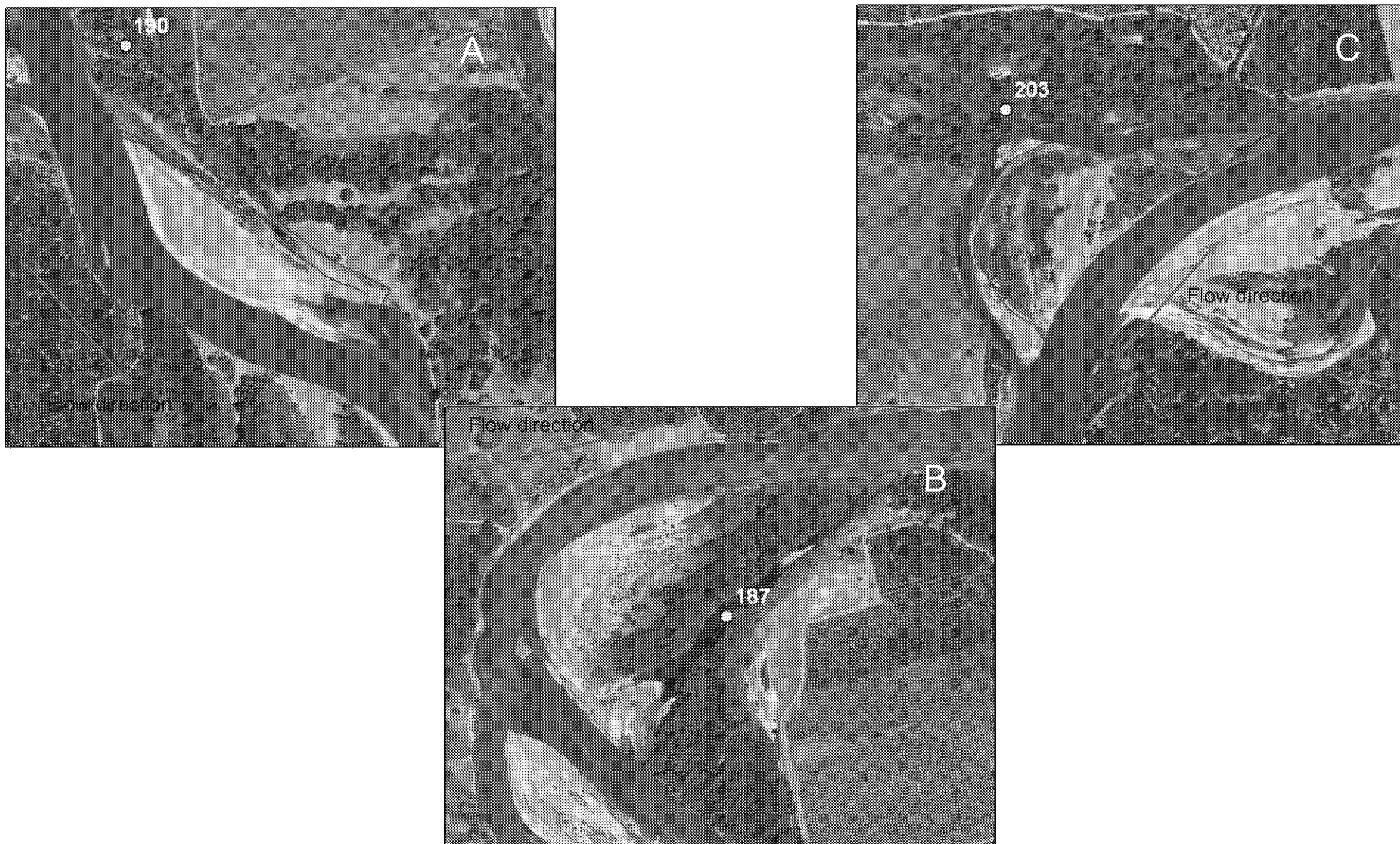
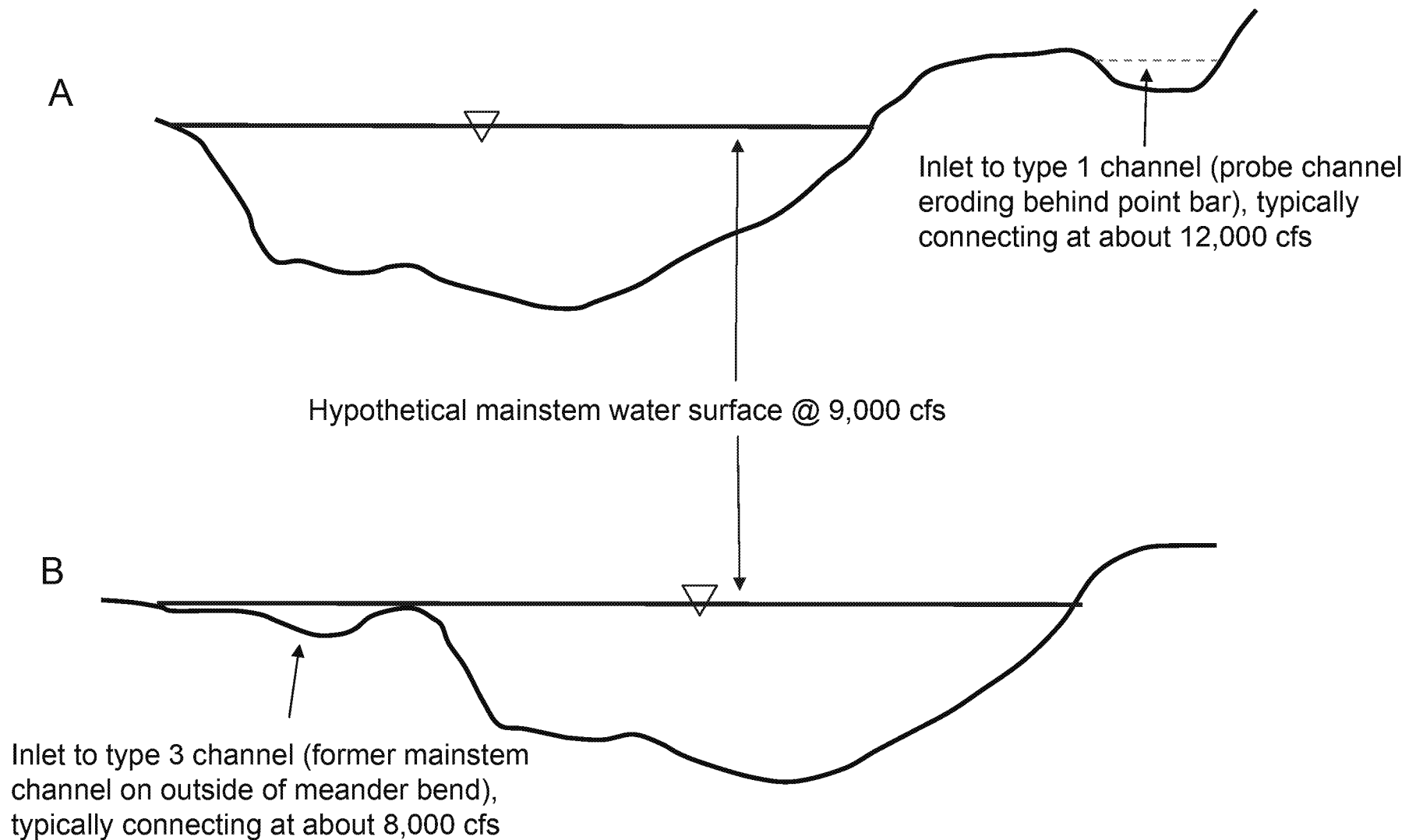
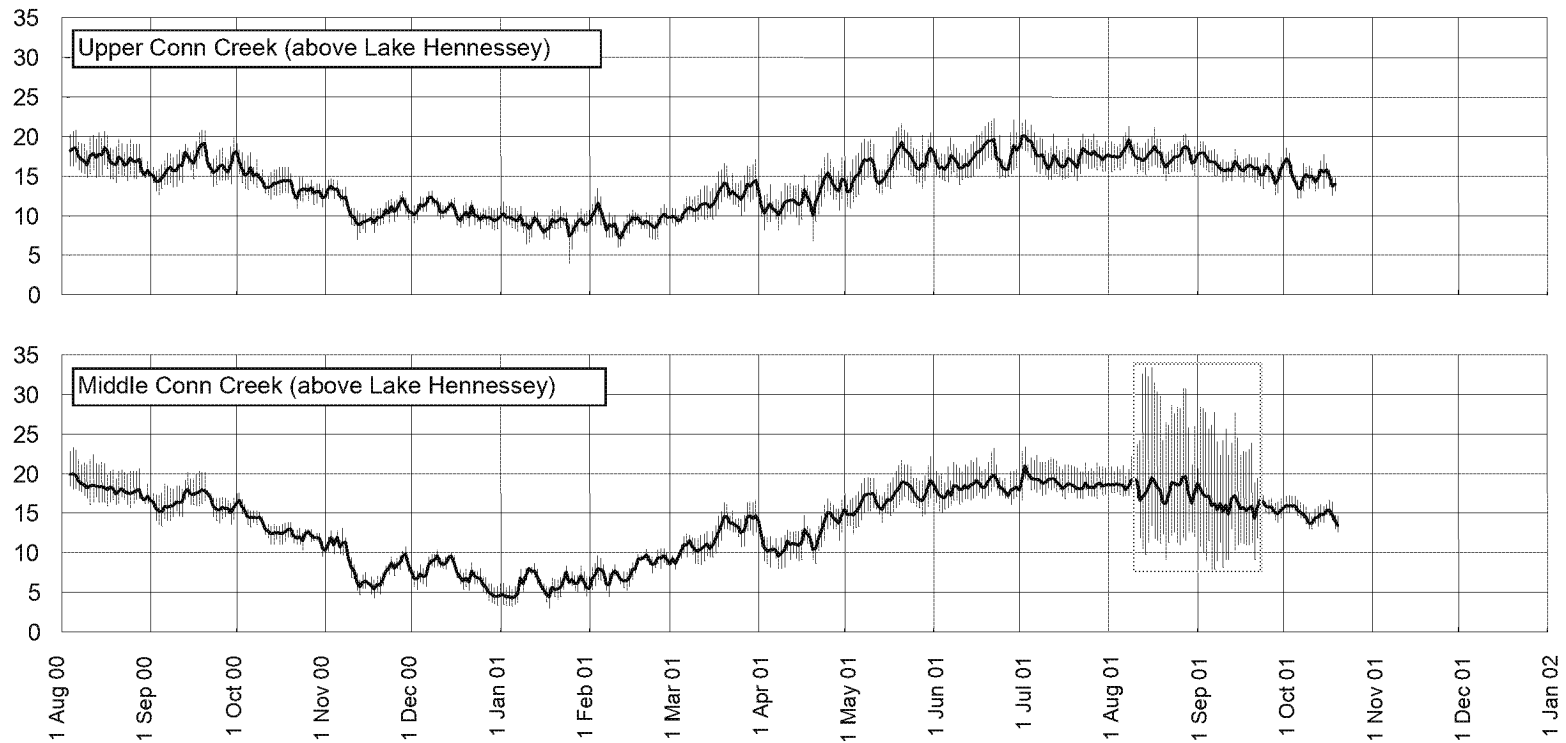


Figure 3. Examples of off channel water bodies studied for inundation flows on the Sacramento River: (A) Type 1- probe channel eroding behind an active point bar, (B) Type 2- an abandoned channel on the inside of a meander bend as the mainstem continues to erode outward, and (C) Type 3- a former main channel position on the outside of a bend that is abandoned as the main channel cuts behind a point bar.





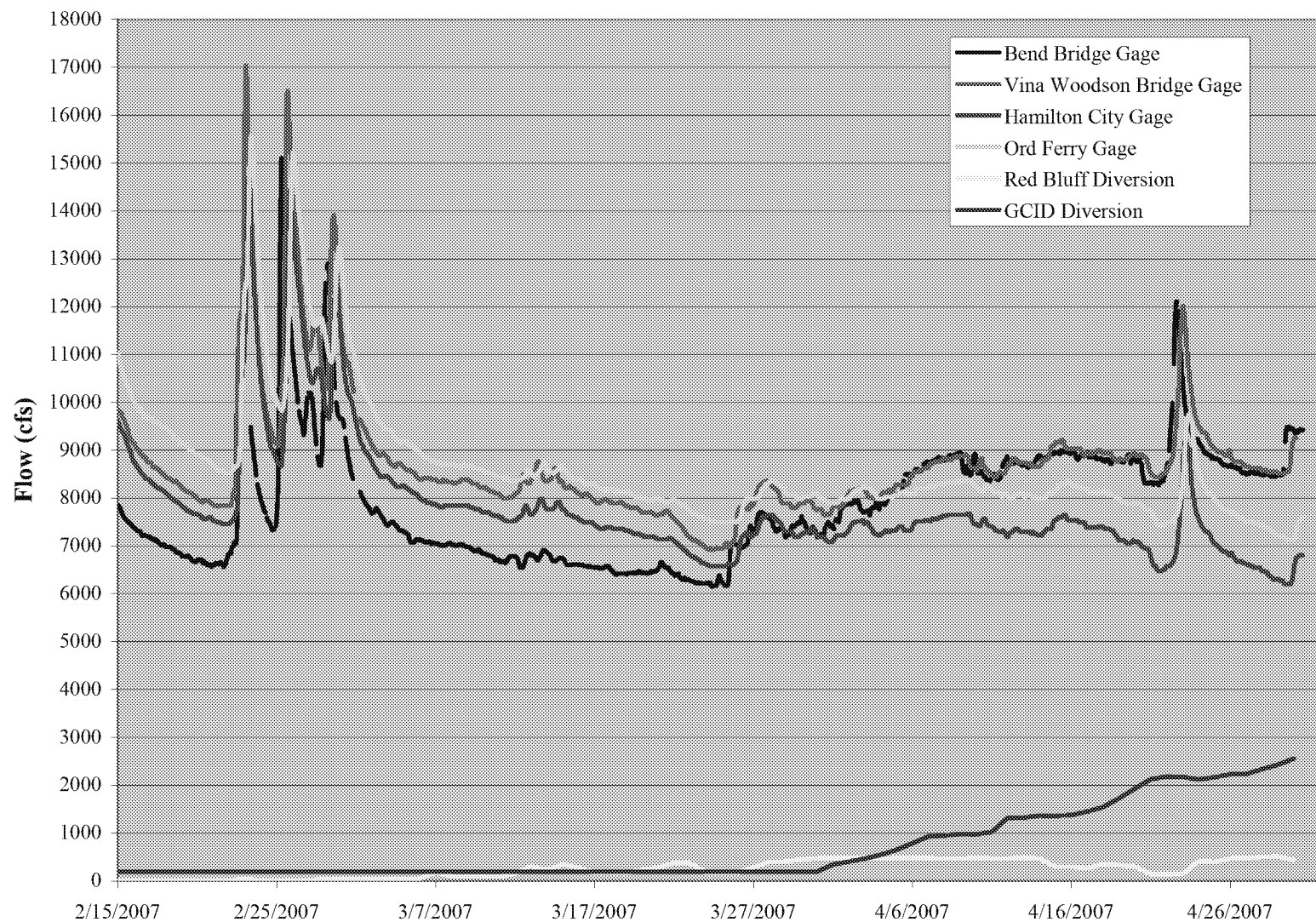
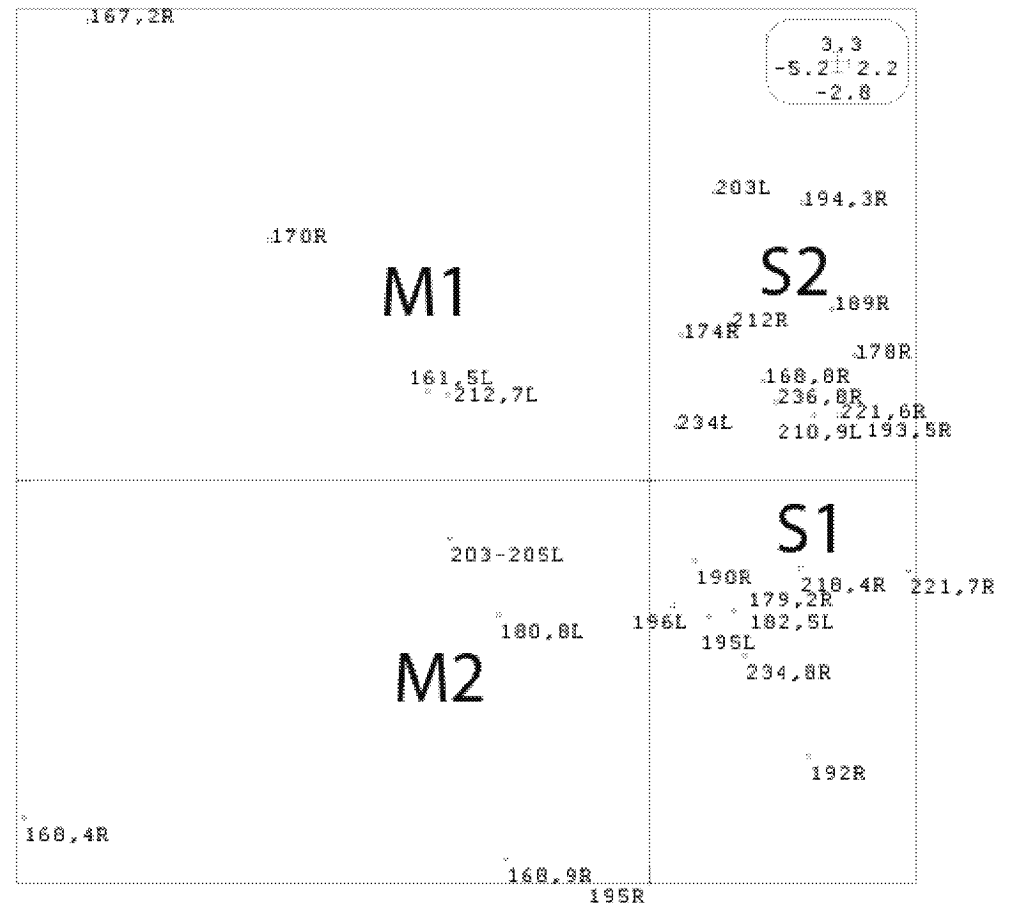
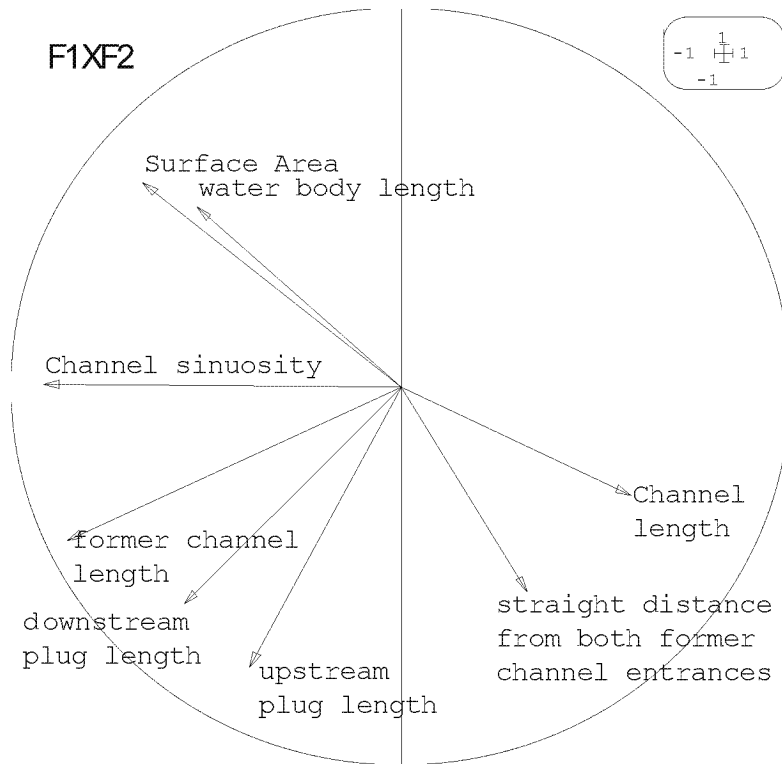


Figure 6. CA DWR flow gauges and flow diversions on the Sacramento River used to analyze OCWB study sites from 2/15/2007 to 4/30/2007.



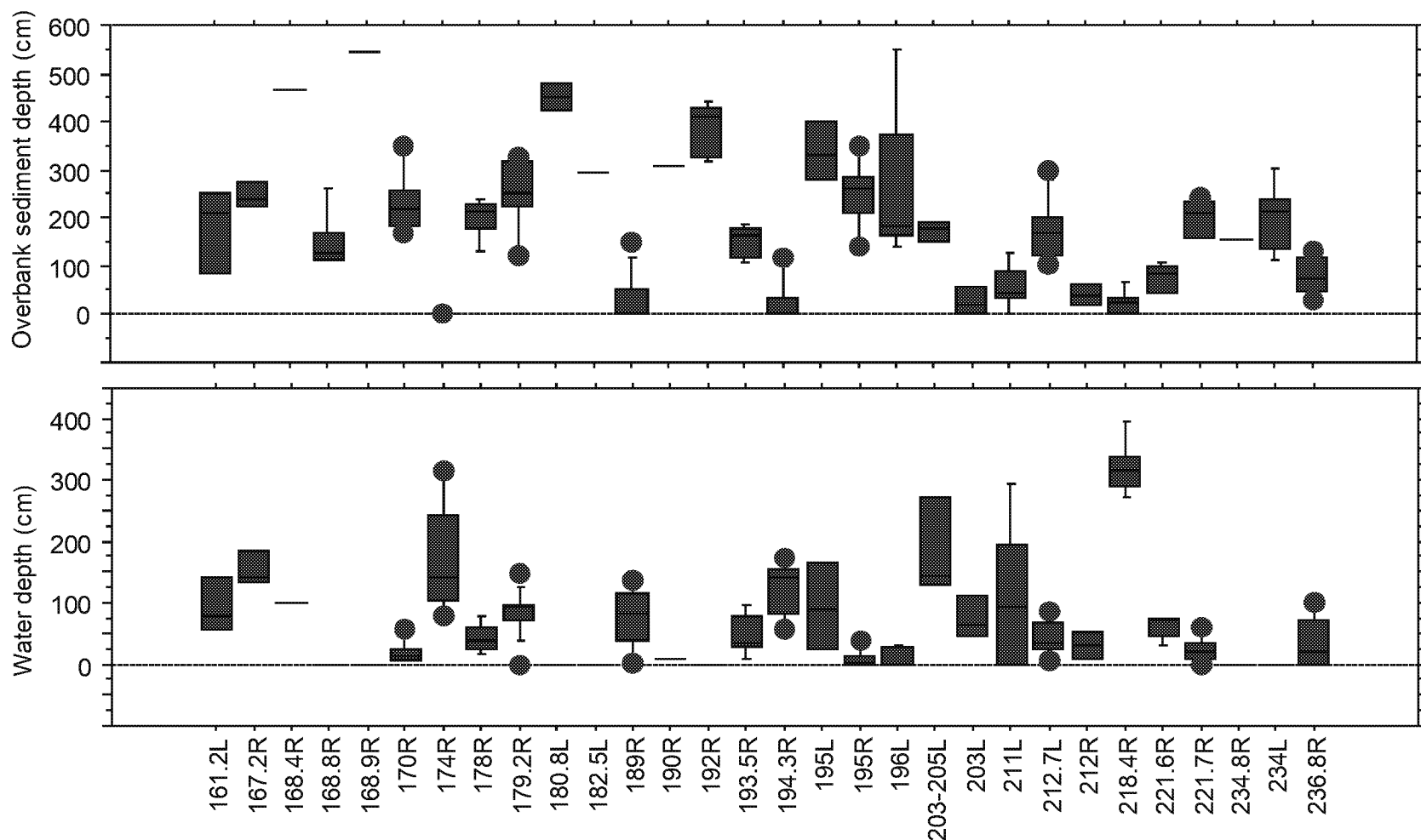


Figure 8. Sediment thicknesses and water depths measured in OCWBs of the Sacramento River, presented as box-and-whisker plots (Tukey 1977), in which the spread of the middle 50% of the data is shown by the box, and upper and lower outliers indicated by points connected to the box by lines (whiskers).

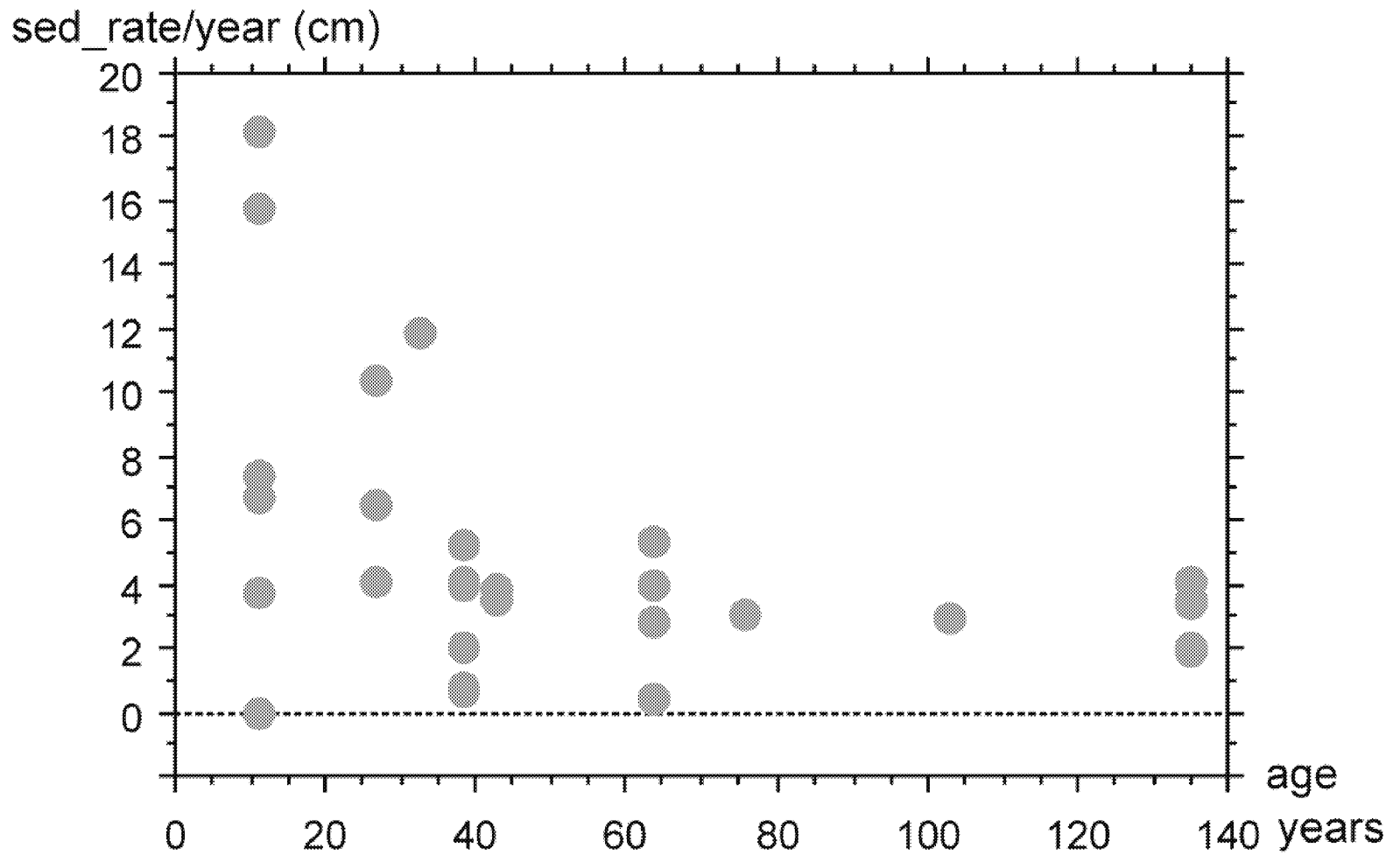


Figure 9. Sedimentation rates measured in OCWBs plotted against age of the channel being cut off from the mainstem Sacramento River.

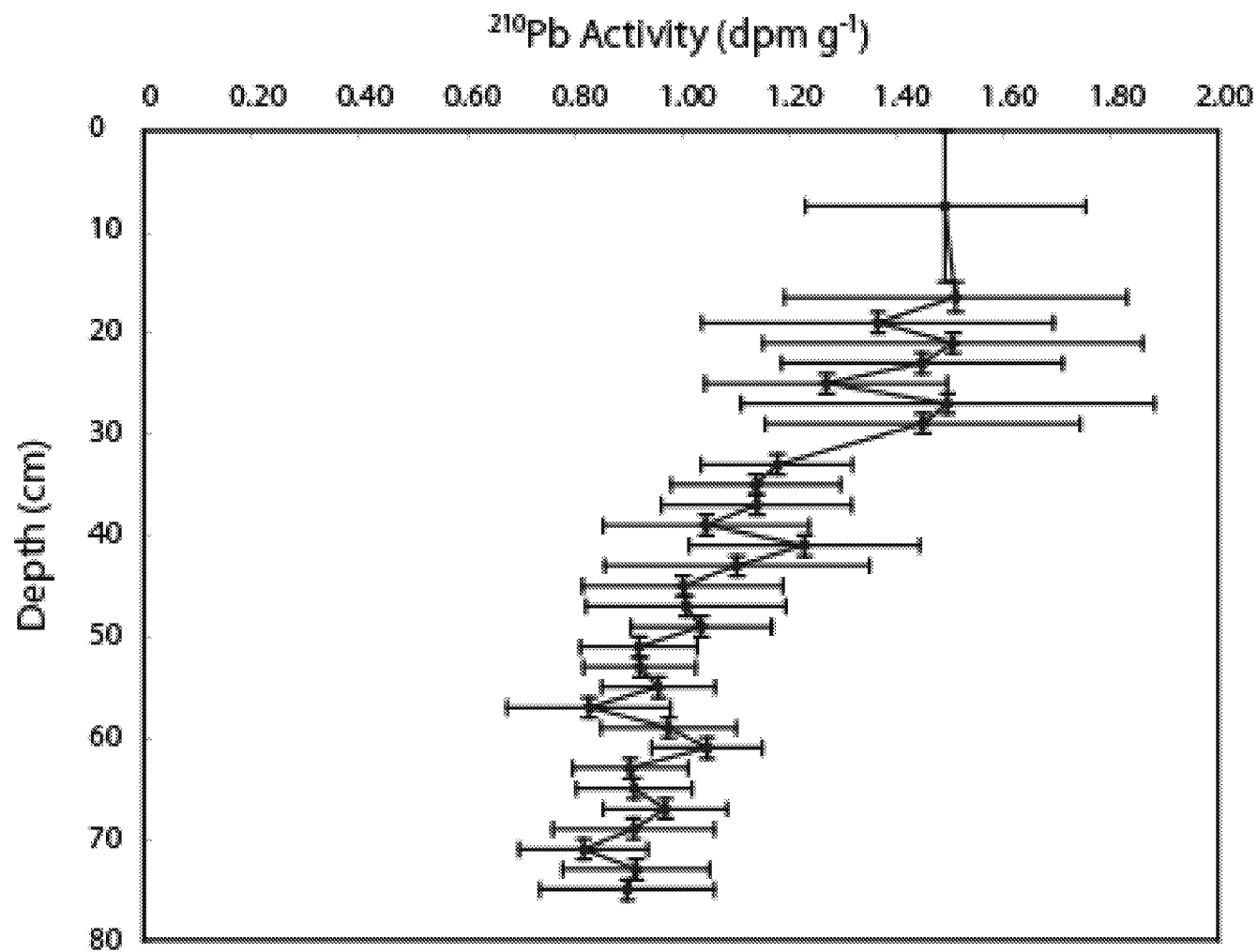


Figure 10. Activity of ^{210}Pb in units of decays per minute per gram, through the depth of a sediment core from Packer Lake. The core was taken near the apex of the lake.

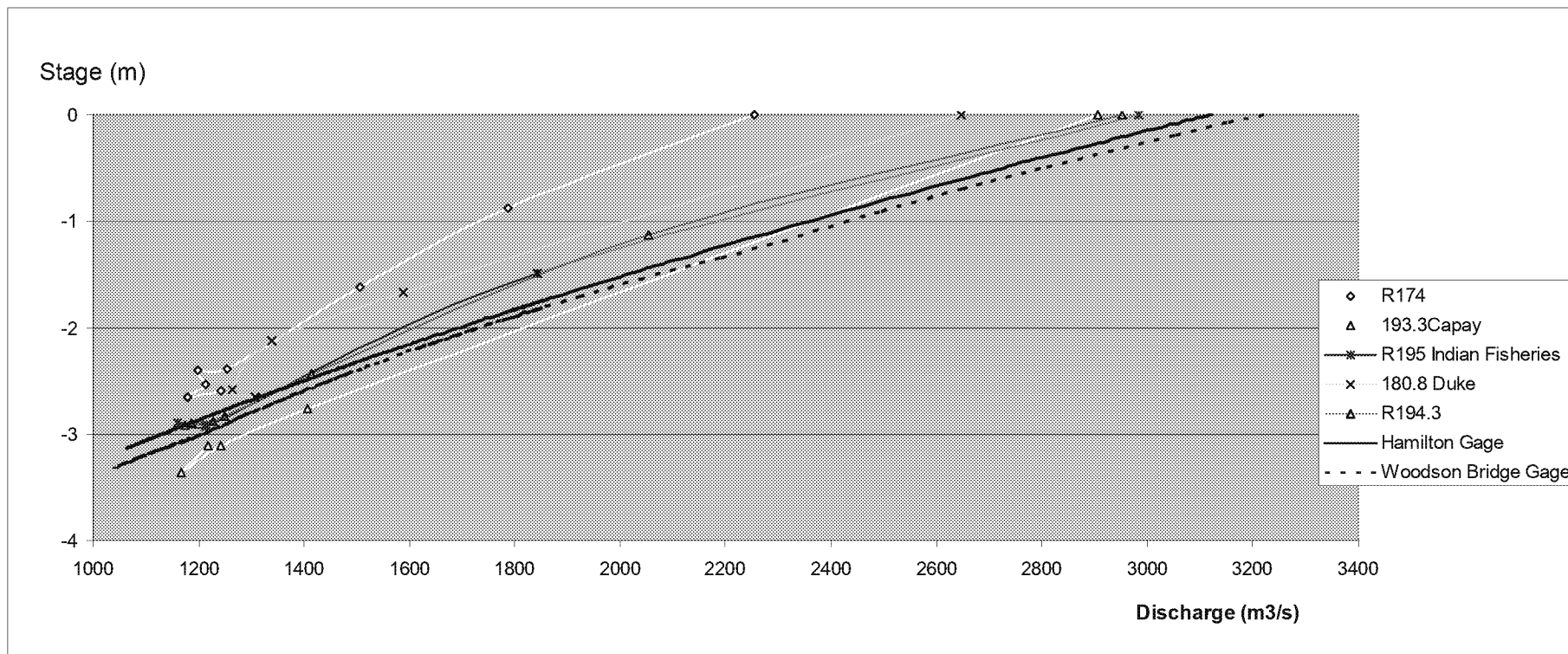


Figure 11. Stage-discharge relations during recession limb of the March 2006 for the mainstem at Woodson Bridge and Hamilton City, and for five OCWBs. For each site shown, the point along the zero line at the top of the figure represents the highest reading (at the beginning of our period of measurement during the flood's recession limb). The later observations are along the line descending to the left. The mainstem lines show linear declines. The OCWBs with straight lines reflect good connection between side channel and mainstem, while the non-linear traces reflect poor connection to the main channel.

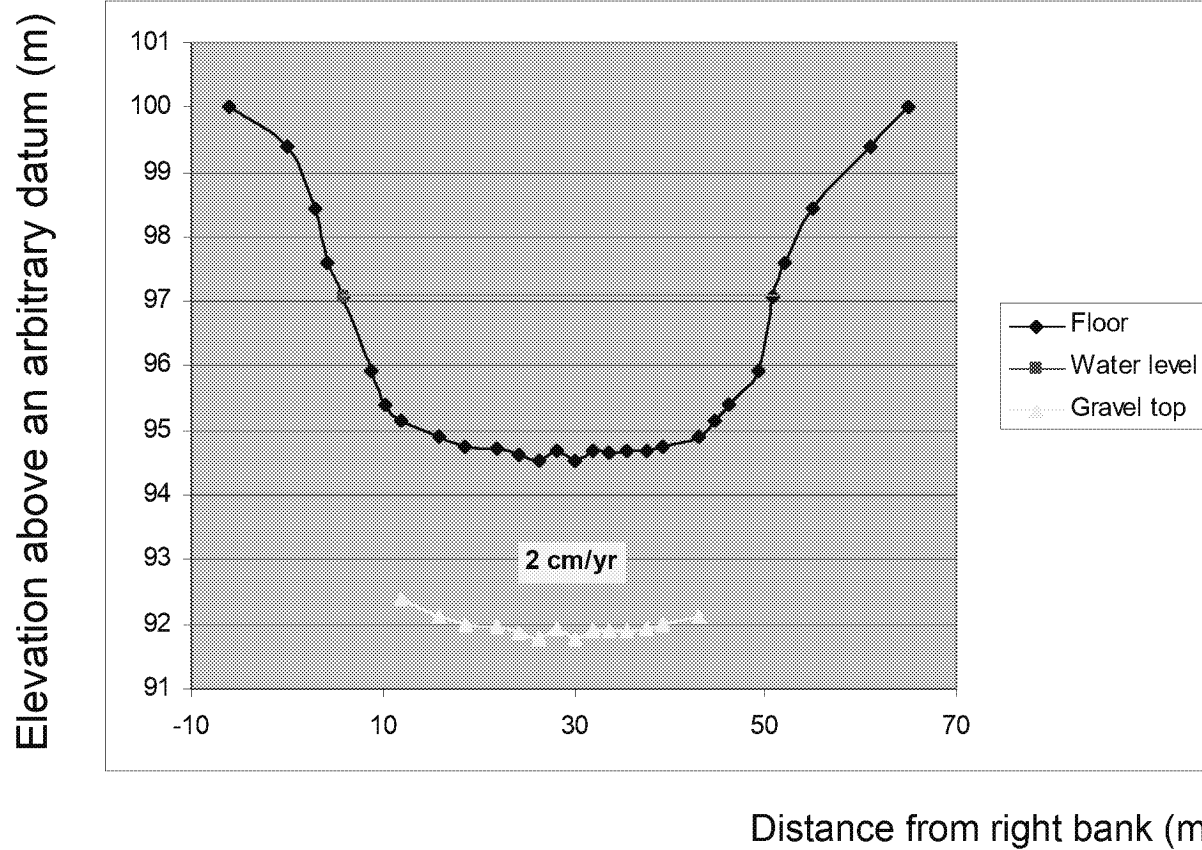


Figure 13. Cross section of Phelan Island OCWB.

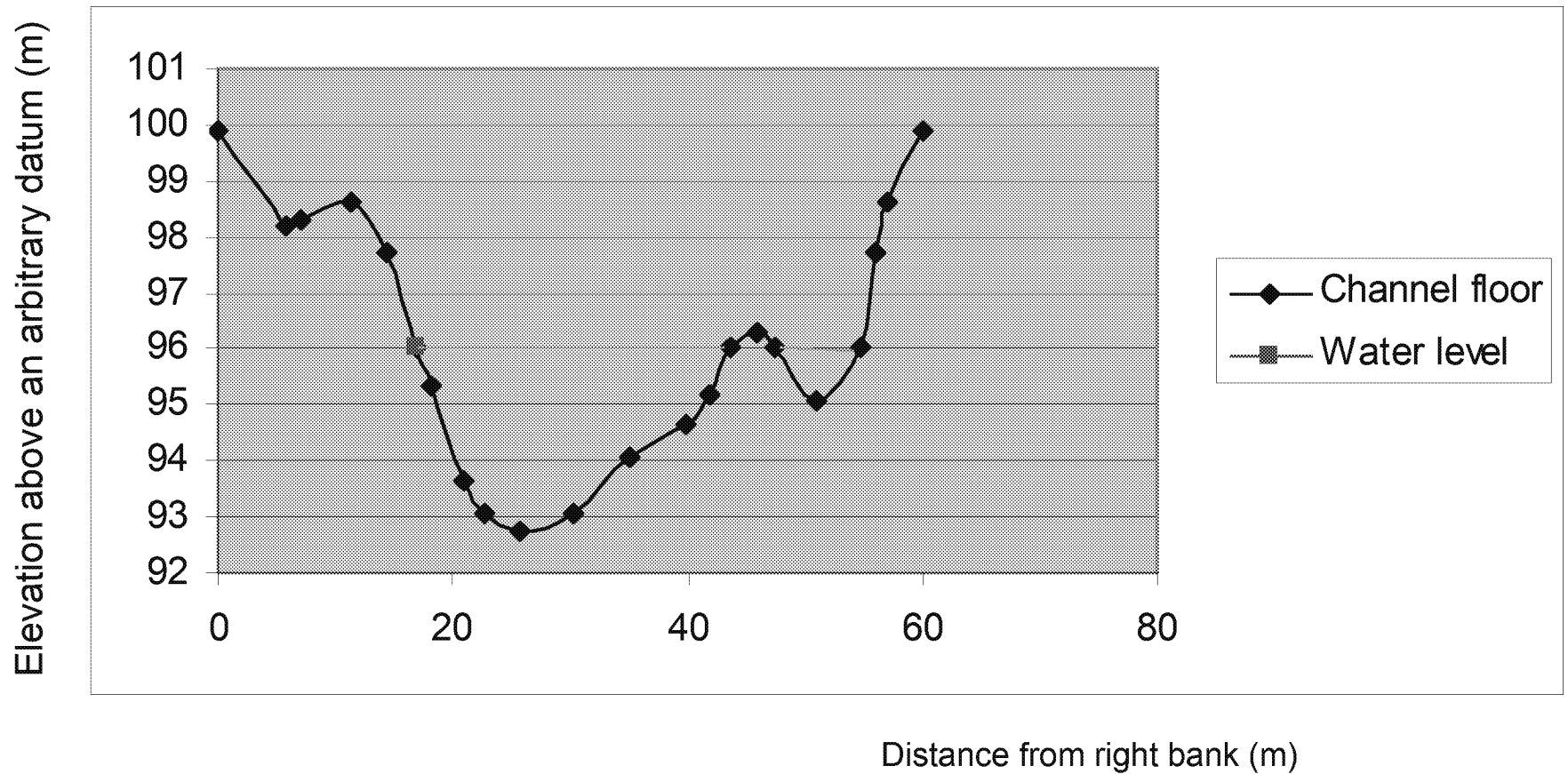


Figure 14. Cross section of Capay OCWB.

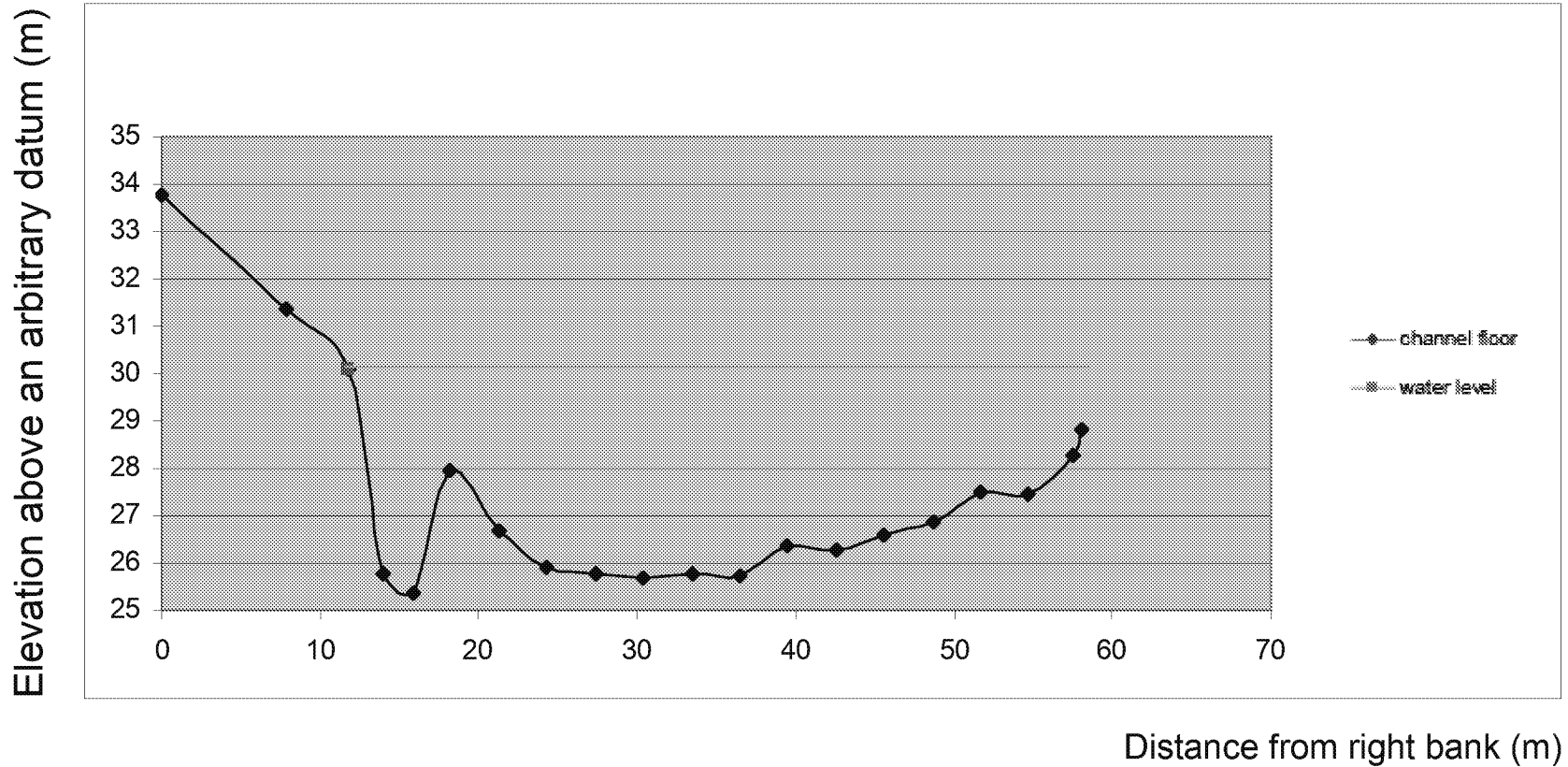


Figure 15. Cross section of Jacinto OCWB.

Elevation above an arbitrary datum (m)

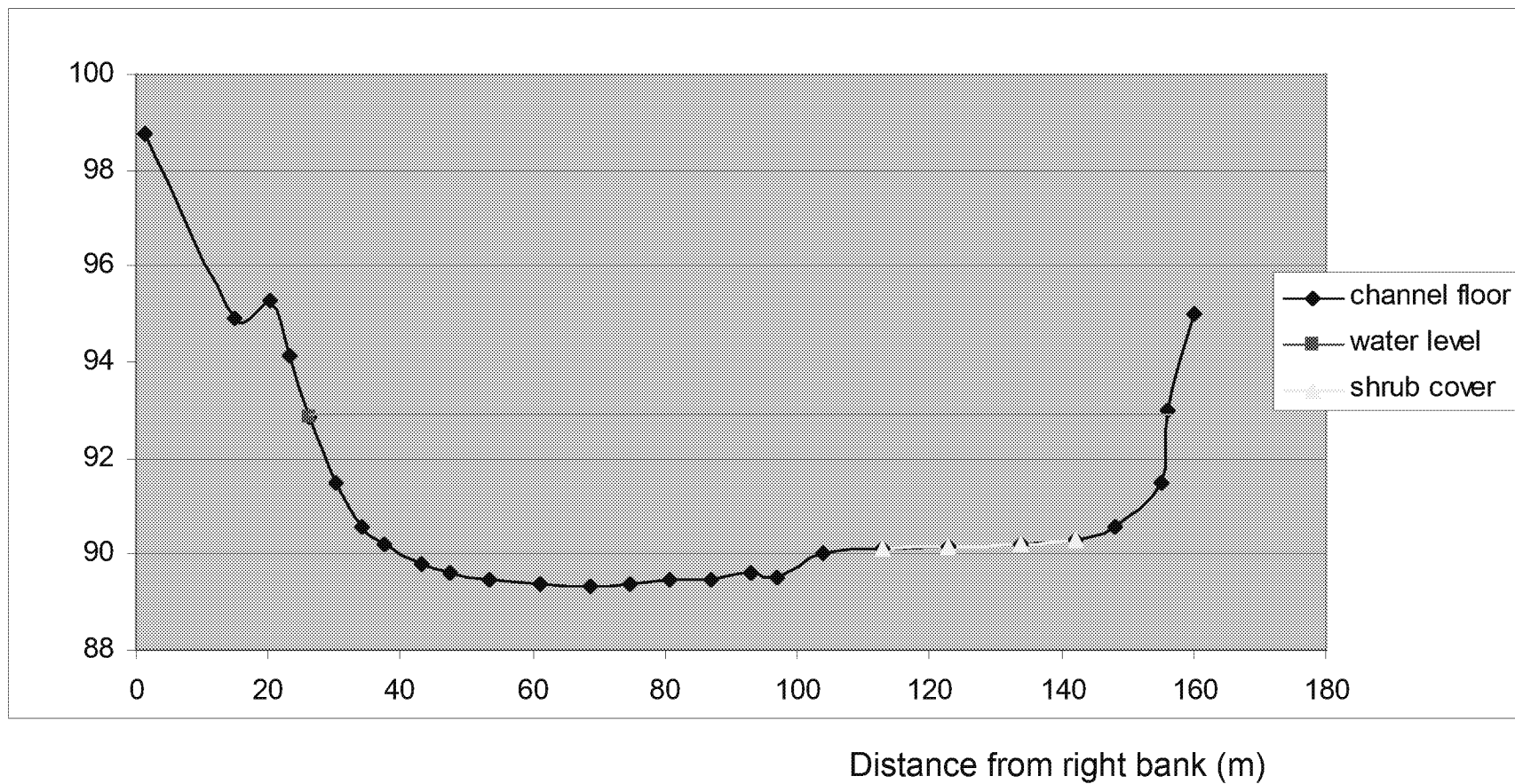


Figure 16. Cross section of Old Rasor OCWB.

Elevation above an arbitrary datum (m)

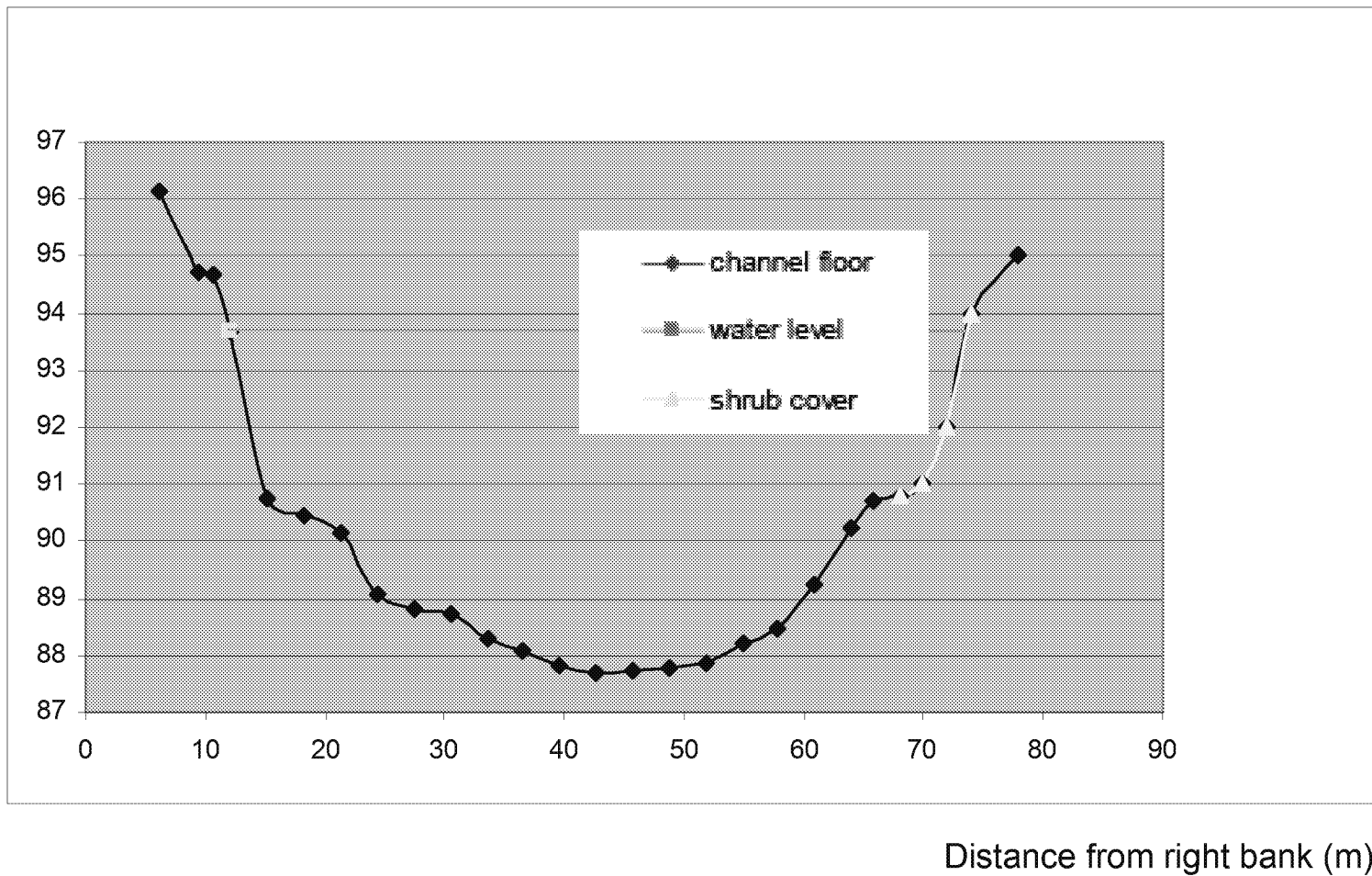
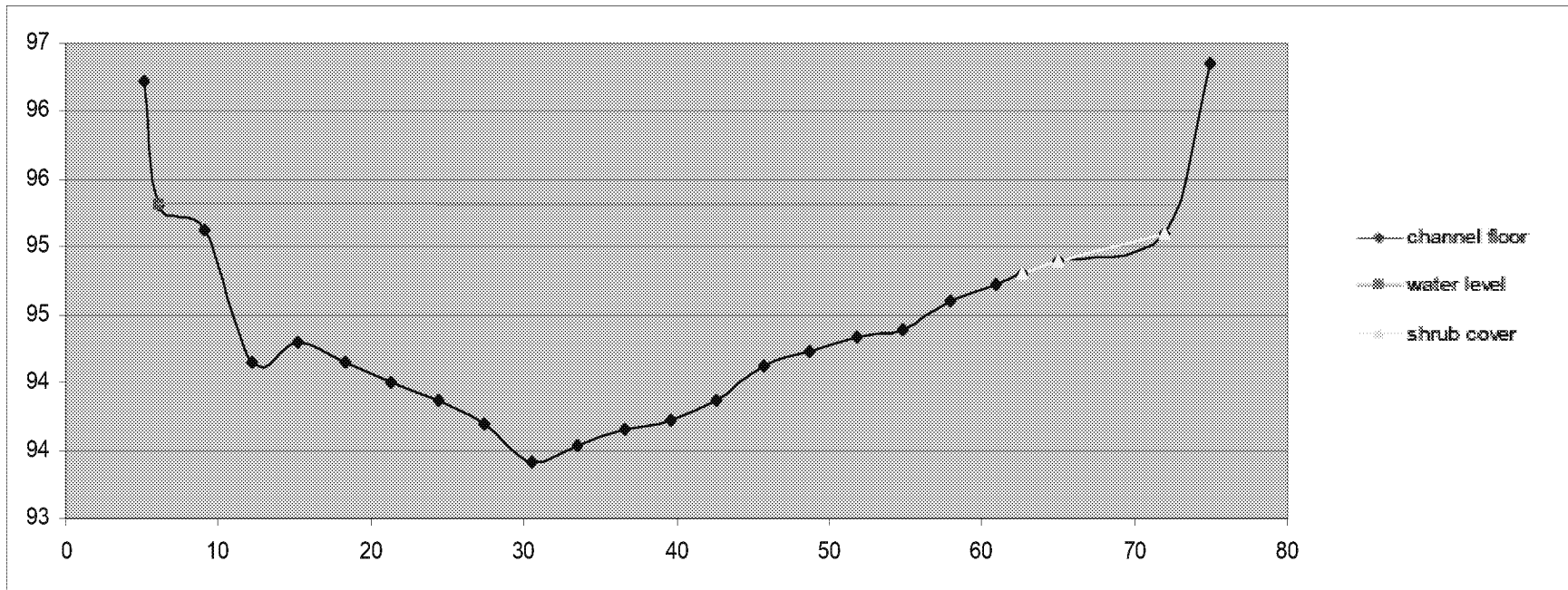


Figure 17. Cross section of Kopta main OCWB.

Elevation above an arbitrary datum (m)



Distance from right bank (m)

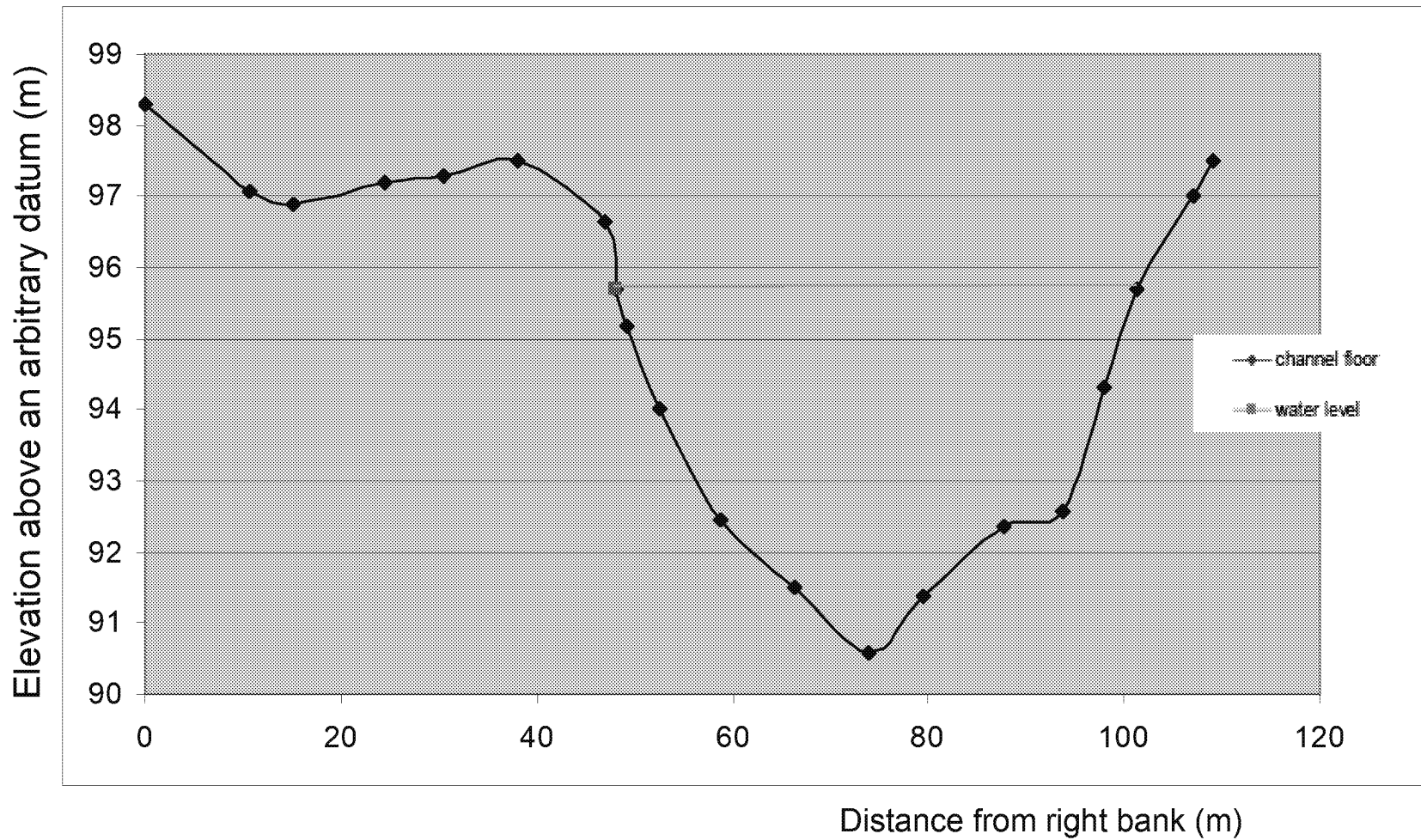


Figure 19. Cross section of Young Razor slough OCWB.

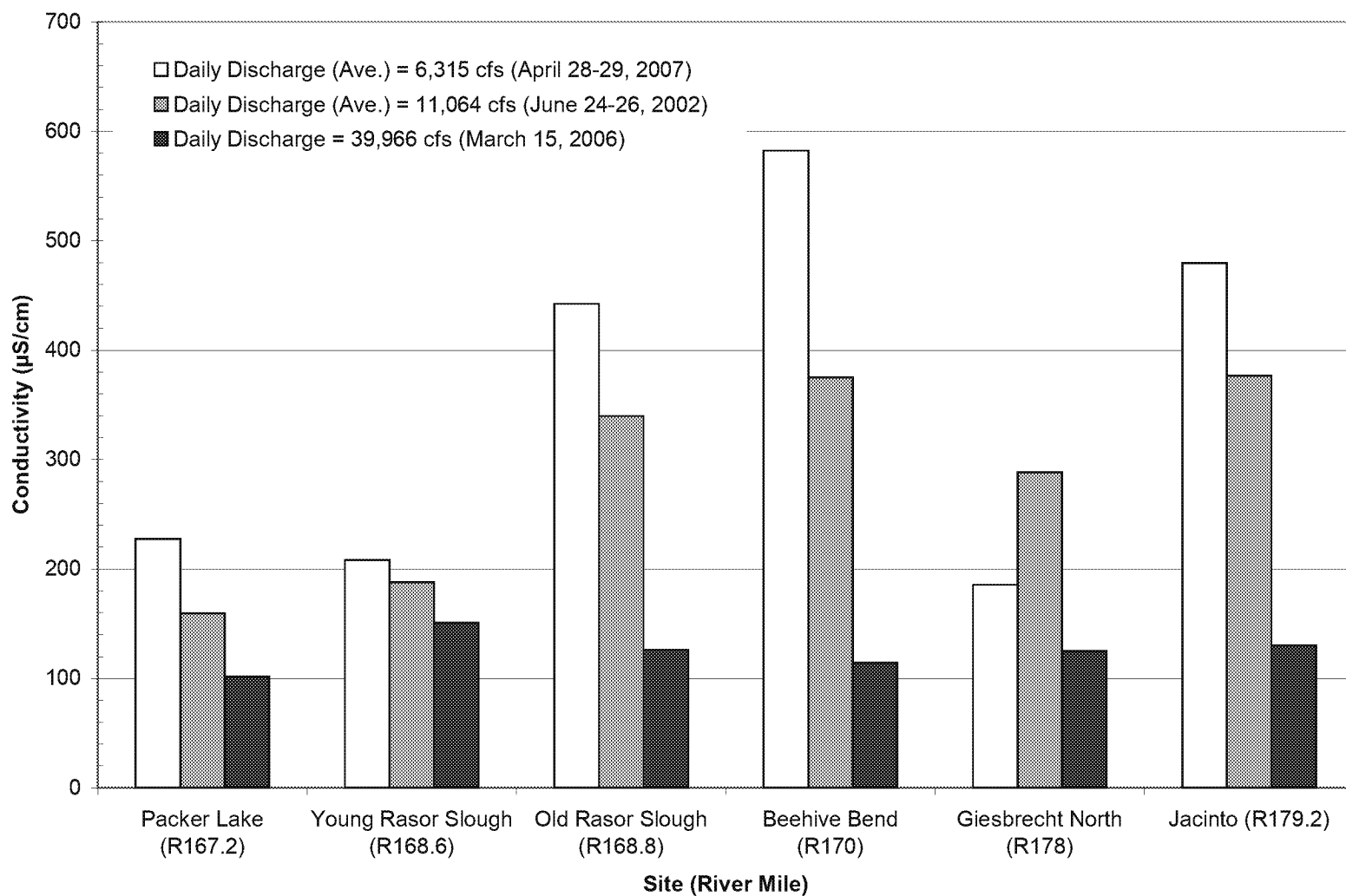
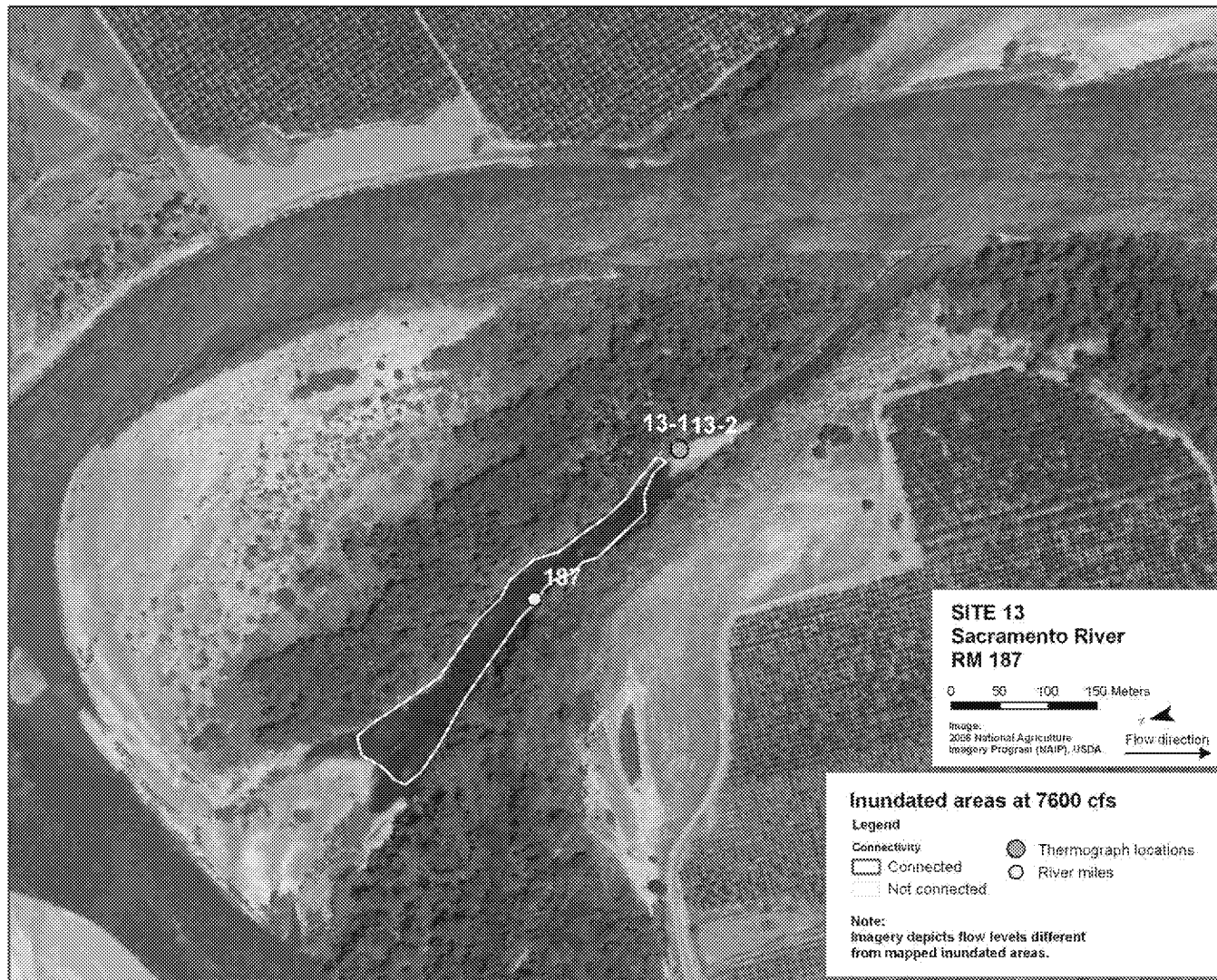
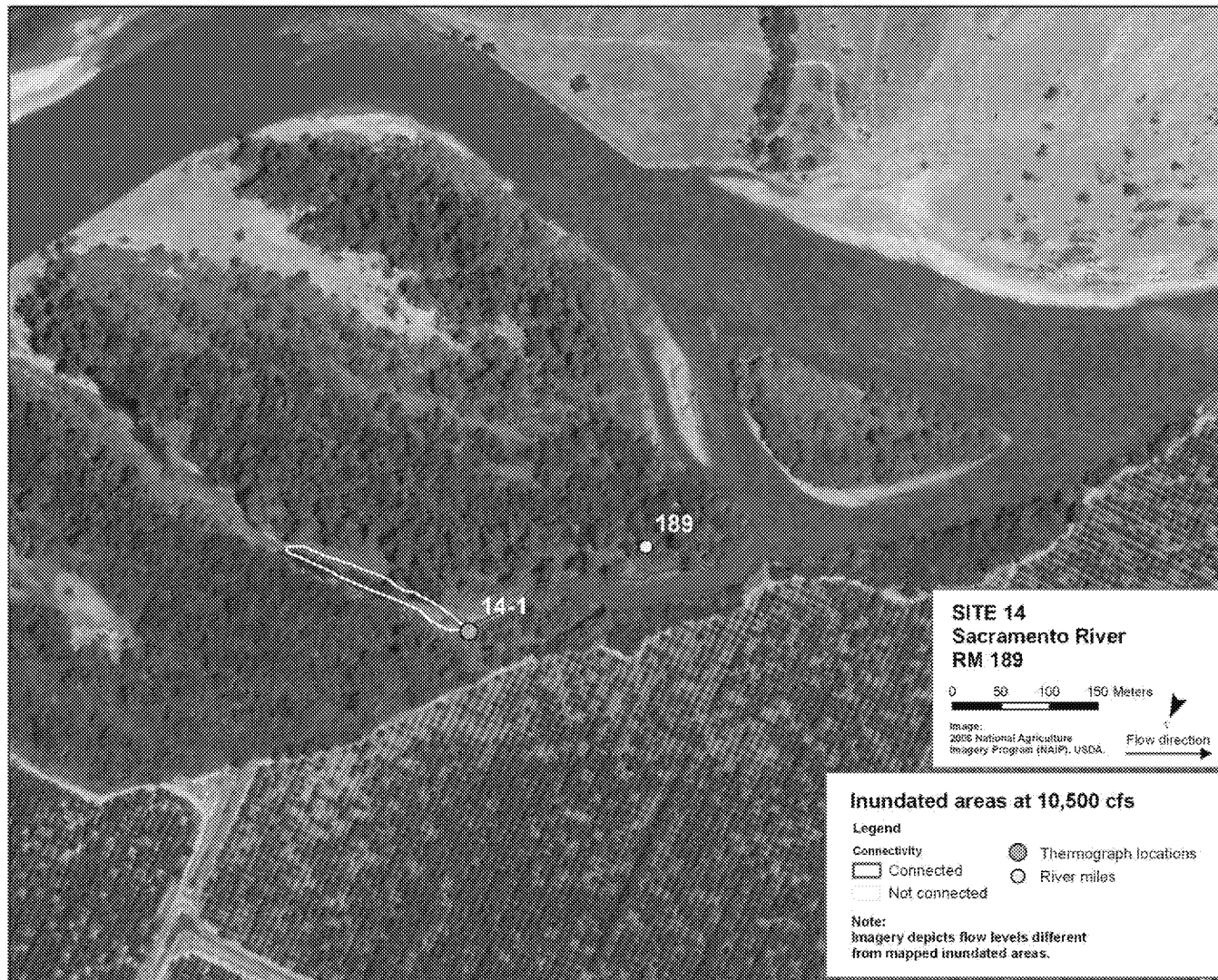


Figure 20. Conductivity measurements for selected OCWB sites taken during a range of Sacramento River discharge rates.







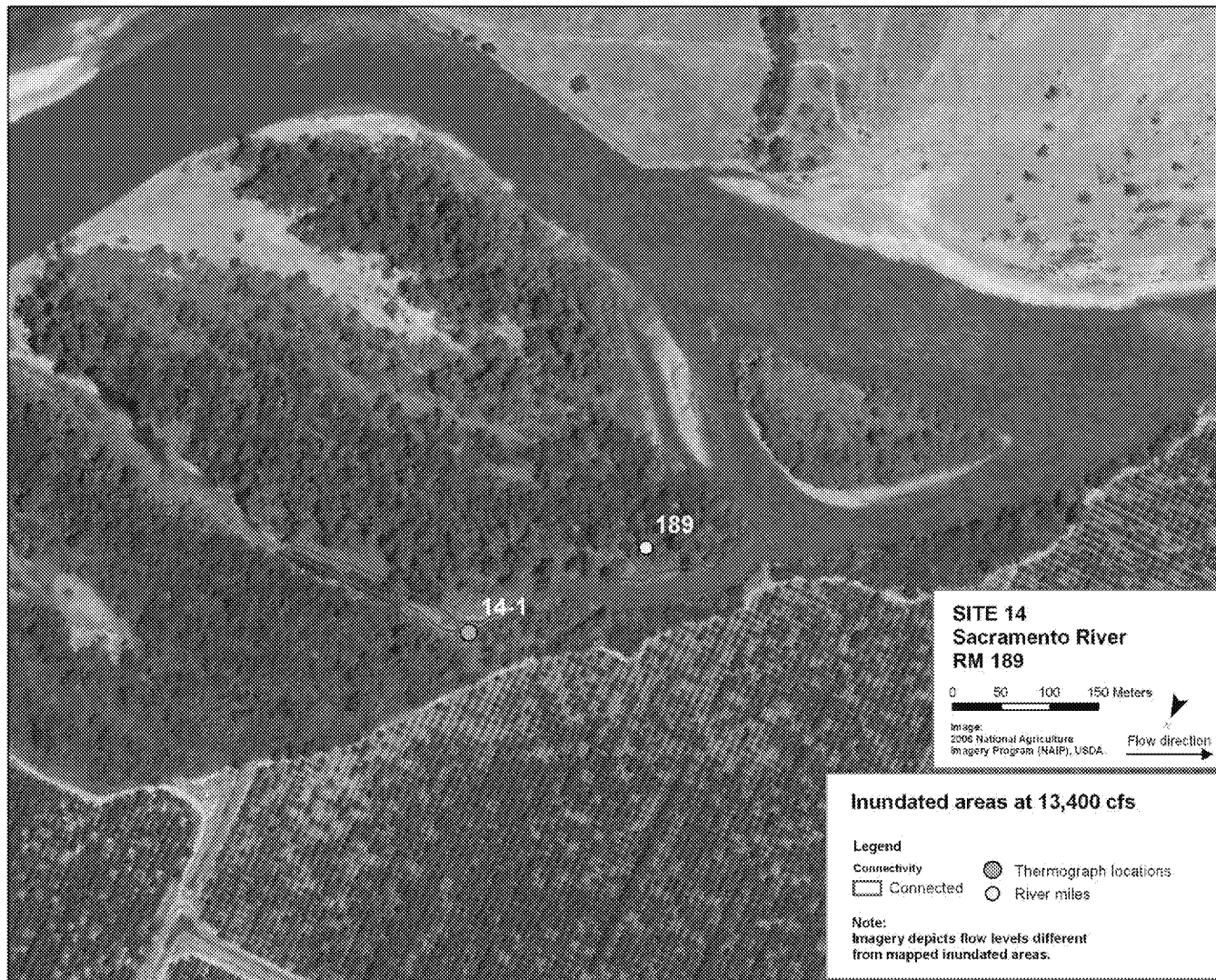


Figure 22b. Inundated areas at site 14 (RM 189R) with flows of 13,400 cfs, areas based on thermograph temperature records and field surveys.

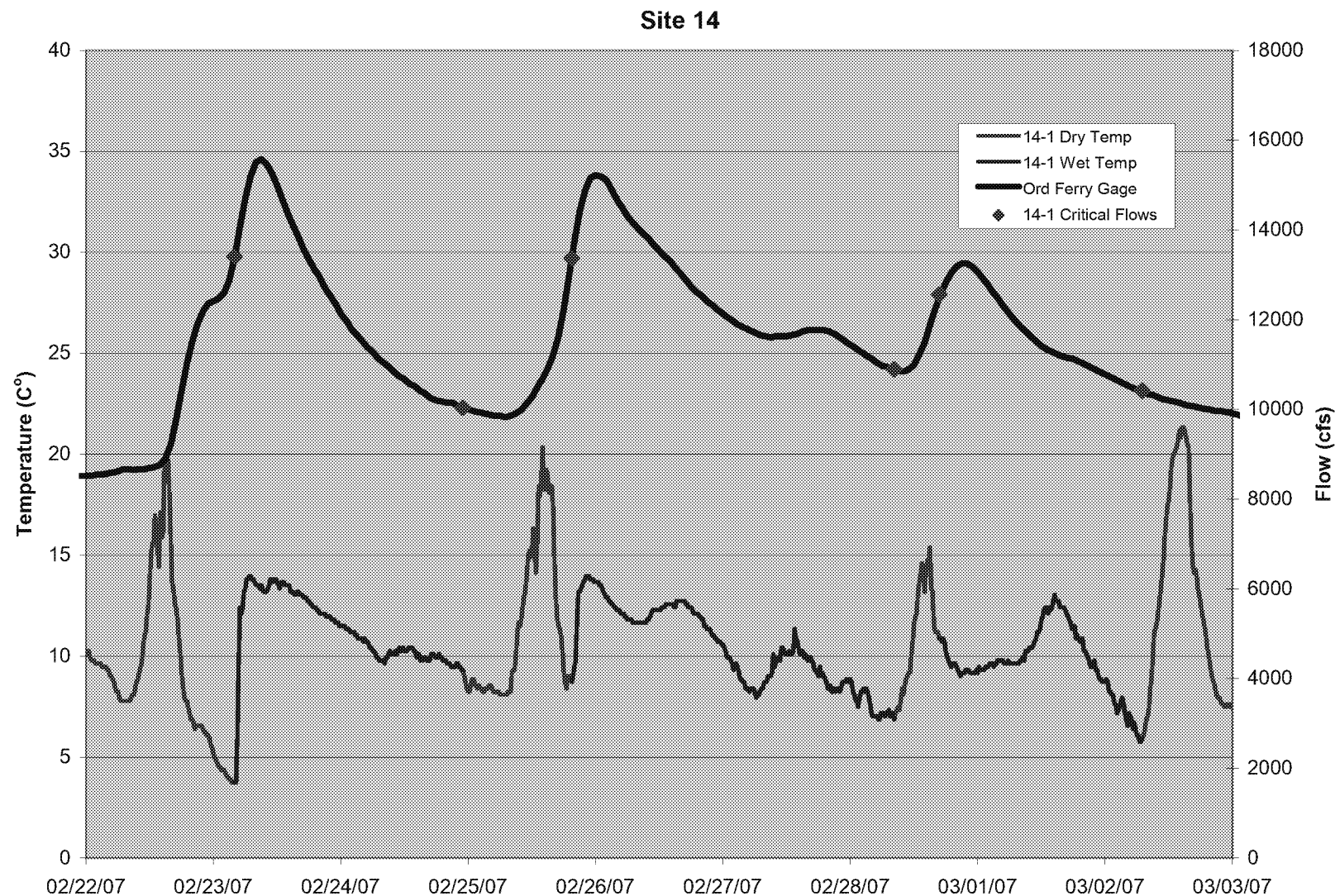
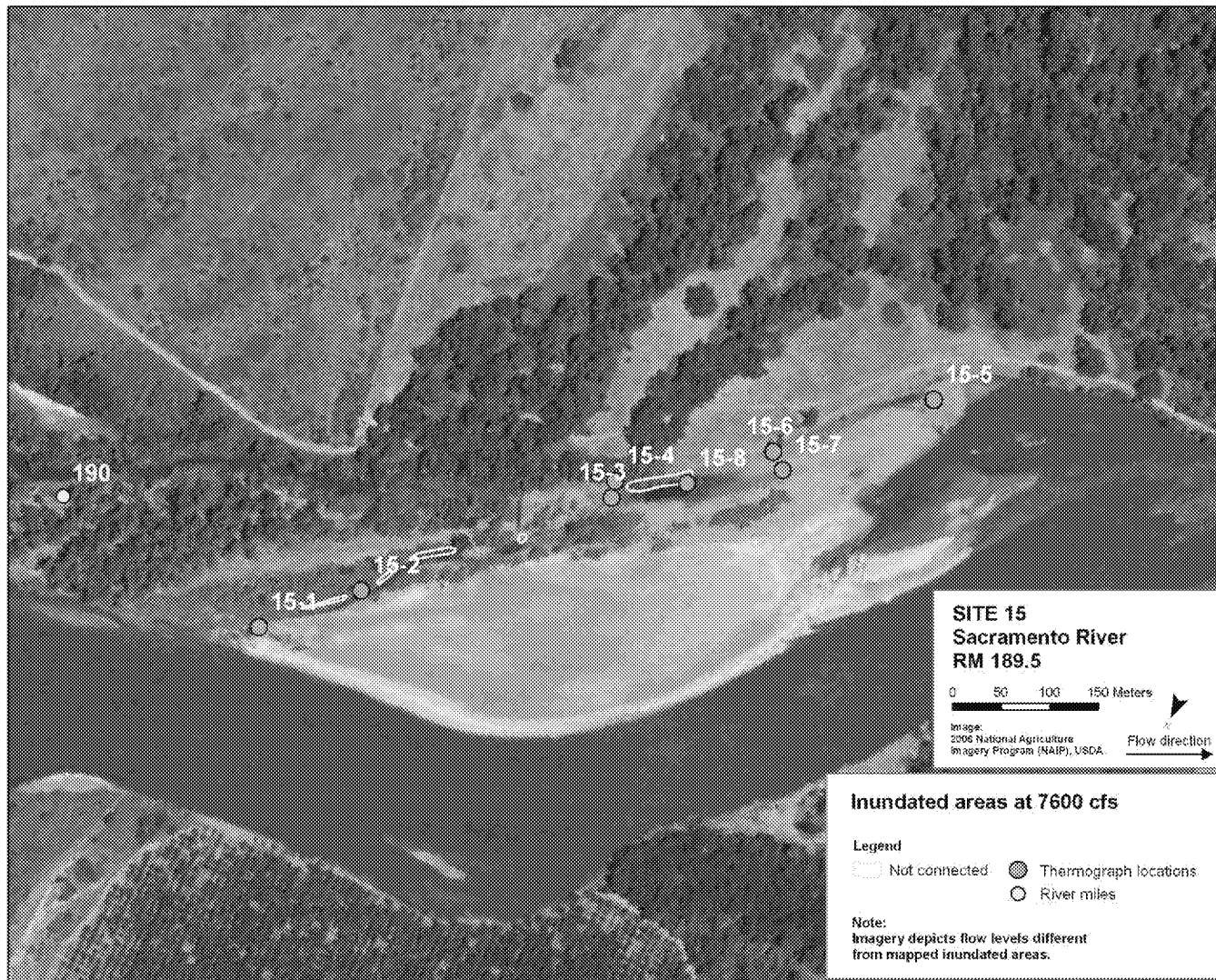
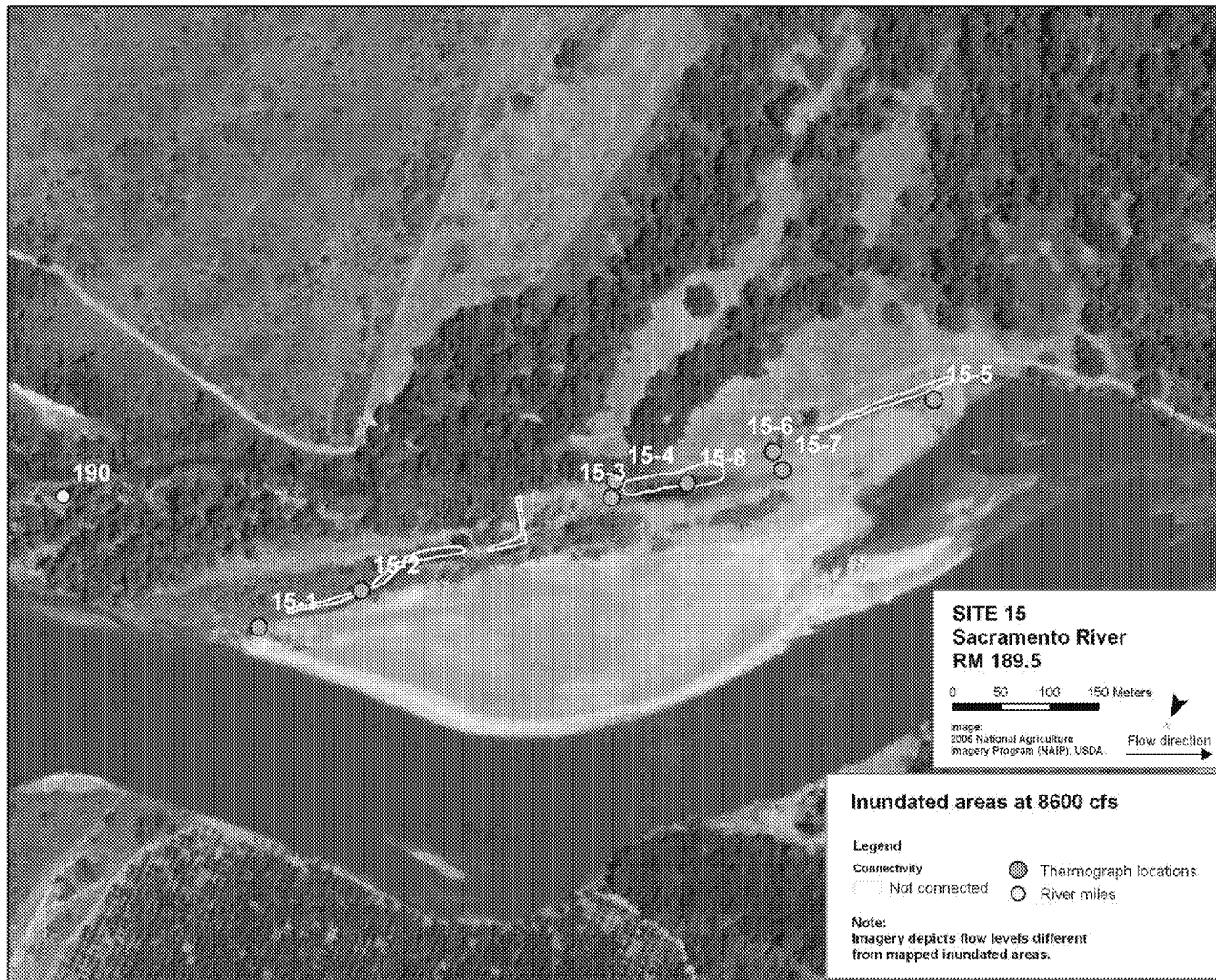
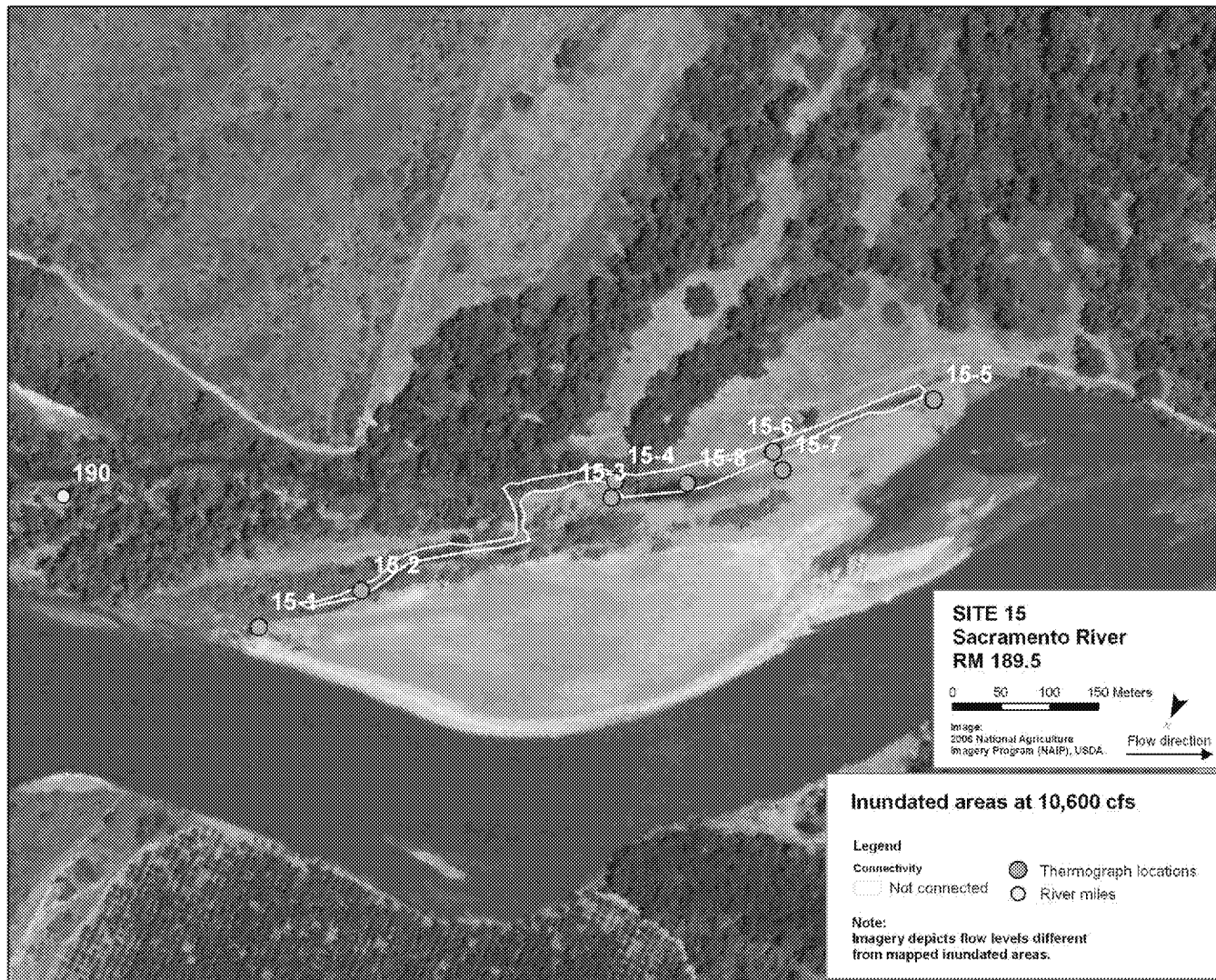
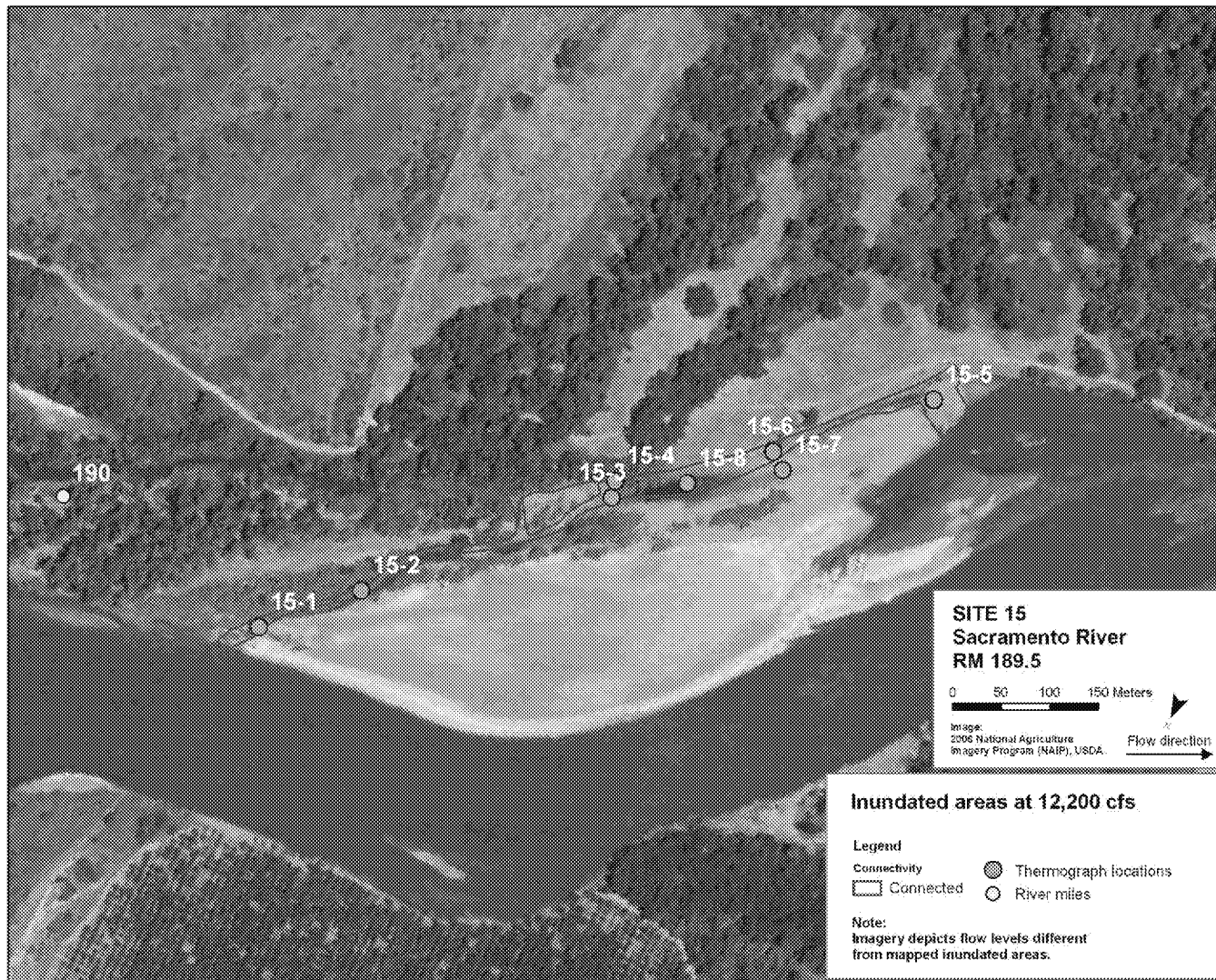


Figure 23. Thermograph data for site 14 (RM 189R) and discharge at Ord Ferry between 2/22/07 and 3/3/07. Critical flow points depict thermograph changes between dry and wet status.

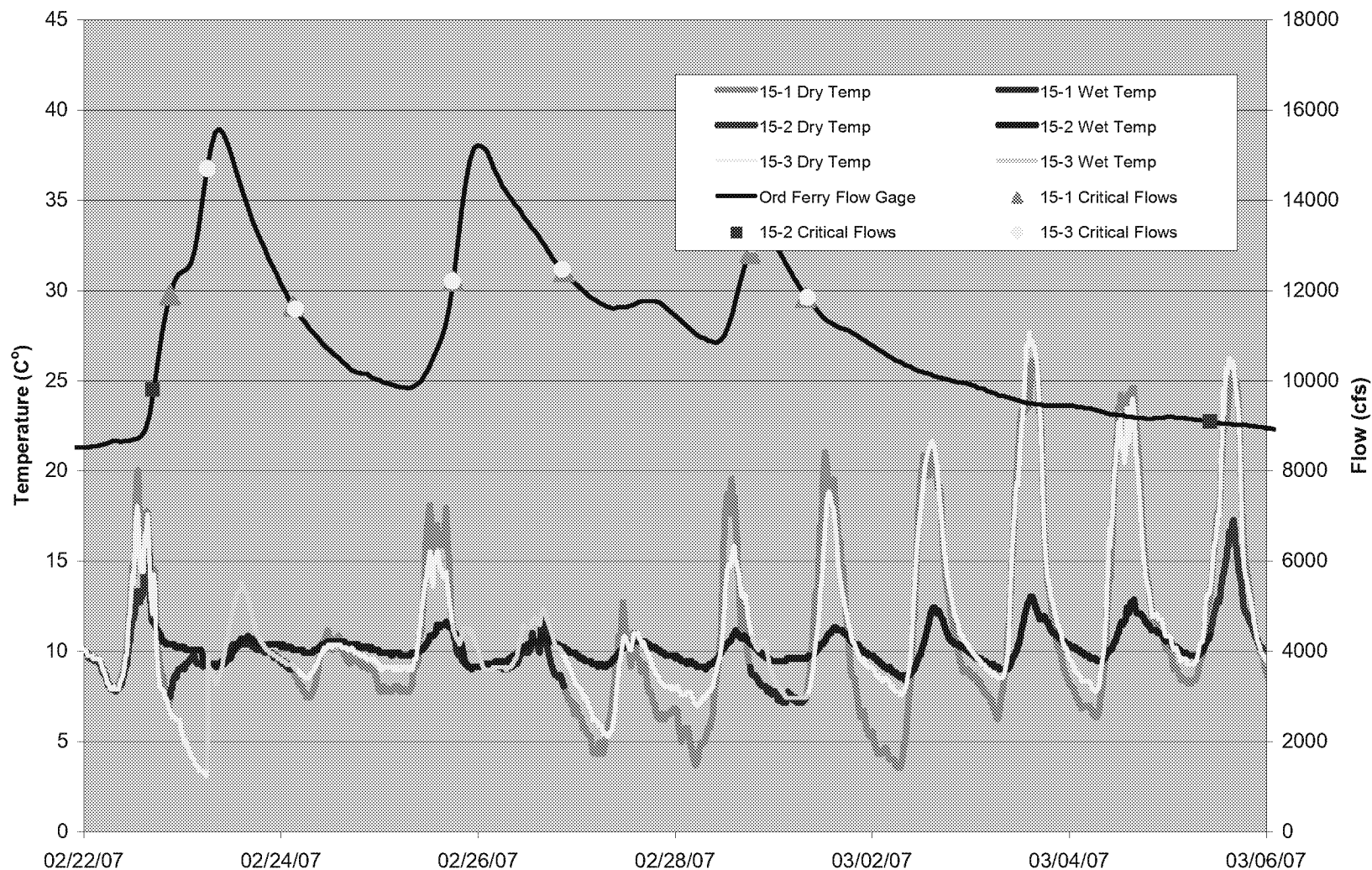








Site 15



Site 15

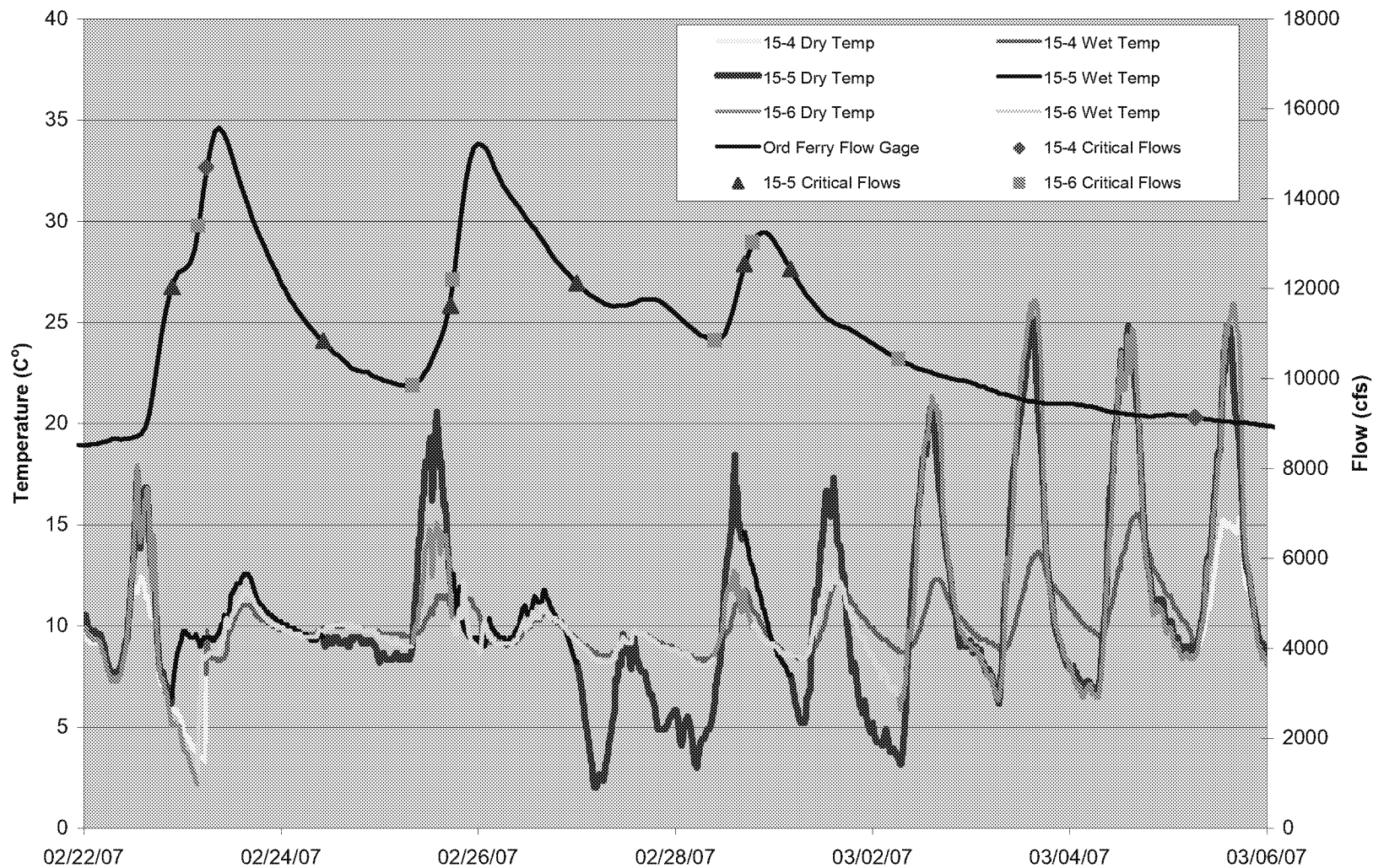


Figure 25b. Thermograph data for site 15 (RM 189.5L) and discharge at Ord Ferry between 2/22/07 and 3/6/07. Critical flow points depict thermograph changes between dry and wet status.







Site 16

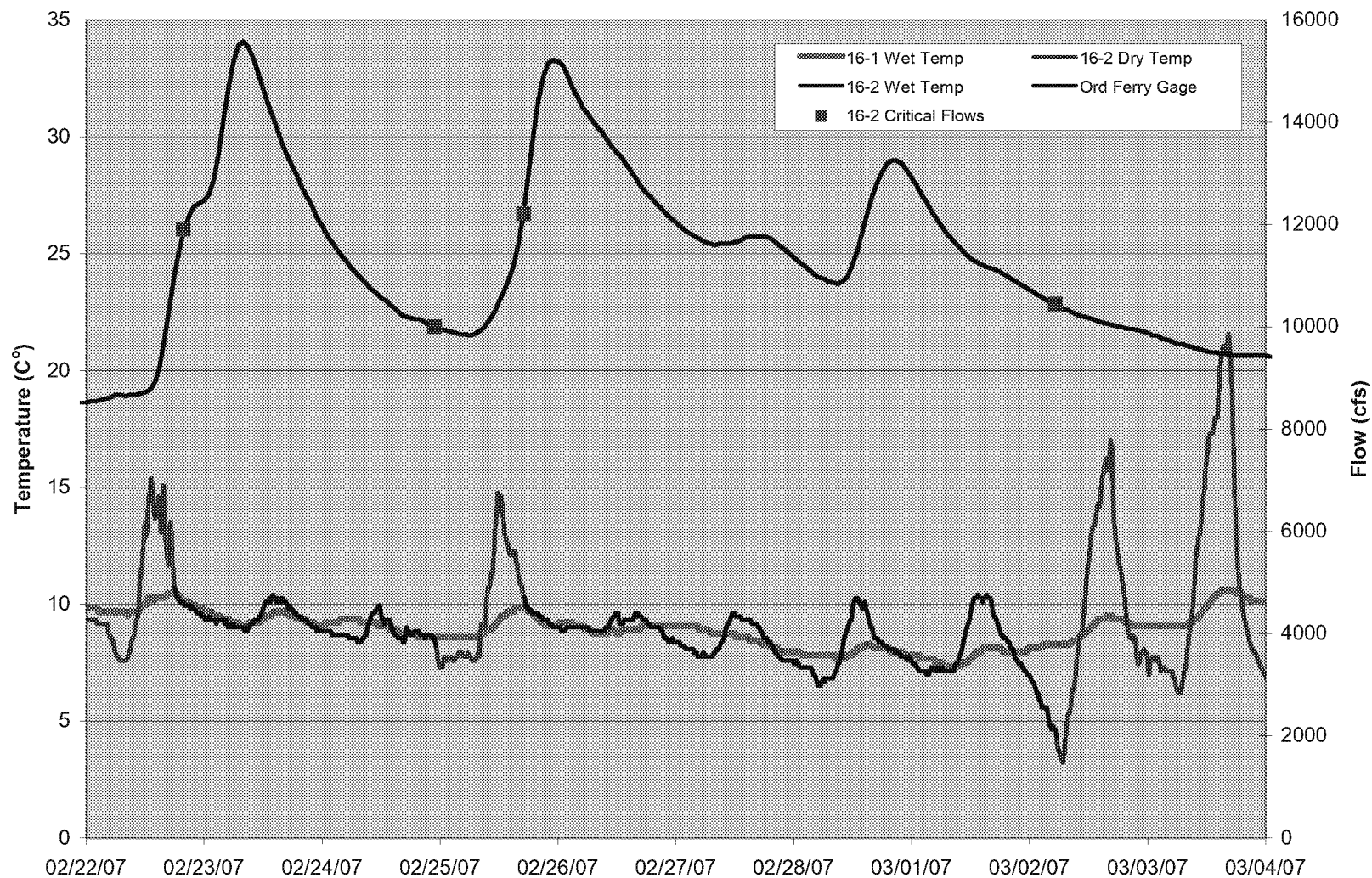
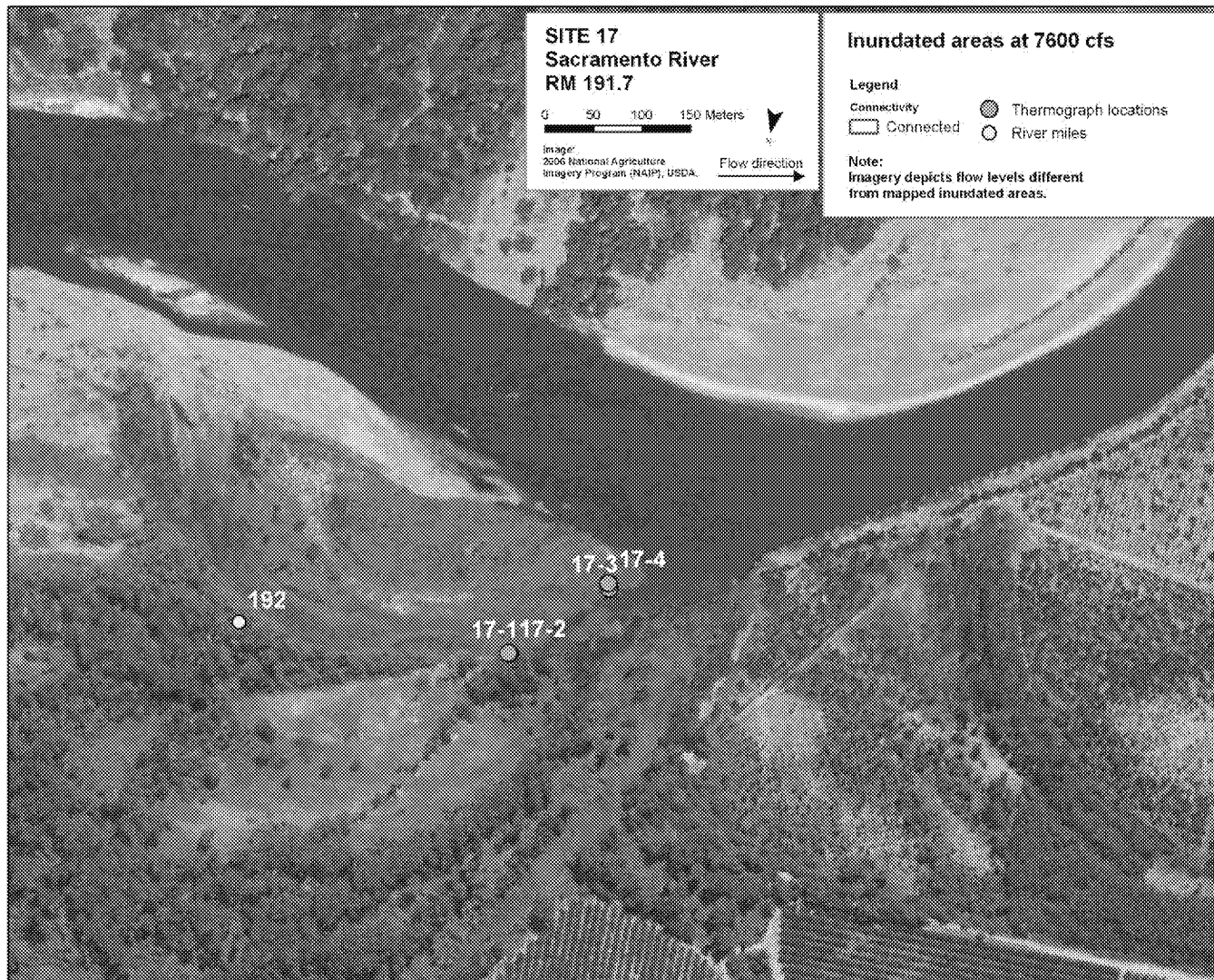
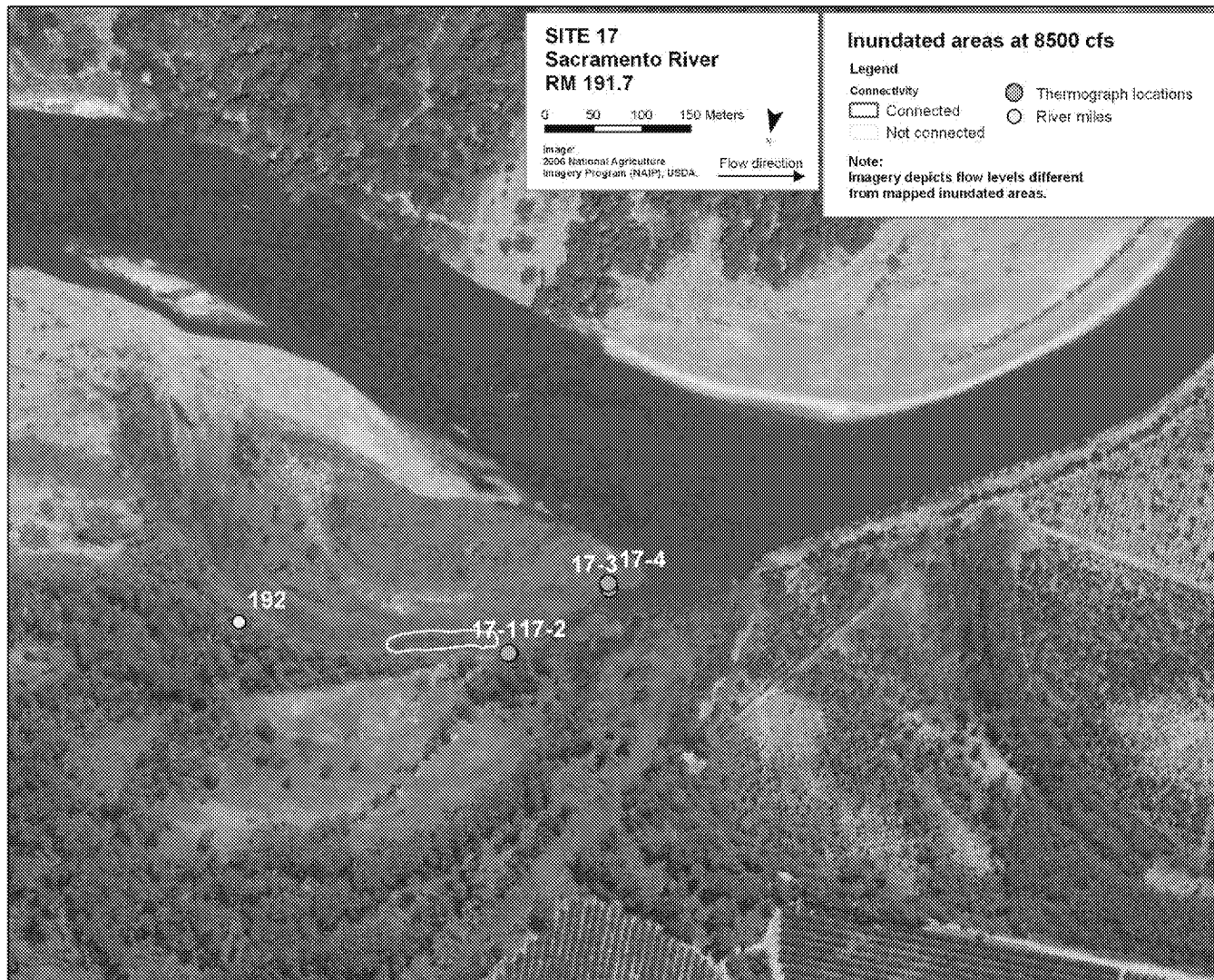
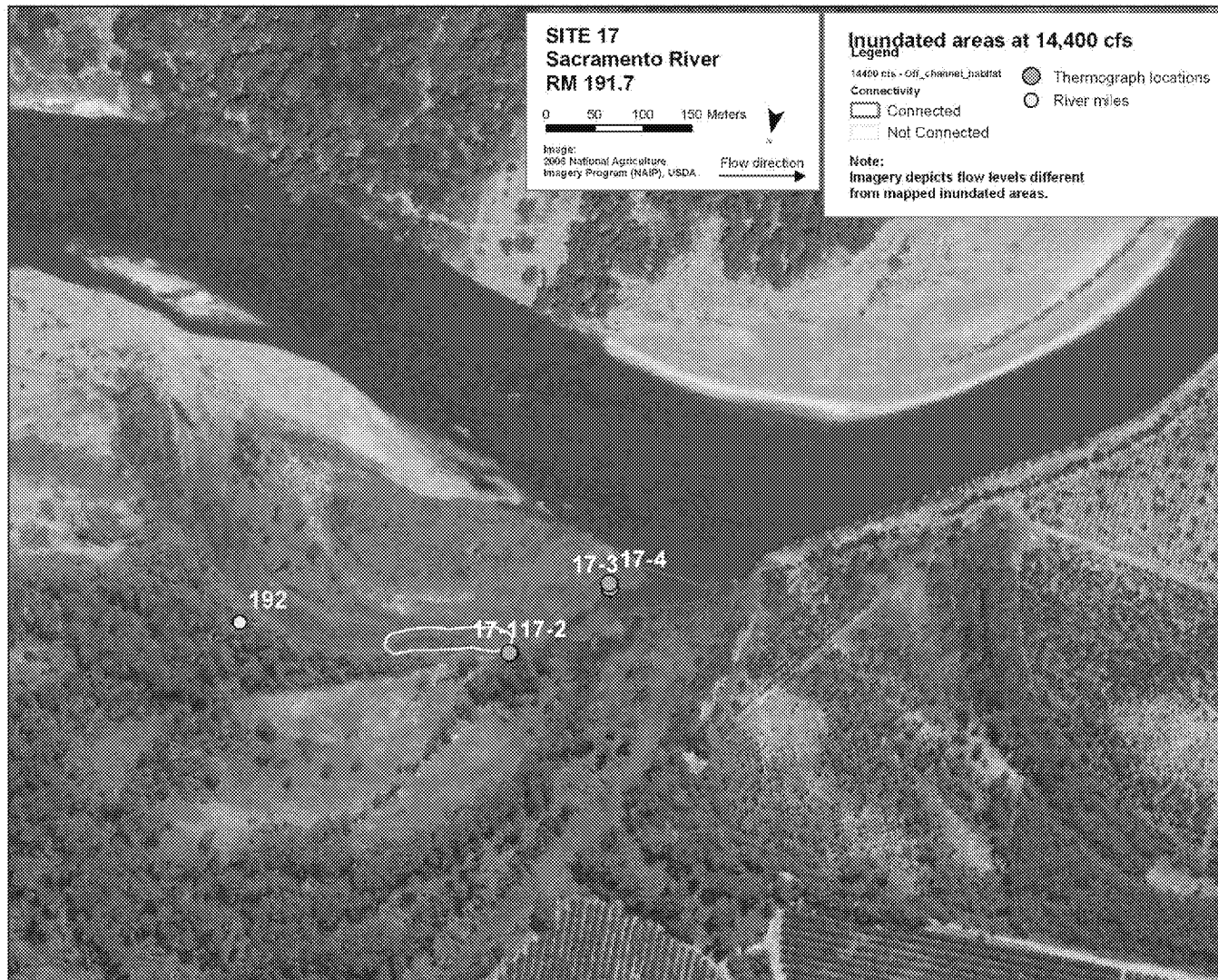


Figure 27. Thermograph data for site 16 (RM 191L) and discharge at Ord Ferry between 2/22/07 and 3/4/07. Critical flow points depict thermograph changes between dry and wet status.







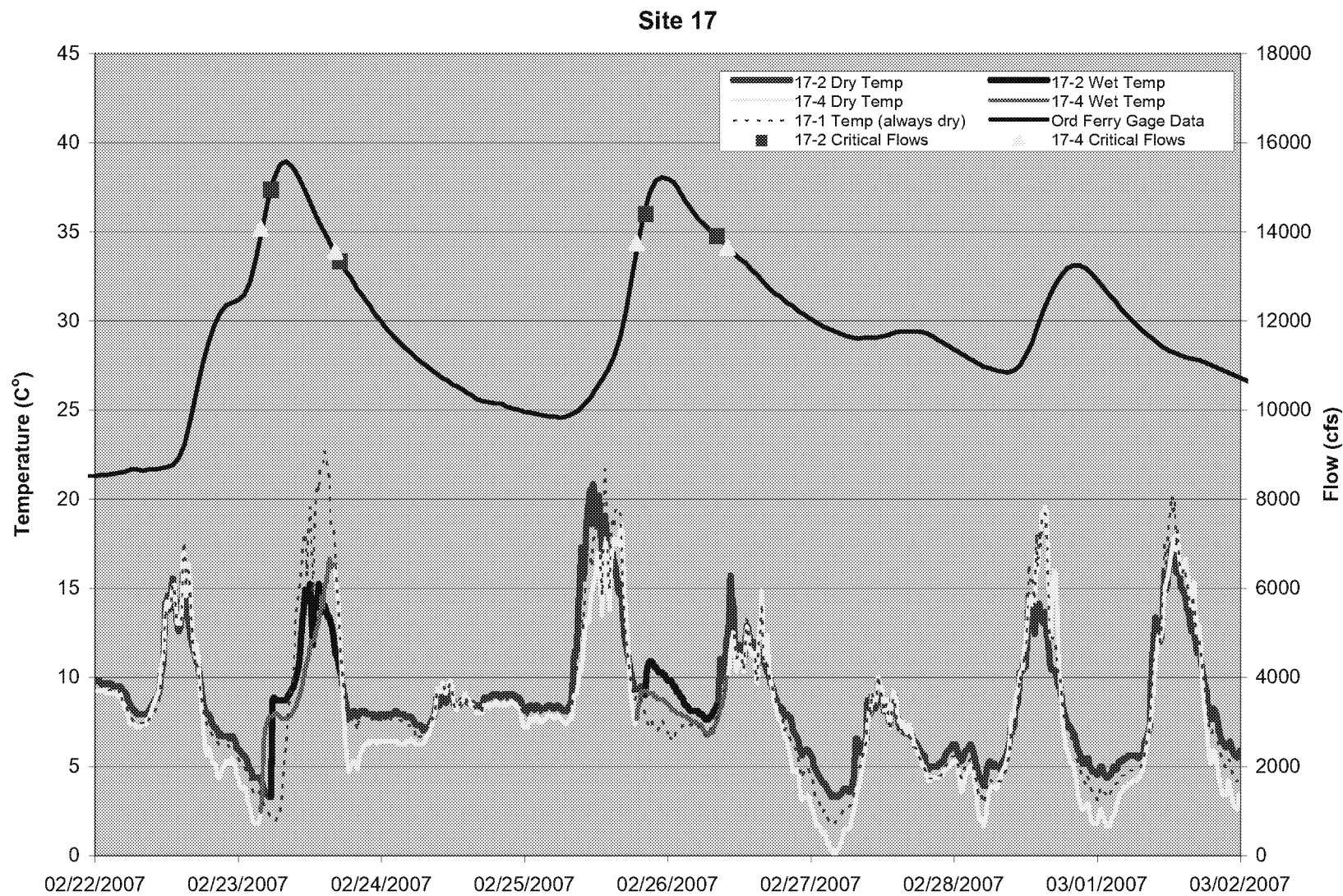
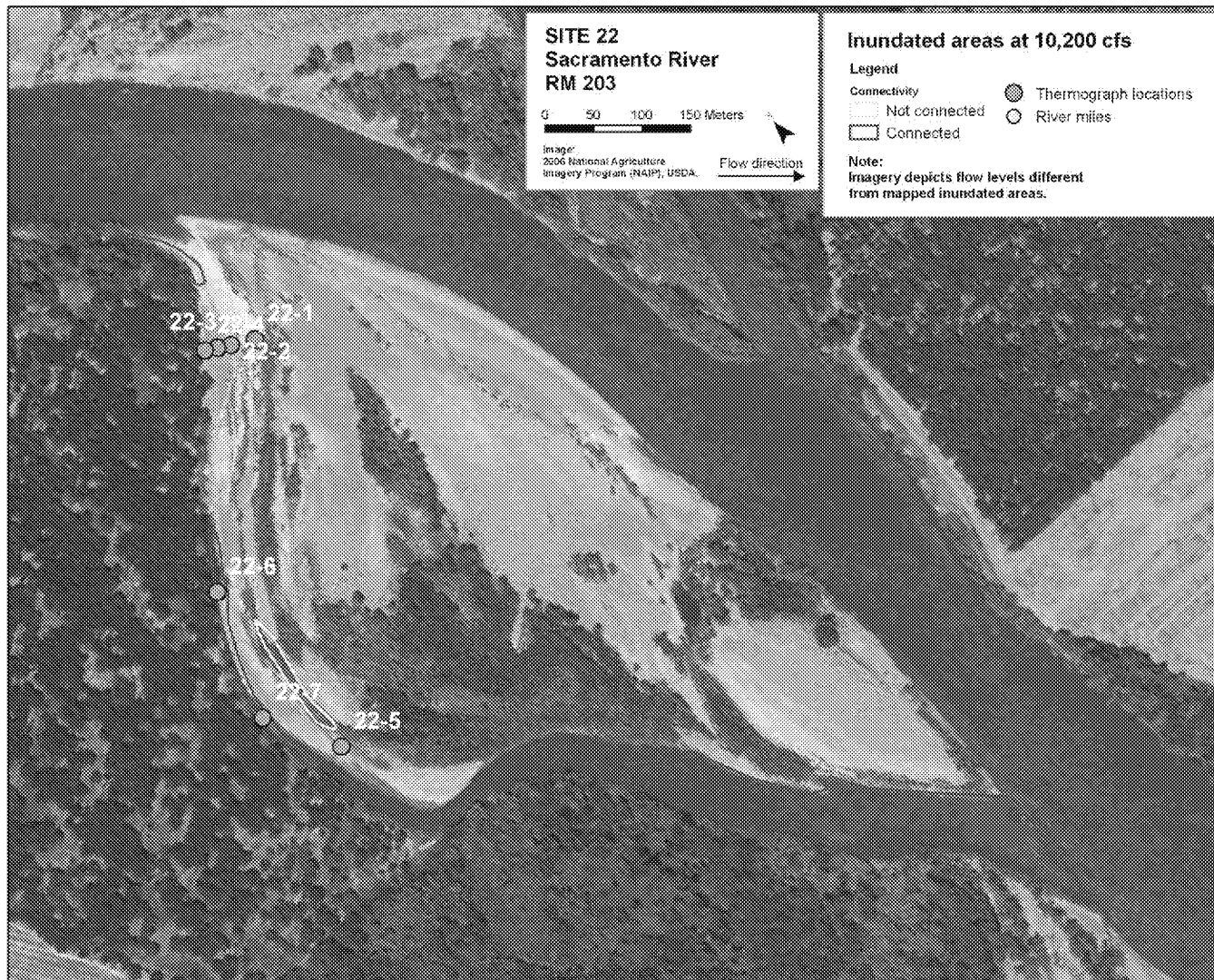


Figure 29. Thermograph data for site 17 (RM 191.7R) and discharge at Ord Ferry between 2/22/07 and 3/2/07. Critical flow points depict thermograph changes between dry and wet status.







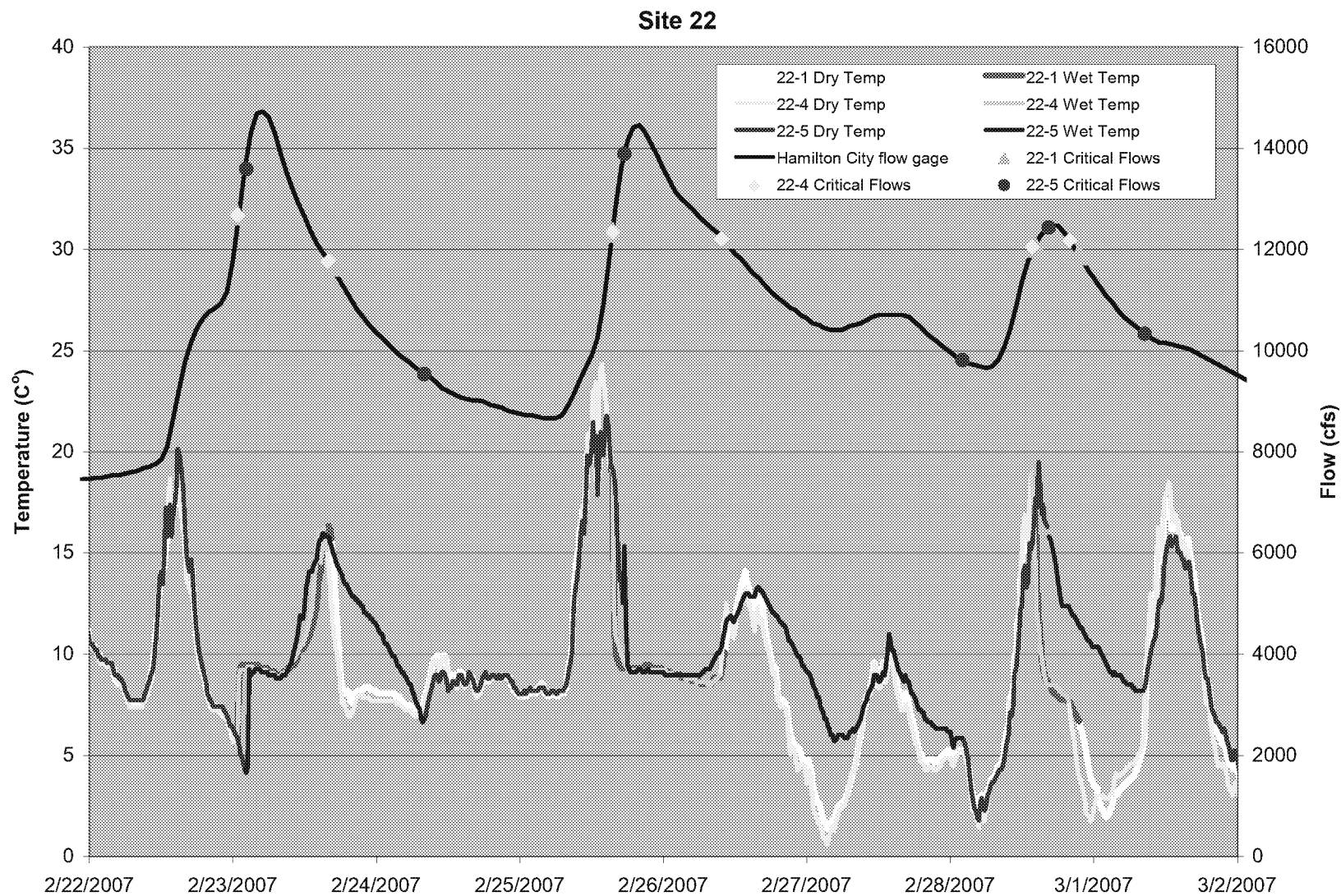
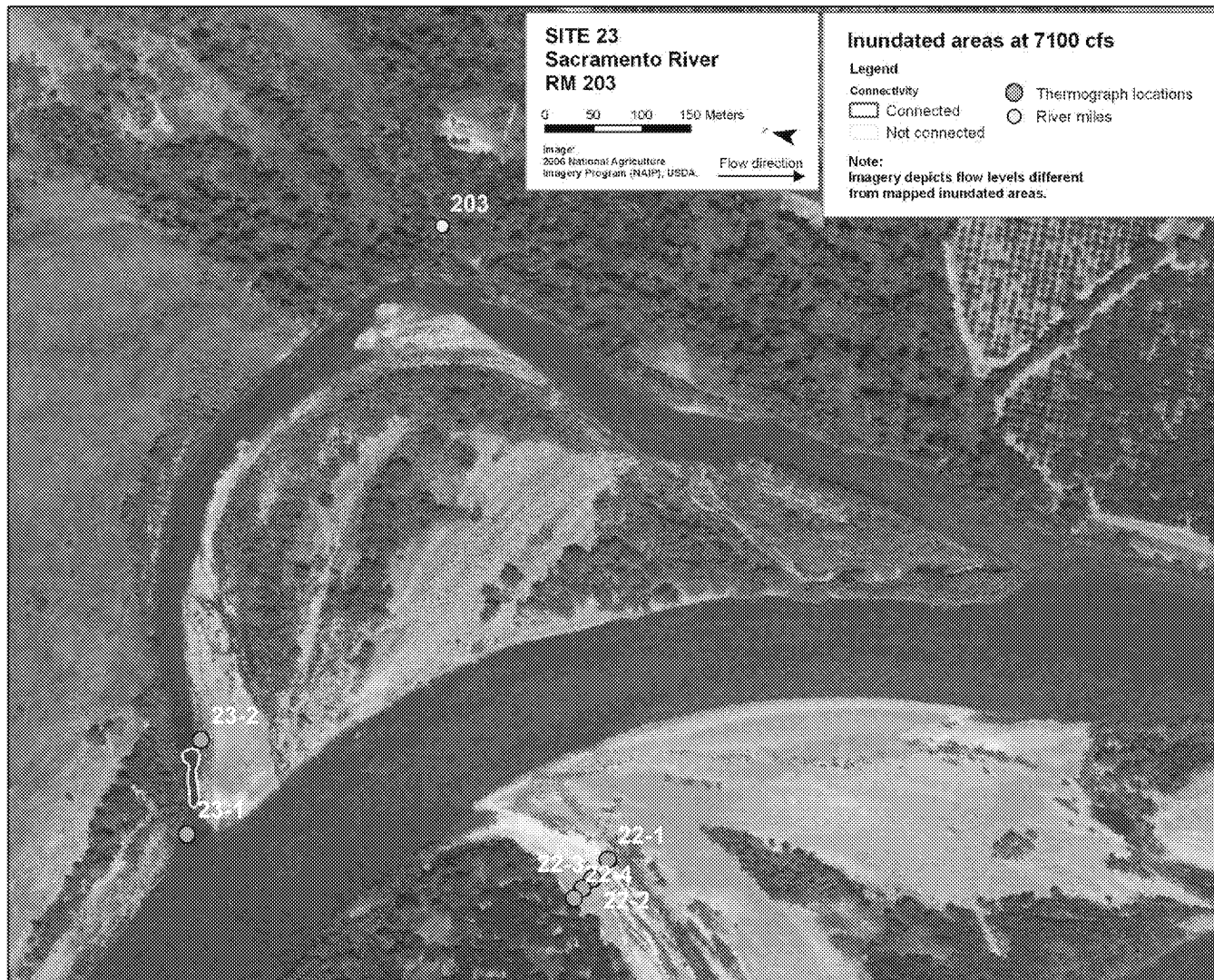
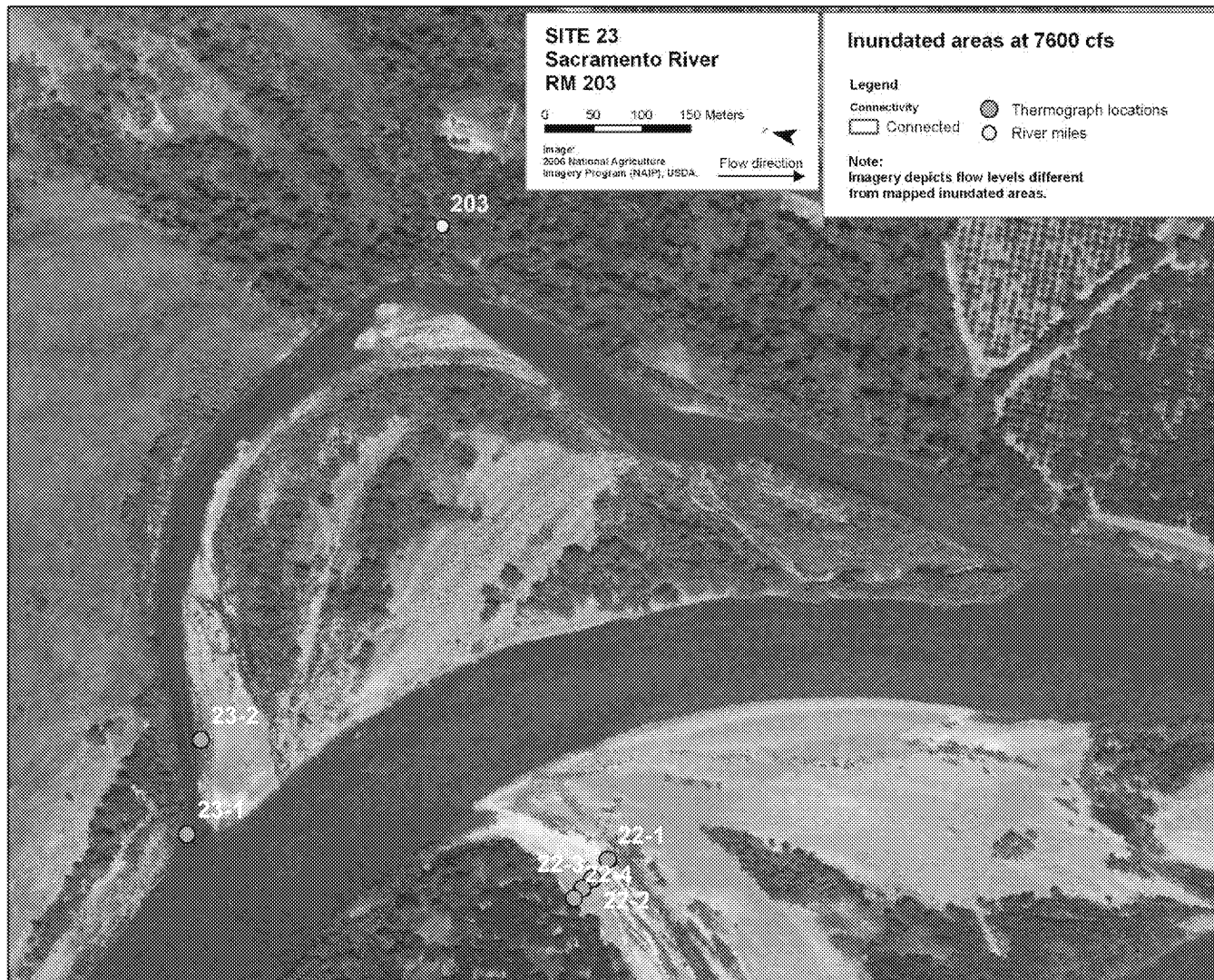
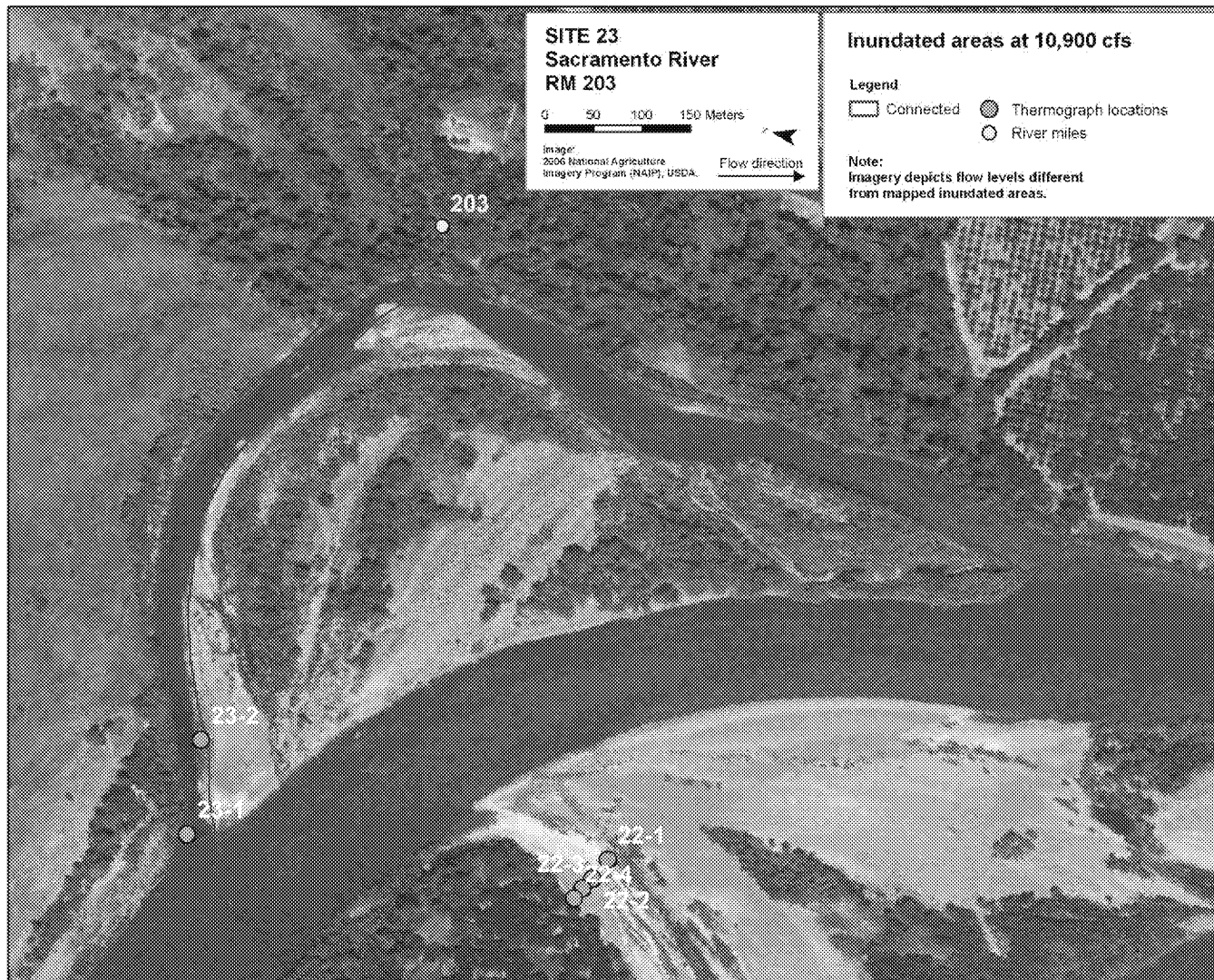


Figure 31. Thermograph data for site 22 (RM 203R) and discharge at Hamilton City between 2/22/07 and 3/2/07. Critical flow points depict thermograph changes between dry and wet status.







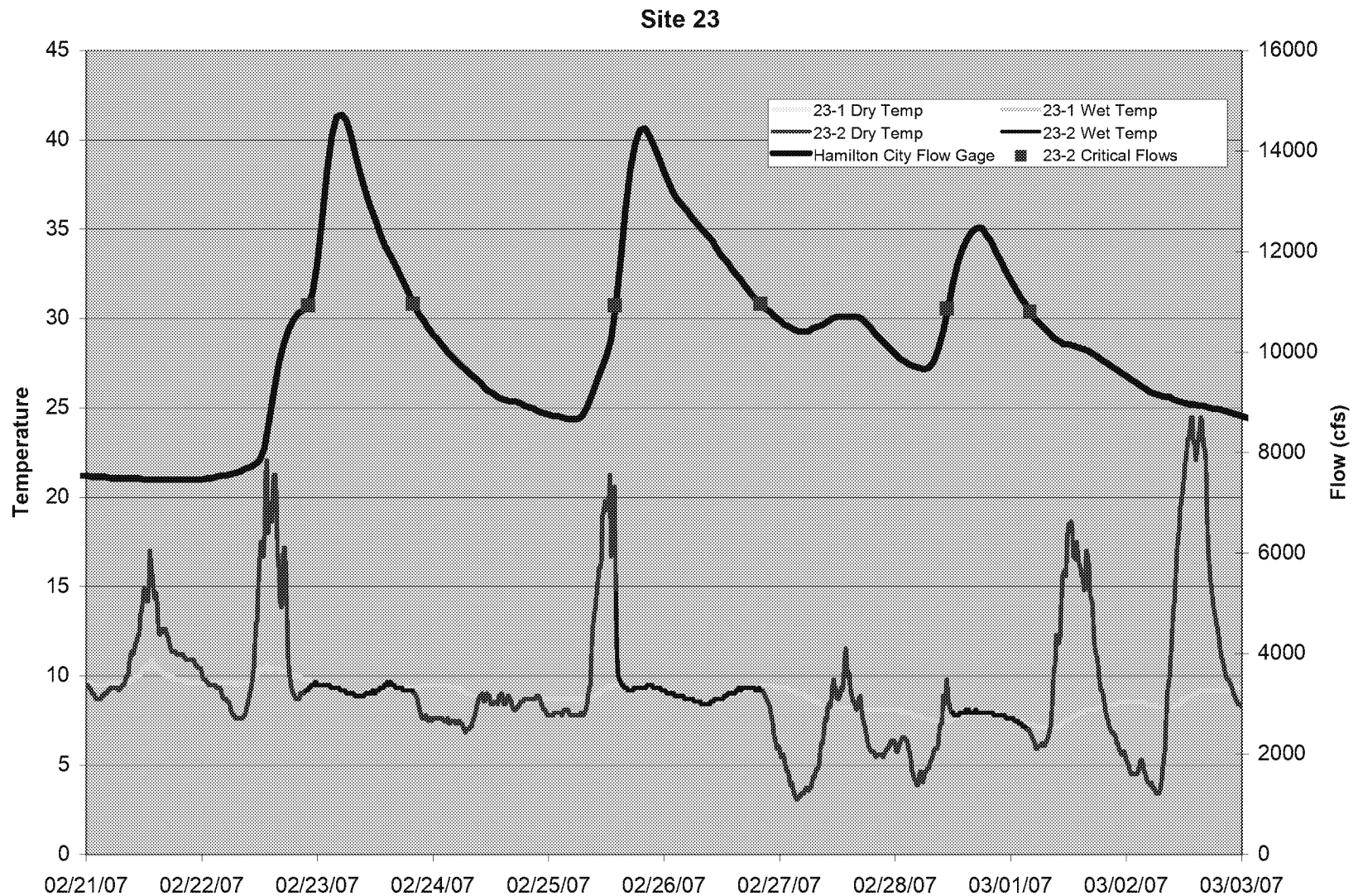


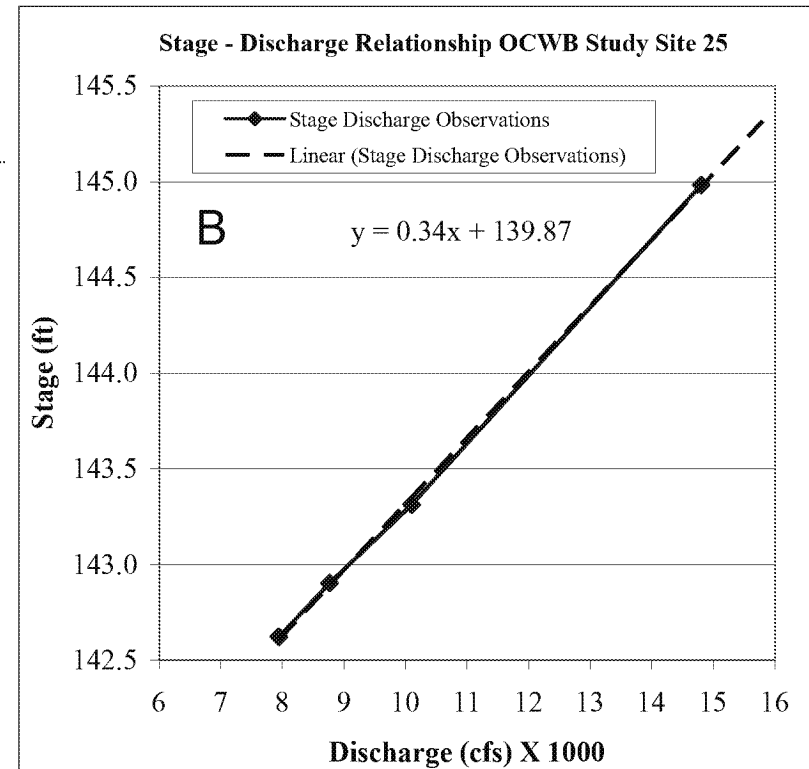
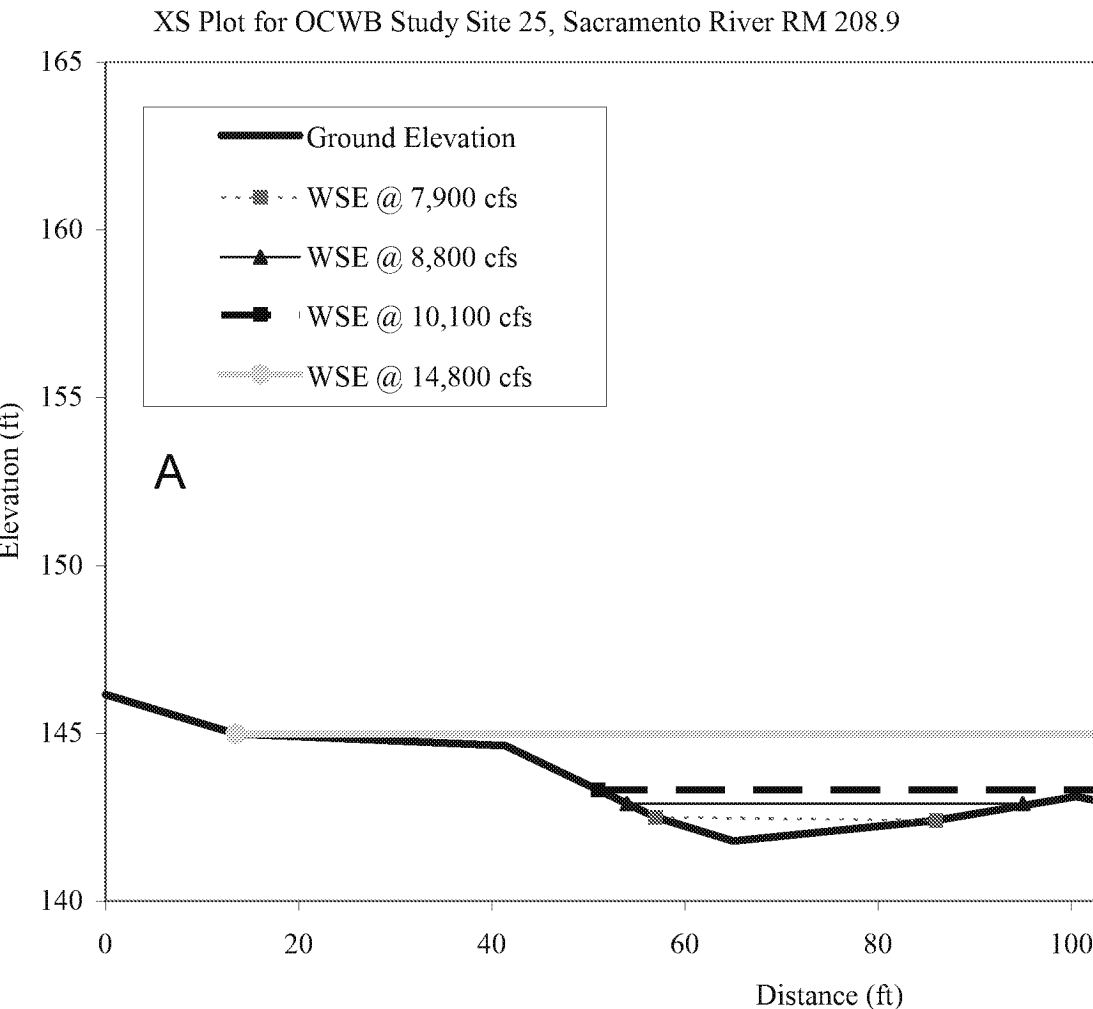
Figure 33. Thermograph data for site 23 (RM 203L) and discharge at Hamilton City between 2/21/07 and 3/3/07. Critical flow points depict thermograph changes between dry and wet status.











Site 25

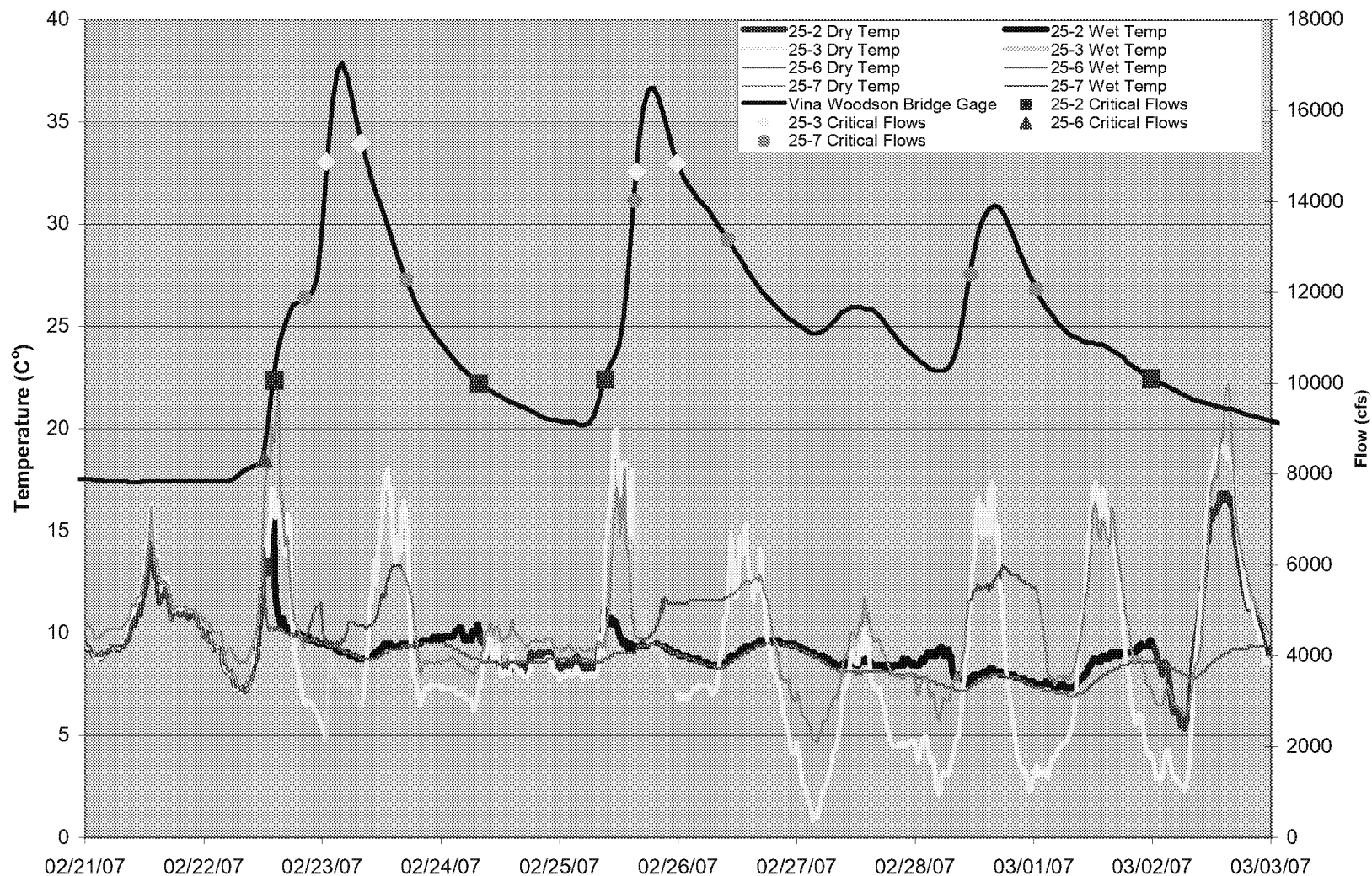
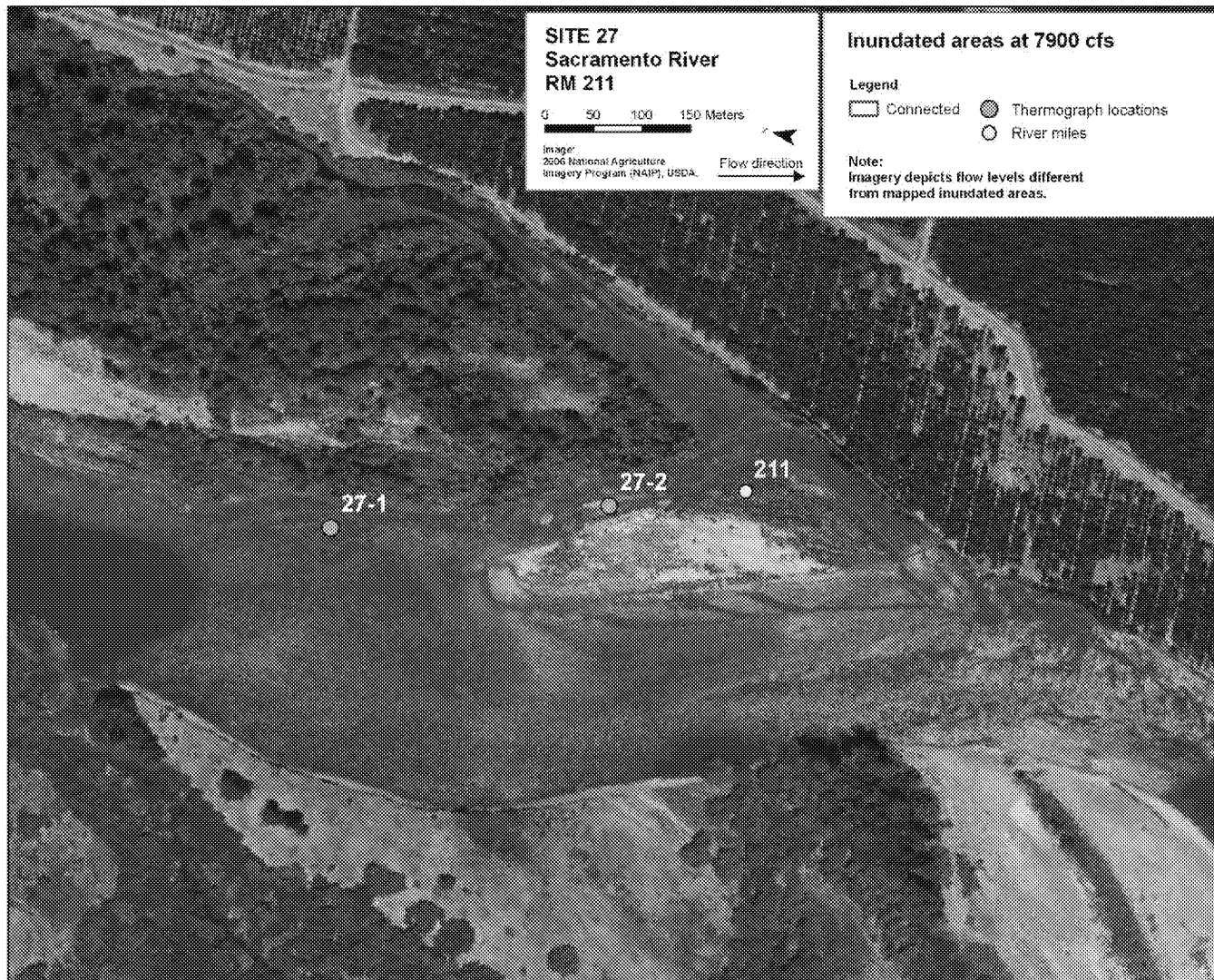
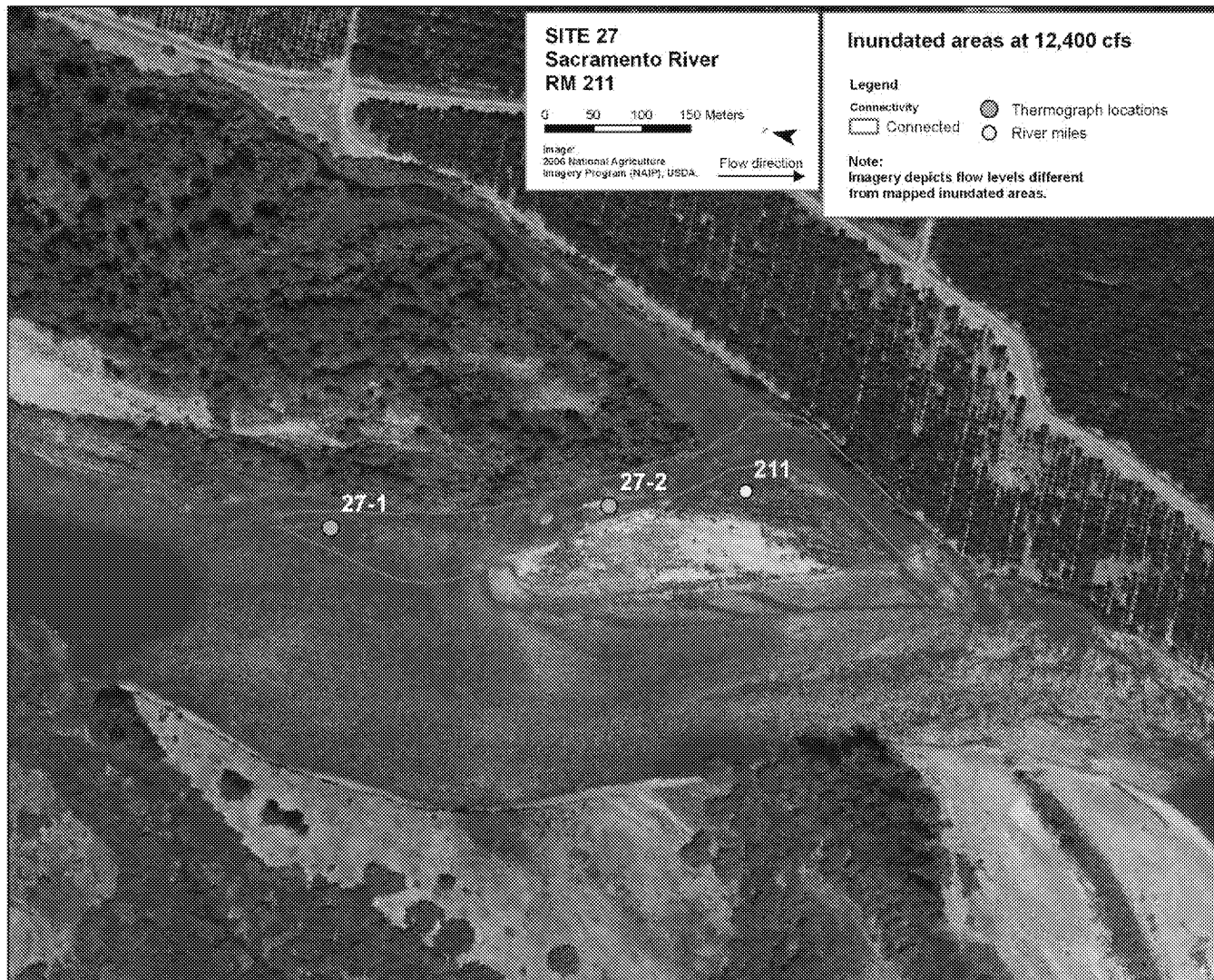


Figure 36. Thermograph data for site 25 (RM 209L) and discharge at Vina Woodson Bridge between 2/21/07 and 3/3/07. Critical flow points depict thermograph changes between dry and wet status.





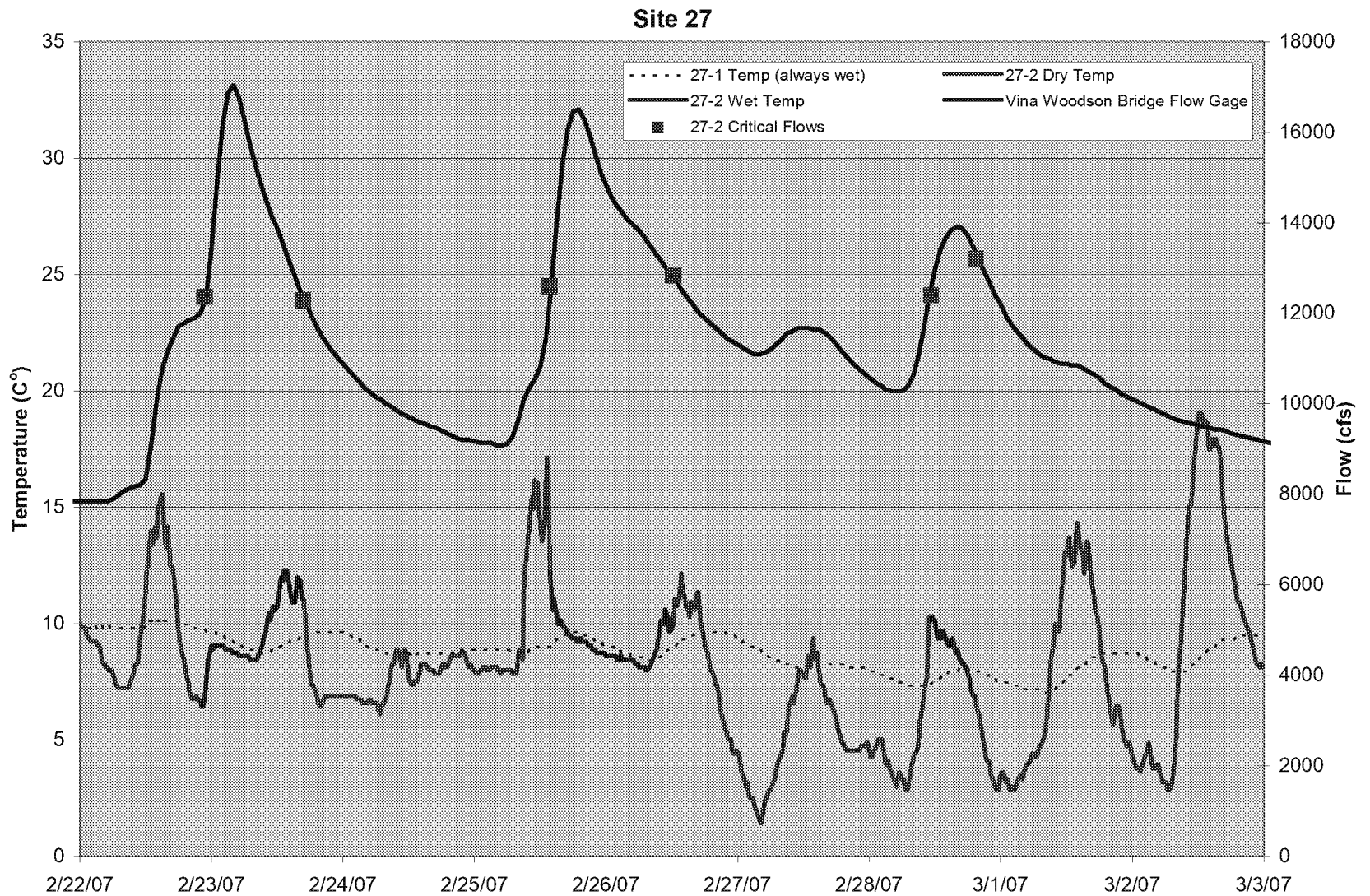
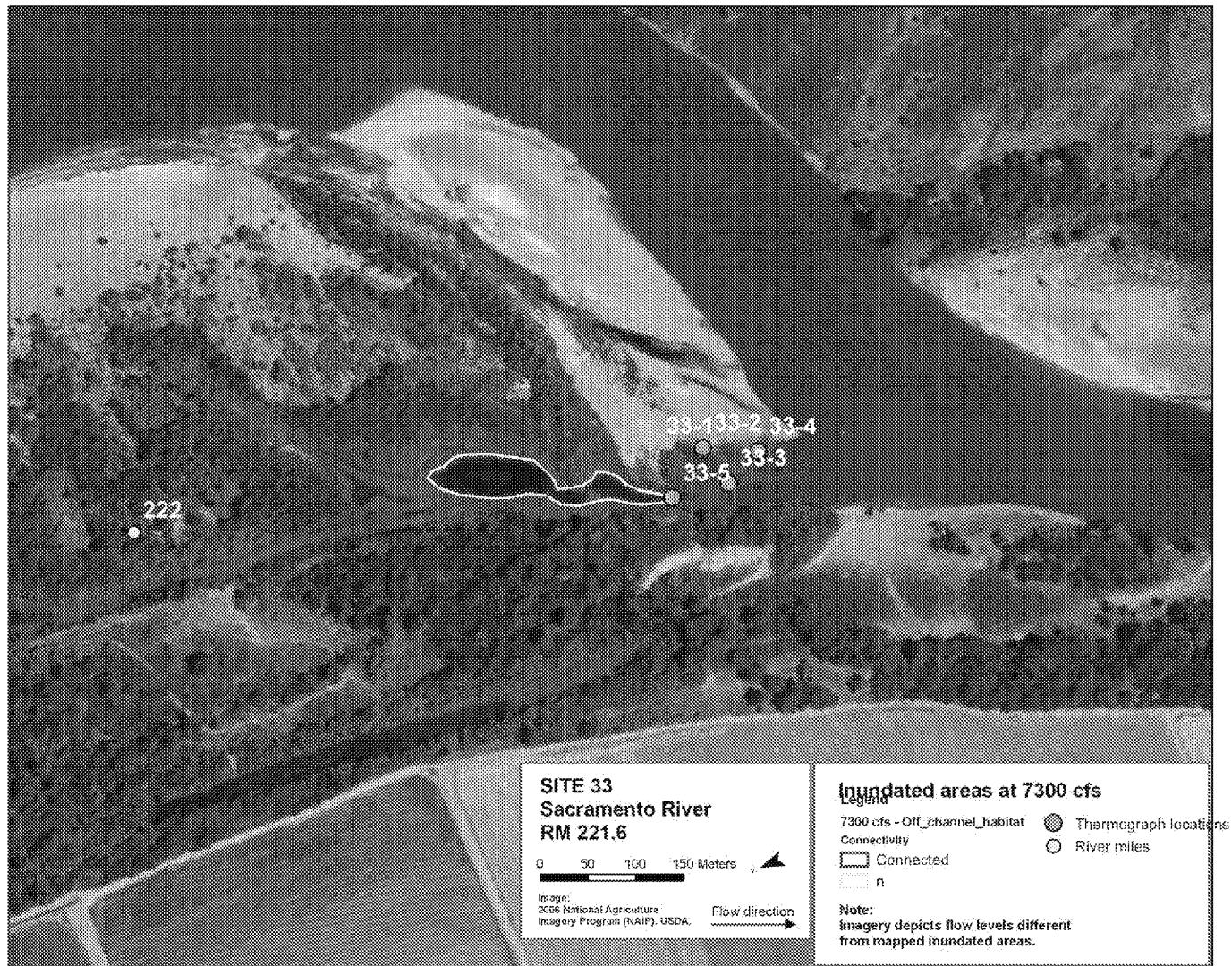
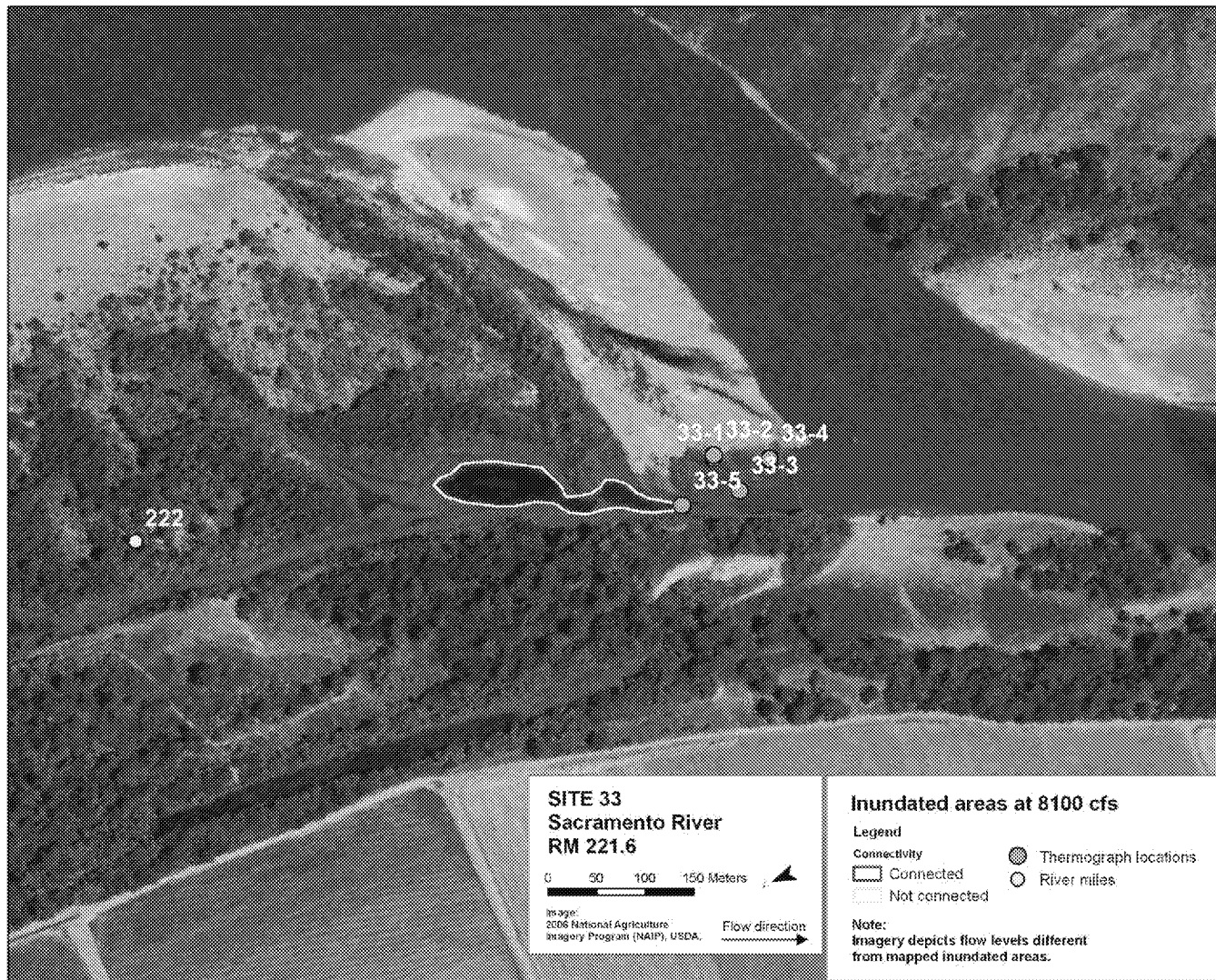
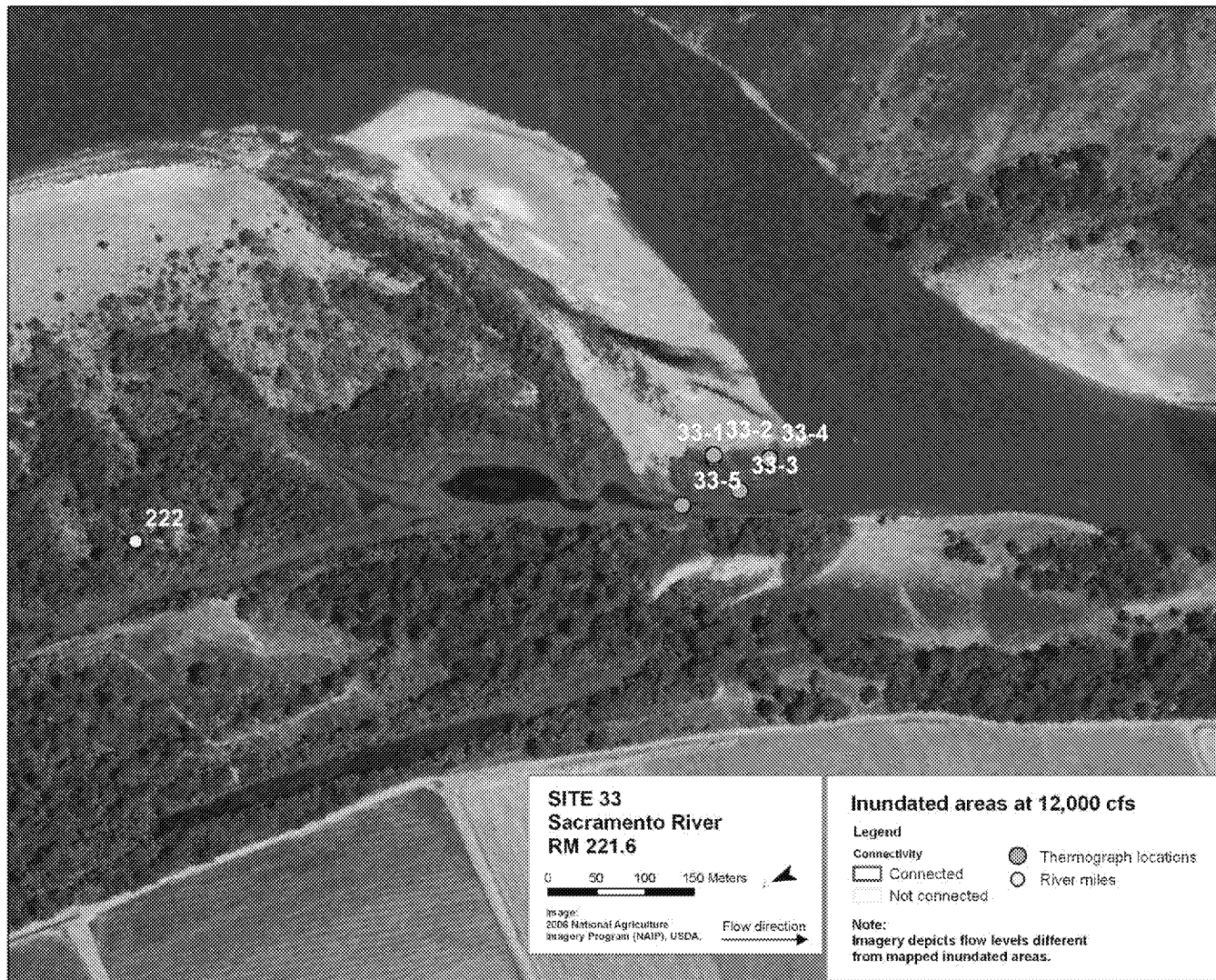


Figure 38. Thermograph data for site 27 (RM 211L) and discharge at Vina Woodson Bridge between 2/22/07 and 3/3/07. Critical flow points depict thermograph changes between dry and wet status.







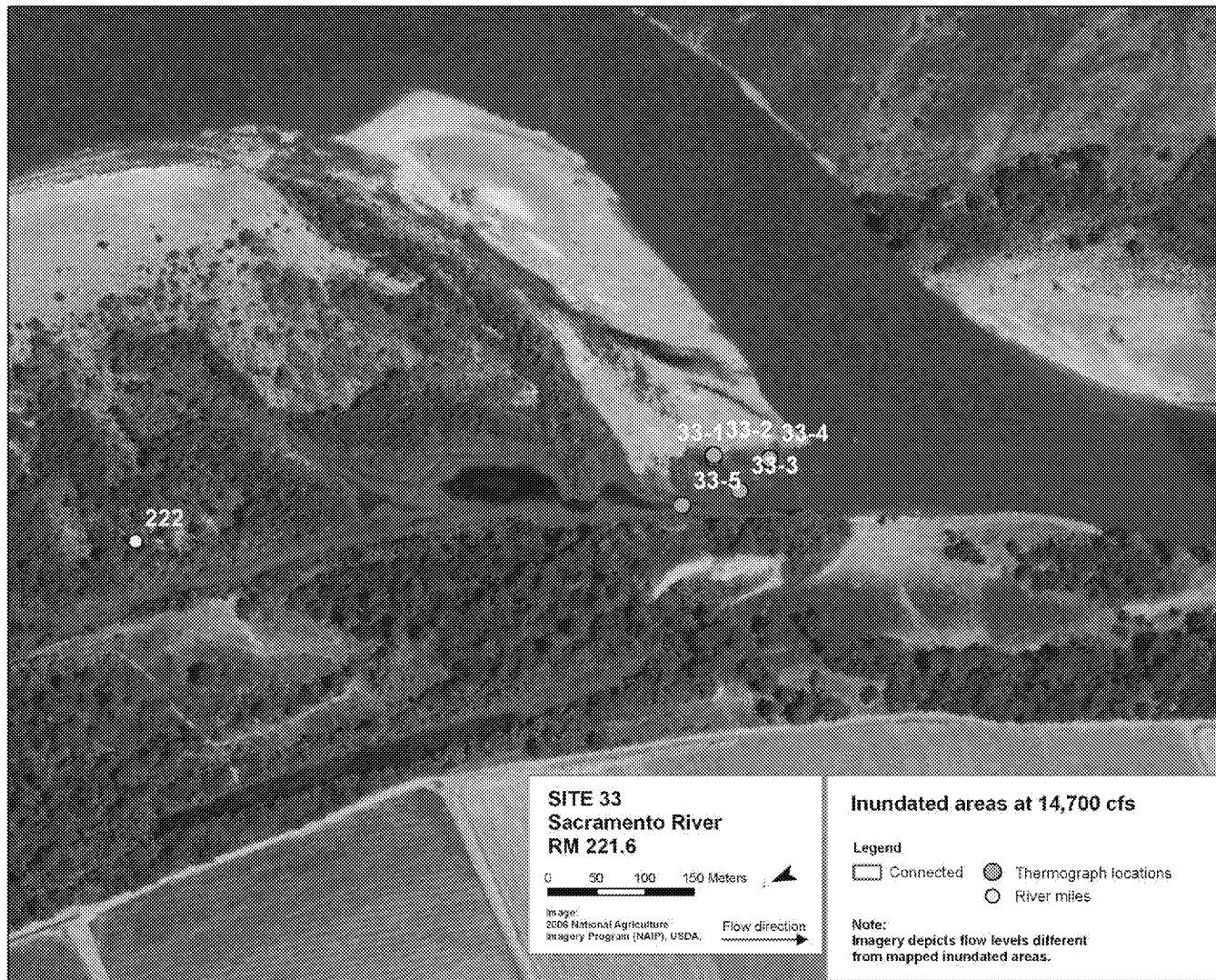
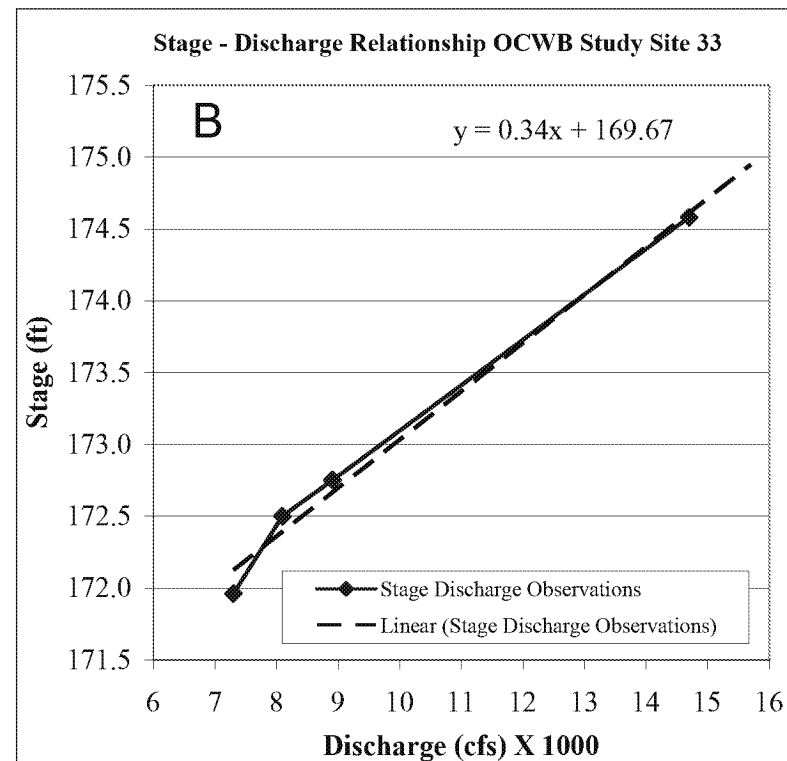
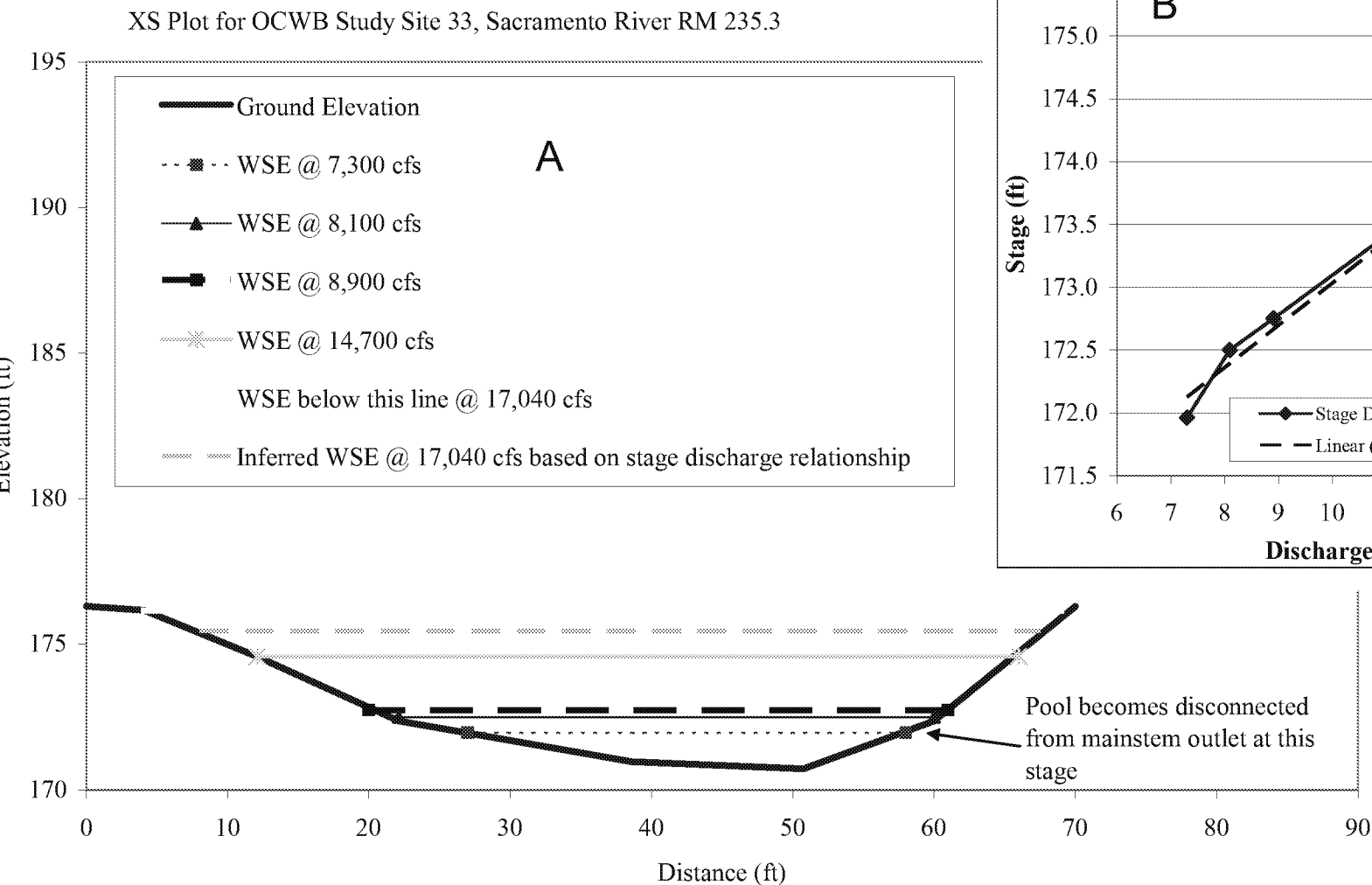


Figure 39d. Inundated areas of site 33 (RM 221.6R) at flows of 14,700 cfs , areas based on thermograph temperature records and field surveys.



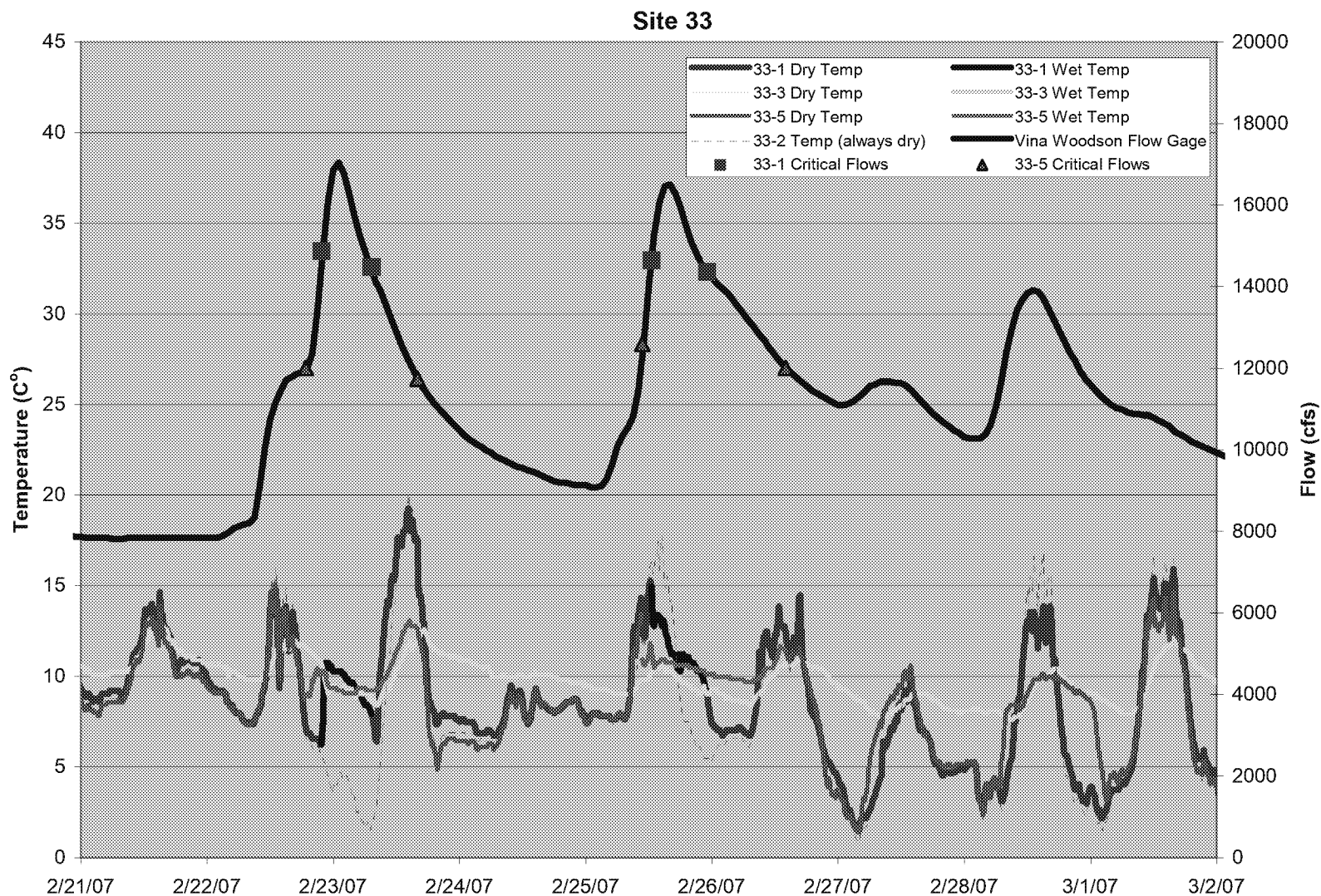
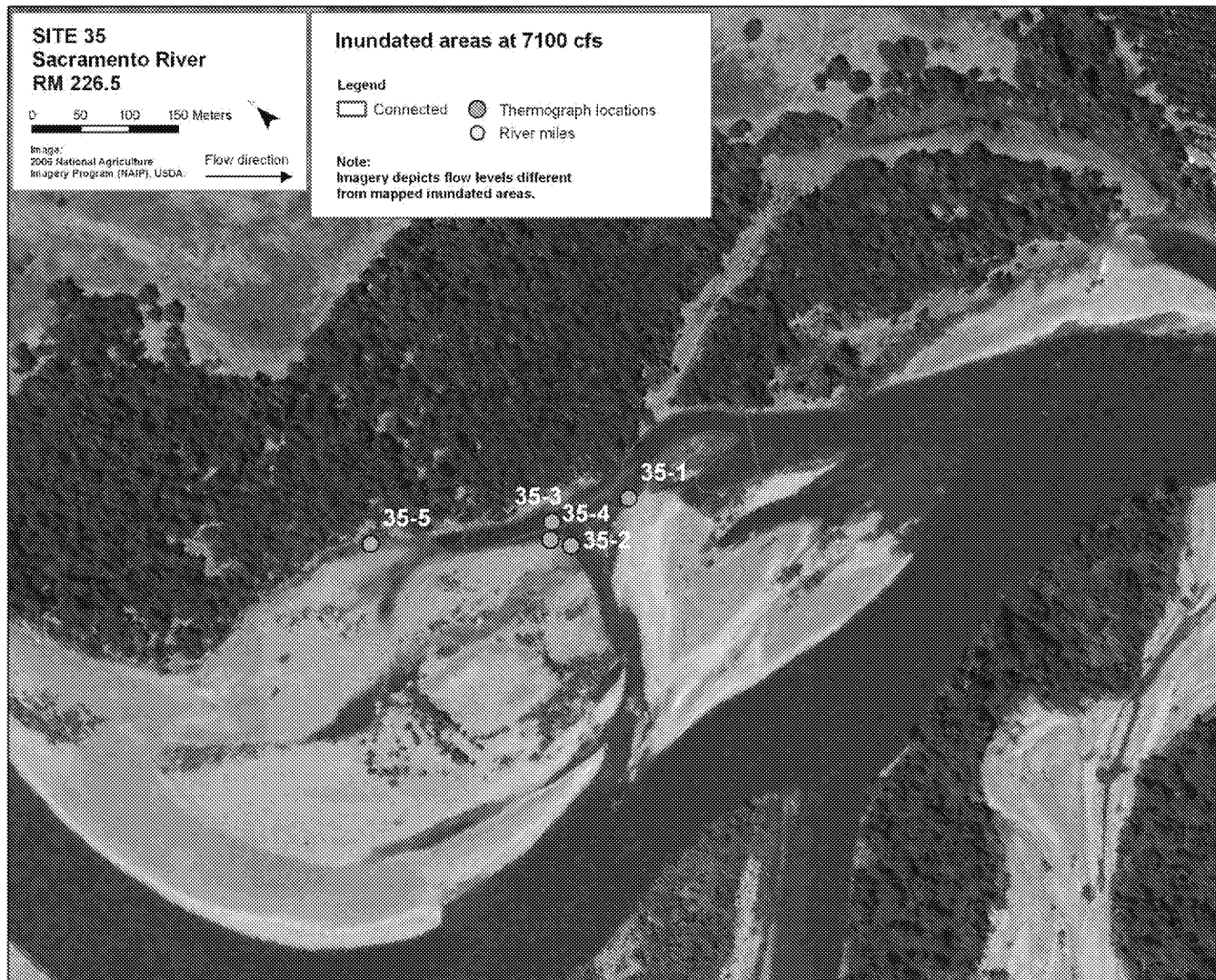
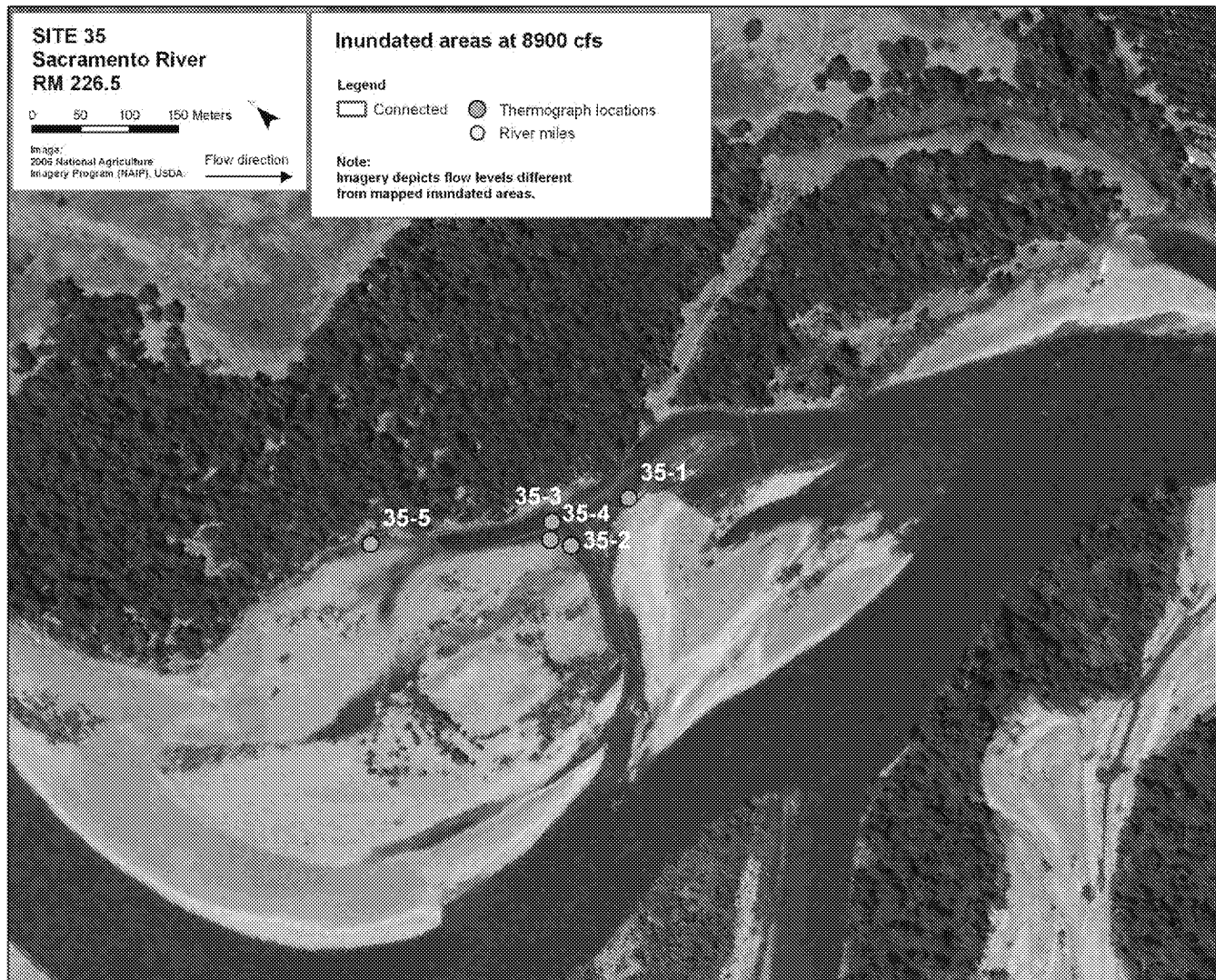
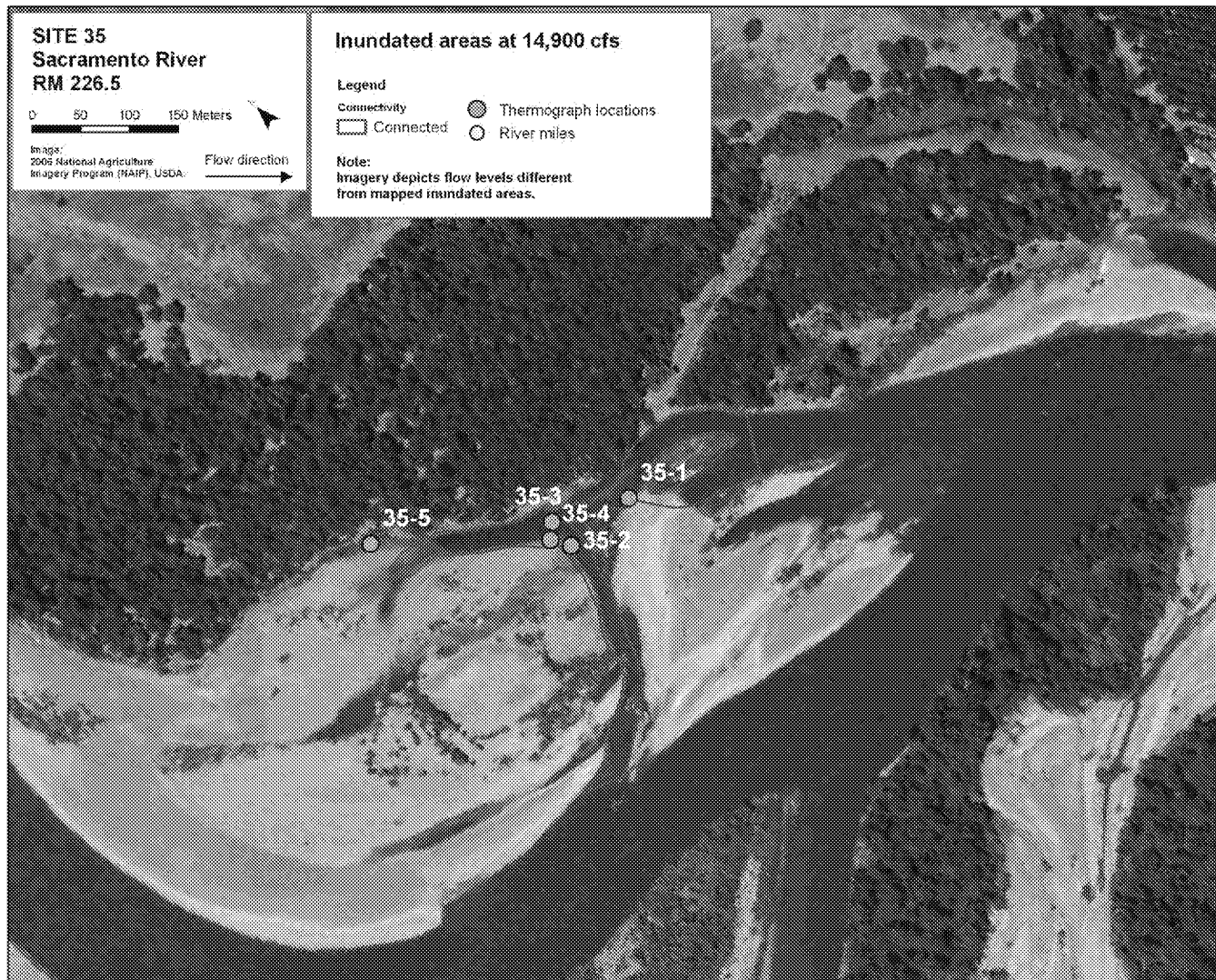


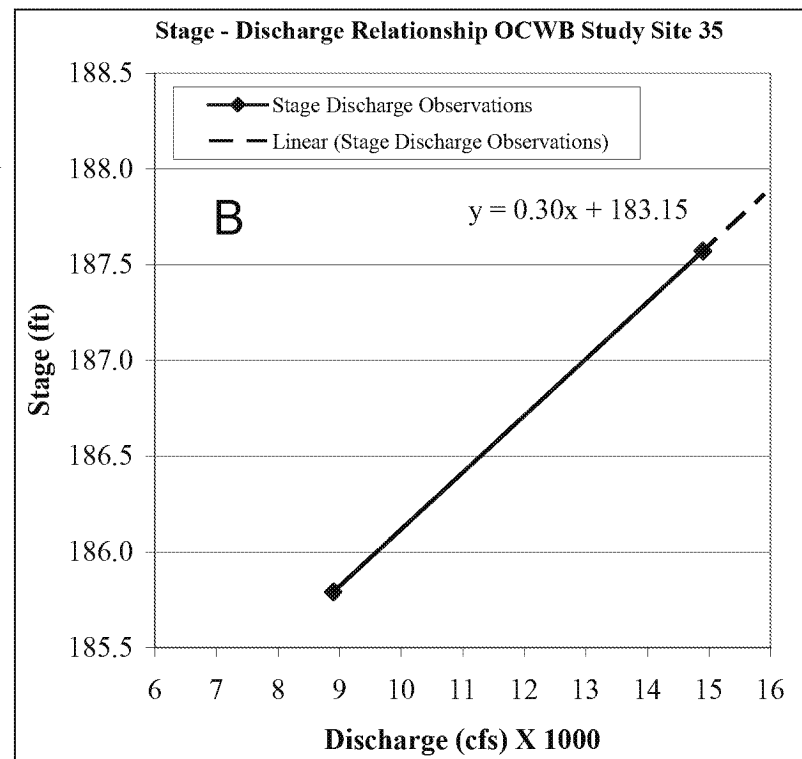
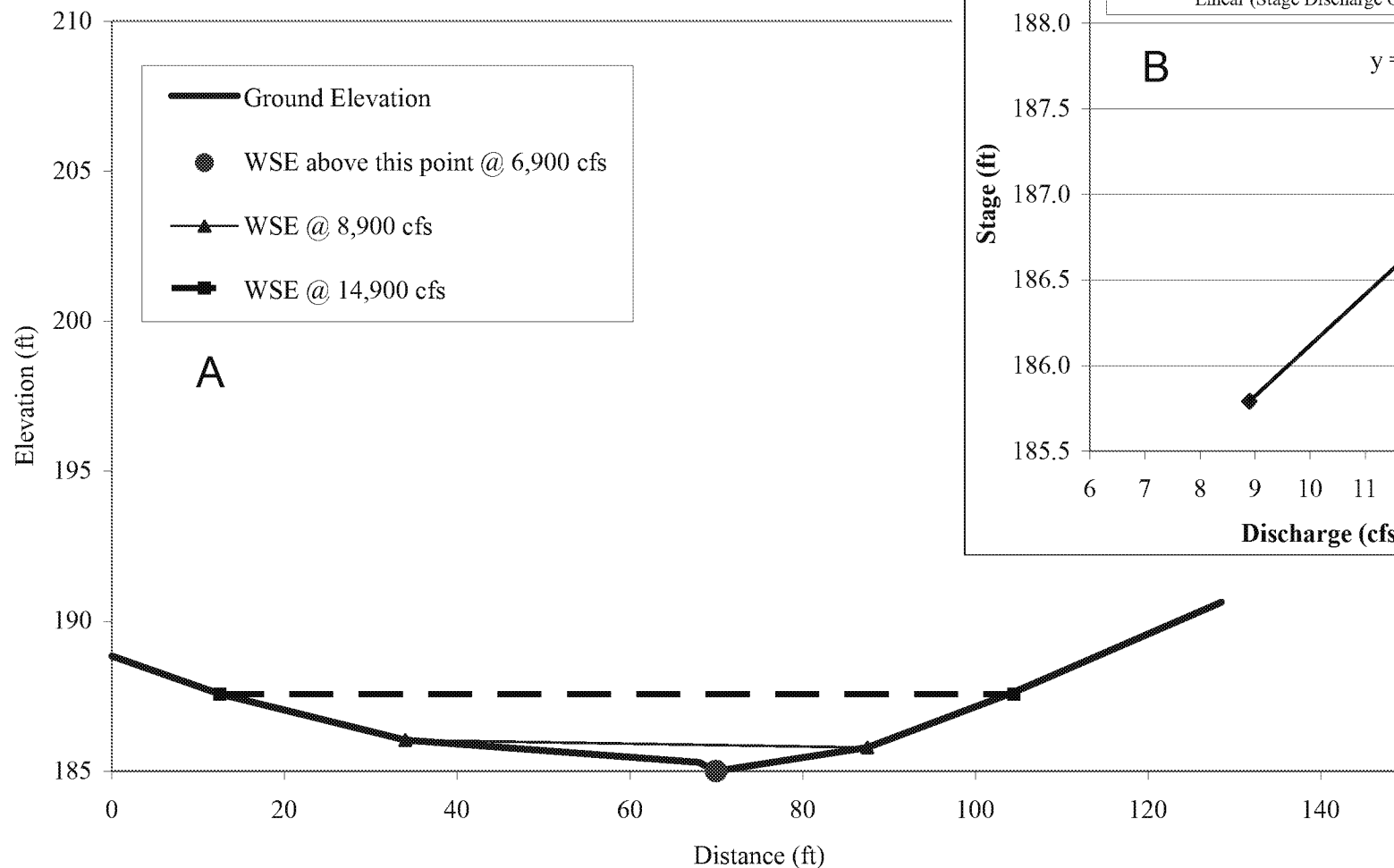
Figure 41. Thermograph data for site 33 (RM 221.6R) and discharge at Vina Woodson Bridge between 2/21/07 and 3/2/07. Critical flow points depict thermograph changes between dry and wet status.







XS Plot for OCWB Study Site 35, Sacramento River RM 226.5



Site 35

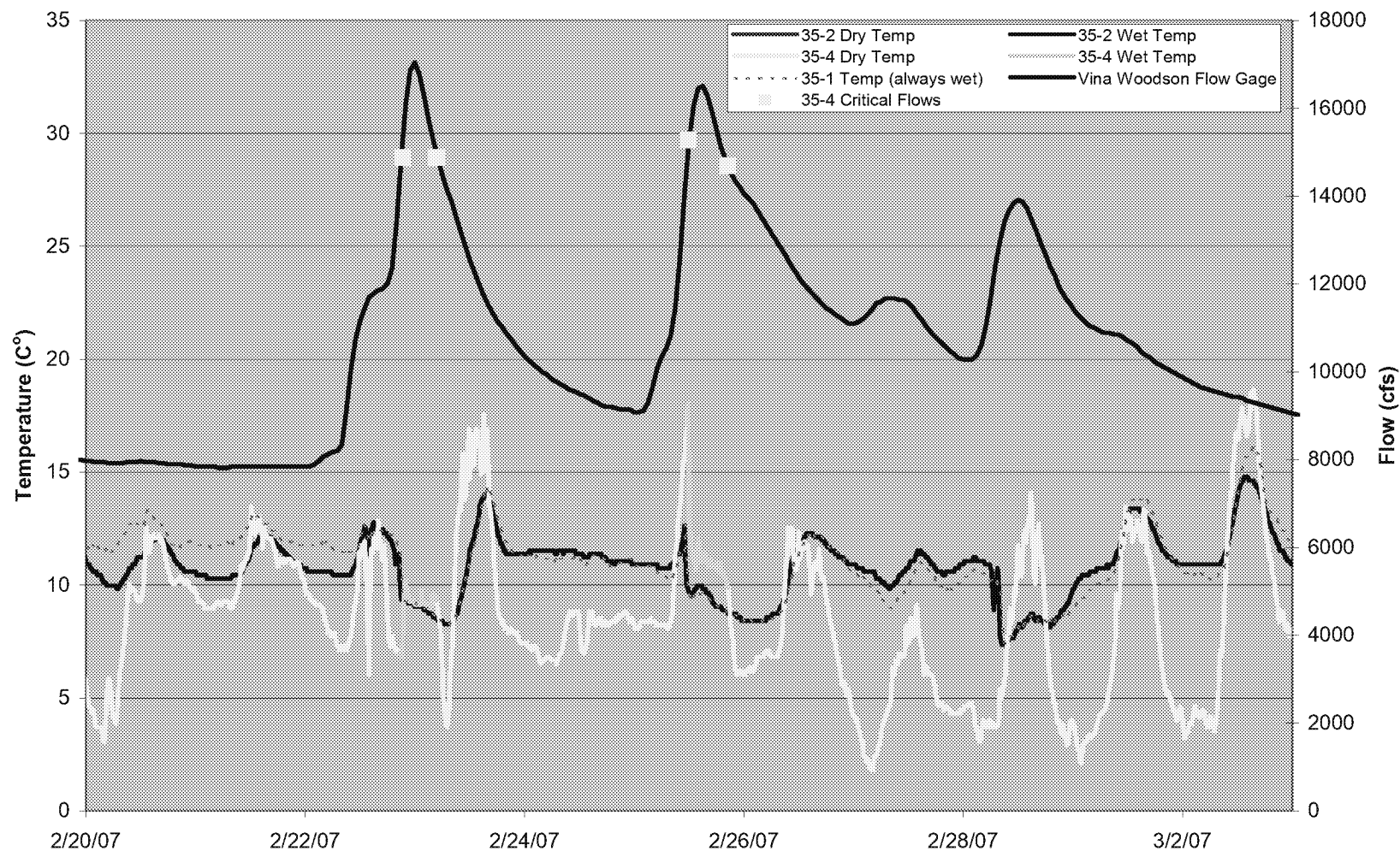


Figure 44. Thermograph data for site 35 (RM 226.5L) and discharge at Vina Woodson Bridge between 2/20/07 and 3/3/07. Critical flow points depict thermograph changes between dry and wet status.





Site 39

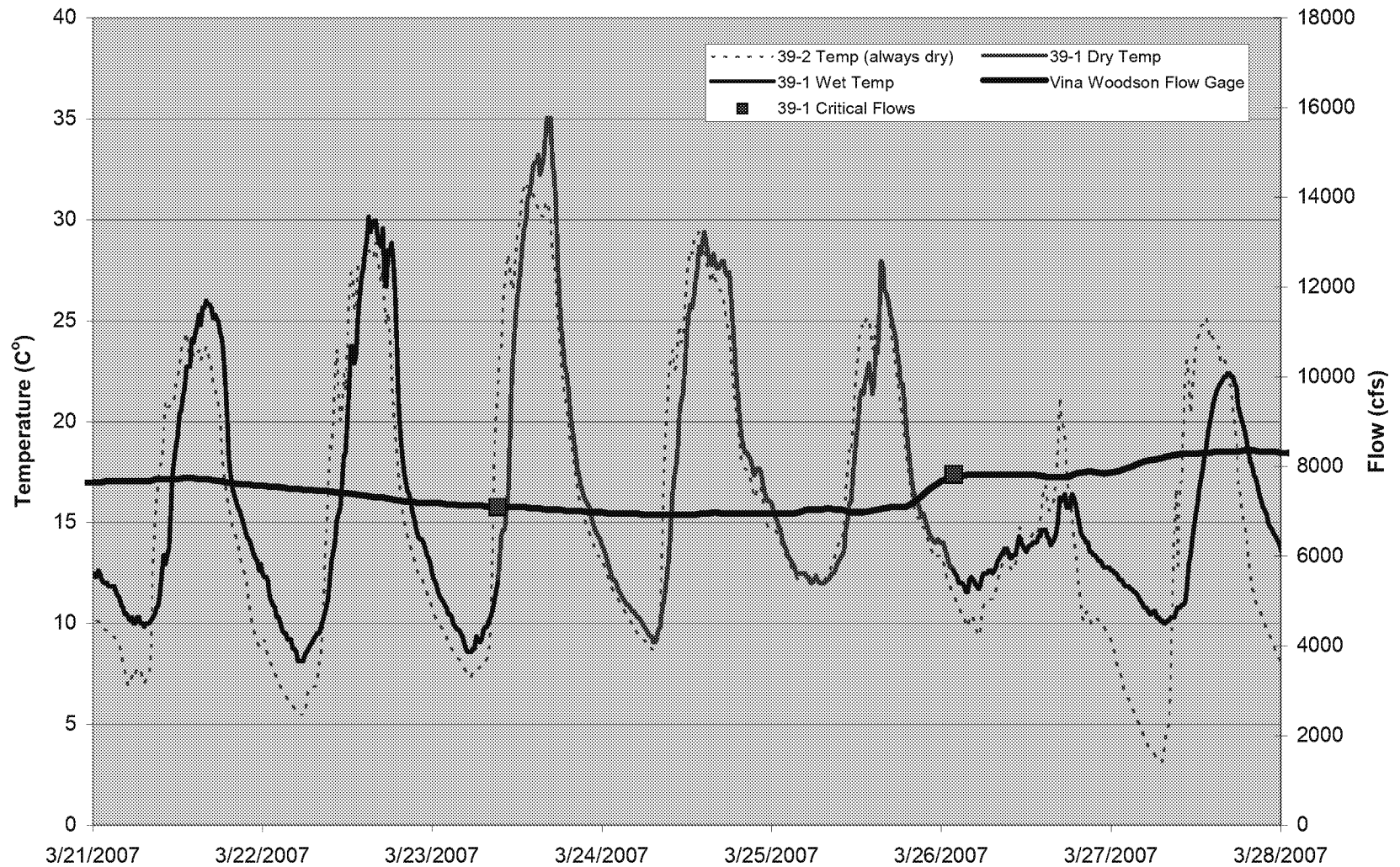
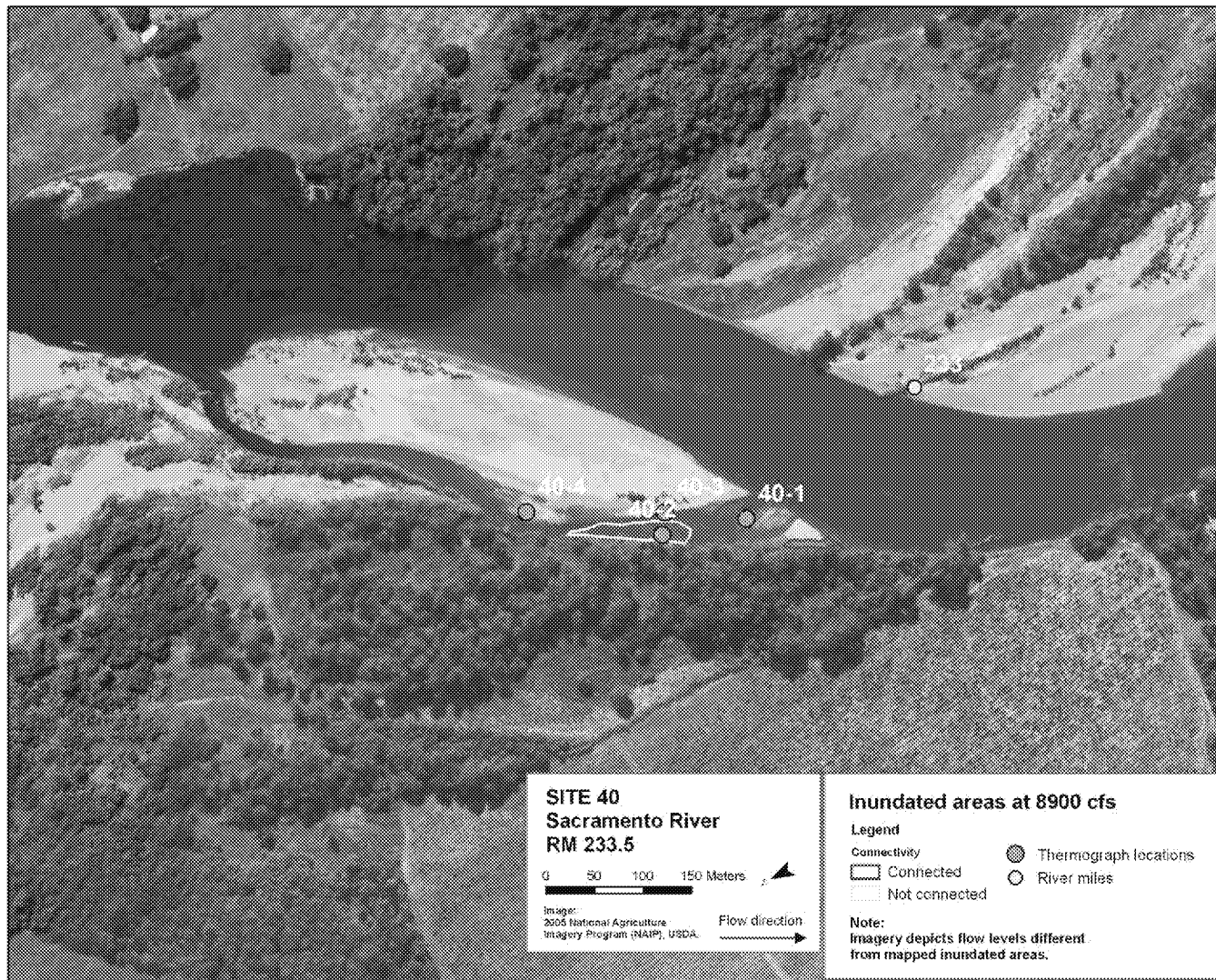
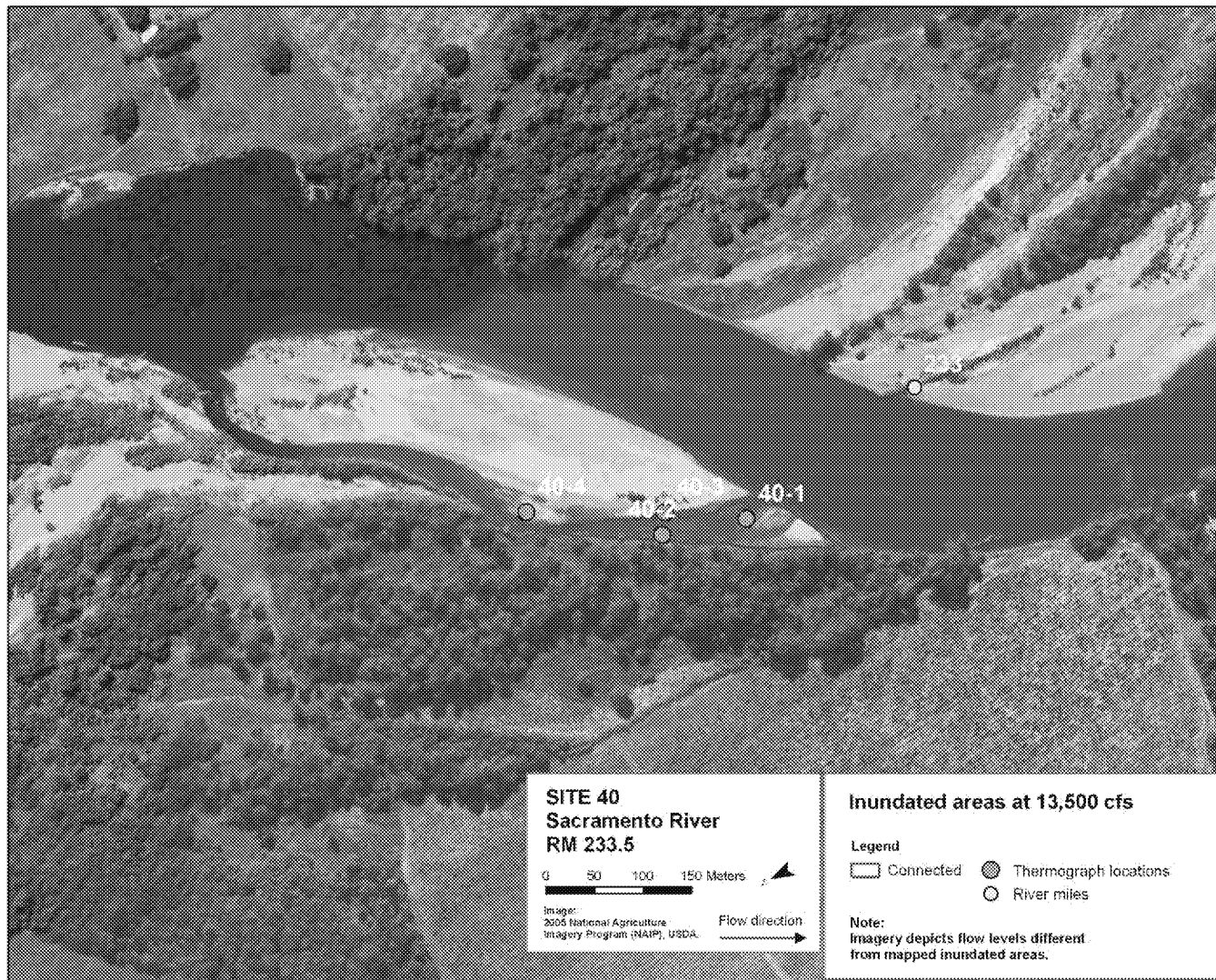


Figure 46. Thermograph data for site 39 (RM 232.8L) and discharge at Vina Woodson Bridge between 3/21/07 and 3/28/07. Critical flow points depict thermograph changes between dry and wet status.





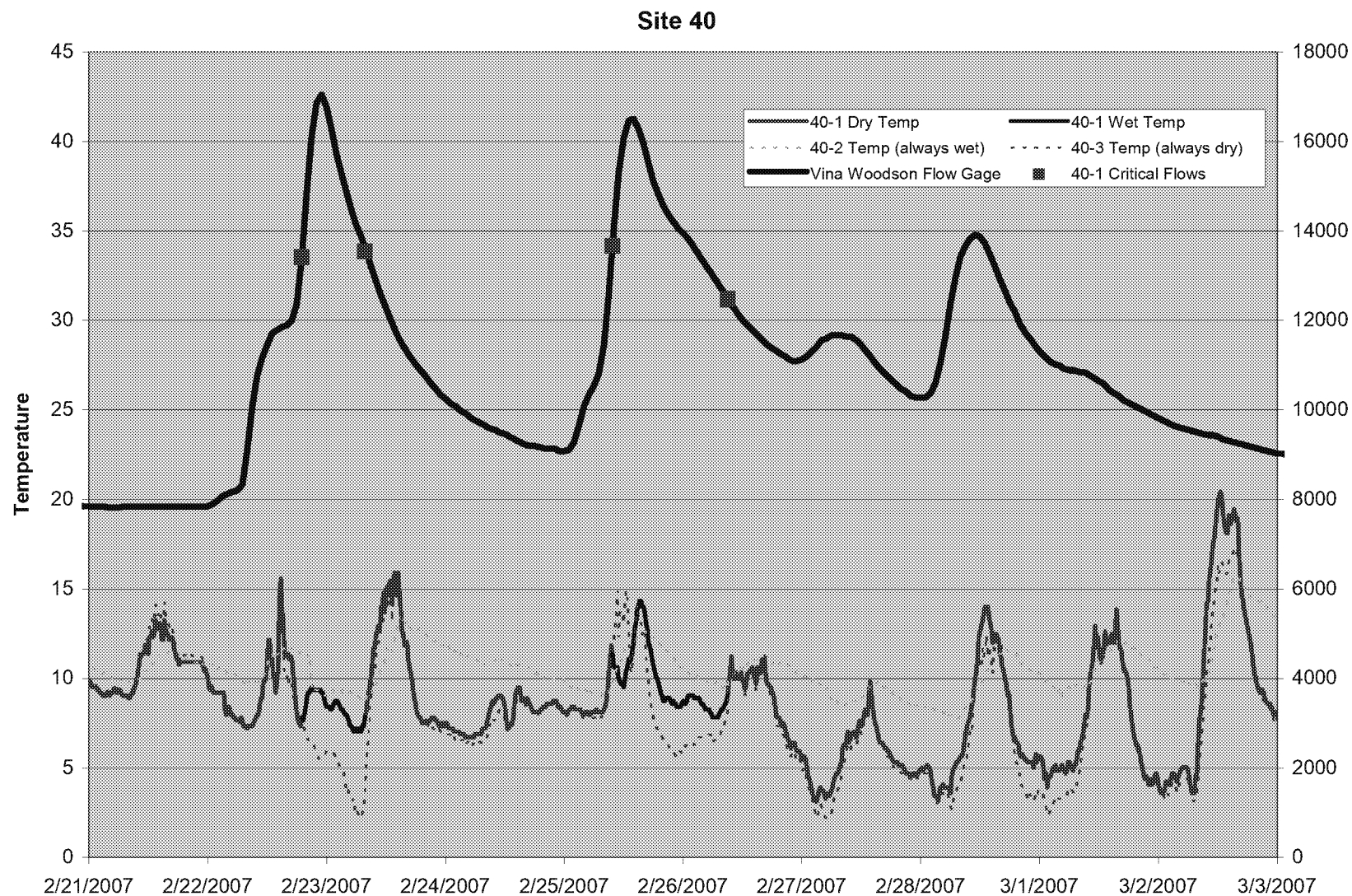
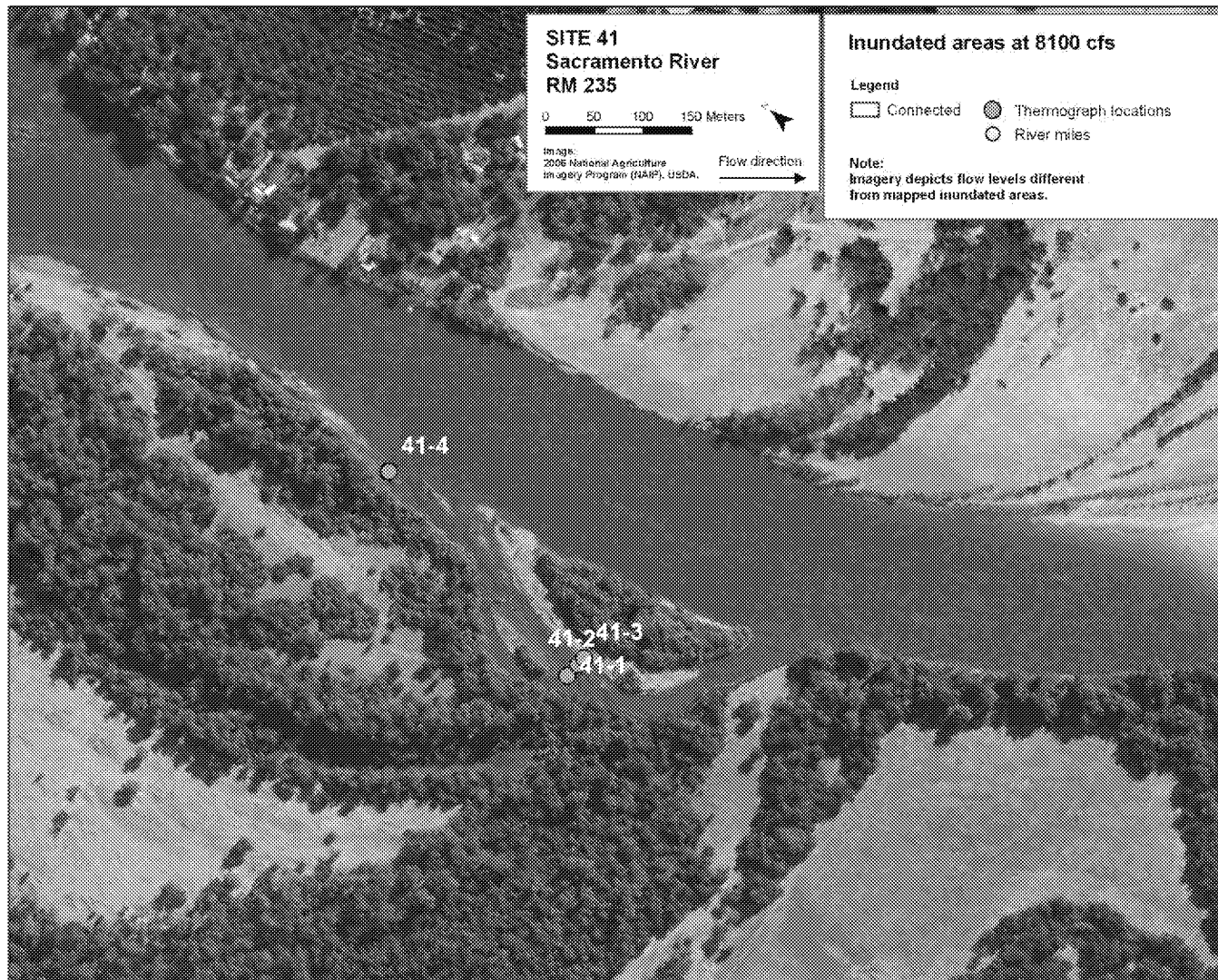
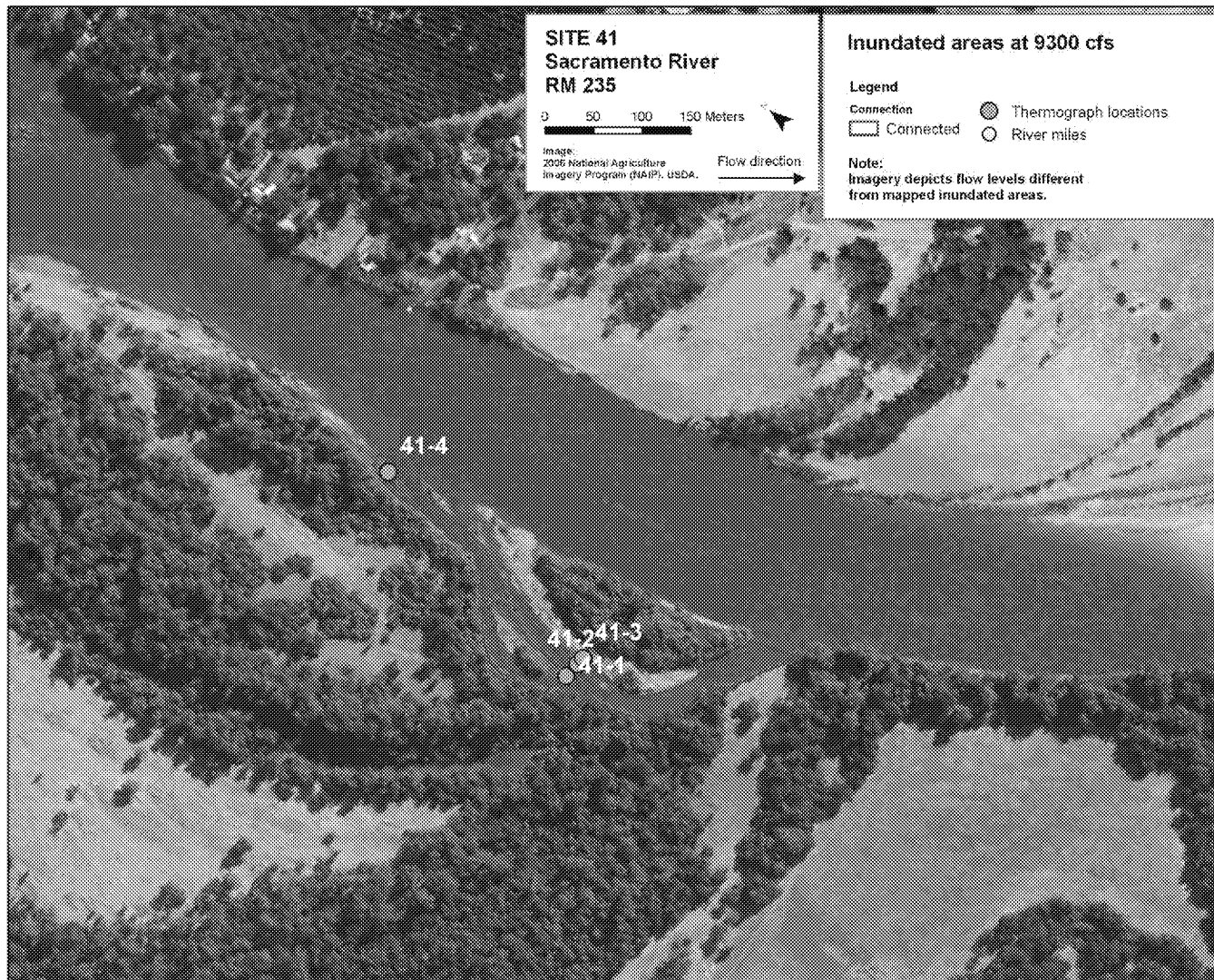
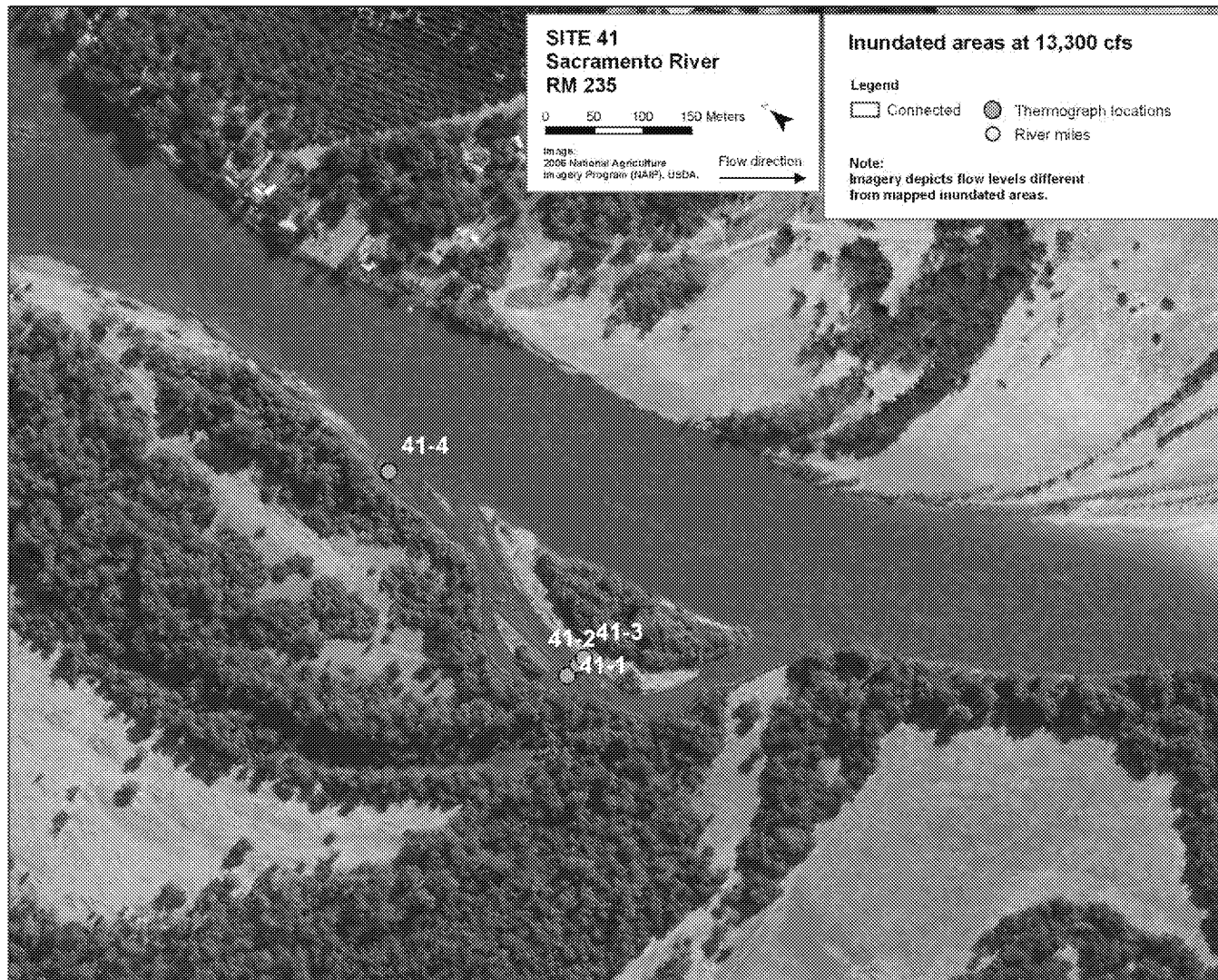
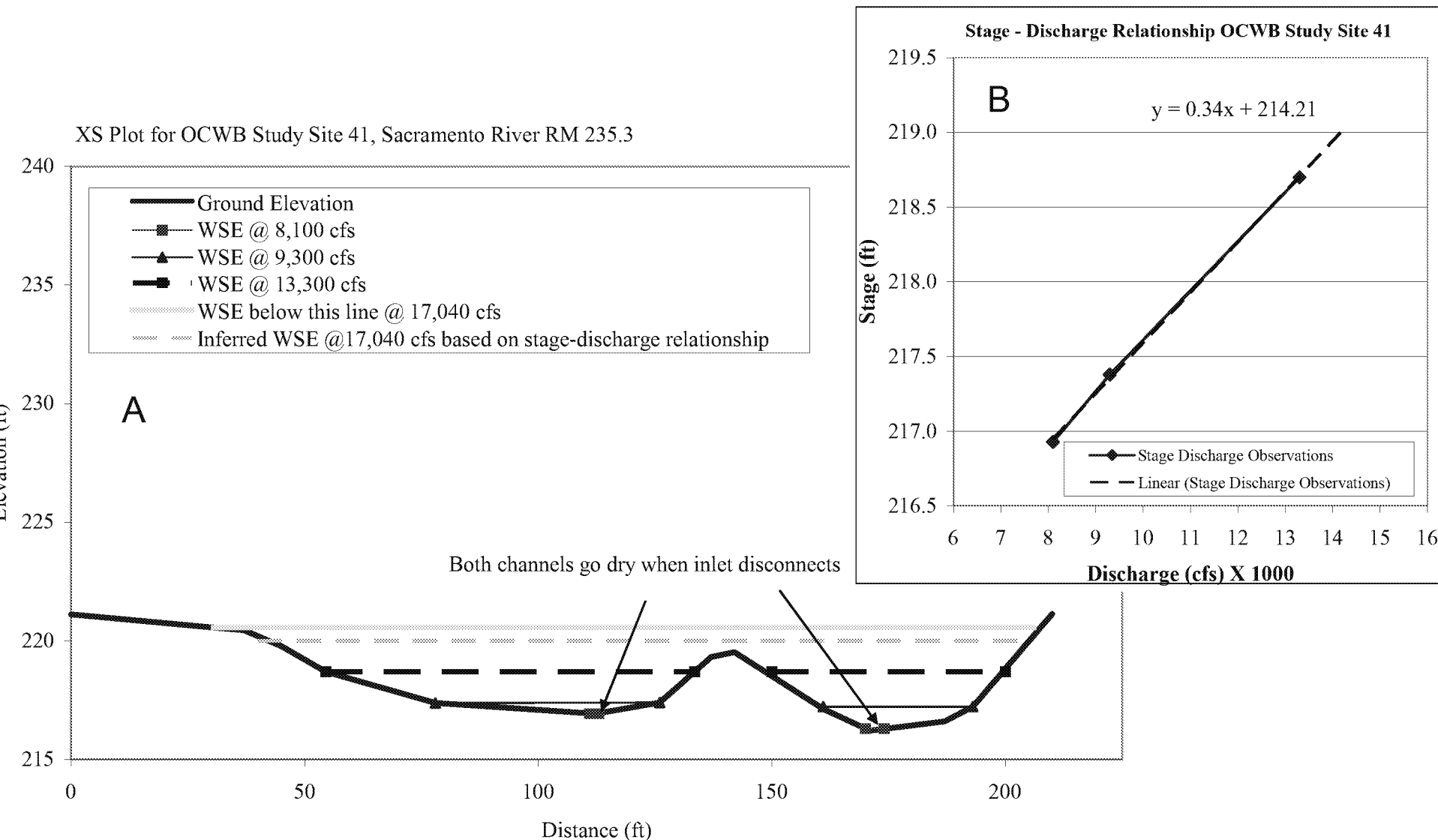


Figure 48. Thermograph data for site 40 (RM 233.5R) and discharge at Vina Woodson Bridge between 2/21/07 and 3/3/07. Critical flow points depict thermograph changes between dry and wet status.

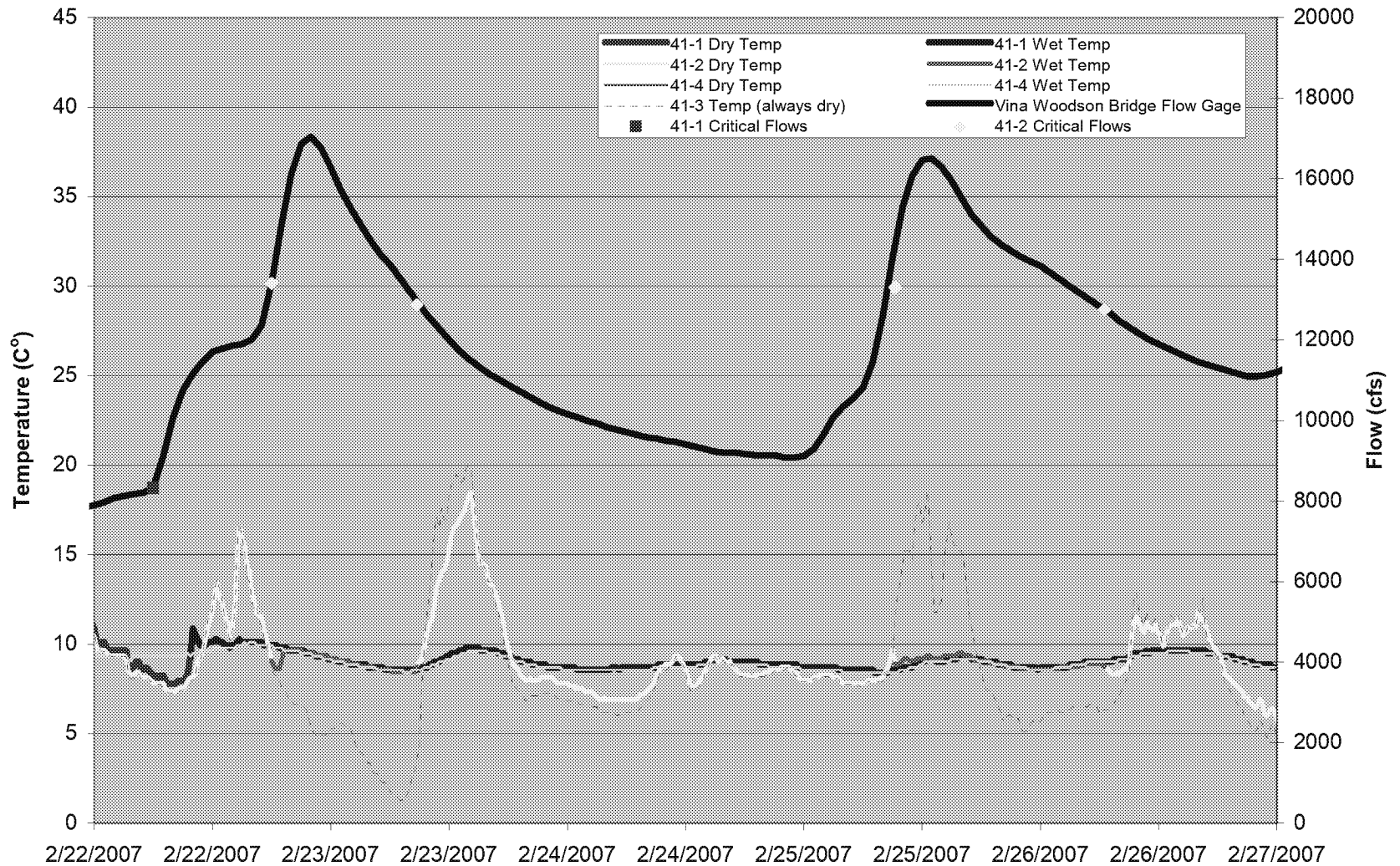


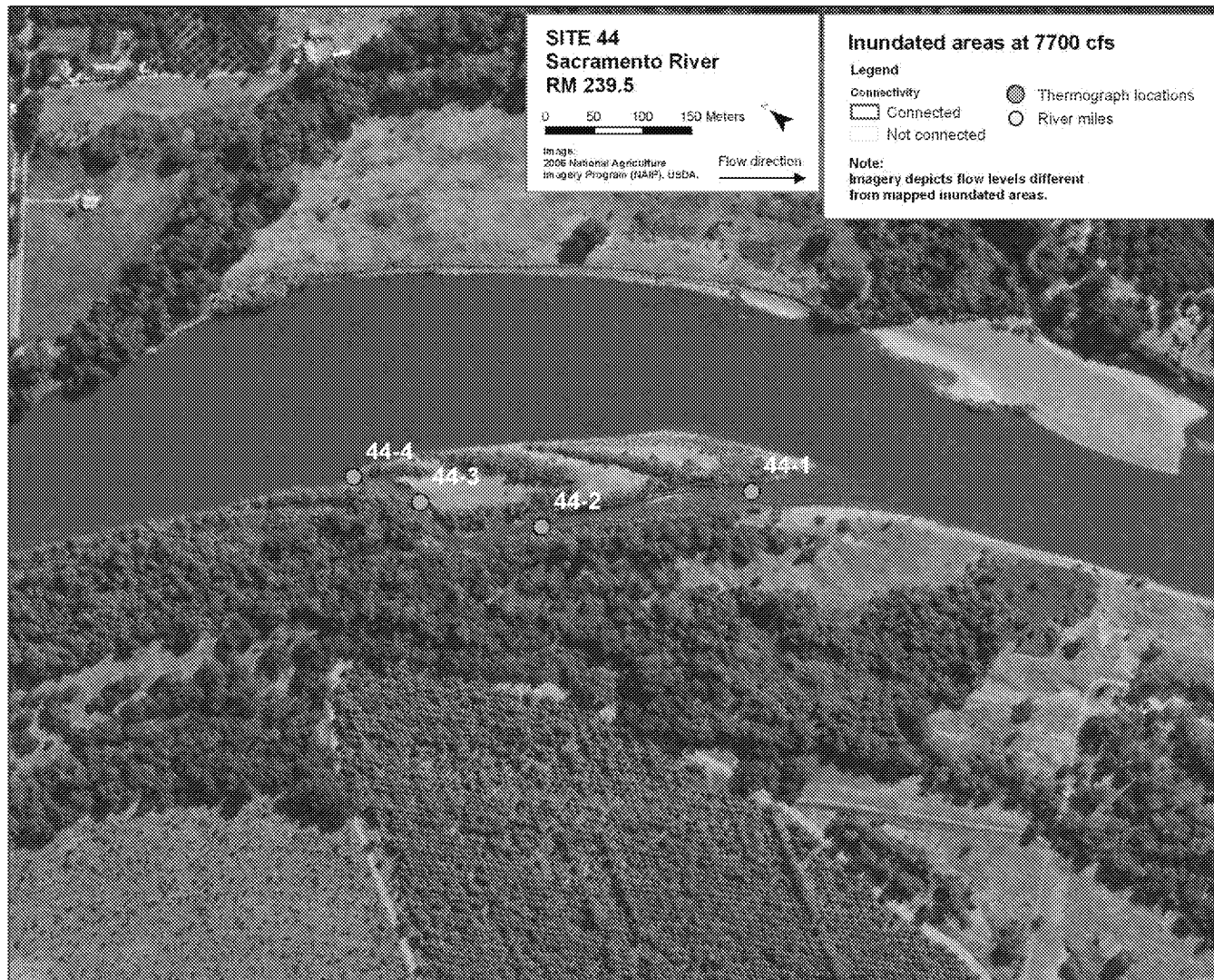


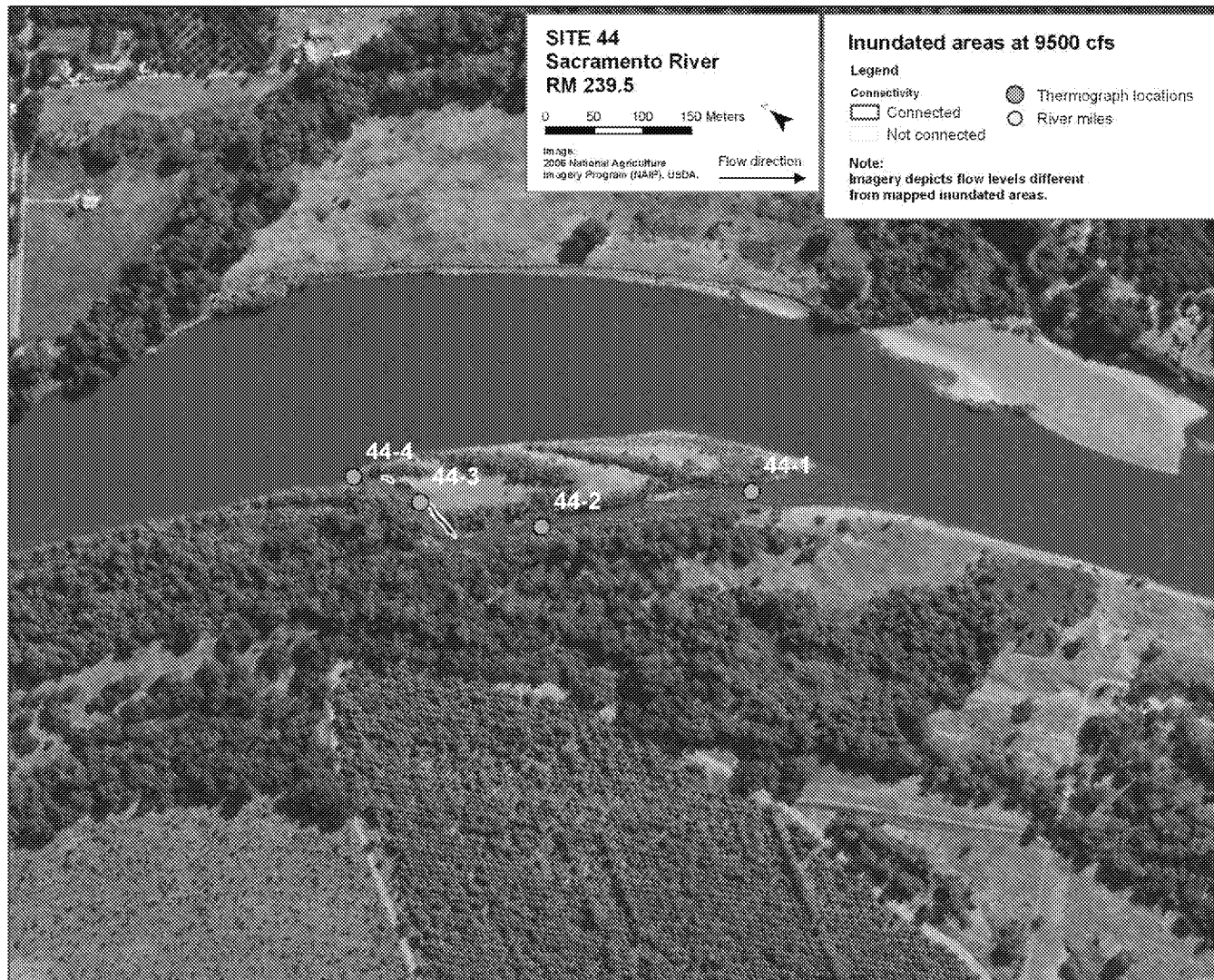


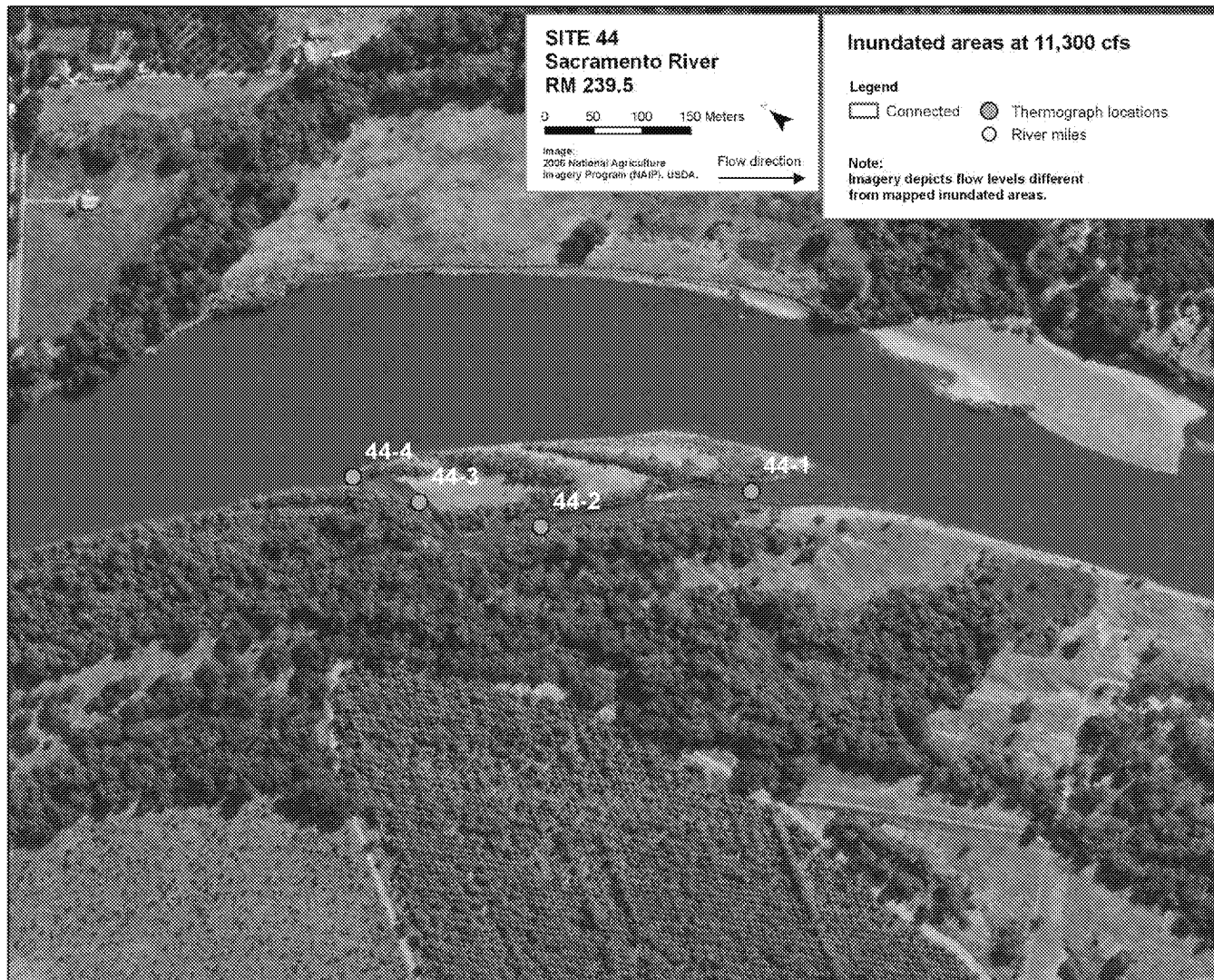


Site 41

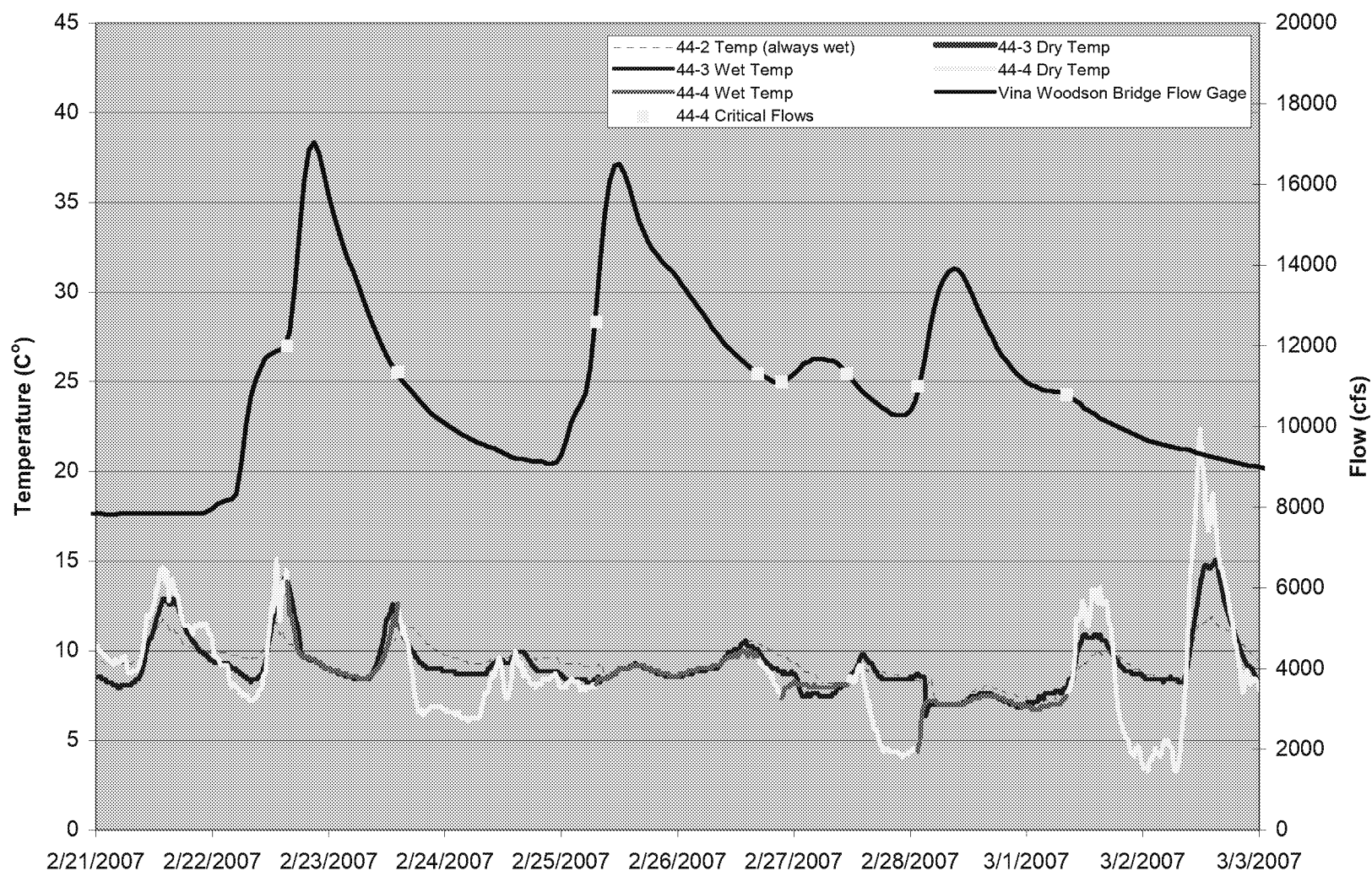


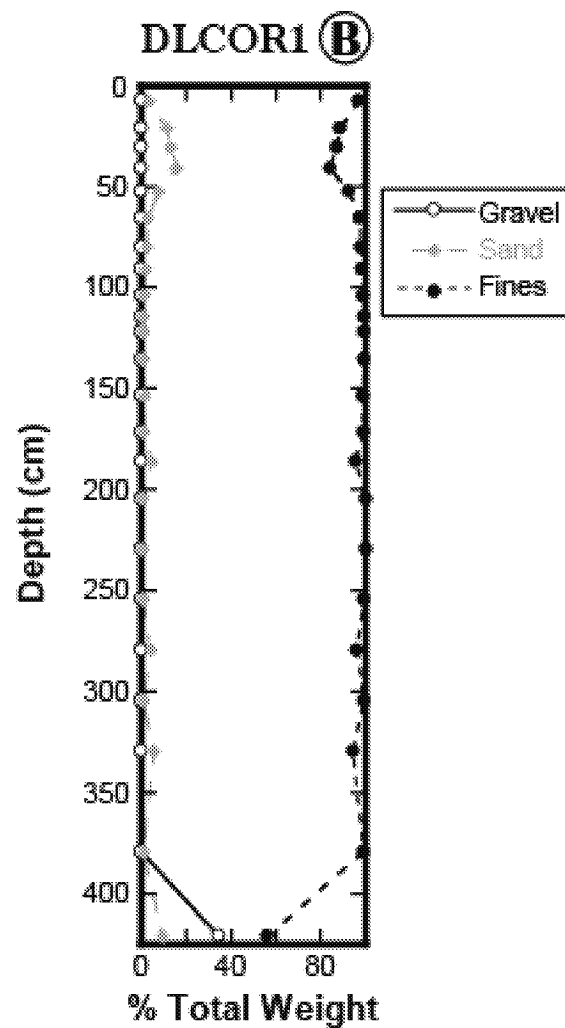


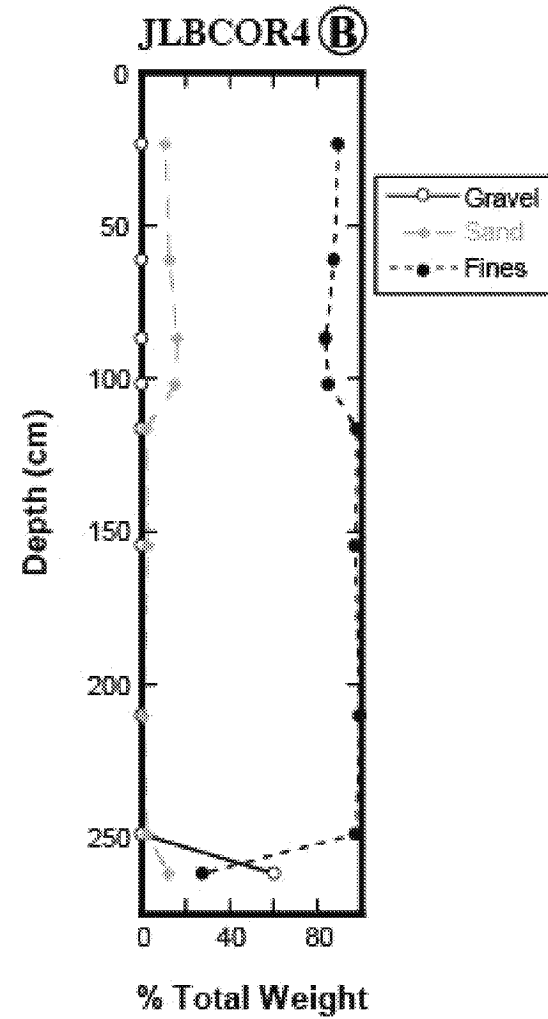


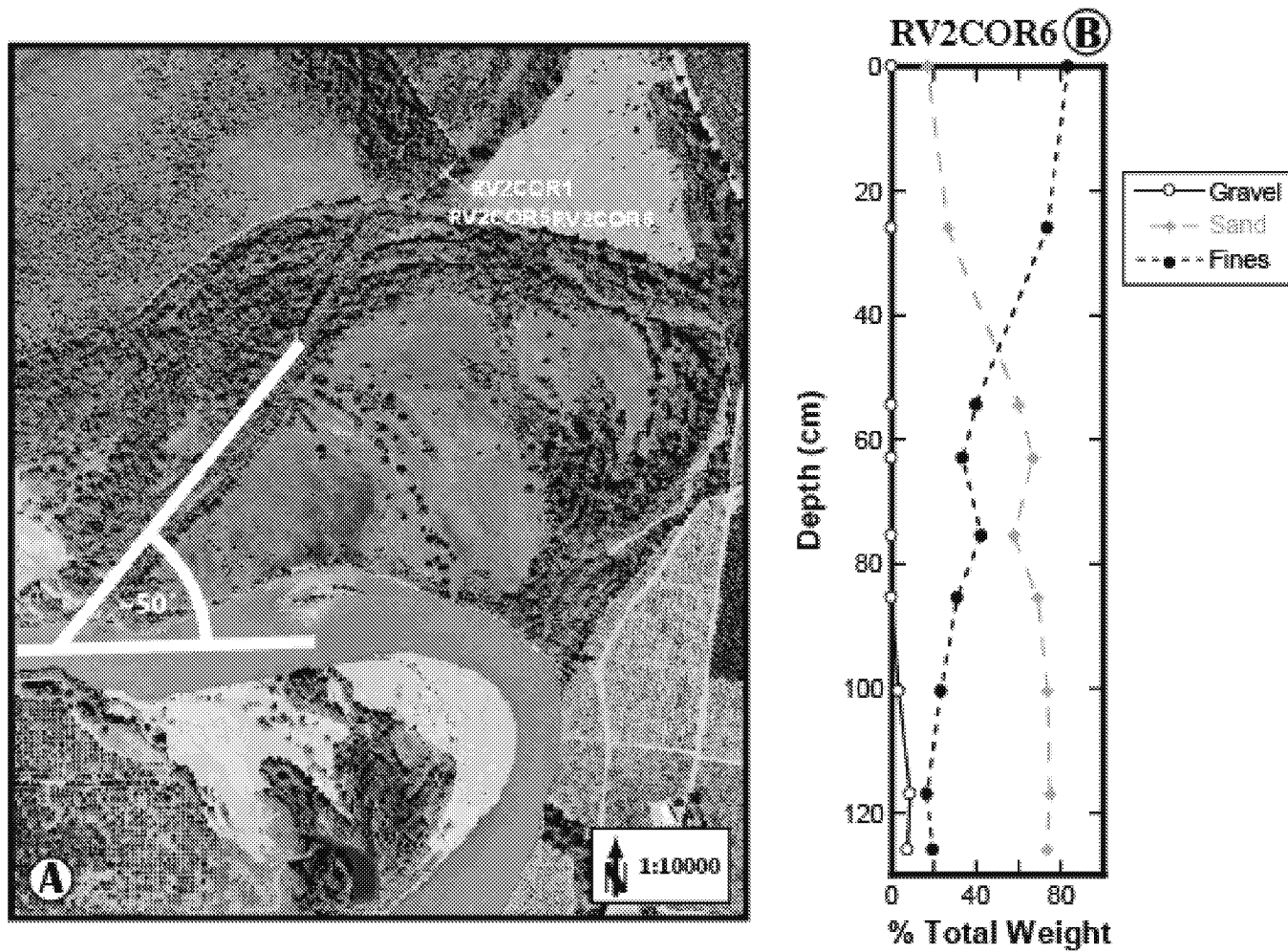


Site 44









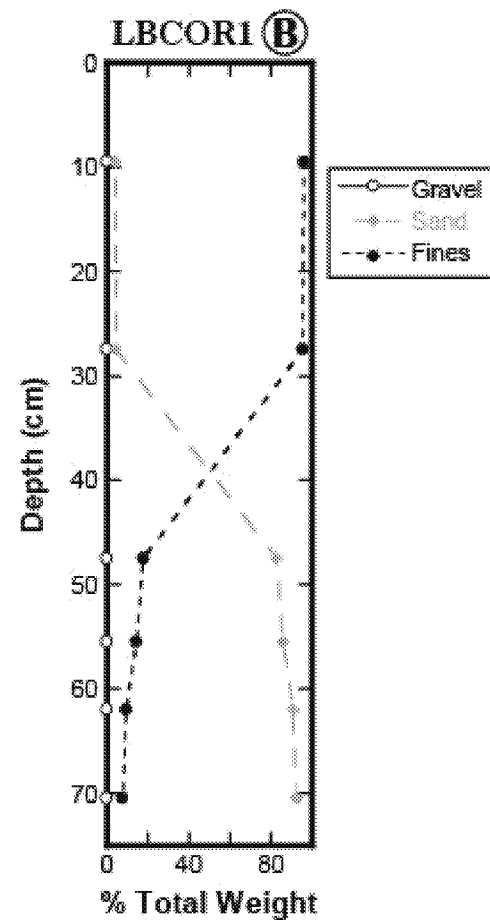


Figure 57. (A) Aerial photo of La Barranca near river mile 237 taken in 2004. The diversion angle and the core location are shown within the photo. (B) Granulometric profile for core LBCOR1.

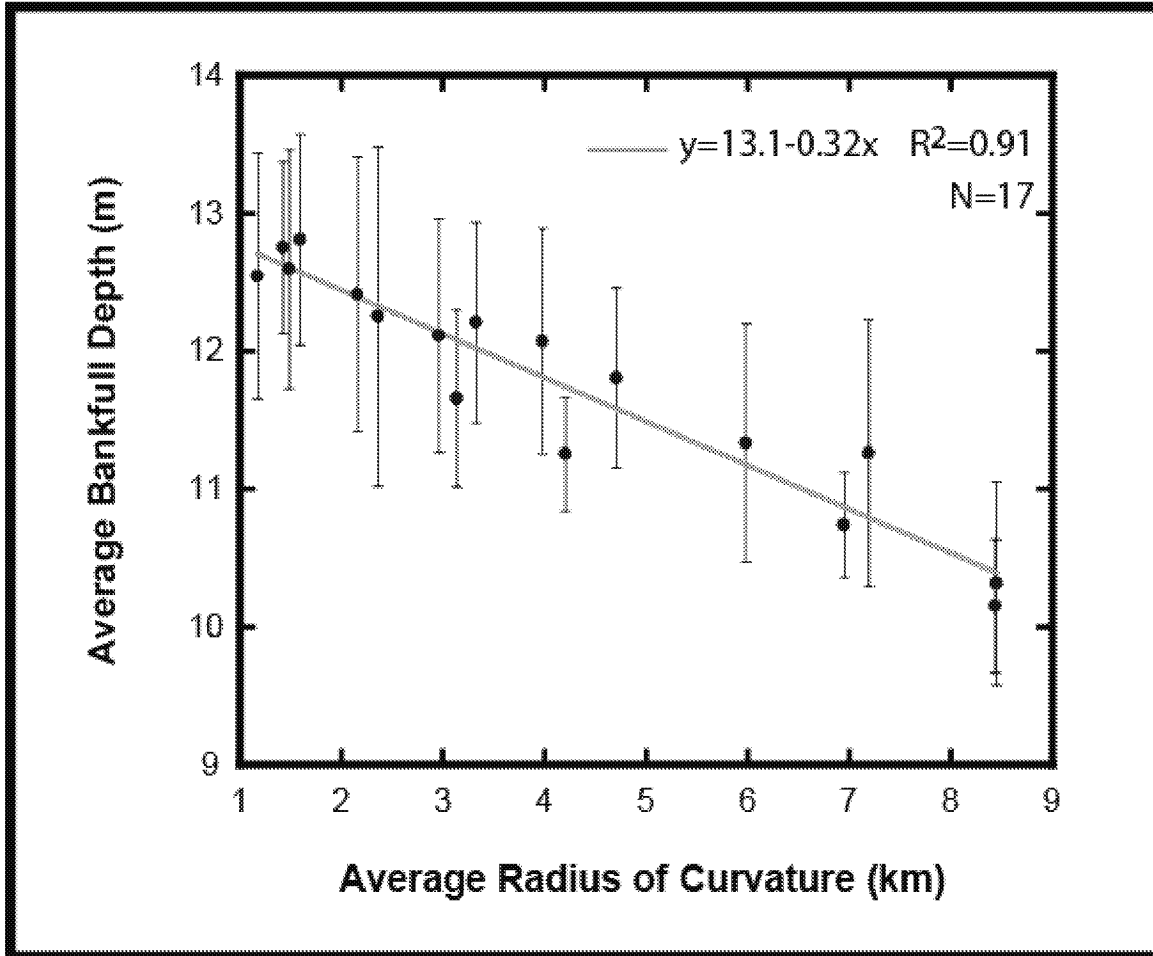
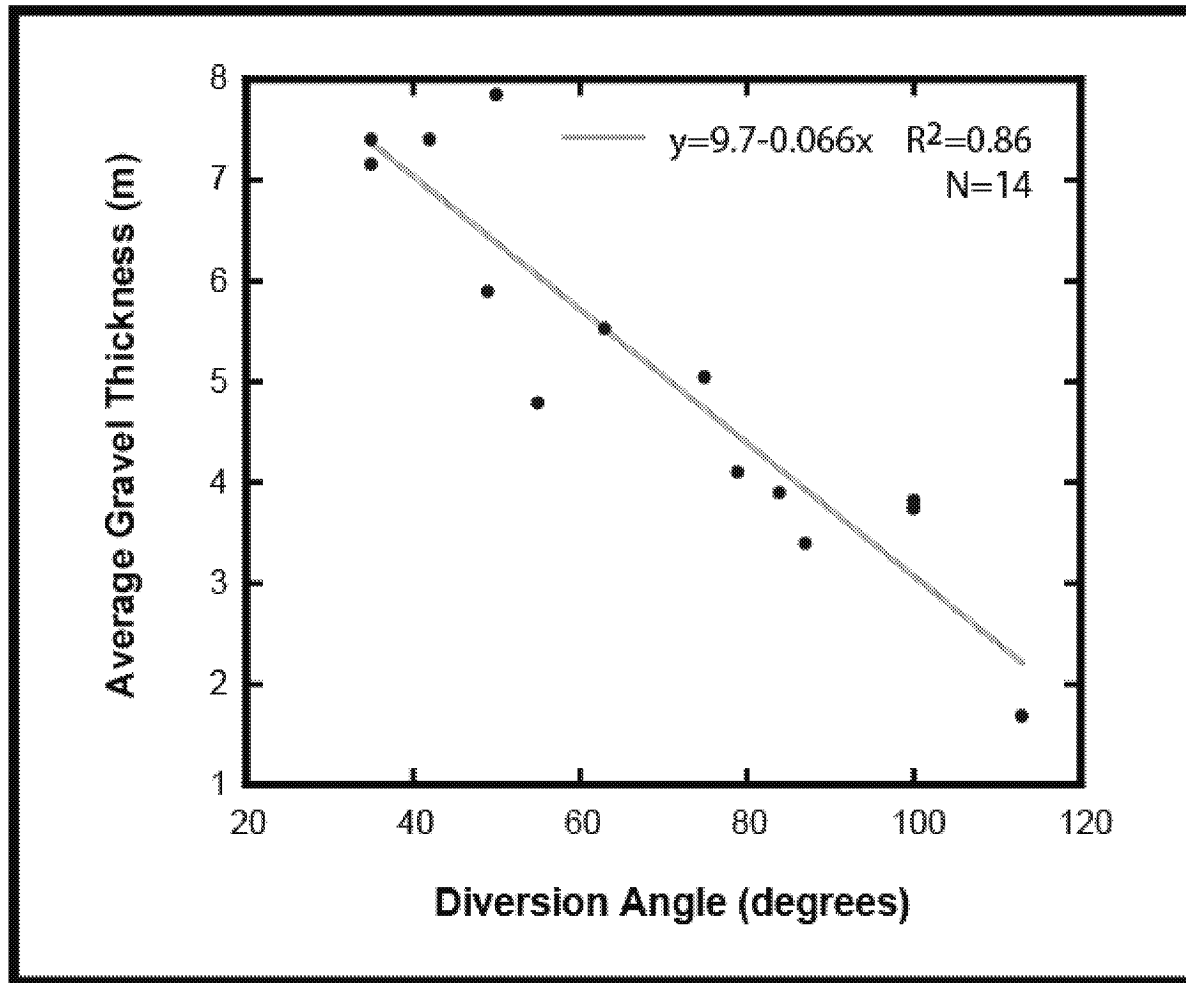


Figure 58. The average bankfull depth of meanders comprising the 1997 Sacramento River versus the average radius of curvature of each meander. Error bars represent one standard deviation.



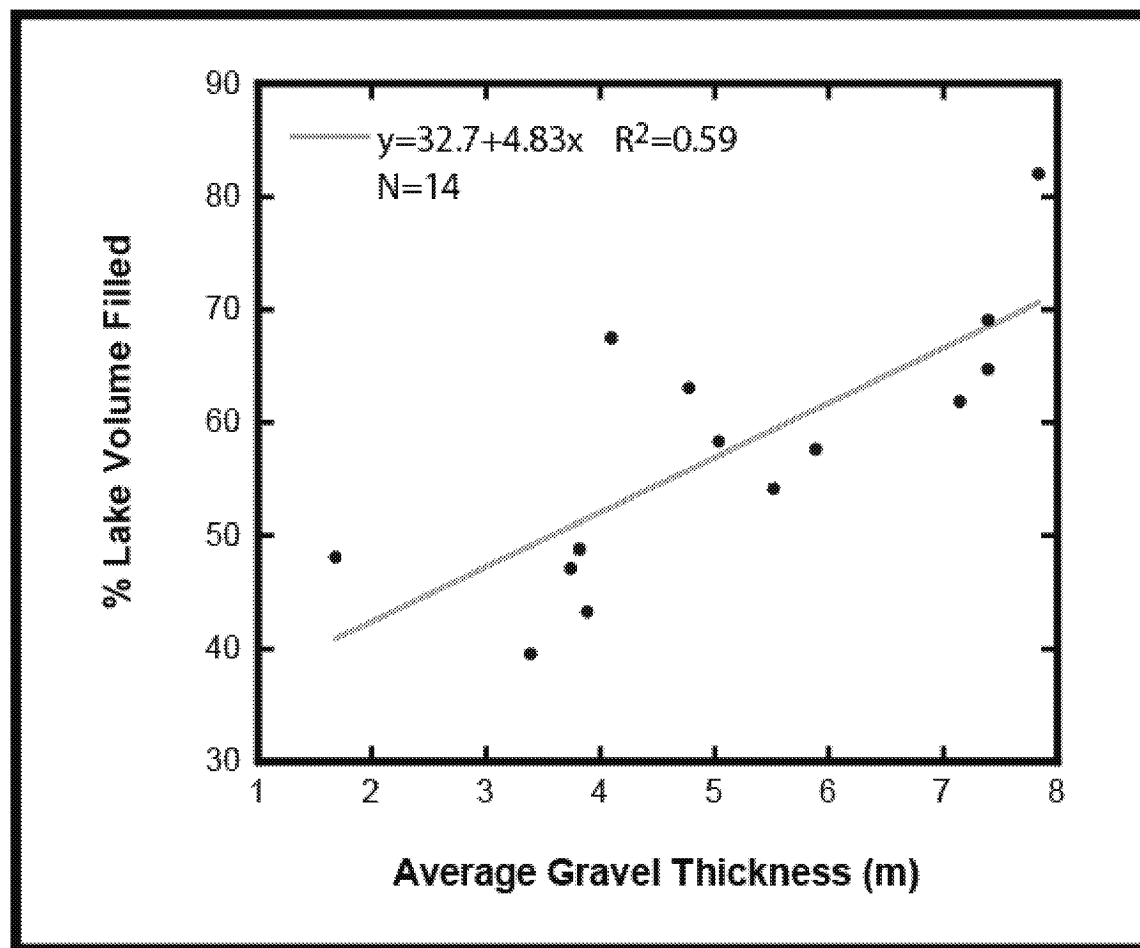


Figure 60. The percentage that an oxbow has been filled, measured as the total thickness of sedimentary fill divided by its average original depth, versus average gravel thickness.

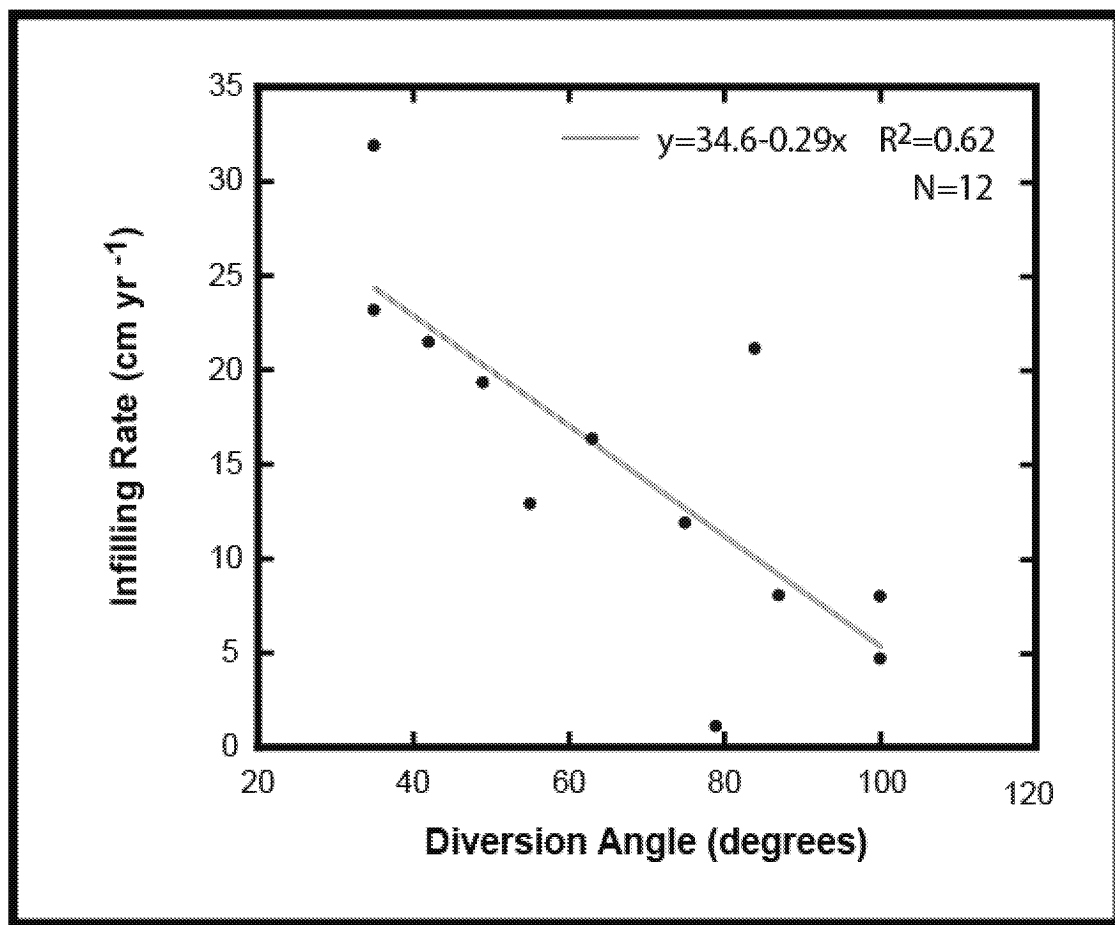
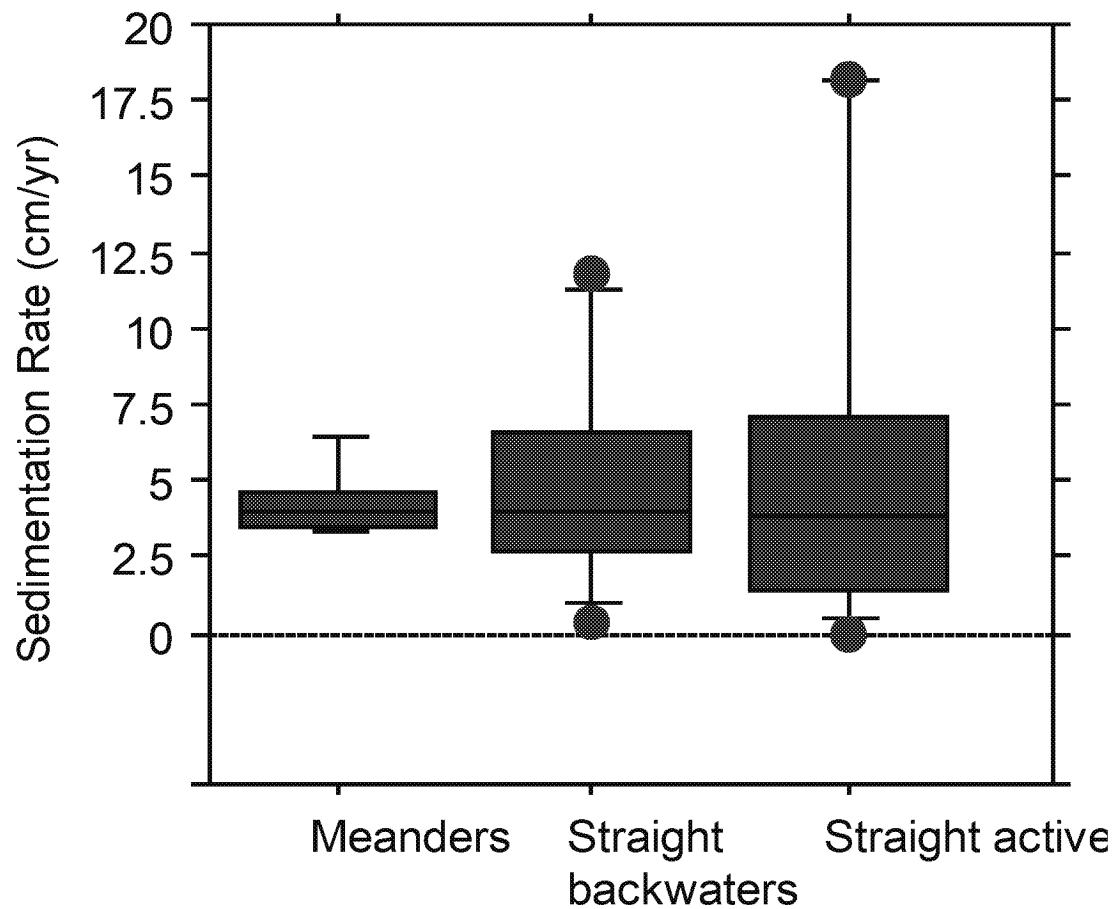
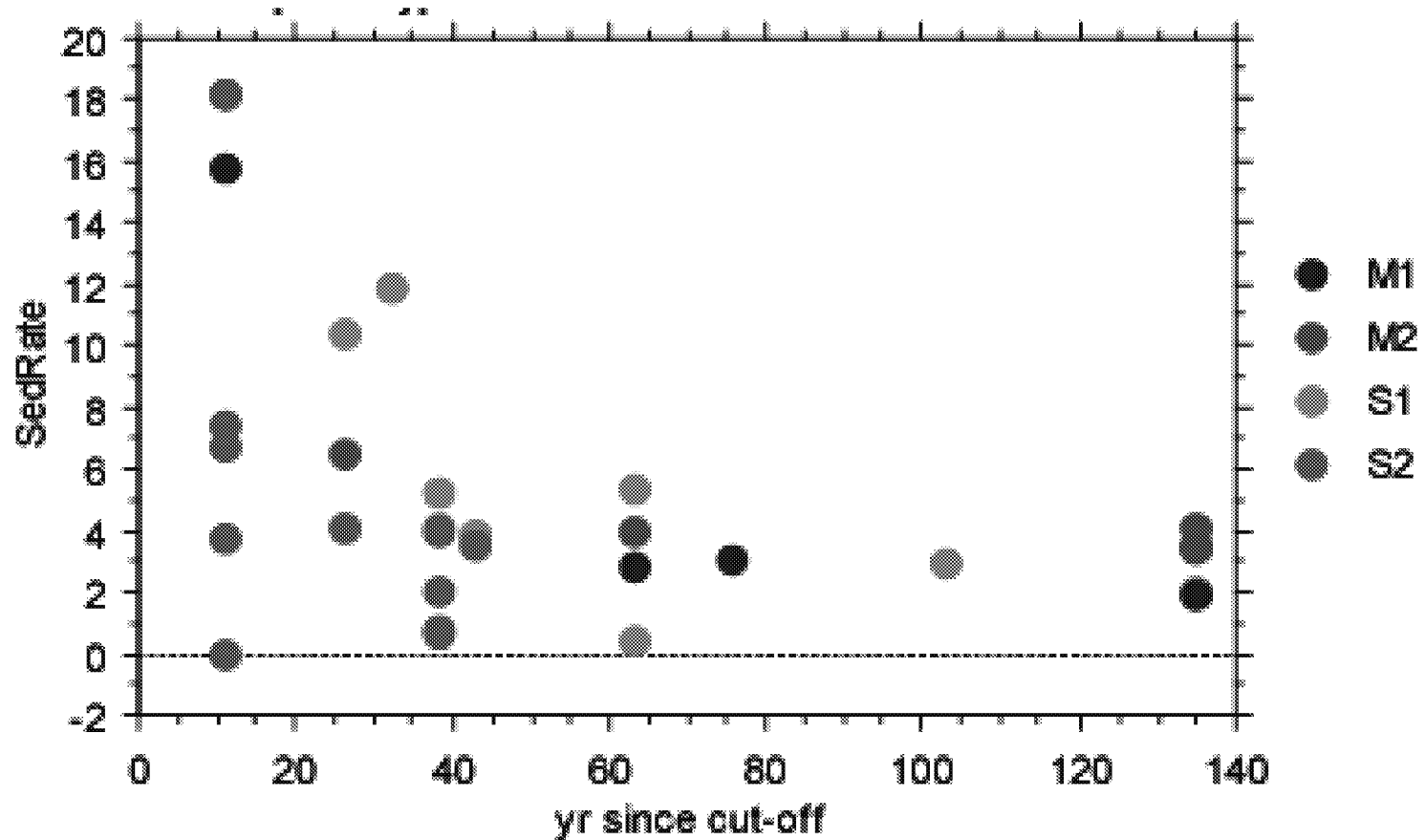


Figure 61. The percentage that an oxbow has been filled, measured as the total thickness of sedimentary fill divided by its average original depth, versus average gravel thickness.





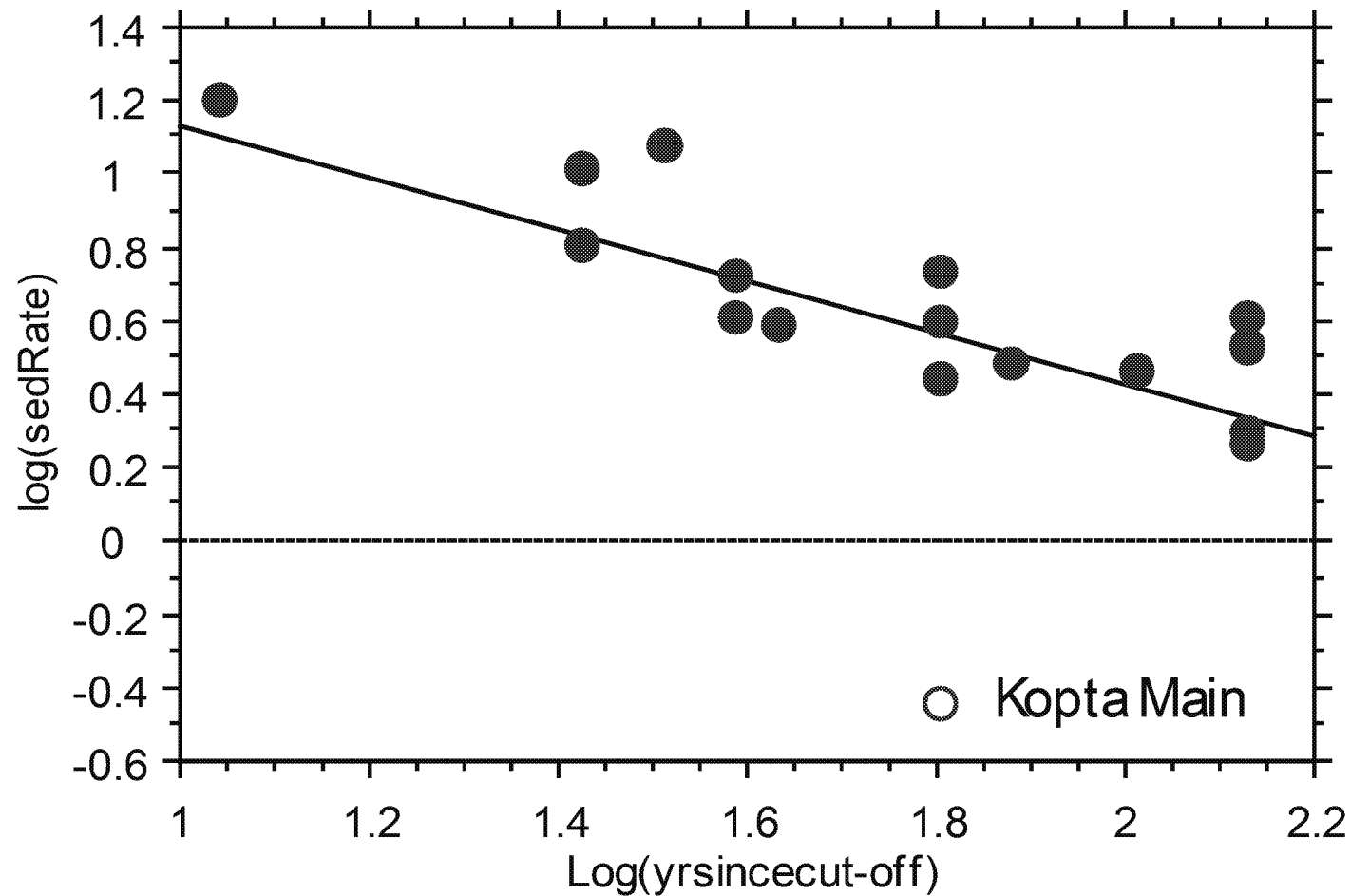


Figure 64. Log-log scale regression model relating sedimentation rate to the age of the OCWB unit. The regression equation is $\text{Log } y = 1.92 - 0.72 \log x$; $R^2 = 0.78$ (Kopta outlier excluded)

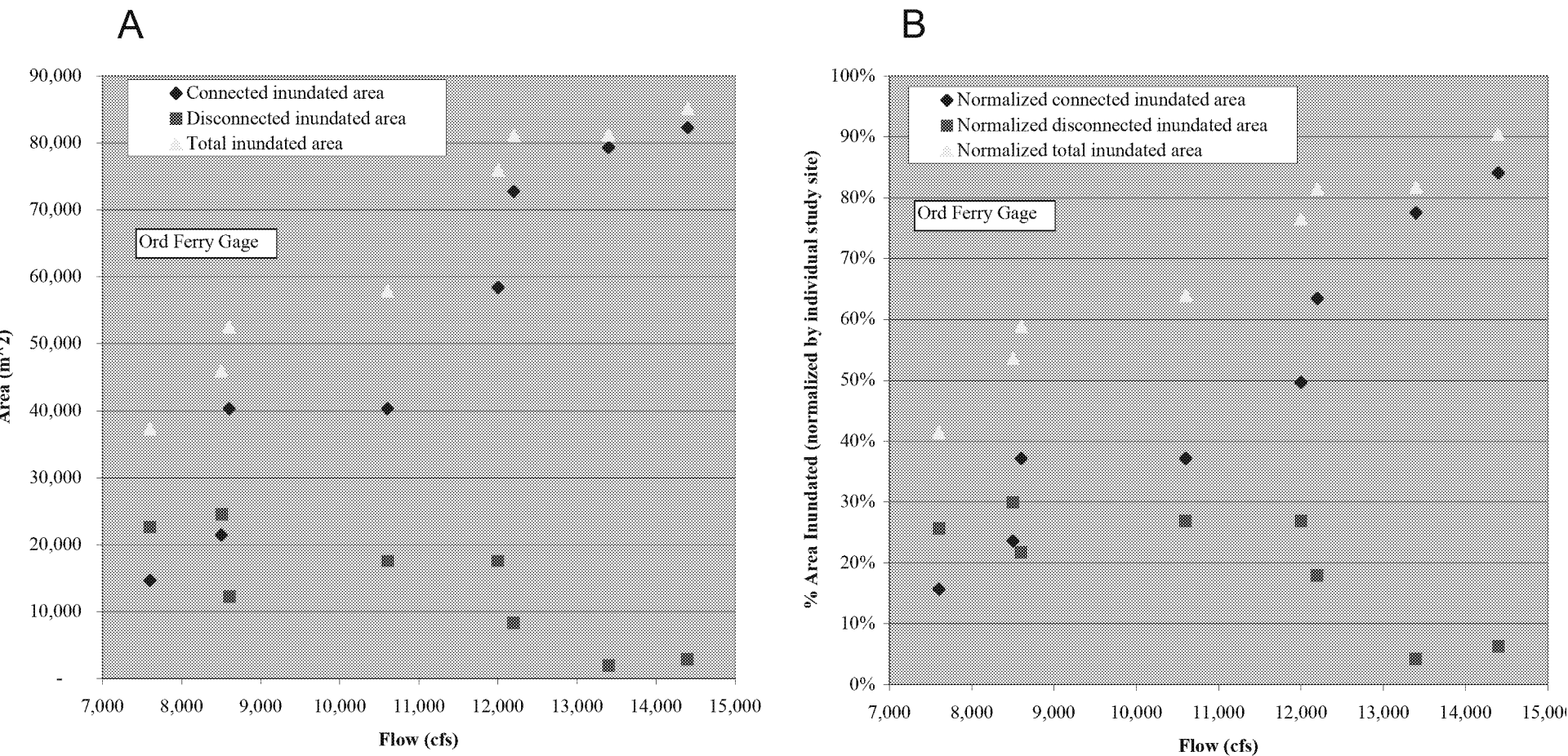


Figure 65. (A) Cumulative connected, disconnected, and total inundated area at 5 study sites related to the Ord Ferry gauge on the Sacramento River. **(B)** Normalized connected, disconnected, and total inundated area at study sites related to Ord Ferry gauge on the Sacramento River. Each site is normalized by its maximum potential inundated area that could be characterized by the thermograph deployment, such that each site has equal weight in determining the % inundated area.

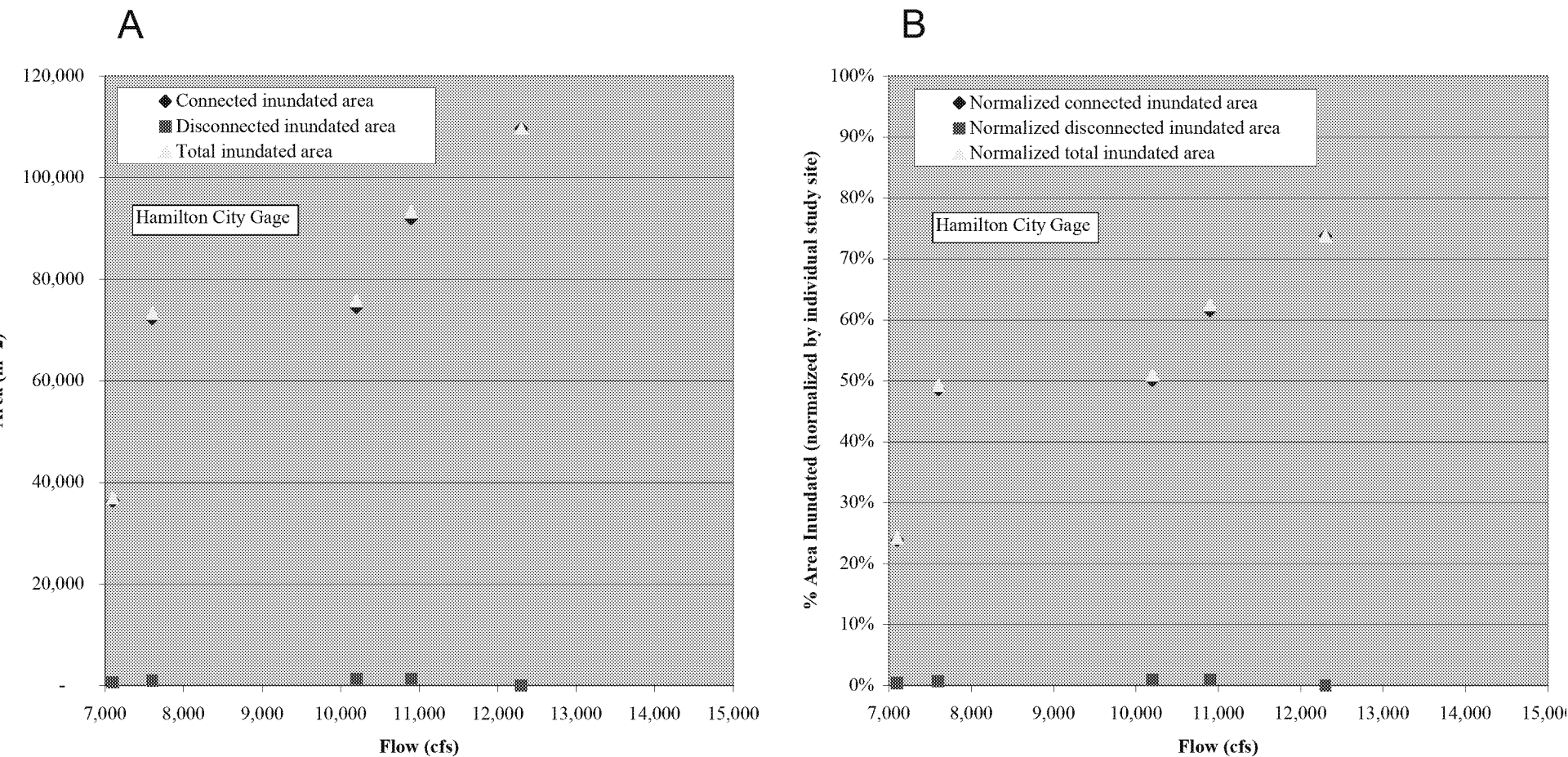


Figure 66. (A) Cumulative connected, disconnected, and total inundated area at 2 study sites related to the Hamilton City gauge on the Sacramento River. **(B)** Normalized connected, disconnected, and total inundated area at study sites related to Hamilton City gauge on the Sacramento River. Each site is normalized by its maximum potential inundated area that could be characterized by the thermograph deployment, such that each site has equal weight in determining the % inundated area.

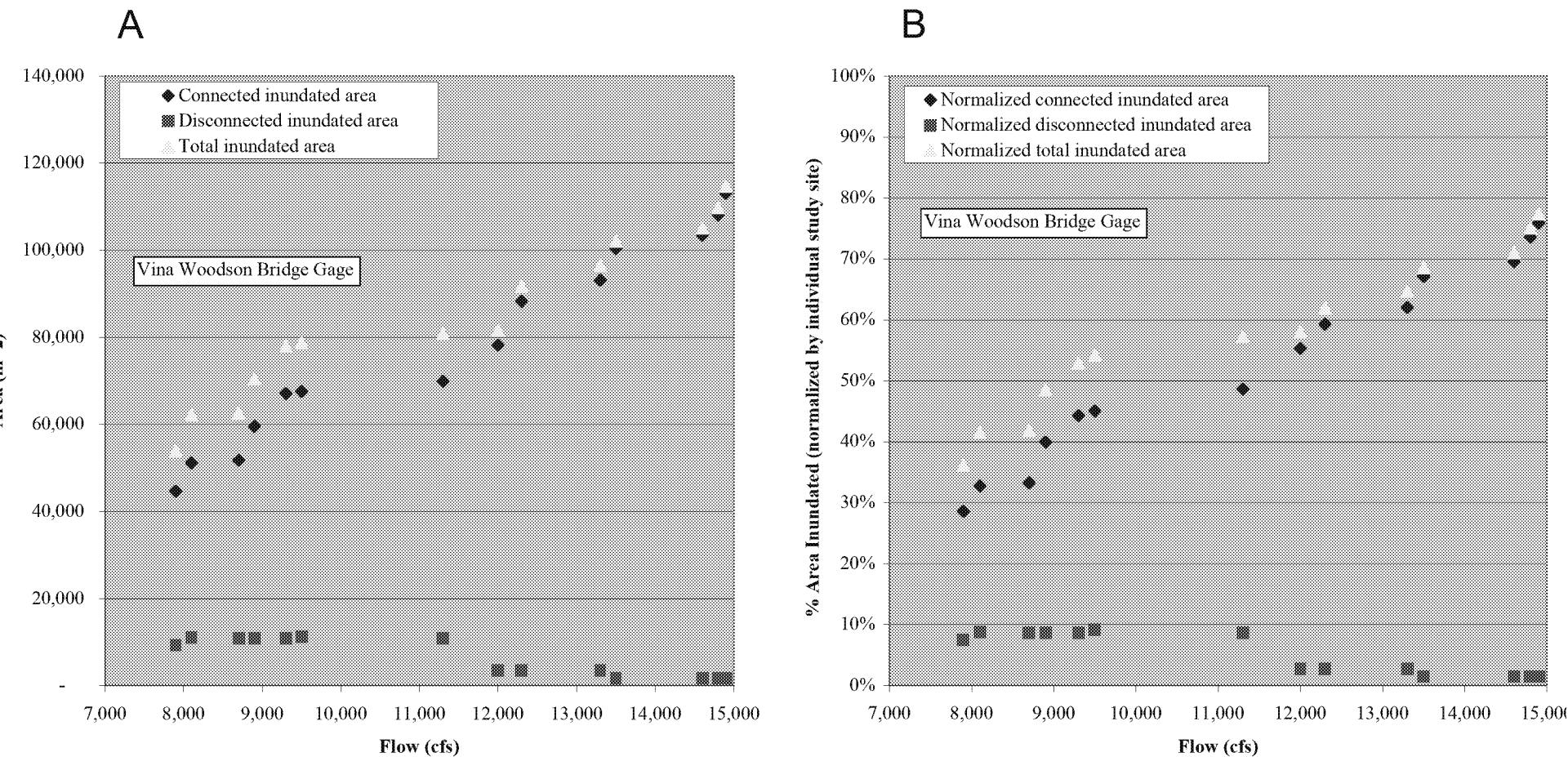
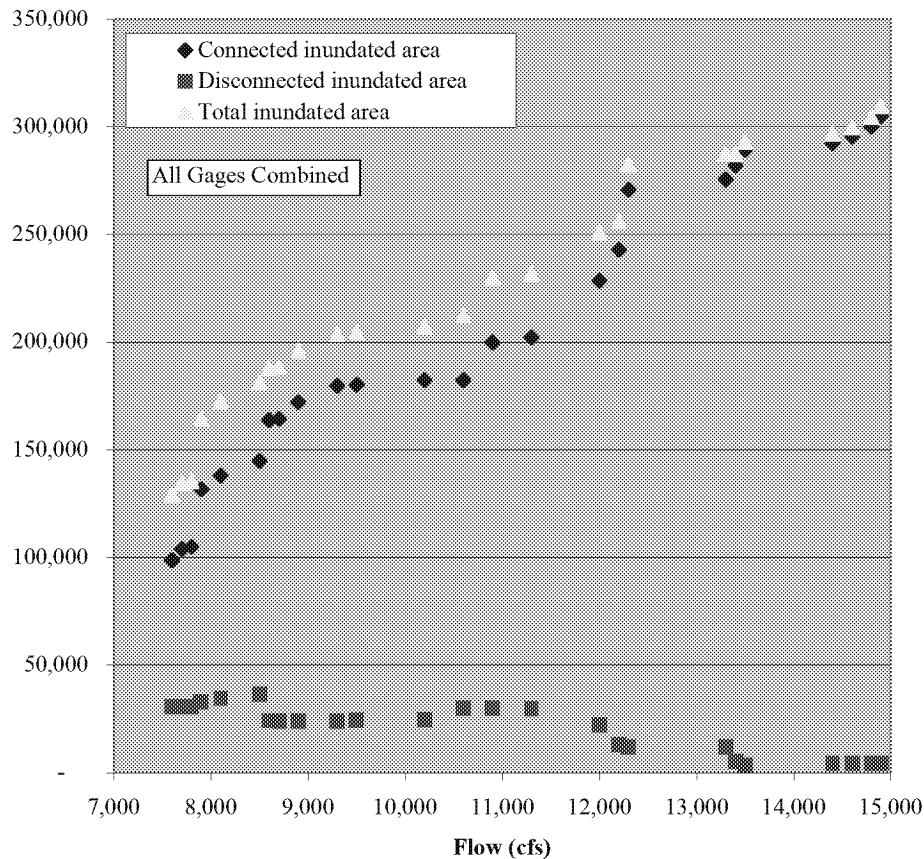


Figure 67. (A) Cumulative connected, disconnected, and total inundated area at 8 study sites related to the Vina Woodson Bridge gauge on the Sacramento River. **(B)** Normalized connected, disconnected, and total inundated area at study sites related to Vina Woodson Bridge gauge on the Sacramento River. Each site is normalized by its maximum potential inundated area that could be characterized by the thermograph deployment, such that each site has equal weight in determining the % inundated area.

A



B

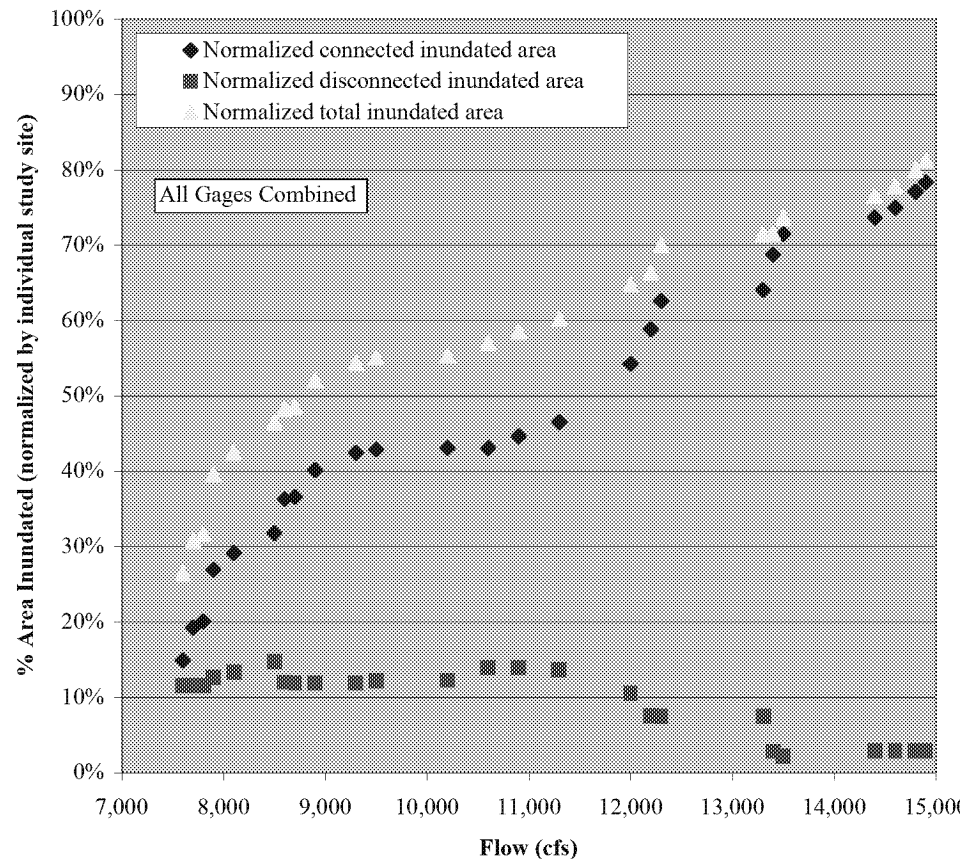


Figure 68. (A) Cumulative connected, disconnected, and total inundated area at all study sites (15) at varying flows on the Sacramento River. **(B)** Normalized connected, disconnected, and total inundated area at all study sites at varying flows on the Sacramento River. Each site is normalized by its maximum potential inundated area that could be characterized by the thermograph deployment, such that each site has equal weight in determining the % inundated area.

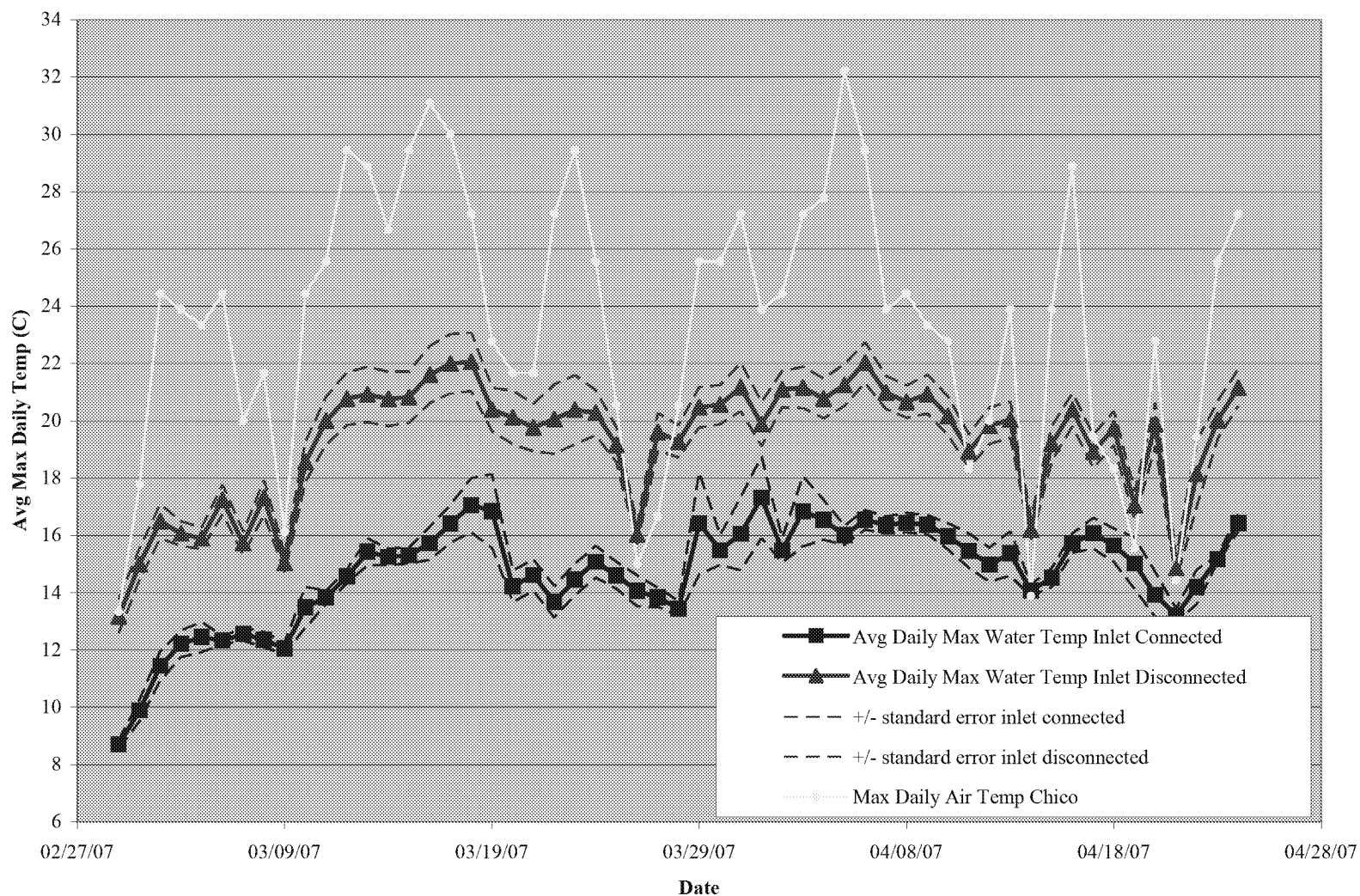


Figure 69. Average maximum daily water temperatures for submerged thermographs with inlets connected and disconnected to the mainstem. The maximum daily air temperature from Chico, CA (site maintained by CDF) is also displayed.

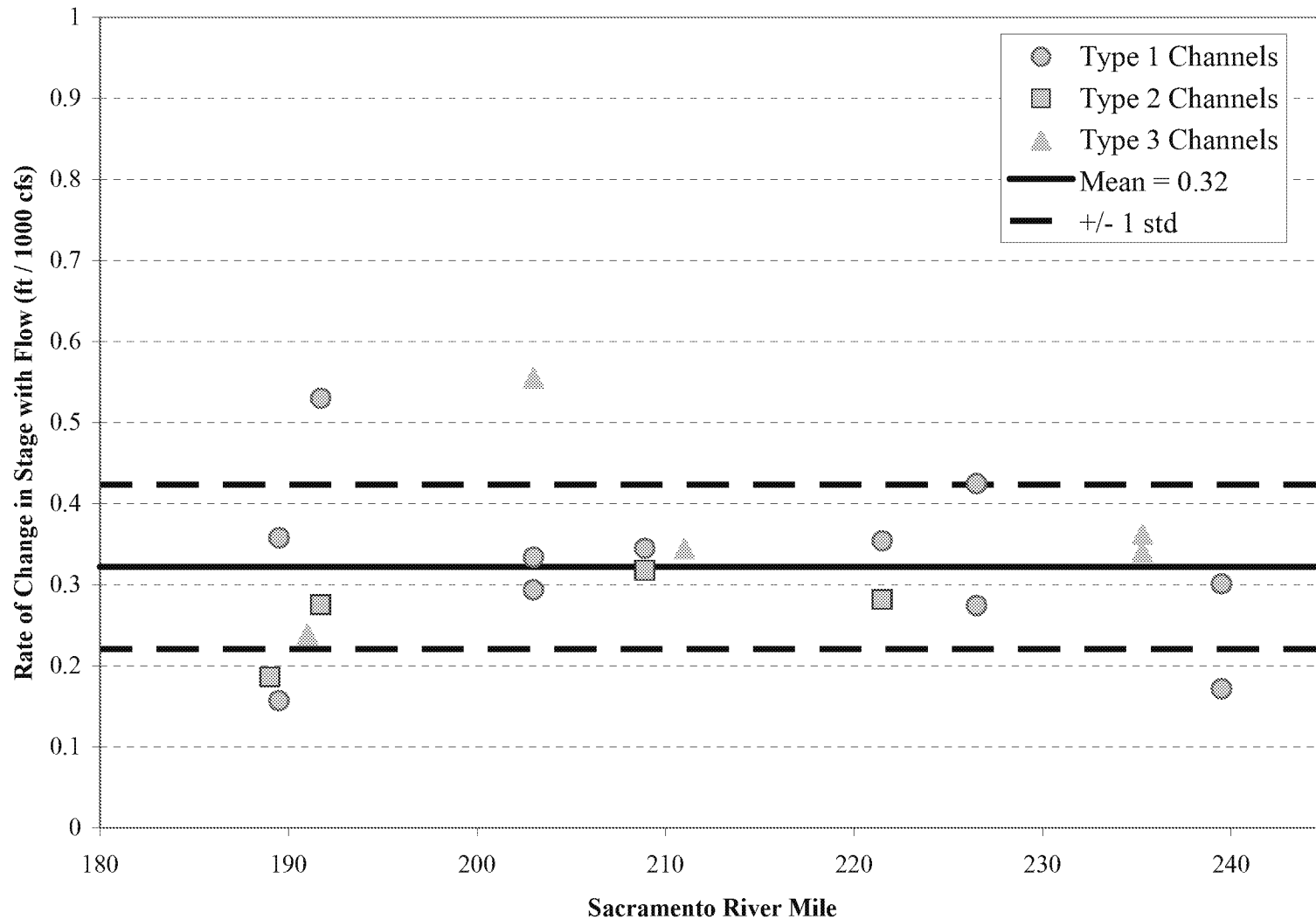


Figure 70. Rates of stage change (ft) within OCWB study sites per 1,000 cfs changes in mainstem Sacramento River discharge for type 1, 2, and 3 OCWB channels.

Photos



Photo 1. Photo of study site 17 on 4/26/2007 depicting a site that has significant *Ludwigia* growing within its wetted areas.

A

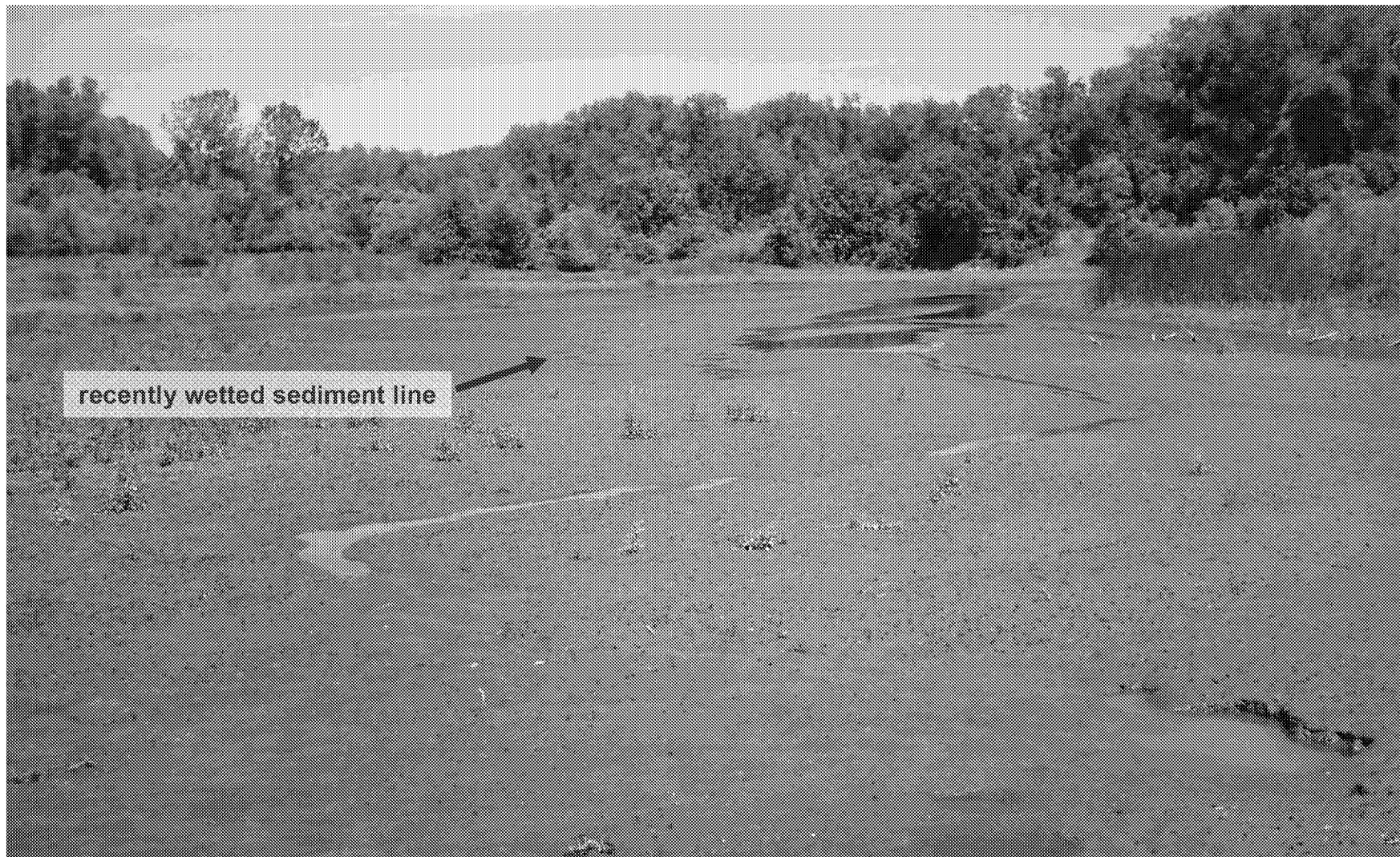
thermograph (13-1) installation

B

thermograph not recovered



Photo 3. Photo of study site 15 on: (A) 2/21/2007 during tidbit deployment (8,600 cfs) when outlet channel contained flow but was still disconnected at downstream end from mainstem, and (B) on 4/26/2007 during tidbit retrieval (7,600 cfs) when outlet channel was dry. See Figures GIS3a and 3b for planform map.



recently wetted sediment line



Appendices

APPENDIX A Detailed Description of Sites and Results for Scour Channels on Point Bars**River Mile 187R**

Study site 13 is located at RM 187L of the Sacramento River, at the downstream end of Shannon Slough (Figure 21). Site 13 is a former main channel flow scar, likely abandoned as the main channel bend at RM 187 continued to erode eastward. Under the classification scheme outlined in Section 2.2.2, site 13 is a type 2 channel, which we expect should generally exhibit good hydraulic connectivity at the outlet, and limited or no connectivity at the inlet. Thermographs were installed on 2/21/2007, when flow was 8,600 cfs (based on data from the Ord Ferry gauge). The inlet was disconnected from the river by a sediment plug, while the outlet was more or less at grade with and thus connected to the mainstem (Figure 21b). The thermographs were installed at two points (one wet and one dry) designed to investigate (i) whether flow would recede enough to disconnect the site's primary pool from the outlet and the mainstem, and (ii) whether flow levels would expand to submerge gravel bars that were sub-aerially exposed at the time of installation.

No fish were observed at site 13. High turbidities made observations difficult in water depths greater than two feet. The site is composed mostly of gravel (55%) and sand (35%), with 5 percent of the wetted area containing emergent vegetation which may provide useful cover for fish. During thermograph removal, 50–100 green sunfish were observed protecting redds near the outlet of the primary pool, upstream of the outlet.

None of the thermographs deployed at site 13 were recovered. However, the primary pool upstream of the outlet became disconnected by the time we arrived to remove the thermographs, (Figure 21a and Photo 2), indicating that flow at the threshold of connectivity occurred at some point between 8,600 and 7,600 cfs.

River Mile 189R

Study site 14 is located at RM 189R, on the west bank of the Sacramento River. Site 14 is an abandoned channel arm which has two large pools separated by a short shallow riffle that was dry during thermograph installation (Figure 22a). Using the classification scheme outlined in Section 2.2.2, site 14 is a type 2 unit, which we expect should generally exhibit good hydraulic connectivity at the outlet, and limited or no connectivity at the inlet. One thermograph was installed in a dry riffle below the study site's primary pool to investigate the pool's connectivity with the mainstem (Figure 22a). Installation occurred on 2/21/2007, when flow was of 8,600 cfs. The thermograph was dry upon retrieval on 4/26/2007, when the Sacramento River was at a flow of 7,600 cfs.

The substrate at site 14 is dominated by silt and sand, with little gravel present. The riparian area adjacent to the margin consists of a dense thicket of bamboo, which appears to rule out competition from other vegetation. No fish were observed during the site visit, but this may have been due, in part, to high turbidities that made it difficult to see deeper than two feet. The maximum water depth was one meter. Average water depth was 0.3 meter.

The thermograph data and direct observations of inundation from the site indicate that the upstream pool connected and disconnected with both the lower pool and the mainstem channel three times during the triple peak storm event in late February (Figure 22b). The upstream pool became connected at a flow of about 13,400 cfs and disconnected after flows levels dropped to

between 10,000 to 11,000 cfs (Figure 23). Hydrologic connectivity between the pools is associated with elevated water tables and increased groundwater flow as the inlet to the pools was connected to the mainstem. Disconnection likely has a time lag relative to changes in flow on the mainstem due to groundwater tables receding slower than the stage in the mainstem. This would explain why the range of estimated discharges during disconnection spans a wider range than the flows associated with inundation.

River Mile 191L

Study site 16 is located on the east bank at RM 191L of the Sacramento River, and is considered a type 3 unit under the classification scheme outlined in Section 2.2.2. Two thermographs were installed on 2/21/2007 at a flow of 8,500 cfs when the inlet was connected. The thermographs were installed in pattern to investigate when (i) the inlet is connected and (ii) the wetted width expands to a maximum channel width of the study site (Figure 26b). Both thermographs were recovered dry on 4/26/2007 at a flow of 7,600 cfs when the inlet was disconnected (Figure 26a).

No fish were observed in site 16. The visibility was poor in this site due to the water depth, turbidity, and time of day the site was sampled. This site is dominated by silt and sand, with willow comprising the majority of the vegetation adjacent to the watercourse. *Ludwigia* (water primrose) was observed at this site, although not in abundance.

The inlet to site 16 disconnected 4 times during the study period, all at approximately 8,000 cfs (Figure 26b, Photo 4). Thermograph 16-2 at the outer edge (break in slope between channel and perennial vegetation that was continuous around the entire circumference of the study site) became inundated twice during the study period at approximately 12,000 cfs (Figures 26c and 27). However, the precise time signal for each inundation was slightly ambiguous and 12,000 cfs was the overlapping discharge between the two inundation cycles and was selected as the critical discharge. Thermograph 16-2 went dry at a lower discharge (10,200 cfs) than when it became inundated.

River Mile 191.7R

Study site 17 is located on the west bank at RM 191.7R of the Sacramento River. Site 17 is located at the downstream end of an active point bar, but the channel geometry and planform location suggest that it is also an abandoned main channel position, and is classified as both a type 1 and 3 unit (Figure 28a). Thermographs were installed on 2/21/2007 at a flow of 8,500 cfs (Figure 28b), at which time the outlet was connected to the mainstem but the inlet was disconnected. Four thermographs were installed in an array to investigate lateral channel expansion and connection of upstream pools that were disconnected at the time of installation. Three thermographs were recovered on 4/26/2007 at a flow of 7,600 cfs (Figure 28a).

The channel substrate at site 17 is primarily composed of silt and sand. The turbidity was high which made fish observation difficult and no fish were observed. *Ludwigia* thoroughly covers the wetted and non-wetted surfaces of this site. It appears to be the dominant aquatic vegetation at this site in the summer season, out-competing other native plant species. An active beaver dam is located between the two pools and contributes to the disconnection of the upstream pool.

The connected pool at the outlet expanded to its maximum channel width at a flow of about 13,800 cfs (Figure 29), and was presumably receiving the additional flow from increased backwater from the mainstem as the thermograph (17-1) placed at the connection point with the

upstream pool never became inundated during the study period. Thus the upstream pool remains disconnected from the mainstem up to a flow of at least 15,600 cfs. However, thermograph 17-2, which was 0.23 m below 17-1, became inundated at 14,400 (Figure 28c). Thermograph 17-2 becoming inundated illustrated when the upstream pool expanded to its maximum width, likely via groundwater associated with the increased water table in the mainstem. During thermograph removal the upstream pool was found completely dry.

River Mile 203L

Study site 23 is located on the east bank at RM 203L of the Sacramento River. Site 23 is a type 3 channel where we would expect a higher degree of inlet and outlet connectivity (Figure 32a). Two thermographs were installed on 2/20/2007 at a flow of 7,600 cfs (Hamilton City gauge) at which time both the outlet and the inlet were connected to the mainstem (Figure 32b). Thermographs were installed in an array to investigate the inlet connection with the mainstem and at which flows the depth and width within the pool increase. Two thermographs were recovered on 4/26/2007 at a flow of 7,100 cfs, and both of the thermograph sites were dry (Figure 32a).

Site 23 consisted of wide, shallow, gravel-dominated pools connected by shallow riffles. Large tree stumps reside in the wetted area and provided excellent cover near the inlet. The average depth was 0.2 m with a maximum depth of 0.4 m. No fish were observed. Infrequent grasses were located on the dry sand and gravel bars.

The inlet to site 23 disconnected 4 times during the study period, consistently between flows of 7,100 and 7,200 cfs (Figure 32a). The thermograph at the outer edge of the channel of the study site became inundated twice during the study period at about 10,900 cfs (Figures 32c and 33), which represented a 50% increase in available habitat relative to the amount available when the inlet disconnects.

River Mile 211L

Study site 27 is located on the east bank at RM 211L of the Sacramento River. Site 27 functions similarly to a type 3 channel as described in Section 2.2.2; although, it may not be an abandoned former mainstem channel but rather a former probe channel that cut across the downstream end of a point bar and has established a more perennial connection than a typical type 1 channel and formed an island by dissection the point bar (Figure 37a). Site 27 likely stays perennially connected to the mainstem at the outlet and an additional slough is also likely perennially connected to the study site at the downstream end. Two thermographs were installed on 2/20/2007 at a flow of 7,900 cfs (Figure 37a) at which time both the inlet and outlet were connected to the mainstem. Thermographs were installed in an array to investigate (i) connectivity of the inlet and (ii) lateral expansion of available habitat. Both thermographs were recovered on 4/26/2007 at a flow of 8,800 cfs.

At the time of installation, study site 27 maintained an average width of 30 m and had a maximum depth of 1.2 m. The cloudy sky conditions and high turbidity made fish observations difficult, and no fish were observed. The substrate consisted of a mix of sand (55%) and gravel (35%) throughout the site with some cobble intermixed. Large woody debris settled near the inlet to site 27 and provides habitat for fish when flows come up. Submerged *Ludwigia* was observed in sparse accumulations near the inlet as well.

The inlet remained connected to the mainstem for the duration of the study period. The channel width expanded to the maximum channel width (break in slope between exposed substrate and established perennial vegetation) at about 12,400 cfs, and rapidly dewatered during the receding flow limbs (Figures 37b and 38).

River Mile 221.6R

Study site 33 is located on the west bank at RM 221.6R of the Sacramento River. Site 33 is a combination of both a probe channel eroding behind an active point bar (type 1 unit) and a former main channel flow scar (type 2 channel that currently functions as a slough) that converge at the downstream end of site 33 (Figure 39a). Kopta Slough North (RM 221.7, Table 1) is located slightly west of the outlet of site 33, and the slough that enters site 33 is referred to as Kopta Slough Backwater in Table 1. Five thermographs were installed on 2/19/2007 at a flow of 8,100 cfs at which time a wide, shallow backwater pool existed at the outlet that was not connected to Kopta Slough Backwater (Figure 39b). Thermograph placement was designed to investigate (i) the discharge Kopta Slough Backwater connected to site 33 and the mainstem, and (ii) the lateral and longitudinal connectivity of the portion of site 33 that extends up the probe channel across the point bar. Five thermographs were recovered on 4/25/2007 at a flow of 8,900 cfs.

No fish were observed in site 33. The channel substrate consists of sand (100%) throughout, with large portions of the sand bars covered in grasses. In areas that appear to be wetted throughout the summer, *Ludwigia* covers the channel. The current wetted portion of site 33 had 25% coverage of floating vegetation, 20% submerged (most likely *Ludwigia*), and 10% emergent, with a total of 55 percent of its area covered in vegetated. Little to none vegetative canopy cover existed at the pool. An active beaver dam contributed to the disconnection of Kopta Slough Backwater.

Kopta Slough Backwater connected and disconnected from site 33 three times during the study period, connecting around 12,000 cfs and disconnecting at about 11,300 cfs (Figures 39c and 41). Stage within the portion of site 33 classified as a type 1 channel increased at a rate of approximately 0.1 m (0.34 ft) per 1,000 cfs increase in discharge, but never expanded to its full channel width (Figure 40). Stage increases were likely a product of backwater from the mainstem as the site never received surface flow from the inlet. The deepest portion of the scour channel (thermograph 33-3) did go dry around 7,300 cfs, after which likely only a small pool at the outlet remained (Figure 39a). Thermograph 33-3 also exhibited high water temps (25°C) while submerged at low flows.

River Mile 226.5L

Study site 35 is located on the east bank at RM 226.5L of the Sacramento River. Site 35 is a type 1 channel with additional high flow channels that cut laterally across the bar and enter site 35 (Figure 42). Five thermographs were installed on 2/16/2007 at a flow of 8,900 cfs (Figure 42b) at which time the inlet was disconnected and the outlet connected to the mainstem. Thermographs were installed in an array to investigate (i) the connectivity of the inlet and outlet, (ii) the extent of lateral and longitudinal inundation, and (iii) when an additional lateral high flow channel connects to the site. Four thermographs were recovered on 4/25/2007 at a flow of 8,900 cfs. During both installation and removal the lateral high flow channel was receiving input through groundwater as it was flowing into to site 35 but not connected at its inlet to the main channel (Figure 42b).

The maximum depth at the site is 1.8 m and the average depth is 0.7 m. Some vegetation and LWD existed in the arms providing fish habitat, although none were observed. Water depth and turbidity limited fish observations in the deeper pools. The substrate composition at the site is sand (85%) with small patches of gravel (15%). *Ludwigia* and other aquatic vegetation were present in 15 % of the unit and sparsely distributed.

Thermograph 35-5 was placed to investigate when the inlet to the main probe channel became connected with the mainstem, and this thermograph was not recovered. However, based on field evidence indicating a lack of surface and thermographs placed at other study sites at similar elevations above the water surface that did not become inundated, the inlet to the main probe channel likely did not connect during the study period. At 14,900 cfs, the primary pool in the main probe channel had increased its depth by 0.5 m (1.7 ft) to a maximum depth of 1.3 m (4.1 ft) (Figures 42c and 43). Because the inlet to site 35 did not connect to the mainstem, stage increases within the main pool are likely due to increased flow inputs from the lateral high flow channel and backwater from the mainstem. During the monitoring period, the pools in the main probe channel did not go dry (thermographs 35-1 and 35-3). The lateral high flow channel that was wet and connected to site 35 at 8,900 cfs did go dry at about 7,100 cfs (Figure 42a).

River Mile 232.8L

Study site 39 is located on the east bank at RM 232.8L of the Sacramento River. Site 39 is a type 1 channel that erodes behind a point bar that significantly increased in size between the 2005 and 2006 aerial photography images. Two thermographs were installed on 2/16/2007 at a flow of 8,900 cfs, and the inlet was disconnected and the outlet connected to the mainstem (Figure 45b). Thermographs were deployed in a manner to investigate (i) lateral channel expansion and (ii) when pools in the study site dried. Two thermographs were recovered on 4/25/2007 at a flow of 9,000 cfs.

In a shallow portion of the wetted area, 50 Sacramento pike minnow were observed using overhanging vegetation as cover. Small woody debris and large woody debris were sparsely located in the unit. The outlet of the unit exceeded two meters of depth which presented problems for fish observations in the outlet pool. Turbidities were also relatively high and no additional fish species were observed. Sand is the dominant substrate (100%) and 10% of the wetted area is covered with aquatic vegetation, one of three species present being *Ludwigia*.

Shallower pools along the longitudinal axis of site 39 went dry at about 7,100 cfs and became inundated at 7,800 cfs (Figures 45a and 46). During low flow periods, water temperatures in the pools were very high when thermographs were submerged, reaching a maximum of 30°C. During the study period, flows were insufficient to induce water level rises outside the thalweg area of the probe channel and submerge thermograph 39-2. During thermograph removal, three small pools near LWD that were disconnected from the study site appeared to be going dry and had high potential for fish stranding (no fish were observed in the pools). These pools were not present during thermograph deployment, which was at a flow about 100 cfs less than when the pools were observed during retrieval.

River Mile 233.3L

Study site 40 is located on the west bank at RM 233.3L of the Sacramento River. Site 40 is type 1 channel where we would expect low degrees of connectivity at the inlet and outlet. Thermographs were installed on 2/16/2007 at a flow of 8,900 cfs. At 8,900 cfs the inlet and

outlet were disconnected, the outlet was connected to the mainstem, and a long shallow disconnected pool provided the majority of fish habitat (Figure 47a). Four thermographs were installed in an array to investigate when the inlet, isolated pool, and outlet were connected to the mainstem and the overall longitudinal connectivity within the site. Four thermographs were recovered on 4/25/2007 at a flow of 8,900 cfs.

No fish were observed in the long, shallow pool in Study site 40. The maximum depth in the pool was 1 m, with an average depth of 0.3 m. The substrate consisted of 100% sand, with *ludwigia* and willow growing throughout.

The isolated pool connected and disconnected twice from the mainstem during the study period at approximately 13,500 cfs (Figures 47b and 48). The inlet did not connect to the mainstem during the study period nor did the primary pool go completely dry. Water temperatures within the pool were high (maximum of 26°C) when the study site was disconnected from the mainstem. During the study period, flows were insufficient to induce water level rises outside the shallower portion of the primary pool and submerge thermograph 40-3.

River Mile 235.3R

Study site 41 is located on the west bank at RM 235.3R of the Sacramento River. Site 41 is located in an ephemeral channel flowing around an island and may have been a former main channel location (Figure 49). Site 41 is considered a type 3 channel according to the classification scheme outlined in Section 2.2.2, where we would expect higher degrees of inlet and outlet connectivity. Four thermographs were installed on 2/15/2007 at a flow of 9,300 cfs at which time both the inlet and outlet were connected to the mainstem (Figure 49b). Thermographs were installed in a pattern to investigate when the inlet disconnected and three were placed in cross-section array to investigate lateral and longitudinal connectivity. All four thermographs were recovered on 4/25/2007 at a flow of 8,900 cfs.

No fish were observed in Study site 41. A majority of the site consisted of broad, shallow braided channels and willow-vegetated sand bars. Most wetted areas were shallow with the average depth being 0.5 m and a maximum depth of 1.3 m. Small and large woody debris was interspersed throughout the site primarily located in the upstream portion of the site. The bed material was composed of sand (85%) and gravel (15%). Sparse amounts of aquatic vegetation were present including *Ludwigia*.

The inlet disconnected from the mainstem at about 8,100 cfs and the thermograph (41-1) placed in the thalweg of the scour channel went dry about 10 hours prior to this at about 8,150 cfs (Figures 49a and 50). Thermographs in the cross-section array were placed in the thalweg, atop mid-elevation bench, and on a higher elevation bench that would reflect the maximum channel width (Figure 50). During the study period the mid-elevation bench became inundated 4 times, typically around 13,300 cfs (Figures 49c, 50, and 51) and the upper elevation bench that characterized the maximum channel width never became inundated. The stage discharge relationship at the cross-section indicated that the rate of stage change relative to mainstem discharge was 0.1 m (0.34 ft) per 1,000 cfs change in discharge (Figure 50), which is consistent with the rate of stage change observed at cross-sections in study sites 25 and 33.

APPENDIX B List of Researchers and Institutional Affiliations

Principal Investigators:	Affiliation
G. Matt Kondolf kondolf@berkeley.edu	Dept of Landscape Architecture and Environmental Planning, University of California, Berkeley 94720
Hervé Piégay hervé.piegay@ens-lsh.fr	Centre National de la Recherche Scientifique UMR 5600 Environnement - Ville - Société Site ENS-Lsh, 15 Parvis René Descartes BP 7000, 69342 Lyon cedex 07, France
Bruce Orr bruce@stillwatersci.com	Stillwater Sciences 2855 Telegraph Ave Berkeley, CA 94705
Researchers:	Affiliation
Ingrid Morken Dave Shaw Kate Huxster (undergrad assistant)	Dept of Landscape Architecture and Environmental Planning, University of California, Berkeley 94720
Jose Constantine	Dept of Earth Science, University of California, Santa Barbara
Mike Singer	U.S. Geological Survey, Menlo Park, CA
Julien Levrat	University of Lyon 3, CNRS UMR 5600, Lyon, France
Gudrun Bornette, Sara Puijalon	University of Lyon 1, CNRS UMR5023, France
Simon Dufour	Université of Aix-en-Provence and CNRS UMR 5600 of Lyon, France
Adrien Alber, Vincent Gaertner, Kristelle Michel, Marie-Laure Tremelo, Monika Michalkova	CNRS UMR 5600, Lyon, France
John Wooster, Yantao Cui, Michael Fainter	Stillwater Sciences, 2855 Telegraph Ave, Berkeley, CA 94705

APPENDIX C Lessons from Chute-Cutoff Modeling Exercises**Introduction**

As part of the Sacramento River Ecological Flow Study, Stillwater Sciences attempted to develop a numerical, mechanistically-based, chute-cutoff numerical model for prediction of the discharge required to form a chute cutoff channel. Unfortunately we have been unsuccessful in producing a workable model due to the complexity of the physical process and the associated numerical difficulties. This appendix briefly reexamines the hypothesis we outlined in our scope of work and discusses the main technical difficulties that we encountered during model development. Our aim is to provide useful information for future research.

Reexamination of hypotheses and recommendations for future research

The proposed hypotheses in the scope of work are as follows:

- Hypothesis 1. The shorter (and thus steeper) passage for flow along the potential cutoff route creates a significantly higher friction slope, relative to conditions in the main channel, and is a key regulator of cutoff.
- Hypothesis 2. Chute-cutoff can be simulated with a one-dimensional approximation of flow in which water bifurcates through the main channel and the potential cutoff route as soon as it inundates the potential cutoff route.
- Hypothesis 3. Cutoff initiates when the shear stresses over the potential cutoff route exceed the "critical" shear stress for erosion of the riparian layer.
- Hypothesis 4. Once a cutoff is initiated, such that flow cuts through the more erosion-resistant riparian layer, sediment transport in the incipient cutoff will be similar to fluvial sediment transport in rivers (such that it can be simulated by conventional sediment transport modeling).
- Hypothesis 5. The initiation of a cutoff channel will allow for more concentrated flow and thus increased shear stresses and accelerated cutoff progress.

Below we consider each hypothesis, to provide some insights about what didn't work in this case and what might work in future efforts.

Hypothesis 1

We were unable to fully test this hypothesis because we were unable to produce a workable numerical model. We believe this hypothesis is likely true as agreed upon by several experts working in the area of sediment transport and river mechanics during a mini technical workshop held in Berkeley in July 2005.

The simulated shear stress distribution in the Sacramento River near RM 172 corroborates the hypothesis. Figure 1 shows the River-2D simulated shear velocity, defined as

$$u_* = \sqrt{\tau / \rho},$$

(in which u_* denotes shear velocity, τ denotes shear stress, and ρ denotes density of water), indicating substantially higher shear velocities near the dashed line (marking the potential cutoff route), as compared to the surrounding area for a flow of 3,400 m³/s (120,000 cfs). River-2D simulations of higher discharge events revealed similar patterns.

Hypothesis 2

We were unable to test this hypothesis because we could not produce a workable numerical model. Even so, we suspect that this hypothesis may be valid; our difficulties in producing the model stemmed mostly from other technical issues, as discussed later in this memorandum. Unless technical difficulties of the model are solved in a separate research effort, however, we do not recommend any further effort to examine this hypothesis, because it will most likely be fruitless.

Hypothesis 3

Strictly speaking, this should not be treated as a hypothesis because it has been widely accepted that shear stress drives soil erosion. What is challenging and needs further research to improve chute-cutoff modeling, is quantifying the relationship between shear stress and the rate of erosion of stratified and heterogeneous sediment deposits that may be reinforced with dense root systems from trees, shrubs and grasses. Without further understanding of this relationship, any numerical modeling would at best be useful only as a gaming tool. On the other hand, a model with a good characterization of the relationship between shear stress and erosion rate will be far more useful. We did not attempt to quantify the relationship between shear stress and erosion rate in this research, as we were interested in a gaming tool as a first step.

Hypothesis 4

Similar to the other hypotheses, we did not have a chance to test this because the model was not successfully developed. The hypothesis is most likely valid, based on general observations in the field from cut-banks where surface sediment is usually seen to be more erosion resistant due to the presence of vegetative root system.

Hypothesis 5

This hypothesis was not tested because the model was not successfully developed.

Major difficulties in developing the numerical model

We encountered technical difficulties both in the simulation of water flow and the simulation of sediment transport. The difficulty in simulating water flow was caused by the fact that multiple solutions for water depth exist for a given total energy head in a compound channel (e.g., Chaudhry 1993) during the calculation for energy conservation. This makes it difficult to write a robust algorithm even for a relatively simple subcritical flow condition. The difficulties are compounded in the real world, where we are often faced with subcritical, supercritical, and transient flow conditions.

Moreover, it turns out that researchers have not yet developed a robust algorithm for transient flow conditions in complex compound channels. To the best of our knowledge, there is not even a robust algorithm for the simplest, subcritical conditions in compound channels. We actually thought we had produced a robust algorithm at one point because our initial testing with a specific topography produced reasonable results. However, when we modified the topography to reflect conditions at Sacramento River RM 172, however, the model produced very unrealistic results, revealing that our algorithm was not robust. Worst of all, this was not discovered until the later stages of the project, and repeated efforts to subsequently to fix the problem failed.

The first technical difficulty we faced in the sediment transport simulation was that we were unable to produce a quasi-equilibrium profile (i.e., one with minimal cumulative aggradation and degradation in the channel) near a bend by routing sediment through the reach. This is most likely an indication that the one-dimensional approximation was not adequate. The second

technical difficulty we faced in sediment transport simulation was that researchers had not yet developed a defensible theory for partitioning sediment transport at the point of bifurcation.

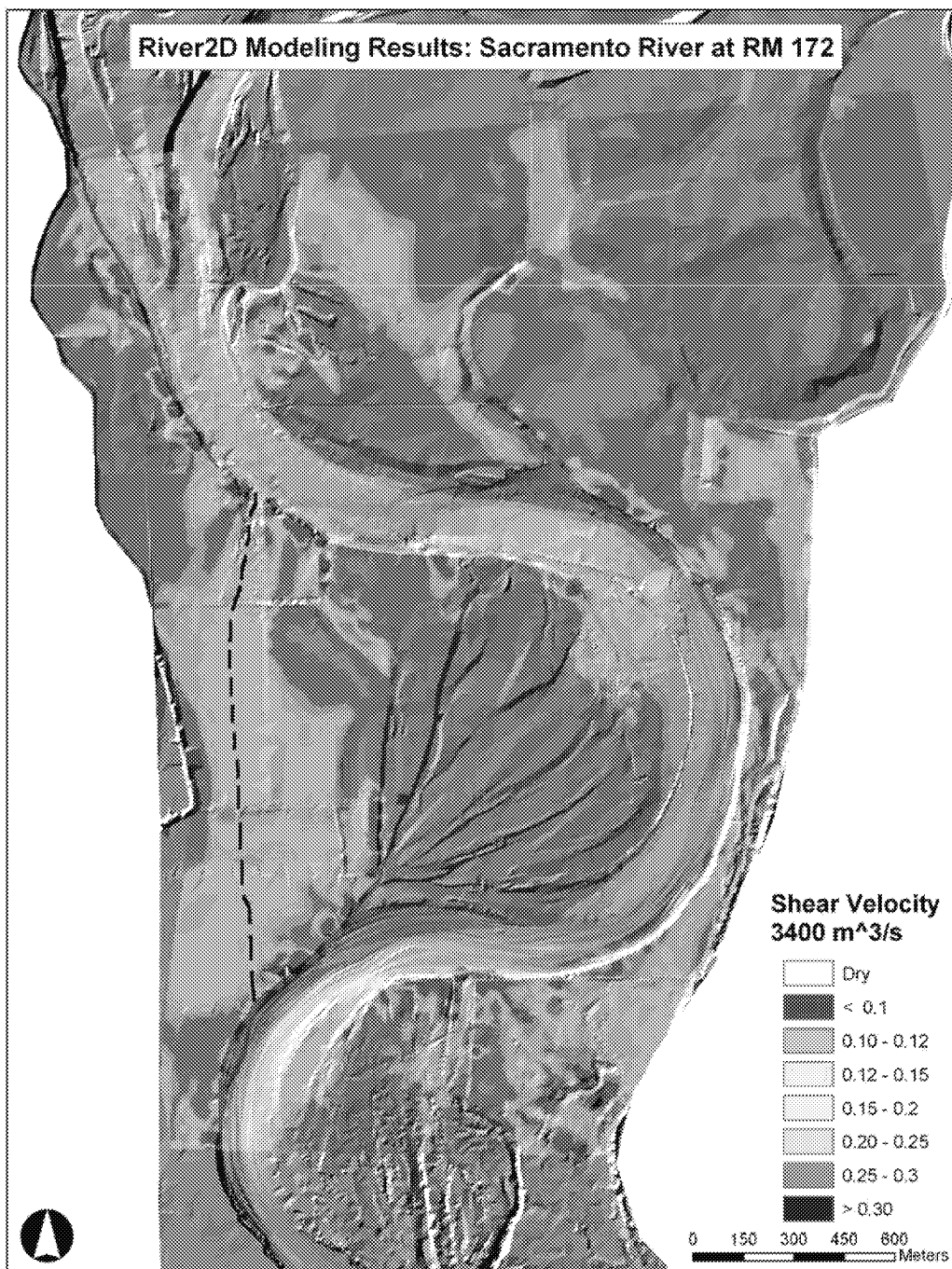
During study plan development, we assumed that we could overcome the technical difficulties in sediment transport modeling by making the following assumptions:

- the formation of the chute-cutoff channel is a purely erosional process, allowing us to ignore the other sediment transport process in the river and focusing only on sediment erosion within the cutoff channel; and
- the modeling can ignore the silting process in resultant oxbow lake once the cutoff channel is formed.

We were unable to test these assumptions after we discovered the problems with the flow algorithm (see discussion above) and were unable to fix it.

Reference

Chaudhry, M. H. 1993. Open-Channel Flow. Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, ISBN 0-13-637141-8.



Appendix C, Figure 1. Simulated shear velocity at discharge = 3,400 m³/s (120,000 cfs), showing high shear stress along potential cutoff route (dashed line) compared to surrounding area.

APPENDIX D Off-Channel Habitats Study Plan



Sacramento River Ecological Flow Study

Off-Channel Habitat Study Plan

Prepared for
The Nature Conservancy
500 Main Street
Chico, CA 95928

Prepared by

Dr. G. Mathias Kondolf
2241 Ward Street
Berkeley, CA 94705

and

Stillwater Sciences
2855 Telegraph Avenue, Suite 400
Berkeley, CA 94705

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Sacramento Ecological Flow Study Off-Channel Habitat Study Plan

1. Introduction

Large rivers like the Sacramento River create a variety of secondary channels (e.g., oxbow lakes, side channels) that are formed by channel migration, cutoff, and avulsion. These secondary channels evolve over time, often as a function of sediment deposition and scour, vegetation colonization and succession, and the buildup of organic detritus from aquatic vegetation. Secondary channels in the Sacramento River corridor provide important habitat for a variety of native species, such as Western Pond Turtle (*Clemmys marmorata*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychochelilus grandis*), California roach (*Hesperoleucus symmetricus*) and Chinook salmon (*Oncorhynchus tshawytscha*).

Large rivers also create shallow-water, seasonally inundated habitats that form as a function of overbank flows (e.g., floodplains) and point bar dynamics (e.g., scour channels on point bars and edge habitat). Shallow-water areas provide important rearing habitat for juvenile salmon (Lister and Genoe 1970, Bjornn and Reiser 1991), including the runs of Chinook salmon that occur in the Sacramento River basin (Sommer et al. 2001).

As with most aquatic riverine habitats, the formation and maintenance of secondary channels is a function of flow and sediment dynamics, both of which have been altered dramatically in the Sacramento River by the construction and operation of water storage and delivery systems. Flow regulation often reduces the frequency and magnitude of high flow events that drive the fundamental processes of bank erosion and meander migration, which are essential for creating off-channel water bodies (OCWBs). Bank armoring activities are designed specifically to halt bank erosion and meander migration, thus preventing the creation of new OCWBs.

Similarly, human activities like bank armoring and flow regulation influence the seasonal inundation of shallow-water habitat in the Sacramento River basin. For example, flow regulation can reduce the magnitude and frequency of high flow events, thereby reducing the frequency, extent, and duration of floodplain inundation. Bank armoring often induces the scour of deeper pools on the outside of meanderbends where rip-rap is typically placed, which in turn causes channel cross sections to become steeper as the channel adjusts (Figure 1). These steeper cross-sections generally reduce the area of shallow water habitat associated with point bars opposite of the armored bank. By preventing bank erosion, armored banks can also deprive a reach of an important sediment supply, so that point bars located immediately downstream of armored banks become smaller than point bars that form downstream of eroding banks (CDWR 1994). The smaller size of point bars reduces the area of shallow-water edge habitat, and it often reduces the area of the eddy zone that forms downstream of point bars. These effects on point bars can reduce important rearing habitat for Chinook salmon fry, and they can reduce the area that supports the colonization of riparian vegetation.

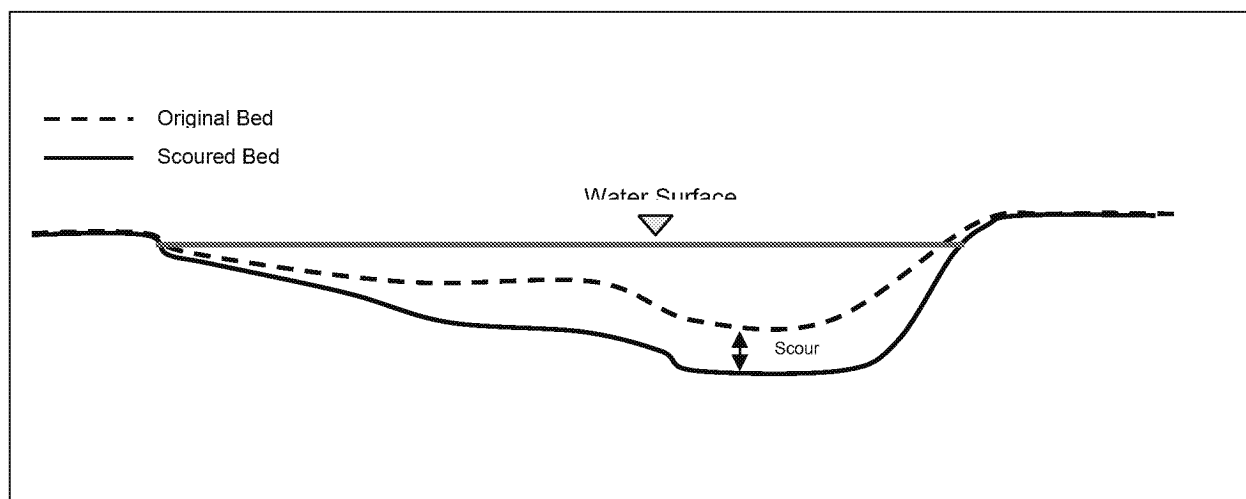


Figure 1. CDWR found thalweg depths in armored bends of the middle Sacramento River to be 6 ft deeper, on average, than those at eroding bank sites. Both CDFG(1983) and CDWR (1994) hypothesized that armored banks induce deeper scour of the bed and cause the cross-sectional slope of the channel to become more steep, thereby reducing the area of channel with suitable hydraulics to support salmonid spawning and rearing.

To develop effective strategies for the conservation and restoration of secondary channel and seasonally inundated habitats, it is important to understand the physical and ecological processes that create these habitats and drive their evolution over time. It is also important to better understand their ecological value in the Sacramento River ecosystem.

Key uncertainties remain in our understanding of the processes that drive the creation and evolution of secondary channel and seasonally inundated habitats in the Sacramento River, and the ecological response to human-induced changes to the physical processes and to water quality in secondary channels. Specifically, we need to understand:

- the mechanisms and flow triggers for meander bend development, cutoff and side channel sedimentation,
- the effects of land and water management on these processes,
- how the hydrologic connectivity of side channels changes with changing mainstem discharge,
- how water quality in side channels is affected by connectivity with the mainstem, by groundwater seepage, and by runoff from surrounding land uses, and
- flow magnitudes required to create shallow-water habitat within the bank full channel.

2. Study Objectives

The goal of this study is to identify potential management measures (e.g., changes in flow releases, changes in bank armoring, excavation of off-channel habitats) that can help to conserve and restore secondary channel habitats and maintain their ecological value for a number of species. To achieve this overarching goal, this study is guided by four primary objectives:

- 1) evaluate the physical processes that create chute cutoffs;
- 2) evaluate the life span of secondary channels as a function of flow and sedimentation;

- 3) survey aquatic vegetation and monitor water quality in secondary channels to identify factors affecting aquatic vegetation composition and distribution; and
- 4) identify flows that create shallow-water, seasonally inundated habitats within the bankfull channel to support juvenile salmonid rearing.

3. Field Studies

3.1 Sediment coring of former channels

In unregulated river systems, overbank flows that inundate former channels (e.g., oxbows, side channels) carry fine sediments that settle out in the lower velocity secondary channels. Over time, secondary channels can accumulate sediment and generally become more shallow and narrow, thereby altering the type of habitat through changes in vegetation, open water area, thermal stratification, etc. However, in river systems regulated by large water supply and flood control dams, it is unclear how changes in sediment supply and high flow events affect sedimentation rates in former channels. Large dams generally reduce the frequency and magnitude of high flow events, thus reducing the number of overbank flows capable of transporting fine sediment into former channels. Dams also tend to reduce the sediment supply by trapping sediment from the upper watershed, which may combine with the reduced frequency of overbank flooding to prolong the longevity of secondary channels by reducing sedimentation. However, land use changes downstream of large dams (e.g., conversion of floodplains to agriculture, timber production in tributaries) can increase the fine sediment supply, thus increasing the potential load of fine sediment that can be deposited in former channels during overbank flow events, even if they occur less frequently because of flow regulation. In the Sacramento River, it is unclear how changes in high flow events and sediment supply caused by dam operations and land use changes have affected sedimentation rates in former channels.

To assess potential changes in the sedimentation rates in secondary channels of the middle Sacramento River (Red Bluff to Colusa), we will compare sedimentation rates of secondary channels that cutoff prior to and after the closure of Shasta Dam. Estimating sedimentation rates in former channels provides an indication of probable longevity and future evolution of such channels.

To estimate the rate of sedimentation in former channels, we will collect sediment cores to determine the depth of fine sediment that has accumulated in them since the time of cutoff and compare sediment depth with the estimated age of each sampled channel. The age of each sampled unit will be estimated by examining historical aerial photos and discharge records.¹ Cores will be collected using a hand auger with a screw bit that is capable of penetrating fine-grained sediment quickly, but which encounters resistance when it hits gravel, which we will initially presume to be the former channel bed at the time of cutoff.²

¹ A separate, but parallel, research effort conducted by Dunne and Constantine of UC Santa Barbara will use radiometric dating of sediments cored from secondary channels of the middle Sacramento River. Radiometric dating will support a more detailed assessment of sedimentation rates that will build on the results of this study.

² Former channels with acute angles to the mainstem may partially fill with gravels after the site has been cut off from the mainstem channel, especially near their upstream ends. We will take this into account in interpreting our results.

We will sample at least 15 former channels in the Sacramento River corridor, sampling virtually all former channels for which we can obtain permits and landowner access (Table 1). We will take at least three samples at each location—at an upstream, midpoint, and downstream location along the axis of each secondary channel. Coring depths will be limited to a maximum of 20 feet because of equipment limitations. Depths may be less when groundwater or coarse gravels are encountered.

Former channels that are inundated year-round will be cored by boat when flow magnitudes in the Sacramento River are sufficient to facilitate navigation. Former channels that are dry at low river stage will be cored when water stages have receded, allowing access by foot.

Key personnel: Matt Kondolf (PI), Julien Levrat, Jose Constantine, Hervé Piégay

Table 1. Sacramento River Cut-off Channels: Potential Study Sites, Ownership, and Access

No.	River Mile	Bank	Name	Ownership
1	147.4	L	Colusa Unit North	CDFG
2	161.2	L	Boggs Bend	Private, soon to be CDFG (~Sept.)
3	167.2	R	Packer Lake	USFWS
4	168.4	R	Old Packer Lake	USFWS
5	168.8	R	Rasor Slough	USFWS
6	170.0	R	Beehive Bend	DFG
7	178.0	R	N/A	Rec Board?
8	179.2	R	N/A	private - Llano Seco Rancho
9	180.8	L	Dodge Opening	private - Llano Seco Rancho
10	182.5	L	The Lagoon	private - Llano Seco Rancho
11	186.0	L	Deadman's Reach	USFWS
12	189.0	R	N/A	Rec Board/Private?/state lands
13	190.0	R	Sam's Slough	USFWS
14	190.0	L	Golden State	private
15	192.0	R	N/A	USFWS/state Lands
16	193.5	R	Capay	USFWS
17	194.5	R	Pine Creek West	DFG
18	195.0	L	Indian Fisheries	State Parks/DFG
19	196.0	L	(Pine Ck Backwater)	DFG/DWR/USFWS
20	203-205	L	Wilson's Landing	DFG
21	206.3	L	GCID	private
22	212.7	L	Merrills Landing	DFG
23	218.4	R	Kopta Slough Main	State Parks
24	221.6	R	Kopta Slough North	TNC
25	234.0	L	Ohm	USFWS
26	234.8	R	Ohm	USFWS
27	236.8	R	La Barranca	BLM/USFWS

Note: Highlighted sites indicate locations for which permits have been obtained (blue) or provisional access has been granted (green).

3.2 Hydrologic Connectivity of Off-Channel Habitats

The manner in which a former channel habitat is connected to the mainstem channel (e.g., whether the channel is connected at the upstream end, at the downstream end, or at both ends) can affect sediment dynamics in the off-channel water body and the rate of sedimentation. Similarly, the magnitude of flow required to inundate an off-channel water body, and the seasonal timing of inundation, can determine its ecological value for different species.

To provide an initial assessment of the hydrologic connectivity of secondary channel habitats, we will observe changes in river stage and flow direction in side channels during the recession limb of a flood, and survey the water surface elevations and establish benchmarks to which the stage can be associated. These benchmarks will then be surveyed by the Department of Water Resources with survey-grade GPS to an accuracy of 2-3 mm. We will work with Constantine at UC Santa Barbara to apply their hydraulic model with a digital elevation model of the river to determine the frequency of overbank flow at upstream and downstream entrances to the former channels, using our field-observed flood-recession-limb flow directions, flow velocities, and stage. We estimate the accuracy of the modeling to be about 1 foot.

Key personnel: Matt Kondolf (PI), Julien Levrat, Jose Constantine, Hervé Piégay

3.3 Macrophyte surveys and water quality sampling

The vegetative cover in an off-channel habitat can affect the habitat value for different species. For example, dense areas of water primrose (*Ludwigia*) may benefit the ambush tactics of non-native bass species that prey on juvenile salmonids (Moyle 2002), while areas of open water may provide better habitat for juvenile salmon (M. Limm, personal communication, May 1, 2005). Similarly, secondary channels with heavy loads of decaying vegetation can cause dissolved oxygen sags, which can favor some species over others. We will survey aquatic macrophytes in up to 15 secondary channels of the Sacramento River to better understand the composition and density of aquatic vegetation in these habitats. The surveys will identify the spatially dominant species of aquatic vegetation with an estimate of the percentage cover for each species.

Previous research on aquatic macrophytes in off-channel habitats of the Rhone River indicates that plant diversity is a function not only of hydrologic connectivity with the mainstem channel, but also of water quality. Water quality can also affect the quality of secondary channel habitats in the Sacramento River for aquatic species like juvenile salmonids. Conditions in secondary channels can range from heterotrophic to eutrophic. Members of the research team will use the Hydrolab Minisonde owned by the TNC Chico office to monitor pH, water temperature, electrical conductivity, and dissolved oxygen in 17 off-channel habitats of the Sacramento River. The secondary channels surveyed for water quality will overlap with those for which sediment cores will be collected and macrophyte surveys will be conducted (Table 1), provided that the sites are inundated during the period of water quality sampling.

Surveys of aquatic macrophytes will be conducted in the fall, 2005, and water quality sampling will be conducted in the fall, 2005 and spring, 2006.

Key personnel: Gudrun Bornette, Ingrid Morken, Sara Puijalon, Julien Levrat, Hervé Piégay

3.4 Scour Channels on Point Bars

Shallow-water habitat provides important rearing habitat for juvenile salmonids, especially salmon fry (Bjornn and Reiser 1991, Lister and Genoe 1970). In a large river system like the Sacramento River, shallow-water habitat usually occurs within the channel along channel margins and point bars. Shallow-water habitat is also created outside of the channel as periodic high flows inundate floodplains that border the river.

Previous research in the Sacramento River suggests that seasonally inundated habitats that fall within the bankfull channel provide important rearing habitat for juvenile salmonids (Limm and Marchetti 2003). Many of these habitat types are associated with point bars where scour channels form on the inner edge of the bar (Figure 2), creating a surface that becomes inundated during periods of elevated flow. When discharge magnitudes drop, these scour channels can become hydraulically disconnected from the mainstem channel, stranding juvenile salmonids (Limm and Marchetti 2003). Subsequent flow pulses that re-connect these seasonally inundated habitats permit stranded juvenile salmonids to re-enter the mainstem channel and continue their downstream migration. Estimating the discharge magnitudes that inundate these seasonal, shallow-water areas can provide flow targets designed to enhance growth opportunities for juvenile salmonids during periods of fry dispersal. Estimating the discharge magnitudes that connect these seasonal habitats with the mainstem channel can also inform the design of spring flow pulses that prevent or reduce stranding of juvenile salmonids. This study component focuses on the reach below Red Bluff Diversion Dam (RBDD) (RM 243.5) because it is the alluvial reach of the Sacramento River where point bar dynamics are still active, and because little is known about salmonid rearing habitat between RBDD and Knight's Landing (RM 89).

Using recent aerial photos (NAIP 2005), we will identify seasonally inundated habitats that occur within the bankfull channel of the middle Sacramento River to develop a pool of candidate study sites. We will conduct a field reconnaissance of the candidate study sites to select at least ten representative sites to sample. For each selected study site, we will use a high resolution GPS to survey a water surface elevation in inundated sites, which we will correlate with the nearest flow gauge to develop a stage-discharge relationship.



Figure 2. Example of a scour channel that forms on the downstream end of a point bar. (Photo Source: CDWR 1999)

Field crews will also plant miniature water temperature recorders within each study site to record areas and periods of inundation. The temperature recorders will sample temperatures at 15-minute intervals. When the temperature recorders are exposed to the open air, the diurnal fluctuations are typically more pronounced than when the recorders are inundated (Figure 3).

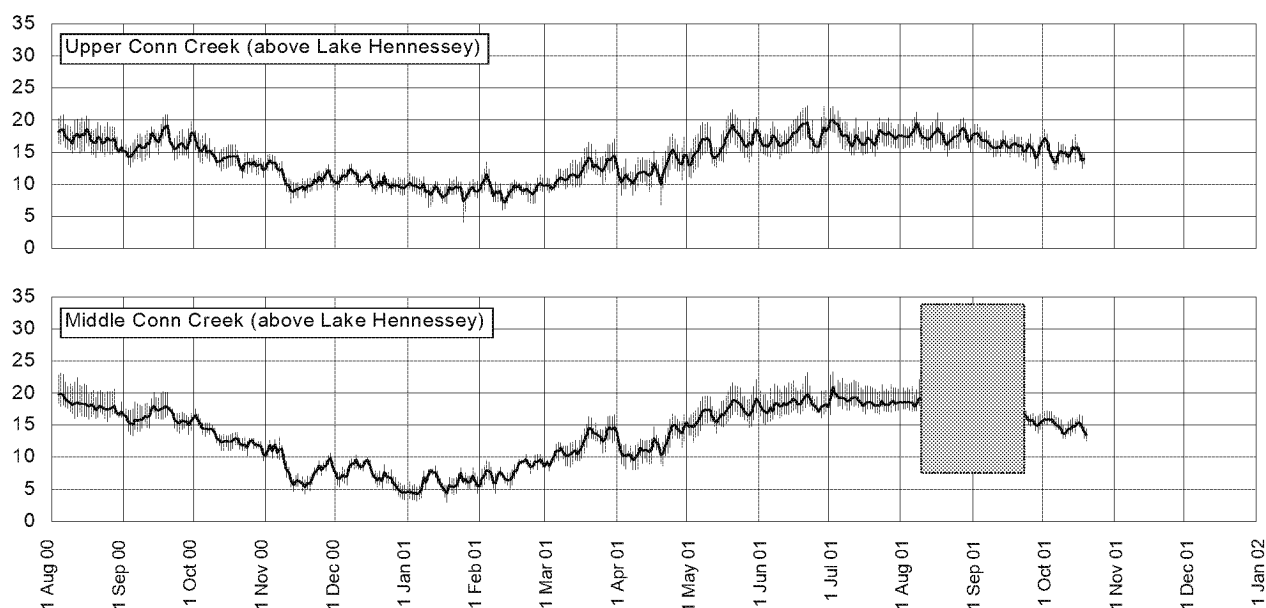


Figure 3. Miniature water temperature recorders can be used to identify periods of inundation and desiccation. Diurnal temperature fluctuations are generally muted during periods of inundation, and more pronounced when they are exposed to the open air (gray box).

By planting temperature recorders throughout the study sites (Figure 4), the time series can be correlated with discharge data from nearby gauges to estimate a stage-discharge relationship. The temperature recorders will also be placed so that estimates of the inundated surface area can be developed at several of the study sites. The elevation of each temperature recorder will be surveyed relative to a temporary benchmark, and the elevation of each temporary benchmark will be surveyed using a differential GPS unit. By comparing the resultant dataset with data from nearby flow gauges, we will develop estimates of the discharge required to inundate the study sites and to characterize inundation characteristics (e.g., depth and area).

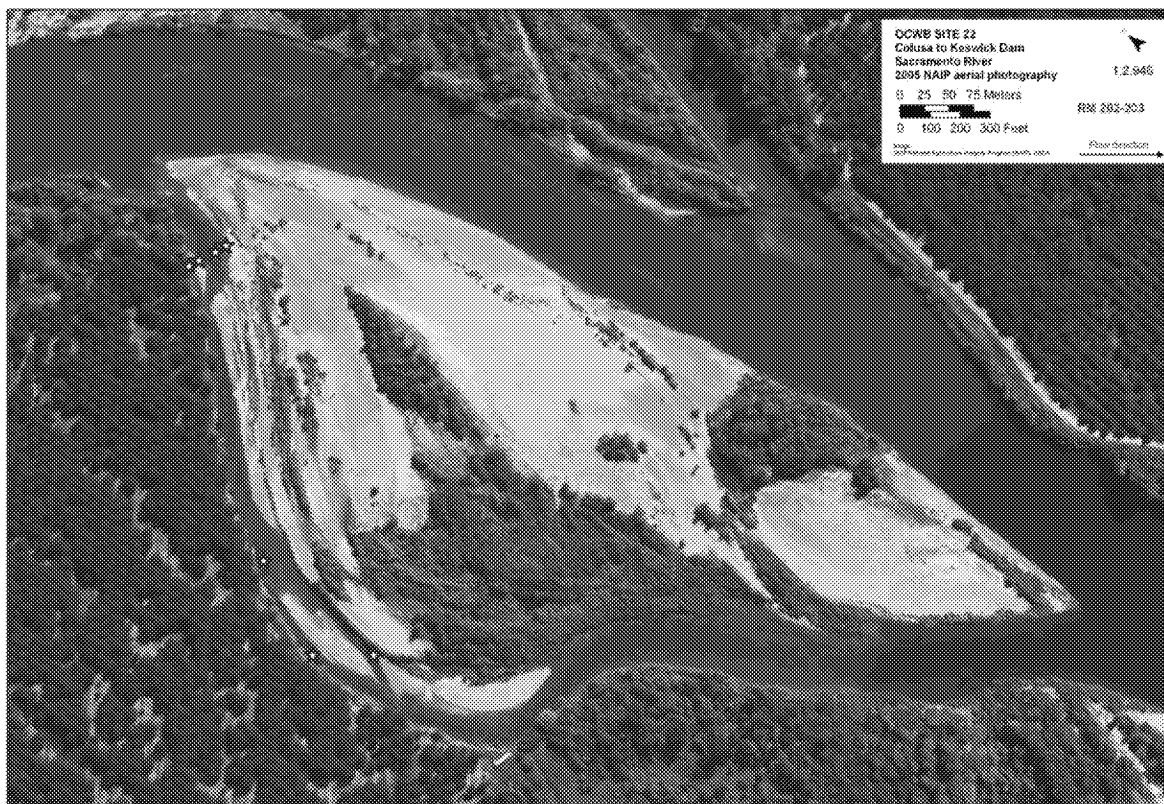


Figure 4. Temperature recorders can be planted throughout a sample site to identify when different elevations are inundated and desiccated. By correlating periods of inundation and desiccation at each temperature recorder with discharge data from nearby flow gauges, it is possible to estimate a stage-discharge relationship for each site. It is also possible to characterize inundation characteristics (e.g., depth, area) for different discharges by correlating the temperature and flow data. The stars in the figure represent the hypothetical location of temperature recorders to facilitate the development of local stage-discharge relationships and inundation characteristics.

For each seasonally inundated habitat unit identified by the inventory, field crews will also estimate the area of inundated habitat by measuring the axial length and width of the inundated surface. For those habitat units that are not inundated during the time of the survey, field crews will measure the axial length and width of the graded surface. We will also characterize sampled habitats in terms of inundated area, water depth, water temperature, and other habitat metrics (e.g., vegetative cover, substrate composition, etc.).

The field survey will be conducted in the winter of 2006-2007 to capture habitat conditions during a period of elevated flow when the target habitats are inundated.

Although the field crew will not directly sample juvenile salmonids, they will record any observations of salmon fry, including the number observed and estimated fork lengths.

Key Personnel: Frank Ligon, Russ Liebig, Michael Fainter, John Wooster

4.0 Modeling

4.1 Chute Cutoff Modeling

Oxbow lakes are a type of off-channel habitat, and they form when meanderbends eventually cut off as flow occupies a new, straighter main channel alignment. Oxbow lakes can form from neck or chute cutoffs. Neck cutoffs occur when the radius of curvature of a meanderbend becomes so extreme that bank erosion eventually scours the narrow “neck” of floodplain that separates the upstream and downstream end of a meanderloop. Therefore, neck cutoffs are primarily a function of bank erosion.

In comparison, chute cutoffs form during high flow events when overbank flows scour a pilot channel on the floodplain and eventually capture the discharge, as illustrated in Figure 5.

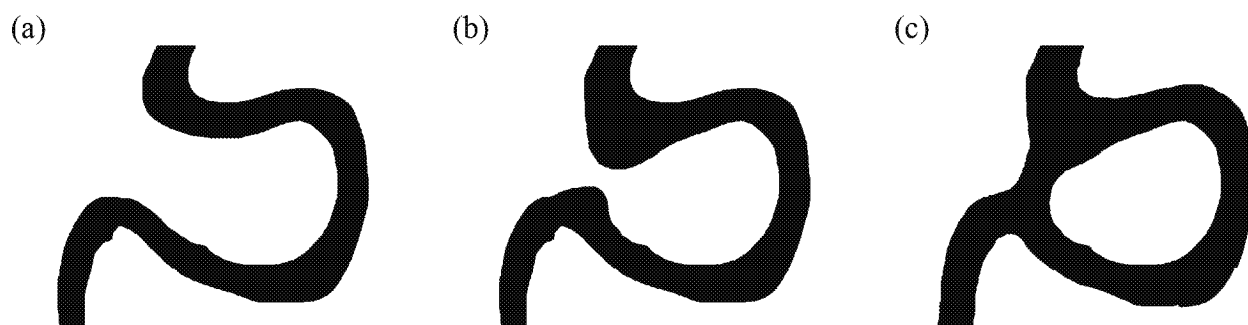


Figure 5. Evolution of a chute cutoff.

During low flow events, flows pass through the existing channel (Figure 5a). With an increase in discharge, water will inundate the lower area near the bend where previous high flow events may have carved the topography lower (Figure 5b). Once the discharge increase is high enough, flow will pass through both the existing channel and the area where the cutoff is to occur (Figure 5c). Although the water in the cutoff area is shallow, its gradient is significantly higher than the existing main channel, which will result in scouring and the promotion of channel cutoff.

Thus, the physical processes that initiate a chute cutoff are different than those that create neck cutoffs. It is possible to identify the potential for neck cutoffs by applying a meander migration model like the one developed by UC Davis, because the model simulates the effects of bank erosion. There is currently no model to simulate how flows initiate chute cutoffs.

We will develop a mechanistically-based, one-dimensional, numerical model to simulate the initiation and evolution of chute-cutoff in low-gradient alluvial rivers. The model can be used to examine what potential flow event is needed to initiate a chute cutoff at a specific site by running different hydrographs through the model. The model will require the following input parameters for an identified cutoff route: (1) topographic data; (2) discharge record; (3) critical shear stress for erosion; (4) other erosional characteristics. Because the model is one-dimensional, the potential cutoff route has to be identified outside of the model and incorporated as an input parameter. The model can be used to evaluate the potential for cutoff for any identified cutoff route on any bend in the river.

The chute cutoff model will be developed using a potential chute cutoff at RM 172 to predict the

Dr. G. Mathias Kondolf and Stillwater Sciences

flow events required to initiate chute cutoff at that site.

Conceptual model and coding for the chute cutoff model will be conducted between March and July, 2005. A field tour of potential chute cutoff sites will be conducted in July, 2005. Debugging of the chute cutoff model, using site-specific information from the cutoff at RM 212-215, will be conducted between November, 2005 and June, 2007. Application of the chute cutoff model to a potential chute cutoff at RM 172 will be conducted between October, 2006 and July, 2007.

Key Personnel: Yantao Cui, Lisa Micheli, Bill Dietrich

5.0 References

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From: Janis Offermann [janis@horizonh2o.com]
Sent: 1/19/2021 10:07:41 AM
To: Kevin Spesert [kspesert@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]
CC: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Subject: Revised Sites Reservoir figures
Attachments: Figure_ArchaeoIsolates.pdf; Figure_ArchaeoSites.pdf

Hi, Kevin and Ali

I had my GIS staff update the figures depicting archaeological site and isolate locations with the new project footprints. Laverne had mentioned that he would like to see this. Although I am sure his GIS staff could do it, I told him we would create the figures. I am sending them to you for review prior to passing them along to him. I will also send them to Colusa so that they have the most up-to-date information.

Thanks
janis

Janis Offermann

Cultural Resources Practice Leader
Horizon Water and Environment
400 Capitol Mall, Suite 2500
Sacramento, CA 95814
916.465.8076 – office
530.220.4918 – mobile

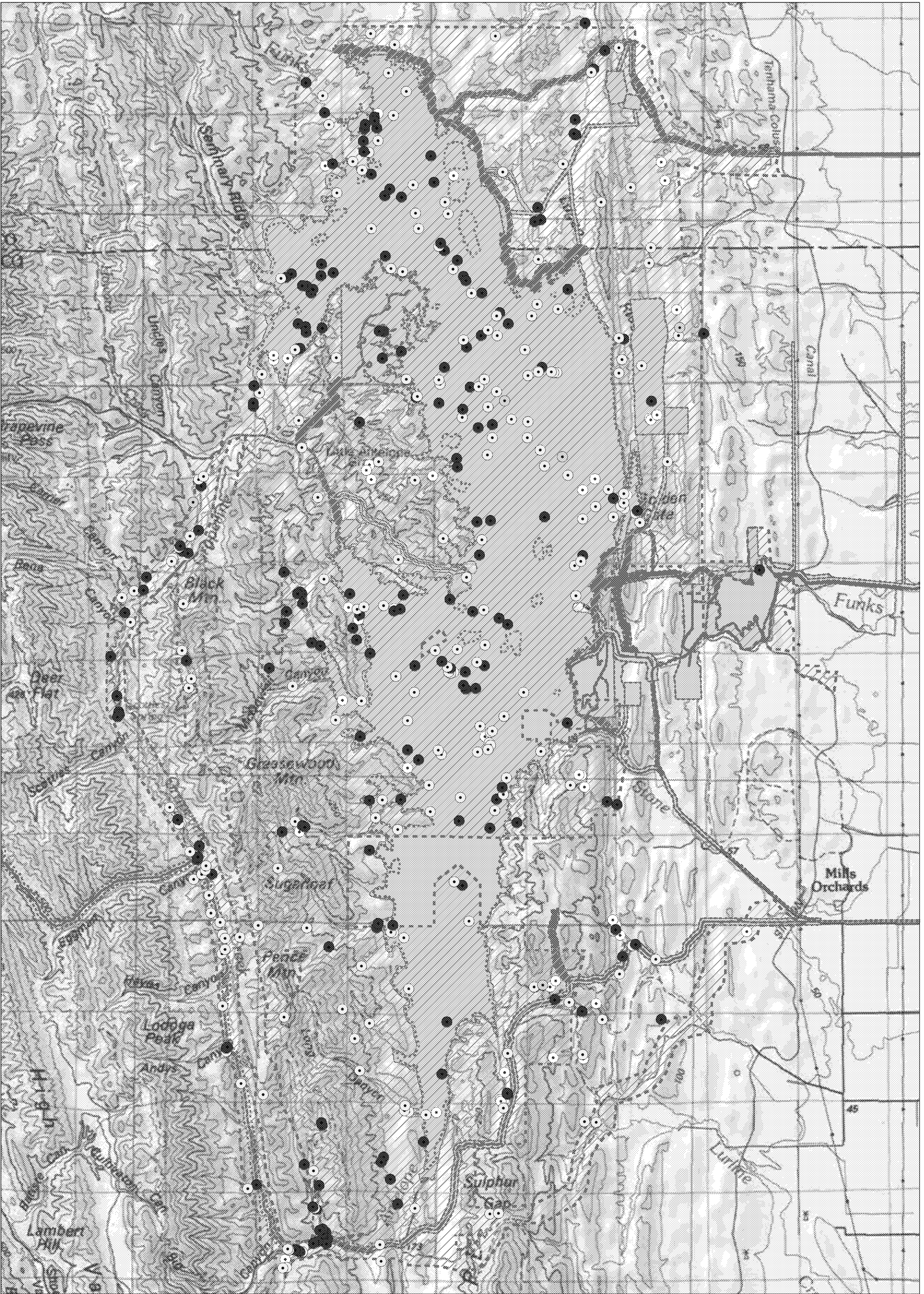
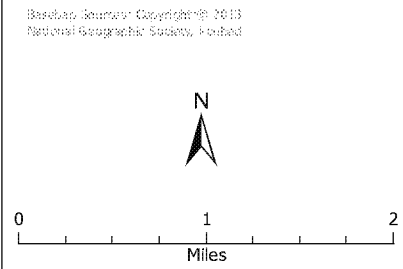
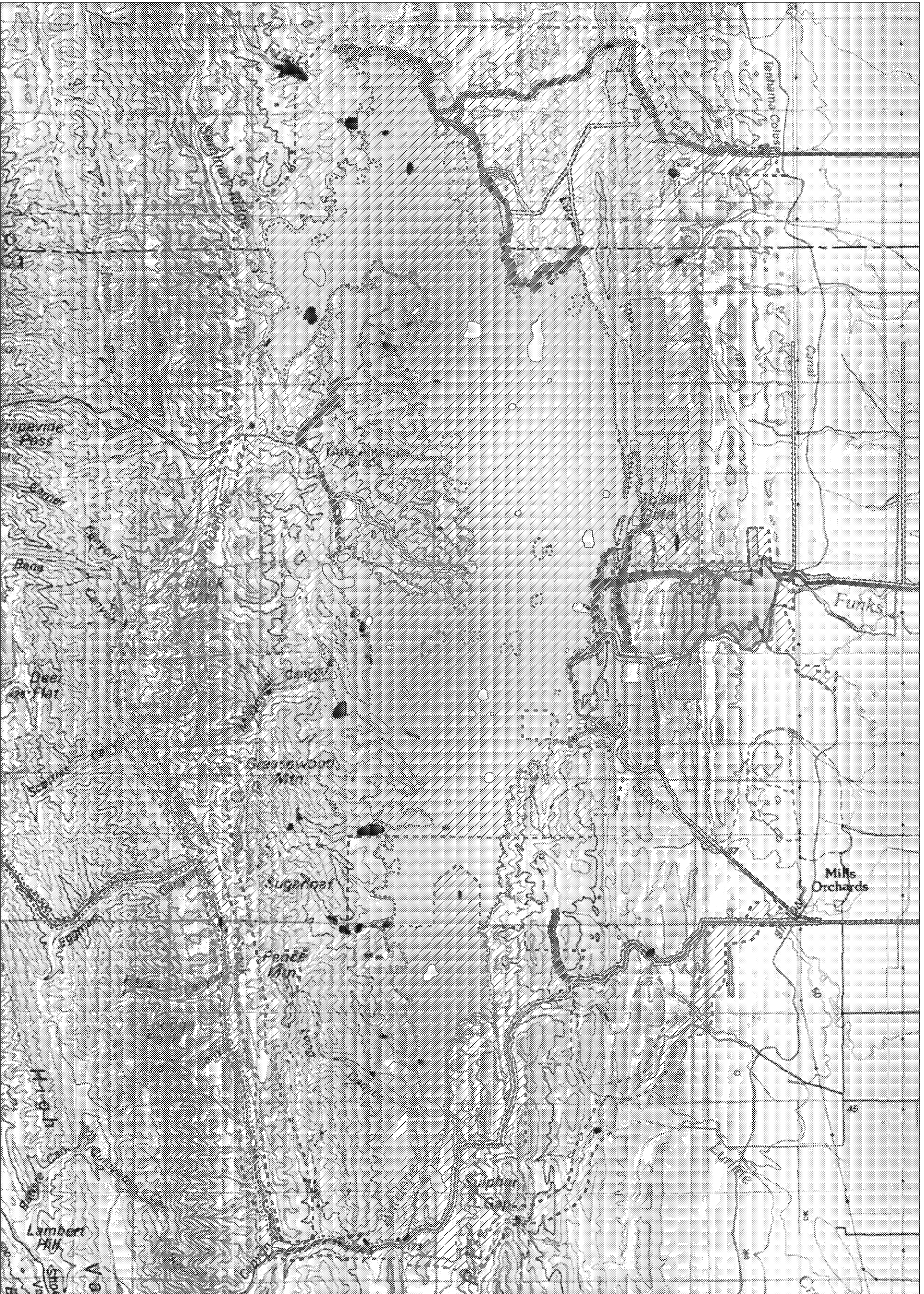
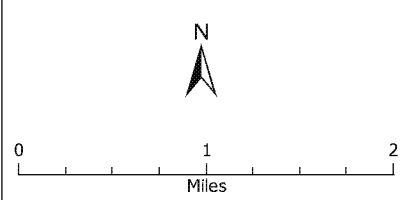


Figure X
Archaeological Isolate Locations
in the Sites Reservoir Portion
of the Study Area





Baseline Source: Copyright © 2013
National Geographic Society, Inc.



Cultural Resource Site

- Historic
- Multicomponent
- Prehistoric

Previously Surveyed

- Alternative 1
- Alternative 2

Figure X
Archaeological Site Locations in
the Sites Reservoir Portion
of the Study Area

Sites Reservoir

From: Cooke, Robert@DWR [Robert.Cooke@water.ca.gov]
Sent: 1/19/2021 10:32:14 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
CC: Jerry Brown [jbrown@sitesproject.org]; Okita, David@DWR [David.Okita@water.ca.gov]
Subject: RE: WSIP CEQA

Thanks Ali for your quick response. I have an internal DWR meeting to discuss this issue further on Thursday.

In response to your question "In reading David's email below, he states "and make sure that document meeting all DWR CEQA needs for that project". What does this mean and how would we accomplish this?"

DWR must have CEQA coverage on the WSIP projects that allows it to make certain decisions "adequate decision documents". We are in the process to filling out that spreadsheet outlining all the decisions DWR must make. This spreadsheet will help DWR get its arms around the CEQA needed.

After we finish drafting the spreadsheet, it would be good for you to make sure the list is complete, at least for the Sites WSIP Project, and make sure we have addressed and satisfied the potential environmental impacts. DWR's goal is to make sure this is done on all the WSIP Projects, separately and cumulatively.

Rob-

Rob Cooke
Principal Engineer, PE, RA
Department of Water Resources
(916) 365-7915

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Tuesday, January 19, 2021 4:57 AM
To: Cooke, Robert@DWR <Robert.Cooke@water.ca.gov>
Cc: Jerry Brown <jbrown@sitesproject.org>
Subject: RE: WSIP CEQA

Hi Rob – The short answer is yes. As we revise the Draft EIR, we intend to list DWR as a Responsible Agency. Right now we are focusing on the following actions for DWR – Cooperative Operations with Sites (Exchanges at Oroville, diversion of Sites water at Banks, and use of SWP Facilities south of Delta), and contract for flood protection and recreation benefits.

In reading David's email below, he states "and make sure that document meeting all DWR CEQA needs for that project". What does this mean and how would we accomplish this?

Ali

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

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From: Cooke, Robert@DWR <Robert.Cooke@water.ca.gov>
Sent: Monday, January 18, 2021 1:55 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>

Cc: Jerry Brown <jbrown@sitesproject.org>

Subject: FW: WSIP CEQA

Ali,

I've been asked to confirm question #3 below from David Okita. Can you please confirm for me? I'm assuming the answer is yes, DWR will be recognized as a Responsible Agency and the document will meet DWR's CEQA needs and will be routed through DWR for compliance type comments.

Rob-

Rob Cooke

Principal Engineer, PE, RA

Department of Water Resources

(916) 365-7915

From: Okita, David@DWR <David.Okita@water.ca.gov>

Sent: Thursday, January 14, 2021 8:21 AM

To: Tang, Hoan@DWR <Hoan.Tang@water.ca.gov>; Deaver, Katerina@DWR <Katerina.Deaver@water.ca.gov>; Gordon, David@DWR <David.Gordon@water.ca.gov>; Sandino, David@DWR <David.Sandino@water.ca.gov>; Kirkland, Marianne@DWR <Marianne.Kirkland@water.ca.gov>; Maroney, Jagruti@DWR <Jagruti.Maroney@water.ca.gov>; Cooke, Robert@DWR <Robert.Cooke@water.ca.gov>

Subject: WSIP CEQA

We are working on the scope of work for the Initial Study for State Agency actions for the WSIP projects. As part of this process we need to identify DWR actions we want covered in the IS.

We have a meeting with SWRCB, DFW and AECOM on 1/28 where we will go over the draft scope (under development) and ask them what actions they want covered in the IS.

Attached is a spreadsheet showing State actions I have identified associated with WSIP projects. I will be sending this out with the agenda for the 1/28 meeting, but wanted to give DWR a head start on this. We don't have to make a decision on 1/28, but we will in the next month or so to finalize the scope of work.

Based on earlier discussions with David Sandino, DWR will be issuing a Notice of Determination and CEQA Findings when we approve agreements/amendments for WSIP projects. Because each of the WSIP project have or will have their own CEQA documents, we need to determine if existing or future CEQA documents meet DWR needs for approvals - or if we need to cover it under the new State agency CEQA document. The IS will determine if a MND or EIR is necessary.

So... I have the following assignments and questions.

1. David Sandino - do the public benefit contracts that DWR is responsible for need CEQA coverage?
2. For Los Vaqueros Katerina is reviewing LVE FEIR/EIS to see if that document provides adequate coverage
3. For Sites I assume that when they revise EIR to reflect a smaller reservoir that DWR will be recognized as a Responsible Agency and make sure that document meeting all DWR CEQA needs for that project - Rob Cooke please confirm.
4. For 3 Pulse flow projects the Initial Study will need to address San Luis Reservoir and Oroville impacts. We will assume that local CEQA documents cover local impacts.
5. For Kern Fan - Marianne to work with Katerina to see if FEIR is adequate for new turnout agreement.

6. For Willow Springs - Marianne to work with Katerina to see if prior EIRs are adequate for new turnout agreement. Since This project is uncertain, just a cursory review at this time is needed and we can decide on coverage later.
7. Hoan - feel free to give this to AECOM so they can see what we are doing.

David Okita, PE
Department of Water Resources
530 902-7588

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 1/19/2021 1:33:54 PM
To: Jerry Brown [jbrown@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: Alt 3 - Proposed Breakdown

Sounds good. I asked for an answer by the end of the week. They are going to request we change our preferred alternative to Alt 3 so they can consult on that action... just want to give you the heads up.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

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From: Jerry Brown <jbrown@sitesproject.org>
Sent: Tuesday, January 19, 2021 1:09 PM
To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Re: Alt 3 - Proposed Breakdown

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

I think this works. Give them a deadline to get it done.

From: "Heydinger, Erin" <Erin.Heydinger@hdrinc.com>
Date: Tuesday, January 19, 2021 at 12:08 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>, Jerry Brown <jbrown@sitesproject.org>
Subject: RE: Alt 3 - Proposed Breakdown

Also, Jerry, I asked Reclamation staff what they thought was the best way to get this finalized and move on. They suggested routing it through the technical team to management. So, I suggest we do not put management on the spot this afternoon for concurrence since they won't have had a chance to talk to the technical team to see if they think it could work.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

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From: Heydinger, Erin
Sent: Tuesday, January 19, 2021 12:04 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Jerry Brown <jbrown@sitesproject.org>
Subject: Alt 3 - Proposed Breakdown

Hi Ali and Jerry,

Here's what I'd like to propose for the storage breakdown for Alt 3. I also included the other alternatives as a reference.

	Alt 1A	Alt 1B	Alt 2	Alt 3
Total Storage	1500	1500	1270	1500
Dead Pool	120	120	120	120
Total PWA Storage	1136	1045	906	791
Sac Valley	279	257	223	101
South of Delta	857	788	683	690
Federal	0	91	0	345
State	244	244	244	244

For Alt 1B, we assume proportional reduction in all investors to accommodate Reclamation. Same with Alt 2 for the smaller reservoir. For Alt 3, I ran the conversion assuming:

GCID = 1,500 AFY

TCCA = 15,000 AFY

RD108 = 0 AFY

Colusa County = 5,000 AFY (we didn't speak to the County specifically about reducing their storage so I didn't want to assume too much of a drop)

This does show a drop in SOD, but a greater % of the reduction comes from the Sac Valley. **I had a chance to run this by staff at Reclamation and while they need management buy-in, they did think this alternative would be workable for them.**

These conversions assume State and Federal storage is set based on investment and the rest is divided proportionally based on subscriptions.

Let me know what you think.

Thanks,
Erin

Erin Heydinger, PE, PMP
Asst. Project Manager
Water/Wastewater

HDR
2379 Gateway Oaks Dr, #200
Sacramento, CA 95833
D 916.679.8863 M 651.307.9758

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From: Berryman, Ellen [Ellen.Berryman@icf.com]
Sent: 1/20/2021 11:12:30 AM
To: Cordova, Daniel A [dcordova@usbr.gov]; Dekar, Melissa D [mdekar@usbr.gov]; Torres, Juan@Wildlife [Juan.Torres@wildlife.ca.gov]; Boyd, Ian@Wildlife [Ian.Boyd@Wildlife.ca.gov]; Kearns, Zachary@Wildlife [Zachary.Kearns@Wildlife.ca.gov]; Wilson, Billie@Wildlife [Billie.Wilson@wildlife.ca.gov]
CC: John Spranza [John.Spranza@hdrinc.com]; Briard, Monique [Monique.Briard@icf.com]; Haire, Jennifer [Jennifer.Haire@icf.com]; Alicia Forsythe [ali@forsythe-group.com]
Subject: Sites Reservoir, terrestrial species models
Attachments: Sites_Crotch_Western_bumble_bee_species_model.docx; Sites_SWHA_model description.docx; Sites_Tricolored Blackbird_model description.docx; Sites_VELB_Species_Model Description.docx; Sites_VP_Crustacean_Species_Model Description.docx; Sites_YBCU_Checkermallow_Bird-Beak_Species_Model Description.docx; Sites_GGS_model description.docx; Sites_CRLF_Species_Model Description.docx

Greetings BOR and CDFW folks,

I hope you're all well and having a good new year. As we discussed during meetings last year, here are the terrestrial models of state and federally listed species potentially affected by the Sites Reservoir Project, for your review.

The attachments include both state and federally listed species, so you can disregard the species not relevant to your respective agency. Dan, as we discussed earlier, we're sending the models to BOR for review before forwarding to USFWS.

We would very much appreciate your input on these models by November 11, if possible, so we can incorporate any needed revisions prior to analyzing impacts for the EIR/S. If there are significant outstanding issues resulting from your review, we'd like to set up a subsequent meeting for resolution.

CDFW has already reviewed and ok'ed the GGS model description, after we incorporated their comments. The only model revisions since then were editorial and format related.

Feel free to email or call me at (530) 798-1945 if you have any questions or which to discuss anything.

Thank you!!!

Ellen

Crotch bumble bee

In California, Crotch bumble bee historically occurred on the Pacific coast and in the western desert, Central Valley, and adjacent foothills (Williams et al. 2014:114–116, 132). Crotch bumble bee now appears to be absent from much of its historic range in the southern two-thirds of California, including the Central Valley (Xerces Society 2018:17, 32–35, 43, Hatfield et al 2014). Based on Williams et al. (2014:114–116, 132) and a review of CNDDDB records (California Department of Fish and Wildlife 2020; no page number), Crotch bumble bee forages and nests in open grasslands and scrub habitats in California. Crotch bumble bees are generalist foragers that feed on a variety of widely distributed plant genera including *Antirrhinum*, *Phacelia*, *Clarkia*, *Dendromecon*, *Eschscholzia*, and *Eriogonum* (Koch et al. 2012:82).

Habitat Model Description

The parameters of the modeled habitat for Crotch bumble bee consist of land cover types that could provide both suitable floral resources and nesting sites for the species and would therefore be considered suitable habitat. These land cover types consist of annual grasslands, seasonal wetlands, chamise, mixed chaparral, oak savannah, and ruderal areas adjacent to these land cover types. Crotch bumble bee's range includes the Central Valley and thus the geographic extent of the model covers the entire study area.

Assumptions

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption: Potentially suitable Crotch bumble bee habitat consists of annual grasslands, seasonal wetlands, chamise, mixed chaparral, oak savannah, and ruderal areas adjacent to these land cover types.

Rationale: In California, Crotch bumble bee inhabits open grasslands and scrub habitats (Xerces Society 2018:32). A generalist forager, the plant families most commonly associated with Crotch bumble bee include Fabaceae, Apocynaceae, Asteraceae, Lamiaceae, and Boraginaceae (Richardson 2017). In an analysis conducted by Thorp et al. (1983), based on California records, Crotch bumble bee was found to be associated with Fabaceae, Lamiaceae, Hydrophyloideae, Asclepiadoideae, and Asteraceae. These floral associations do not necessarily represent the species' foraging preference, but a representation of the prevalence of these flower types across the landscape (Xerces Society 2018: 32).

Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., Confirming that areas mapped provide suitable nesting and foraging habitats). Bumble bees require the availability of nectar and pollen from floral resources throughout the duration of the colony period (spring, summer, and fall) (Xerces Society et al. 2018: 30); however, based on aerial imagery only, it is not possible to determine if sufficient flowering resources are present year round within the modelled habitat. It is assumed that suitable

land covers provide the floral resources to support bumble bee populations. Thus, the model provides a conservative estimate of potentially suitable Crotch bumble bee habitat because all mapped nesting and foraging habitats are deemed to be equally suitable.

References¹

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¹ References are in the process of being collected and may be modified based on refinement of the model.

Western bumble bee

The known range of the Western bumble bee extends throughout California, although populations from Central California to the southern British Columbia border have declined sharply since the late 1990s, particularly from lower elevation sites (Williams et al 2014:116; Hatfield et al. 2015). Western bumble bee populations are currently largely restricted to high elevation sites in the Sierra Nevada (Xerces Society 2018: 6). The habitat for this species varies widely and includes open grassy areas, urban parks and gardens, chaparral and scrub lands, and mountain meadows (Williams et al 2014:116). Western bumble bee feeds on a wide variety of flowering plants and has been documented visiting *Melilotus*, *Ceanothus*, *Centaurea*, *Cirsium*, *Trifolium*, *Centaurea*, *Chrysothamnus*, *Eriogonum*, *Lupines*, *Rubus*, *Solidago* (Williams et al 2014:116).

Habitat Model Description

The parameters of the modeled habitat for Western bumble bee consist of land cover types that could provide suitable floral resources and nesting sites for the species and would therefore be considered suitable habitat. These land covers consist of annual grassland, seasonal wetland, oak savannah, mixed chaparral, chamise, and ruderal areas adjacent to these land cover types.

Assumptions

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption: Potentially suitable Western bumble bee habitat consists of annual grasslands, seasonal wetlands, oak savannah, mixed chaparral, chamise, and ruderal areas adjacent to these land cover types.

Rationale: In California, Western bumble bee inhabits grassy areas, urban parks and gardens, chaparral and scrub lands, and mountain meadows (Williams et al 2014:116). Meadows and grasslands with abundant floral resources provide suitable habitat for this species (Xerces Society 2018:33). A generalist forager, the plant families most commonly associated with Western bumble bee include *Cirsium*, *Eriogonum*, *Solidago*, *Aster*, *Ceanothus*, *Centaurea*, and *Penstemon* (Xerces Society 2018: 34). An analysis by Thorp et al. (1983) reported Western bumble bee primarily associated with plants in the Fabaceae, Asteraceae, Rhamnaceae, and Rosaceae families. These floral associations do not necessarily represent the species preference over other flowering plants but represent the abundance of these flowers in the landscape (Xerces Society 2018: 34).

Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., Confirming that areas mapped provide suitable nesting and foraging habitats). Bumble bees require the availability of nectar and pollen from floral resources throughout the duration of the colony period (spring, summer, and fall) (Xerces Society et al. 2018: 30); however, based on aerial imagery only, it is not possible to determine if sufficient flowering resources are present year round within the modelled habitat. It is assumed that suitable land covers provide the floral resources to support bumble bee populations. Additionally,

populations of bumble bees can be negatively affected by pathogen and pesticides (Xerces Society et al. 2018: 30, 31); the presence or absence of pathogens and pesticides, and the landscape level habitat quality, based on aerial imagery, are not considered in the model. Because bumble bees are sensitive to habitat fragmentation, isolated patches of habitat (e.g., habitat fragments that are too small or too distant from surrounding habitat to support diverse bumble bee communities) are not sufficient to fully support bumble bee populations (Xerces Society et al. 2018: 31, Hatfield and LeBuhn 2007: 154-157). The model provides a conservative estimate of potentially suitable Western bumble bee habitat because all mapped nesting and foraging habitats are deemed to be equally suitable.

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DRAFT

Swainson's Hawk

Throughout much of its range, Swainson's hawk (*Buteo swainsoni*) inhabits grasslands, prairies, shrub-steppes, and agricultural landscapes, including dry and irrigated row crop fields, alfalfa and hay fields, pastures, and rangelands. They most often nest in trees in riparian woodlands and farm shelterbelts (Bechard et al. 2020: 3), as well as in urban/suburban areas with large trees adjacent to suitable foraging habitat (England et al. 1995: 180 -183; James 1992: 773) and lone oak trees and oak groves (Estep 1989: i, 11, England et al. 1995: 181-184, Bechard et al. 2020: 4). Nest sites are generally adjacent to, or within flying distance to suitable foraging habitat and near large tracts of agricultural lands (California Department of Fish and Game 2016: 8).

Habitat Model Description

The parameters of the modeled nesting habitat for Swainson's hawk consist of upland riparian¹, blue oak woodland, oak savannah, ornamental woodland, and forested wetland land cover types. Isolated tree stands and isolated trees in agricultural fields or field borders or semi-developed areas were mapped as oak savannah or ornamental woodland and were included as potential nesting habitat, to the extent that they were mapped. Modeled foraging habitat consists of natural foraging areas (annual grassland, oak savannah, seasonal wetland, ruderal), and managed areas (managed wetland, row crops, and hay fields). The oak savannah land cover type is considered nesting and foraging habitat because it provides trees suitable for nesting and foraging opportunities.

Assumptions and Rationales

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption: Potentially suitable Swainson's hawk nesting habitat consists of upland riparian, blue oak woodland, oak savannah, ornamental woodland, and forested wetland land cover types.

Rationale: In the Central Valley, Swainson's hawk frequently nest in large native trees such as valley oak (*Quercus lobata*), cottonwood (*Populus fremontii*), walnut (*Juglans hindsii*), and willow (*Salix* spp.), and occasionally in nonnative trees such as eucalyptus (*Eucalyptus* spp.), however any suitable tree may be used (Estep 1989: 35, England et al. 1995: 181-184, Bechard et al. 2020: 4). Strips of remnant riparian forest along drainages contain the majority of known nests in the Central Valley, which may be a function of nest tree availability (Estep 1984: 3, 16; Schlorff and Bloom 1984: 615-617; Bechard et al. 2020: 3). Swainson's hawk nest sites have also been found at the periphery of riparian woodlands, in roadside trees, trees along field borders, isolated trees, small groves, and on the edges of remnant oak woodlands (California Department of Fish and Game 2016: 6, Anderson et al. 2007: 3, 5, Woodbridge 1998: 5).

Assumption: Potentially suitable Swainson's hawk foraging habitat consists of annual grassland, oak savannah, seasonal wetland, managed wetland, row crops, and hay fields.

¹ The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to but above the stream ordinary high-water mark) that include valley foothill riparian species as well as blue oak, foothill pine, ornamental trees, and other shrub and tree vegetation that were not identifiable from aerial imagery. Orchards and other agricultural lands are not included in this land cover type.

Rationale: Swainson's hawks are essentially plains or open-country hunters, requiring large areas of open landscape for foraging. Historically, the species used the grasslands and relatively sparse shrublands of the Central Valley and other inland valleys, and valley oak savanna (California Department of Fish and Game 2016: 5). The hawks also forage in wetland during the dry summer months when the vegetation in these wetlands is being mowed or disked (California Department of Fish and Game 2016: 5); at other times of the year (i.e., when inundated), wetlands are relatively unavailable for foraging (California Department of Fish and Game 2016: 7). With substantial conversion of natural foraging habitats to farming operations, Swainson's hawks have had to rely more heavily on agricultural lands for foraging. In the Central Valley, Swainson's hawks forage more often in mixed agricultural lands that provide low, open vegetation for hunting and relatively abundant rodent prey populations (California Department of Fish and Game 2016:7). Important land cover for foraging are alfalfa and other irrigated hay crops, grain and row crops, fallow fields, dryland pasture, grassy ruderal lots, and annual grasslands (Swologard et al. 2008: 192, 194; California Department of Fish and Game 2016: 7).

Model Limitations

The model provides a conservative estimate of potentially suitable Swainson's hawk habitat because all mapped nesting and foraging habitats are deemed to be equally suitable. The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., confirming areas mapped provide suitable nesting and foraging habitats). For example, the field-level value of the agricultural crop types can change across the landscape as agricultural land use (e.g., land and farming patterns, agricultural practices, harvesting regimes) and farming operations (e.g., weekly irrigation and monthly mowing during the growing season) are seasonally rotated, thus there is a high degree of variability in the suitability of these agricultural lands. In the Central Valley, specific crop structure and timing of agricultural practice are important in determining the foraging value of a field at any given time (California Department of Fish and Game 2016: 7); however, the model does not factor in changes in crop cultivation over time.

The heights of potentially suitable nest trees are also not discernable from aerial imagery and may be an important factor in nest site selection for the species; studies show the average height of nest trees range from 41.3 feet (12.6 meters) to 82 feet (25 meters) (California Department of Fish and Game 2016: 6). Swainson's hawk have been known to nest in lone trees in agricultural fields or pastures, roadside trees adjacent to suitable foraging habitat (California Department of Fish and Game 2016: 6) and lone oak trees and oak groves (Estep 1989: i, 11, England et al. 1995: 181-184, Bechard et al. 2020:4). To the extent possible, the model includes individual large trees that were surrounded by natural land cover (e.g., annual grassland) as oak savannah; however, not all individual trees in developed areas were mapped, thus the model may underestimate the extent and distribution of potential suitable nesting habitat.

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Tricolored Blackbird

Tricolored blackbird (*Agelaius tricolor*) colonies require access to water, suitable nesting substrates (including marsh vegetation or thorny or spiny vegetation), and foraging habitat (including semi-natural grasslands, agricultural croplands, or alkali scrub habitats) with significant populations of insect prey within a few miles of colonies (Beedy et al. 2020:1; Hamilton 2004:3). Tricolored blackbirds utilize a wide range of foraging substrates, including grasslands, irrigated pastures, grain fields, shallow wetlands, alkali scrub habitats, rice paddies, alfalfa fields, sunflower fields, stored grain, and the air above wetland colonies when aquatic insects are hatching (Beedy et al. 2020:1).

Habitat Model Description

Freshwater marsh, managed wetland, and scrub-shrub wetland land cover types are defined as tricolored blackbird nesting habitat in the model. Annual grassland, seasonal wetland, row crops, and rice are defined as foraging habitat in the model. Additionally, ruderal land cover that is adjacent to another defined foraging land cover type is also included as foraging habitat; ruderal land cover that is not adjacent to foraging habitat is not considered to be suitable foraging habitat. Foraging habitat in the model is located within 3 miles of suitable nesting habitat.

Assumptions and Rationales

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption: Potentially occupied tricolored blackbird nesting habitats consist of freshwater marsh, managed wetland, and scrub-shrub wetland land cover types.

Rationale: Historically (in the 1930s), the majority of tricolored blackbird breeding colonies in the Sacramento Valley were in freshwater marshes dominated by nesting substrate (e.g., cattail [*Typha* sp.], bulrush [*Schoenoplectus* sp.]) that was flooded (Neff 1937:78, Beedy et al. 2020:1). By the 1970s, approximately half of the colonies reported in the Sacramento and San Joaquin Valleys were in wetland vegetation (DeHaven et al. 1975:171, 172). Although the primary nesting substrate used by tricolored blackbirds have different distributions across the breeding range in California (Cook and Toft 2005:80), wetlands with cattail and bulrush substrates are used throughout the breeding range (Graves et al. 2013:2850, 2852) and nesting continues to occur in wetlands (Beedy et al. 2020:1).

Assumption: Modeled foraging habitats consist of annual grassland, seasonal wetland, and agricultural fields (e.g., row crops and rice). Ruderal land cover that is adjacent to other defined foraging land cover is also included as foraging habitat in the model. Ruderal land cover that is not adjacent to other defined foraging land cover is not considered suitable foraging habitat.

Rationale: Tricolored blackbird forages in a wide variety of habitats that may provide sources of seeds and invertebrates (Beedy et al. 2020:1). Historically, native foraging habitats that supported abundant insect prey items and vegetative diet items (e.g., seeds) were grasslands, shrublands, wetlands, riparian, scrub, and other forested habitats (U.S. Fish and Wildlife Service 2019:13). With the loss of the majority of wetlands and perennial grassland, tricolored

blackbirds have shifted to utilizing agricultural-associated habitats and other nonnative vegetation to replace and or supplement their foraging needs (U.S. Fish and Wildlife Service 2019:14–16). Primary foraging habitats for breeding tricolored blackbirds now consists of grasslands, low-density shrublands (e.g., alkali scrub), pastures, dry seasonal pools, and certain agricultural crops such as alfalfa and rice (California Department of Fish and Wildlife 2018:28). For a breeding colony to be successful, adults require abundant insect prey items for egg production and to feed nestlings (California Department of Fish and Wildlife 2018:28–30). Within the study area, the availability of insect prey in isolated patches of ruderal vegetation is likely low; ruderal vegetation that is not adjacent to other foraging land cover types would not likely contain enough prey to support breeding colonies. Vineyards, orchards, and row crops (e.g., sugar beets, corn, peas, beets, onions) do not provide suitable foraging habitat or nesting substrates for tricolored blackbird (Beedy et al. 2018:6, California Department of Fish and Wildlife 2018:30). “Conventional” rice paddies provide limited or no breeding season foraging opportunities, but organic and unsprayed (by insecticides) rice paddies may provide abundant insect populations that breeding colonies need (Beedy et al. 2020:1).

Assumption: Potentially suitable foraging habitat occurs within 3 miles (4.83 kilometers [km]) of nesting habitat.

Rationale: Tricolored blackbirds forage almost exclusively away from the nesting territory and breeding colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site (California Department of Fish and Wildlife 2018:28). Adults feeding young typically forage within 3.11 miles (5 km) of the colony but can range up to 8 miles (13 km) from the colony (Beedy et al. 2018:6, California Department of Fish and Wildlife 2018:2, Beedy and Hamilton 1997:5). The proximity to highly abundant insect food supplies is an important factor in the selection of breeding sites by tricolored blackbirds (Orians 1961:290, 292; California Department of Fish and Wildlife 2018:28). Data is not available to define the minimum extent of foraging habitat; however, studies show that breeding colonies with less than 200–300 acres (81–121 hectares) of foraging habitat do not persist and several thousand acres are necessary to maintain large colonies (Hamilton 2004:10, California Department of Fish and Wildlife 2018:28).

Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., confirming areas mapped provide suitable nesting and foraging habitats). The model provides a conservative estimate of potentially suitable tricolored blackbird habitat because all mapped nesting and foraging habitats are deemed to be equally suitable.

Tricolored blackbirds have been documented nesting in thorny or spiny vegetation such as Himalayan blackberry (*Rubus armeniacus*), willow (*Salix* sp.), wild rose (*Rosa* sp.), milk thistle (*Silybum marianum*), nettle (*Urtica* sp.), and bull thistle (*Cirsium vulgare*) (DeHaven et al. 1975:171, 172; Beedy and Hamilton 1997:4, Graves et al. 2013:2852, Beedy et al. 2020:1, California Department of Fish and Wildlife 2018:24). Tricolored blackbirds have also been found to nest in agricultural grain fields such as triticale, and weedy mustard fields (*Brassica* sp.) (Graves et al. 2013:2857, 2858; Beedy et al. 2020:3, California Department of Fish and Wildlife 2018:24). These vegetation types, however, are not included in the parameters for nesting habitat because these vegetation types are not discernable through aerial interpretation alone. Additionally, grain field nesting sites are mainly in areas south of the study area (e.g., southern San Joaquin Valley), nettle

sites mainly occur in southern San Joaquin Valley and the surrounding foothill grasslands, and thistle sites are primarily in southern Sierra Nevada foothills (California Department of Fish and Wildlife 2018:24, 25). Most colonies still occur in cattails and bulrush in existing wetland habitats and irrigation drainages, but nesting in these native habitats, especially outside of the Sacramento Valley, occurs at a lesser degree than historically (Meese 2017:11).

The composition of crop types across the landscape is important in determining the foraging value of an agricultural field at any given time because it affects the availability of prey items (California Department of Fish and Wildlife 2018:28); cropping patterns can change across the landscape, thus there is a high degree of variability in the suitability of these agricultural lands. The model also does not consider the use of pesticides in the agricultural landscape, which can result in direct mortality or can reduce reproductive success by eliminating suitable foraging vegetation and insects (U.S. Fish and Wildlife 2019:ii, iii, 45). For example, the likelihood of breeding colony presence is influenced by the proportion of grassland and alfalfa cover in the landscape; colonies were more likely to occur in a landscape when there was 30% to 80% grassland cover and 15% alfalfa cover (California Department of Fish and Wildlife 2018:28). The model, however, does not factor in the specific crop that is grown in agricultural lands and may overestimate the amount of suitable foraging habitat.

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Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle is completely dependent on its host plant, elderberry (*Sambucus* sp.) (Eng 1984; Barr 1991; Collinge et al. 2001). Elderberries are a component of riparian forests throughout the Central Valley. Although this shrub occurs outside riparian areas, shrubs supporting the greatest beetle densities are located in areas where the shrubs are abundant and interspersed among dense riparian forest. Associated dominant riparian species include Fremont cottonwood (*Populus fremontii*), box elder (*Acer negundo*), California sycamore (*Platanus racemosa*), black walnut (*Juglans* spp.), white alder (*Alnus rhombifolia*), willow (*Salix* spp.), button willow (*Cephalanthus occidentalis*), Oregon ash (*Fraxinus latifolia*), wild grape (*Vitis californica*), California hibiscus (*Hibiscus californica*), and poison oak (*Toxicodendron diversilobum*) (Barr 1991; U.S. Fish and Wildlife Service 2017 ; Collinge et al. 2001). Elderberry is the obligate larval host plant for the valley elderberry longhorn beetle. Adults have been described as feeding on the nectar, flowers, and leaves of elderberry plants. Eggs are laid on elderberry stems and leaves, and the larvae develops inside, feeds upon, and pupates in the stems of elderberry shrubs (U. S. Fish and Wildlife Service 2019: 1, 2).

Habitat Model Description

The parameters of modeled habitat for the valley elderberry longhorn beetle consist of riparian land cover types (upland riparian¹, scrub-shrub wetland, forested wetland), as well as other potential land cover types that provide suitable habitat such as blue oak woodland, oak savannah, annual grassland, and ruderal land cover types. The modeled habitat was also restricted to areas below 500 feet in elevation.

Assumptions and Rationales

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption: Suitable habitat for valley elderberry longhorn beetle consists of riparian land cover types (upland riparian, scrub-shrub wetland, forested wetland), as well as other potential land cover types that provide suitable habitat such as blue oak woodland, oak savannah, annual grassland, and ruderal land cover types.

Rationale: Valley elderberry longhorn beetle occurs only in association with its host plant, elderberry, which is commonly found in riparian forests and adjacent grasslands in the Central Valley (Barr 1991:4-5). Elderberry is an important component of riparian ecosystems in California (Vaghti et al. 2009). Elderberry shrubs can also be present in non-riparian valley oak and blue oak woodland habitats (U. S. Fish and Wildlife Service 2017, U. S. Fish and Wildlife Service 2019: 2). Occupancy of elderberry by the valley elderberry longhorn beetle is generally low but tends to be highest in riparian communities (Barr 1991, Collinge et al. 2001, Talley et al. 2007) and sites with high elderberry densities (Collinge et al. 2001: 1). Elderberry shrubs also occur in non-riparian

¹ The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to but above the stream ordinary high-water mark) that include valley foothill riparian species as well as blue oak, foothill pine, ornamental trees, and other shrub and tree vegetation that were not identifiable from aerial imagery.

settings in valley oak and blue oak woodlands and annual grasslands (U.S. Fish and Wildlife Service 2017: 5). Elderberry shrubs that are located in isolated sites or drainages may not provide viable colonization habitat for valley elderberry longhorn beetle due to the beetles' limited dispersal abilities (Collinge et al. 2001: 110, U.S. Fish and Wildlife Service 2017: 7).

Assumption: Suitable habitat for valley elderberry longhorn beetle is restricted to areas below 500 feet in elevation.

Rationale: The current presumed historical range of valley elderberry longhorn beetle consists of the Central Valley (the valley floor and lower foothills) from approximately Shasta County south to Madera County (U. S. Fish and Wildlife Service 2019:1, 79 FR 55874). Most beetle observations recorded are from below 500 feet in elevation (U. S. Fish and Wildlife Service 2017).

Model Limitations

The model provides a conservative estimate of potentially suitable valley elderberry longhorn beetle habitat. The model is limited by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., confirm presence of elderberry shrubs). All mapped valley foothill riparian, blue oak woodland, and annual grassland are deemed to be equally suitable for the species and to contain elderberry shrubs. However, studies show that valley elderberry longhorn beetle occurs in widely dispersed metapopulations (Collinge et al. 2001, Talley et al. 2006) and that the beetle occupies elderberry plants in clumps at scales that vary with the watershed; within a watershed, local aggregations of groups also spatially vary (Talley 2007). The valley elderberry longhorn beetle has limited dispersal ability, so for habitat to be suitable, many elderberry plants in reasonably sized patches (32.8-164 feet patches; Talley 2007) that are in close proximity (656- 984 feet apart; Tally 2007), and without movement barriers are required to support a population of valley elderberry longhorn beetle (U. S. Fish and Wildlife Service 2019: 5). Research also suggests that the valley elderberry longhorn beetle is further constrained by being naturally rare within its habitat (U. S. Fish and Wildlife Service 2019: 2).

Additionally, other factors that affect habitat suitability cannot be determined through aerial photograph interpretation, such as the presence or absence of Argentine ant (*Linepithema humile*) and European earwig (*Forficula auricularia*), which are nonnative insects that have been identified as potential threats to valley elderberry longhorn beetle (Talley et al. 2006: 26; 77 FR 60259-60260). Species of understory plants may not be discernable via aerial interpretation alone. Nonnative invasive woody plant species such as black locust (*Robinia pseudoacacia*), giant reed (*Arundo donax*), red sesbania (*Sesbania punicea*), Himalayan blackberry (*Rubus armeniacus*), tree of heaven (*Ailanthus altissima*), and Spanish broom (*Spartium junceum*), may be growing under valley riparian overstory trees; these species may compete with or displace elderberry shrubs (Talley et al. 2006:45).

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Vernal Pool Branchiopods—Conservancy Fairy Shrimp, Vernal Pool Fairy Shrimp, and Vernal Pool Tadpole Shrimp

The wetland ecosystems of the Central Valley support valuable habitat for many vernal pool species, including vernal pool branchiopods. Vernal pools are a unique type of wetland ecosystem that temporarily fill with rainwater in the winter and spring and then dry out until the next rainy season (U.S. Fish and Wildlife Service 2005: I-1). Vernal pool branchiopods primarily occur in vernal pool, swale, or ephemeral freshwater habitats that are confined to a limited area by topographic constraints, soil types, and climatic conditions; additionally, the surrounding upland habitat is important for the ecological function of vernal pool habitat (U.S. Fish and Wildlife Service 2005: vii, I-8, I-10).

Conservancy fairy shrimp (*Branchinecta conservatio*) primarily occurs in large turbid vernal pools (playa pools) that stay inundated for much longer than typical vernal pools, often into summer (Eriksen and Belk 1999:88, U.S. Fish and Wildlife Service 2012:3). Vernal pool fairy shrimp (*Branchinecta lynchi*) commonly inhabit vernal pools or vernal pool-like habitats, typically in grassland landscapes. Most commonly, vernal pool fairy shrimp are found in vernal pools or vernal swales in unplowed grasslands (Eng et al. 1990:257). Vernal pool tadpole shrimp (*Lepidurus packardii*) occurs in a variety of seasonal habitats, including vernal pools and other seasonal pools, ponded clay flats, roadside ditches, and stock ponds (Helm 1998:132; Rogers 2001:1002).

Habitat Model Description

The parameters of modeled habitat for the vernal pool branchiopods (Conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp) consist of seasonal wetlands, identified through aerial imagery, that are mostly present in annual grassland that is north, south, and west of Funks Reservoir.

Assumption and Rationale

The assumption upon which the habitat model parameters was based, and the rationale for the assumption, are described below.

Assumption: In the study area, suitable habitat for vernal pool branchiopods consists of seasonal wetlands that are mostly located within annual grassland that are north, south, and west of Funks Reservoir.

Rationale: Landscapes that support vernal pools are typically grasslands with areas of obstructed drainage that allows the formation of pooled rainwater; however, vernal pools can also be found in other land cover types such as oak woodland, desert, and chaparral (U.S. Fish and Wildlife Service 2005: I-13). Pools may be fed or connected to swales that are fed by the surrounding watershed or filled entirely by direct precipitation (U.S. Fish and Wildlife Service 2005: I-13, Hanes and Stomberg 1998: 38, 44).

The areas east of Funks Reservoir consist of agricultural land and rural development (e.g., town of Delevan and Maxwell), and are therefore, not considered suitable habitat for vernal pool

branchiopods because the conversion of natural lands alters the physical factors required for vernal pool formation. Direct loss of vernal pools is generally irreversible (U.S. Fish and Wildlife Service 2005: I-18). Land conversion often disrupts the physical processes conducive to a functional vernal pool ecosystem because the land conversion can alter the hydrology, soil formation, seed bank and topography of the landscape (U.S. Fish and Wildlife Service 2005: I-16–I-18).

Model Limitations

The model provides a conservative estimate of potentially suitable vernal pool branchiopod habitat because the mapped seasonal wetlands are all deemed to be equally suitable. The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., determine if seasonal wetlands have sufficient depth and ponding duration to support one or more shrimp species). Vernal pool habitat must be inundated sufficiently by rainfall at the appropriate time of year to allow vernal pool branchiopods to reach maturity and reproduce; if the availability of aerial imagery is limited or the resolution is poor, it may not be possible to accurately determine the sufficiency of ponding. Additionally, very small seasonal wetlands that could provide suitable habitat may not be visible on aerial imagery. Other parameters that affect the habitat suitability for vernal pool branchiopods that are not measurable via aerial imagery include water quality, depth, and water temperature (U.S. Fish and Wildlife Service 2005: xiii, xiv).

References¹

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¹ References are in the process of being gathered and may need to be modified as models are refined.

Giant Garter Snake

Giant garter snakes are endemic to the wetlands of the Sacramento and San Joaquin Valleys of California. Giant garter snakes inhabit marshes, ponds, sloughs, small lakes, low-gradient streams and other waterways, and agricultural wetlands, including irrigation and drainage canals, rice fields, and their adjacent uplands (U.S. Fish and Wildlife Service 2006).

Habitat Model Description

The parameters of modeled aquatic habitat for giant garter snake consists of canal (e.g., earthen lined canals), agricultural ditch, freshwater marsh, managed wetland, and rice land cover types. The parameters of modeled upland habitat for giant garter snake consists of annual grassland and disturbed and barren land cover types immediately adjacent to and within 200 feet (61 meters) of the aquatic habitat types previously listed. The modeled habitat for giant garter snake in the study area is bound to the west by GCID Canal, including areas of upland habitat 200 feet west of GCID Canal.

Assumptions and Rationales

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption: Aquatic habitat for giant garter snake consists of earthen lined canal, agricultural ditch, freshwater marsh, managed wetland and rice land cover types.

Assumption: Giant garter snakes do not use areas west of GCID Canal; however, the model does include upland habitat 200 feet west of GCID Canal.

Rationale: Areas east of GCID Canal support agricultural areas including rice and agricultural ditches that are typically used by giant garter snakes. There are also managed wetlands east of the canal. Areas west of the canal consist primarily of grasslands and creeks that generally don't have slow moving or static water for an extended period of time between May 1 and Oct 31 (USGS stream gage 11390672) and have substrates dominated by gravel and sand, which are not suitable for giant garter snake as they require areas with mud substrates (U.S. Fish and Wildlife Service 2017). These streams have high flows during the winter and spring, and generally go dry toward the middle of the summer. Funks Creek, Antelope Creek, Grapevine Creek, and Stone Corral Creek have been defined as intermittent streams (Sites 2017). During summer, much of the streambeds of these streams are dry, except for occasional pooling or when receiving ephemeral spring flows, agricultural drainage or runoff. In addition, water quality is reported to be poor and high in dissolved minerals (Brown, 2000). West of GCID Canal in the project vicinity, there is no rice and the ditches there are not directly connected to the ditches east of GCID Canal. Also, there are no giant garter snake occurrences west of GCID Canal in the project vicinity; however, there is one occurrence (Occurrence Number 205) from 1984 on Stone Corral Creek, which is plotted in the California Natural Diversity Database (CNDDB) as being west of GCID Canal and which is adjacent to areas of rice. This occurrence is approximately 3.2 miles south of the project footprint.

Assumption: Giant garter snakes may use earthen canals but do not likely use concrete lined canals due to a lack of soft substrate (e.g., mud, silt).

Rationale: Giant garter snakes prefer emergent, herbaceous aquatic vegetation accompanied by vegetated banks (U.S. Fish and Wildlife Service 2017). Concrete lined canals do not allow for establishment of the vegetation and support of the prey base needed to support giant garter snakes.

Assumption: Potentially occupied giant garter snake upland habitat consists of the vegetation types listed in *Habitat Model Description*, above.

Rationale: Upland habitat consists of land that is not typically inundated during the active season and is adjacent to aquatic habitat. Characteristics of suitable upland habitat are available bankside vegetation, such as cattails (*Typha* sp.) or tule (*Schoenoplectus acutus* var. *occidentalis*), permanent shelter, such as bankside cracks and crevices, holes or small mammal burrows, and areas that are not overgrazed. Giant garter snakes use upland habitat for basking, to regulate body temperature, and for cover. Giant garter snakes use mammal burrows to avoid predation, shed skin, and cool their bodies during hot days (U.S. Fish and Wildlife Service 2017). Giant garter snakes require basking habitat of grassy banks and openings in waterside vegetation. They also require uplands for cover and refuge from floodwaters during the snake's dormant season in the winter (U.S. Fish and Wildlife Service 2017). Riparian woodlands are unlikely to provide suitable habitat as a result of excessive shade and general lack of basking sites.

Assumption: Potentially occupied giant garter snake upland habitat consists of appropriate land cover types within 200 feet (61 meters) of modeled aquatic habitat.

Rationale: Giant garter snakes use grassy stream banks and upland habitats adjacent to perennial watercourses or wetlands for overwintering, as areas to temporarily seek refuge during the summer, and as transitory habitat (U.S. Fish and Wildlife Service 2017).

Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., identifying areas with suitable upland refugia). The model provides a conservative estimate of potentially suitable giant garter snake habitat because the amount of aquatic habitat and upland habitat mapped is all deemed to be equally suitable.

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California Red-legged Frog

California red-legged frog inhabits marshes, streams, lakes, ponds, and other, usually permanent, sources of water that have dense riparian vegetation (Stebbins 2003:225). Habitat generally consists of still or slow-moving water that is at least 2.5 feet deep and adjacent to willows (*Salix* sp.) or tules (*Schoenoplectus acutus* var. *occidentalis*) and cattails (*Typha* sp.) (Jennings and Hayes 1994:64). California red-legged frog primarily breeds in ponds and less frequently in pools within streams (Thomson et al. 2016:103). The frogs often disperse from breeding sites to various aquatic, riparian, and upland estivation habitats during the summer (66 FR 14628). California red-legged frog travels through a variety of upland habitat types (e.g., grassland, riparian, woodlands) to reach breeding and nonbreeding sites, upland refugia and foraging habitats, or new breeding locations (Bulger et al. 2003:90-91; Fellers and Kleeman 2007:275-276).

Habitat Model Description

The parameters of modeled aquatic habitat consist of perennial and intermittent streams, reservoirs, and ponds that were identified through review of aerial imagery. The parameters of modeled upland habitat consist of annual grassland, oak savannah, forested wetland, and upland riparian¹ land cover types within 300 feet of modeled aquatic habitat, and potentially suitable dispersal habitat consists of upland land cover types (defined above) within 1 mile of aquatic habitat. Modeled habitat was restricted to areas west of the canals running north to south to Funks Reservoir, because the remaining areas consist of agricultural lands on the valley floor that are unsuitable for this species.

Assumptions and Rationales

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption: In the study area, potentially occupied California red-legged frog aquatic habitat consists of perennial and intermittent streams, reservoirs, and ponds.

Rationale: California red-legged frog uses a variety of aquatic habitats. Ponds are suitable for all life stages (e.g., egg, tadpole, metamorph, adult) (U. S. Fish and Wildlife Service 2002:12). A variety of aquatic habitats provide breeding habitat, and larvae and metamorphs have been documented in streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds, dune ponds, and lagoons; breeding adults are often associated with deep (greater than 2 feet) still or slow moving water and dense, shrubby riparian or emergent vegetation (Hayes and Jennings 1988: 146–147, U. S. Fish and Wildlife Service 2002:12). California red-legged frog has also been documented in shallow sections of streams that lack riparian vegetation and in stock ponds (U. S. Fish and Wildlife Service 2002:12). An important feature for a breeding pond or slow-flowing stream is vegetation or other material to which egg masses can be attached (75 FR 12817).

¹ The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to but above the stream ordinary high-water mark) that include valley foothill riparian species as well as blue oak, foothill pine, ornamental trees, and other shrub and tree vegetation that were not identifiable from aerial imagery. Orchards and other agricultural lands are not included in this land cover type.

Assumption: Potentially suitable California red-legged frog upland habitat consists of annual grassland, oak savannah, forested wetland, and upland riparian land cover types within 300 feet of aquatic habitat.

Rationale: California red-legged frogs regularly use a variety of upland habitat types (e.g., grassland, riparian, woodlands) as upland refugia, foraging habitats, and to travel between breeding and nonbreeding locations (Bulger et al. 2003:90–91; Fellers and Kleeman 2007:275–276).

Frogs typically travel much shorter distances between aquatic and upland refugia and foraging habitats than when dispersing between breeding and nonbreeding aquatic habitats (Bulger et al. 2003:89, 91). Studies have shown that California red-legged frogs remain close to aquatic habitat except when migrating. In one study, non-migrating California red-legged frogs in a mesic environment (Santa Cruz County) were almost always found within 16 feet of their resident pond or stream during dry intervals in the summer. In another study, conducted in a drier environment (eastern Contra Costa County) during fall, winter, and spring over 2 years, 57 percent of frogs with radio transmitters stayed at their breeding pools, whereas 43 percent moved into adjacent upland habitat or to other aquatic sites. Upland movement ranged from 3 to 233 feet and averaged 80 feet (Tatarian 2008:161). Other telemetry studies have shown that the majority of California red-legged frogs monitored remained very close to their in-water capture sites (Bobzien and DiDonato 2007:27).

U.S. Fish and Wildlife Service, in its critical habitat designation for California red-legged frog, defined the upland habitat primary constituent element as 200 feet from aquatic habitat, which provides foraging and dispersal habitat for California red-legged frog (71 FR 19249). Additionally, Bulger et al. (2003:87) found 90 percent of the non-migrating California red-legged frogs were always within 200 feet of aquatic habitat throughout the year. However, a more conservative 300-foot buffer from aquatic habitat is used to define upland habitat in the model in order to include the limited number of California red-legged frogs that may occur more than 200 feet from aquatic habitat (Bulger et al. 2003:87-88).

Assumption: Potentially suitable dispersal habitat consists of all land cover types within 1 mile of aquatic habitat.

California red-legged frog requires upland habitat for cover, aestivation, and movement. Dispersal habitat includes upland areas that provide cover, such as animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris; agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay stacks may also be used (61 FR 25813). Movement corridors may include annual grasslands, riparian corridors, woodlands, and sometimes active agricultural lands (Fellers and Kleeman 2007:277, 279–280, 282, 284). During periods of wet weather California red-legged frog may travel through a variety of upland habitats (e.g., grassland, riparian, woodlands) to reach breeding and nonbreeding sites, upland refugia and foraging habitats, or new breeding locations (Bulger et al. 2003:90–91; Fellers and Kleeman 2007:275–276). Studies of California red-legged frogs living in coastal environments have shown that individuals can move approximately 1 mile over the course of a wet season (U.S. Fish and Wildlife Service 2002:12). Dispersal habitat may include nearly any areas within 0.9 to 1.7 miles (1.4 to 2.7 kilometers) of a breeding site that stays moist and cool through the summer (Fellers and Kleeman 2007:277, 279–280, 282, 284). Dispersal distances are dependent on habitat availability and environmental conditions (U. S. Fish and Wildlife

Service 2002:13). California red-legged frog can be found within streams at distances over 2 miles from the breeding site (U.S. Fish and Wildlife Service 2002:14).

Assumptions: The portion of the study area on the valley floor is not occupied by California red-legged frog.

Rationale: California red-legged frog was probably extirpated from the floor of the Central Valley before 1960 (U. S. Fish and Wildlife Service 2002:5). California red-legged frog may never have been widespread on the valley floor as specimen-based records are scarce north of the Kern River drainage and the last verifiable record of the species on the valley floor was in San Joaquin County in 1957 (U. S. Fish and Wildlife Service 2002:5). The valley floor constitutes a portion of the study area generally east of Funks Reservoir; thus, the modeled habitats for California red-legged frog are limited to suitable land cover types surrounding and to the west, northwest, and southwest of Funks Reservoir.

Model Limitations

The model provides conservative estimates of potentially suitable California red-legged frog habitats because the upland and aquatic habitat types mapped are deemed to be equally suitable. The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., confirming that aquatic habitats provide sufficient ponding duration, depth, water quality, etc.). For example, based on aerial imagery, it may not be possible to determine if emergent vegetation is present for egg mass attachment or if the pond has the appropriate pond structure (e.g., shallow area for tadpoles and a deeper area for predator avoidance) (U. S. Fish and Wildlife Service 2002:12). Additionally, via aerial imagery alone, it is not possible to determine if predators (e.g., bullfrogs, fish) are present in aquatic habitat; however, some stock ponds can support California red-legged frog despite a lack of emergent vegetation cover and the presence of non-native predators (U. S. Fish and Wildlife Service 2002:12). Small mammal burrows and moist leaf litter are important for providing refuge sites for California red-legged frog in upland habitat (U. S. Fish and Wildlife Service 2002:14); the presence of these small features cannot be determined through review of aerial imagery.

References²

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² References are in the process of being gathered and may need to be modified as models are refined.

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From: Berryman, Ellen [Ellen.Berryman@icf.com]
Sent: 1/20/2021 11:20:18 AM
To: Cordova, Daniel A [dcordova@usbr.gov]; Dekar, Melissa D [mdekar@usbr.gov]; Torres, Juan@Wildlife [Juan.Torres@wildlife.ca.gov]; Boyd, Ian@Wildlife [Ian.Boyd@Wildlife.ca.gov]; Kearns, Zachary@Wildlife [Zachary.Kearns@Wildlife.ca.gov]; Wilson, Billie@Wildlife [Billie.Wilson@wildlife.ca.gov]
CC: John Spranza [John.Spranza@hdrinc.com]; Briard, Monique [Monique.Briard@icf.com]; Haire, Jennifer [Jennifer.Haire@icf.com]; Alicia Forsythe [ali@forsythe-group.com]
Subject: RE: Sites Reservoir, terrestrial species models

Oops – I meant February 11 for feedback. ☺ I had the November calendar open when I wrote this.

From: Berryman, Ellen
Sent: Wednesday, January 20, 2021 11:13 AM
To: Cordova, Daniel A <dcordova@usbr.gov>; Dekar, Melissa D <mdekar@usbr.gov>; Torres, Juan@Wildlife <Juan.Torres@wildlife.ca.gov>; Boyd, Ian@Wildlife <Ian.Boyd@Wildlife.ca.gov>; Kearns, Zachary@Wildlife <Zachary.Kearns@Wildlife.ca.gov>; Wilson, Billie@Wildlife <Billie.Wilson@wildlife.ca.gov>
Cc: Spranza, John <John.Spranza@hdrinc.com>; Briard, Monique <Monique.Briard@icf.com>; Haire, Jennifer <Jennifer.Haire@icf.com>; Alicia Forsythe <ali@forsythe-group.com>
Subject: Sites Reservoir, terrestrial species models

Greetings BOR and CDFW folks,

I hope you're all well and having a good new year. As we discussed during meetings last year, here are the terrestrial models of state and federally listed species potentially affected by the Sites Reservoir Project, for your review.

The attachments include both state and federally listed species, so you can disregard the species not relevant to your respective agency. Dan, as we discussed earlier, we're sending the models to BOR for review before forwarding to USFWS.

We would very much appreciate your input on these models by November 11, if possible, so we can incorporate any needed revisions prior to analyzing impacts for the EIR/S. If there are significant outstanding issues resulting from your review, we'd like to set up a subsequent meeting for resolution.

CDFW has already reviewed and ok'ed the GGS model description, after we incorporated their comments. The only model revisions since then were editorial and format related.

Feel free to email or call me at (530) 798-1945 if you have any questions or which to discuss anything.

Thank you!!!

Ellen

From: Chandra Chilmakuri [cchilmakuri@swc.org]
Sent: 1/21/2021 2:34:51 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: Sites Update

Thank you, Ali!

Chandra Sekhar Chilmakuri, Ph.D., P.E.
P: 916.562.2583 | M: 916.335.3017 | cchilmakuri@swc.org

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Thursday, January 21, 2021 2:32 PM
To: Chandra Chilmakuri <cchilmakuri@swc.org>
Subject: RE: Sites Update

Excellent! Thanks Chandra. I think some of our members are looking for a little longer description. We are working on this and will get them something tomorrow or over the weekend. I will share what we come up with.

Ali

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

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From: Chandra Chilmakuri <cchilmakuri@swc.org>
Sent: Tuesday, January 19, 2021 7:24 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Re: Sites Update

Hi Ali,

It was that paragraph you reviewed. Please let me know if you'd like to make any further changes. Thanks!
Chandra

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From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Tuesday, January 19, 2021 6:24:43 AM
To: Chandra Chilmakuri <cchilmakuri@swc.org>
Subject: RE: Sites Update

Hi Chandra – We met with our urban water districts late last week to have a roundtable discussion on Urban Water Management Plans and Sites. They mentioned that the SWC were providing a description of Sites for them to all use in their Plans. Is that the paragraph below or something else? They wanted to make sure that we had reviewed it.

Ali

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

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From: Chandra Chilmakuri <cchilmakuri@swc.org>
Sent: Tuesday, January 12, 2021 11:41 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Re: Sites Update

Hi Ali,
Thank you for the edits and slides!
Chandra

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From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Friday, January 8, 2021 1:28:07 PM
To: Chandra Chilmakuri <cchilmakuri@swc.org>
Subject: RE: Sites Update

Chandra! I was thinking over the holiday break that I had never gotten back to you. I am so, so sorry for that. Attached are a few different PowerPoints that may help you if you still need them. The maps in the NGO file are the most recent.

Great summary. I've made just a few minor changes in red below.

Sites Reservoir is a proposed new 1,500,000 acre-feet off-stream storage reservoir in northern California near Maxwell. Sacramento River flows will be diverted during excess flow periods and stored in the off-stream reservoir and released for use in the drier periods. Sites Reservoir is expected to provide water supply, environmental, flood and recreational benefits. The proponents of Sites Reservoir include 31 entities including several individual SWP Public Water Agencies (PWAs). Sites Reservoir is expected to provide approximately 240 TAF (Sites Reservoir Value Planning Report, Table 8-1) of additional deliveries on average to participating agencies under existing conditions. Sites Reservoir is currently undergoing environmental planning and permitting. Full operations of the Sites Reservoir are estimated to start by 2029 following environmental planning, permitting and construction. Sites was conditionally awarded \$816 million from the California Water Commission for ecosystem, recreation, and flood control benefits under Proposition 1. Reclamation may also invest in Sites under the Water Infrastructure Improvements for the Nation (WIIN) Act and recently transmitted a final Federal Feasibility Report to Congress for the project.

We added Rosedale Rio Bravo WSD and Irvine Ranch to our membership in December, so there are now 31 proponents. I think the 240 TAF number is still relevant. We are wrapping up our Calsim modeling now and our numbers are coming in a little under this, but close.

I added the last two sentences to reflect the state and potential federal investment in Sites.

Hope this helps. Let me know if there is anything else I can help with.

Ali

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

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From: Chandra Chilmakuri <cchilmakuri@swc.org>
Sent: Wednesday, December 30, 2020 10:41 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: Sites Update

Hi Ali,

Here is a brief summary I prepared on Sites Reservoir for the SWC members. Could you please review and give me any edits you think are appropriate? I am especially unsure about the latest yield and who it will be provided to.

Sites Reservoir is a proposed new 1,500,000 acre-feet off-stream storage reservoir in northern California near Maxwell. Sacramento River flows will be diverted during excess flow periods and stored in the off-stream reservoir and released for use in the drier periods. Sites Reservoir is expected to provide water supply, environmental, flood and recreational benefits. The proponents of Sites Reservoir include 29 entities including several individual SWP Public Water Agencies (PWAs). Sites Reservoir is expected to provide approximately 240 TAF (Sites Reservoir Value Planning Report, Table 8-1) of additional deliveries on average to participating agencies under existing conditions. Sites Reservoir is currently undergoing environmental planning and permitting. Full operations of the Sites Reservoir are estimated to start by 2029 following environmental planning, permitting and construction.

Thank you and Happy New Year!!

Chandra Sekhar Chilmakuri, Ph.D., P.E.
P: 916.562.2583 | M: 916.335.3017 | cchilmakuri@swc.org

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Thursday, November 12, 2020 6:32 PM
To: Chandra Chilmakuri <cchilmakuri@swc.org>
Subject: RE: Sites Update

Sure thing. When do you need them by?

I hope you are doing well also!

Ali

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

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From: Chandra Chilmakuri <cchilmakuri@swc.org>
Sent: Thursday, November 12, 2020 4:56 PM

To: Alicia Forsythe <aforsythe@sitesproject.org>

Subject: Sites Update

Hi Ali,

Hope you are doing well in these crazy times!

I have an internal presentation at SWC where I am providing a quick overview of various ongoing water supply projects.

Could you provide couple of slides that you may readily that summarizes the project as it is currently defined and potential water supply implications to SWP participants? Hope this doesn't require you to do any additional work.

Please let me know if you have any questions.

Thank you!

Chandra Sekhar Chilmakuri, Ph.D., P.E.

Assistant General Manager for Water Policy

State Water Contractors

1121 L Street, Suite 1050 | Sacramento, CA 95814

P: 916.562.2583 | M: 916.335.3017 | cchilmakuri@swc.org

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 1/22/2021 8:39:46 AM
To: Marcia Kivett [MKivett@sitesproject.org]
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

On it now

John Spranza

D 916.679.8858 M 818.640.2487

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Friday, January 22, 2021 6:53 AM
To: Spranza, John <John.Spranza@hdrinc.com>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

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Hey John, can you let me know if you are able to review this document this morning. I need to finalize it this afternoon.

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Wednesday, January 20, 2021 2:42 PM
To: Spranza, John <john.spranza@hdrinc.com>
Cc: Marcia Kivett <MKivett@sitesproject.org>
Subject: FW: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Hi John,

Can you add anything to this, particularly for items I highlighted in yellow?

Thanks,

Laurie

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Wednesday, January 20, 2021 11:33 AM
To: Marcia Kivett <MKivett@sitesproject.org>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: Re: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Friday noon.

Sent from my iPhone

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No, you did not miss it. I know he is looking for this information as soon as possible.
Jerry, can you provide a deadline?
Thank you, Laurie.

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From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Tuesday, January 19, 2021 10:17 AM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
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Sent from Mail for Windows 10

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 1/22/2021 9:19:07 AM
To: Marcia Kivett [MKivett@sitesproject.org]
CC: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR
Attachments: Timeline of Significant NGO Engagement since the 2017 Draft EIR (002)lwh_JJS_2.docx

Here you go. I added a few items.

John Spranza

D 916.679.8858 M 818.640.2487

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From: Jerry Brown [jbrown@sitesproject.org]
Sent: 1/22/2021 11:21:59 AM
To: Marcia Kivett [MKivett@sitesproject.org]
Subject: Re: Timeline of Significant NGO Engagement

Done but I didn't see the NGO comment letter submitted on the 2017 Draft EIR. IS is not there and instead I'm thinking of the March 2019 comment letter?

From: Marcia Kivett <MKivett@sitesproject.org>
Date: Friday, January 22, 2021 at 10:35 AM
To: Jerry Brown <jbrown@sitesproject.org>
Subject: RE: Timeline of Significant NGO Engagement

John is done. I've added his comments. Let me know when you are done with your review and I will try to link the attachments. I have a dental appointment and will have to leave my house at 1:30.

☐ Timeline of Significant NGO Engagement - 2017 to present

From: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]
Sent: 1/22/2021 1:08:50 PM
To: Marcia Kivett [MKivett@sitesproject.org]; Spranza, John [john.spranza@hdrinc.com]
CC: Jerry Brown [jbrown@sitesproject.org]
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR
Attachments: Att B_letters_comments matrix.docx; NGO_Tribal letter summaries.docx

Hi Marcia,

The letters that we received from NGOs and tribes are summarized in the attached. All were received during the public review period (Aug 14, 2017-January 15, 2018) except Letter #140, which was submitted in 2019.

Have a great weekend !

Laurie

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Friday, January 22, 2021 11:59 AM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>
Cc: Jerry Brown <jbrown@sitesproject.org>
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Laurie/John, this document is looking good. Can you confirm we do not have a January 2018 response letter. Thanks.

From: Marcia Kivett
Sent: Friday, January 22, 2021 10:22 AM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Thank you both! I think after I'm final on this project, we should save the information where everyone can access it.

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Sent: Friday, January 22, 2021 9:27 AM
To: Spranza, John <john.spranza@hdrinc.com>
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Thanks John !

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Sent from Mail for Windows 10

<Timeline of Significant NGO Engagement since the 2017 Draft EIR (002)lwh_JJS_2.docx>

Attachment B – General Overview of Key Concerns										
	Project Description and Alternatives, Baseline	Modeling approach	Operational Impacts to fisheries	Impacts to Trinity River resources	Indian Trust Assets and Tribal Cultural Resources	Water Supply/ Rights	Water Quality	Impacts to other species	Geology/ Geomorphology and Seismicity	Cumulative impacts/ GHG
Letter#, NGO										
#12 Natural Resources Defense Council	X	X	X					X		X
#17 AquAlliance	X		X		X		X	X		X
#20 Pacific Coast Federation of Fisheries Associations et al ⁱ	X	X	X	X	X		X			X
#21 CA Indian Water Commission	X				X			X		
#23 CA Sportfishing Protection Alliance et al ⁱⁱ	X	X	X			X	X	X		
#24 Friends of the River	X	X	X			X		X	X	X
#25 Friends of the River et al ⁱⁱⁱ	X	X	X			X		X	X	X
#27 Klamath Riverkeeper	X	X	X	X				X		
#30 Save the American River						X	X			
#31 Sierra Club	X		X				X		X	
#122 Sacramento Chapter, CA Native Plant Society								X		
# 140 Save CA Salmon et al ^{iv}	X	X	X	X	X	X	X	X	X	X
Letter #, Tribal Government										
#4 Colusa Indian Community Council					X	X			X	
#139 Karuk Tribe	X	X	X	X	X					

ⁱ et al includes: Institute for Fisheries Resources, Save California's Salmon, San Francisco Baykeeper, and the Winnemem Wintu Tribe

ⁱⁱ et al includes: AquAlliance, and the California Water Impact Network

ⁱⁱⁱ et al includes: Sacramento River Preservation Trust, and Sierra Club

^{iv} et al includes: California Sportfishing Protection Alliance, California Water Impact Network, Environmental Water Caucus, Southern California Watershed Alliance, Friends of the River, Pacific Coast Federation of Fishermen's Associations & Institute for Fisheries Resources, Safe Alternatives for our Forest Environment, Butte Environmental Council, Sacramento Valley Chapter of the California Native Plant Society, Protect American River Canyons, Fly Fishers of Davis, Coast Action Group, Friends of the River, Sacramento River Council, Planning and Conservation League, The Environmental Justice Coalition for Water, Golden Gate Salmon Association, Conservation Fly Fishers International Northern California Council, The Bay Institute, Winnemem Wintu Tribe, Water Climate Trust, Chico 350, Women's International League for Peace And Freedom Earth Democracy

NGO Letters

NRDC Letter (1/15/18) Summary #12

- **EIR/EIS fails to consider a reasonable range of alternatives (I)**
 - Alternatives that reduce water diversions from the Sacramento River (particularly during all but wet water year types and during periods of moderate and low flows) would result in reduced adverse effects on native fish and wildlife in Sacramento River and Bay-Delta estuary
 - Claim “**tiering**” from **CALFED ROD** which was improper
 - Must analyze more than one operational alternative in order to identify alternatives that would minimize or avoid adverse environmental impacts of the project (per their scoping comments).
 - Alternative that would not result in substantial reductions in Delta outflow during winter and spring months
 - One or more alternatives that result in increase in Delta outflow during winter and spring
 - Additional alternative that is consistent with the water operational requirements being proposed for California WaterFix
 - CDFW potential **operational criteria** to protect flows and reduce adverse impacts on salmon, sturgeon, longfin smelt, Delta smelt, and other native fish species need to be evaluated
 - Consider **other storage alternatives such as groundwater storage**, conjunctive use, and/or reoperation of reservoirs to improve water supplies and ecosystem protection
- **Reclamation violated FWCA (II)**
 - Claim FWCA report required to be included in draft EIS
- **Failure to use an accurate environmental baseline (III)**
 - Fails to include several permit conditions imposed prior to the NOP which will be implemented prior to 2030 (primarily the **Revised Shasta RPA and Yolo Bypass restoration including the proposed Fremont Weir notch**)
 - **Fall X2** per 2008 Delta Smelt BO not appropriately addressed
 - Flawed because it is assumed full **contract deliveries** which have never occurred (never more than 75% of contract amounts)
 - **Need to include climate change assumptions in baseline (IV)**
 - Suggests incorporation into baseline rather than separate discussion in Chapter 25
- **2010 CALSIM model inappropriately used (instead of 2015 version) (V)**
 - States inconsistency in Appendix 6D related to Delta Alt D outflow
- **Fails to accurately assess impacts to aquatic resources from proposed operations (VI)**
 - **Arbitrary thresholds of significance** - 5-10 % flow reductions will have significant adverse effects
 - **Longfin smelt** impacts greater than 0 are significant (mandatory finding of significance)
 - Operational impacts of greater than 5% are not called significant
 - Impacts to salmon and steelhead inadequate
 - Ignore reduced flows
 - Assume no impact at **fish screens**
 - Fail to assess impacts from **reduced floodplain inundation**

- **Ineffective mitigation measures**
 - **Fail to use existing life cycle models**
- Consider feasible mitigation measures, including minimum bypass flows
- **Delta smelt** impacts
- **Fails to accurately assess impacts to terrestrial biological resources (VII)**
 - Mitigation measures too broad - revise Mitigation Measure Wild-lb – more specificity by species including **ratios/performance standards**
 - Coordination with CDFW not consistently identified
 - **Giant Garter Snake** impacts and mitigation inadequate
 - **Outdated survey information** – inaccurate estimation of impacts
 - Inadequate assessment of impacts to **wildlife refuges – bird strikes associated with powerlines** and overall **impacts to Delevan NWR** as well as surrounding private lands; need to evaluate impacts to **Colusa and Sutter NWRs**
 - No impacts associated with the **TRR**
- **Fails to adequately analyze cumulative impacts and fails to disclose potentially significant adverse impacts to aquatic resources (VIII)**
 - Need to incorporate **WaterFix and Shasta Lake WRI**
 - Cite prior MBK work that identifies significantly reduced Delta outflows and Sac River flows
- **Presentation of Existing Conditions/No Action Alternative is flawed (IX)**
 - Appendix 12F
 - Appendix 6A
 - Examples of misleading and inaccurate descriptions of modeling results

Additional Analysis Requested:

- 1) Explanation of range of alternatives and reasons for considering single operational alternative;
- 2) Address environmental baseline flaws such as contract delivery assumptions, failure to include climate change, Shasta RPA, Yolo Bypass
- 3) Analyze more alternatives such as: alternatives that reduce water diversions from Sac River (especially in wet year types and during moderate and low flows), alternative that would not result in substantial reduction in Delta outflow, alternative that increases Delta outflow in winter and spring, and alternative that is consistent with Waterfix operational requirements;
- 4) Need to include evaluation of CDFW potential operational criteria to protect flow and reduce impacts on native fish species,
- 5) Consider other storage alternatives (groundwater storage, conjunctive use etc.);
- 6) Update CALSIM model to the most recent model
- 7) 7) Need FWCA report
- 8) Reanalysis of impacts to Aquatic and Terrestrial resources including updated surveys and mitigation measures for potentially significant adverse impacts

AquAlliance Letter (1/15/18) #17

- **CEQA lead should be DWR** given DSOD oversight and need to coordinate operations with SWP
- **Inadequate project description** – lacks detail/inappropriate impact analysis, improper

segmentation of environmental review (cites tie with SVWMA), seismic activity not addressed, **deferred surveys**, inadequate statement of objectives/P&N

- **Hydrology/water quality (selenium, mercury, hazardous materials, salt)** impacts,
- Additional **wetland survey and mitigation** required, stream flow depletion, concerns related to past CVP/SWP operations and regulatory processes/documents and supposed to tie Sites operations and intentions
- **Cultural resources** evaluations, impacts, and mitigation not completed or appropriately identified (including cumulative impacts)
- **Cumulative impacts** not fully analyzed including recent water transfers – provides many projects/actions suggested to be included

Pacific Coast Federation of Fisheries Associations/Institute for Fisheries Resources/Save California's Salmon/San Francisco Baykeeper/Winnemem Wintu Tribe (1/15/18) #20

- EIR/EIS should be prepared a part of a **FERC license application**; numerous deficiencies
- Use of **Existing Conditions/No Project/Action baseline** biases the analysis and avoids CEQA mitigation requirements
- Document needs to include an **operations plan and diversion schedule**
- Use of old information in the **modeling**; outdated and insufficient model
- **Cumulative impacts** evaluation needs to identify numerous other projects and actions (provides list)
- States on-going **economic impacts** associated with salmon decline
- **Modeling** is problematic – monthly modeling insufficient for addressing fisheries needs
- EIR/EIS does not discuss **flow management impacts** of the project
- Proposed project does not adequately account for importance of flow fluctuations and fishery habitat needs
- Impacts to important **floodplains (including Sutter and Yolo bypasses)** – need to be identify impact to fish production and water quality
- **Water quality** impacts – diversion will further impact **water temperatures** downstream of the proposed diversions
- Reduced flows from Shasta and Keswick – concerns over **metals and reduced dilution**; reduced cold/fresh water to the Delta
- Potential **salinity** issues from Sites Reservoir releases – need a reservoir management plan
- **Climate change** impacts not evaluated
- **Fishery impacts** not properly addressed – no analysis of current state of Delta or Sacramento

fisheries as well as Sacramento River tributaries and Trinity system.

- **No economic analysis** – cite 8% reduction in appendixes in highwater years and 11% increase in normal years
- Impacts to **Klamath and Trinity River salmon** populations not properly analyzed – need to reference recent legal decisions since ROD
- **Sacramento River/Delta fisheries** impacts not properly analyzed – project will exacerbate current problems – **winter and spring flows** need to be maintained; project would result in increased **Delta reverse flows**
- **Water quality** conditions will encourage propagation of **non-native fish species**
- **Tribal beneficial uses** (i.e. water and salmon) impacts not disclosed as well as **public trust** resources – need to reference **reintroduction of salmon and fish passage above Shasta Dam** and potential Project effects

California Indian Water Commission (1/15/18) #21

- **Support the No Project** – project counterintuitive to the laws of nature
- **Ecological effects of the project inadequately analyzed** – suggest consulting with tribes; access from the top of contributing watersheds
- **Recommend use of Mauri-o-meter** to assess impacts to the environment – considers cultural wellbeing (inclusive of metaphysical aspects), social wellbeing, and economic wellbeing using a series of questions that are filtered through a heuristic model

CSPA/AquAlliance/California Water Impact Network (1/13/18) #23

- **Inadequate project description** – need to identify who will operate project, how decisions will be made, and responsibility including prioritizing use of Sites releases
- **Operating rules** too vague – speculative and hypothetical
- Averaging of **model results** masks real impacts
- Potential **thermal impacts** associated with reservoir releases
- **Insufficient range of alternatives**
 - Does not include more restrictive bypass requirement than existing standards
 - Need an alternative that includes operations with WaterFix in place
- Inadequately addresses required **water right** amount, timing, and **relationship with CVP and SWP**
- No discussion as to how **water transfers** would be facilitated
- Does not disclose impacts associated with **decreased floodplain inundation**

Friends of the River (1/15/18) #24

- Inadequate **project description** – need to identify how the project will be operated, inconsistencies with Reclamation's feasibility report
- Inadequate **range of alternatives** – speculative and hypothetical
- Lack of meaningful information about **water rights** – how will the project insure only tributary water will be diverted to Sites
- Fails to adequately consider **impacts of Sacramento River diversions**:
 - Models – analysis depends on models with known deficiencies
 - Environmental Standards – existing flow standards inadequate
 - Public Lands and Land Use – analysis barely acknowledges public lands along Sacramento River
- Inadequate description of **impacts on Sacramento River water quality**
 - Models inadequate to accurately assess temperature impacts
- Fails to adequately address **reservoir-triggered seismicity** on local communities and structures – needs to fully examine the role of frequent filling/emptying of reservoir in triggering earthquakes
- Inadequate in addressing **greenhouse gases** - recommends use of World Bank's guidelines on GHG measurement
- Inadequate evaluation of **rare plants** – analysis should include guidelines and sufficient information
- Overstates **project benefits for threatened and endangered salmonids** – not a net benefit of Sites
- Other specific comments on Draft EIR/EIS regarding:
 - Range of alternatives – need to look at smaller reservoirs
 - Surface water resources – needs to address water rights over-allocation issue
 - Fluvial Geomorphology – analysis is adversely affected by Sacramento River between Colusa and Red Bluff considered part of Secondary Study area
 - Terrestrial Biology – disputes findings of the technical analysis, mitigation lacks detail
 - Geology, Minerals, Soils and Paleontology – no mention of mercury
- Request **withdrawal of the Draft EIR/EIS**, revision and recirculation

Friends of the River, Sacramento River Preservation Trust, Sierra Club (1/15/18) #25 (expanded version of comments provided in Letter #24)

- Expanded version of Letter #24 – includes all comments list above and:
 - Appendices 6B and 6C – review of appendices indicates alarming flow impacts to the Sacramento River and Sutter Bypass, particularly drought years
- Request withdrawal of the Draft EIR/EIS, revision and recirculation

Klamath Riverkeeper (1/15/18) #27

- Compliance with **California and Federal Endangered Species Acts** – increased Sacramento River flows and increased outflows from the Delta necessary to support native fish and wildlife; EIR/EIS fails to provide a consistent operational plan

- Compliance with **California Reasonable Use Doctrine** not demonstrated - reasonableness requires evaluation of alternative water supplies to meet given need and evaluation of the impacts of new water uses on existing legal uses and water users
- Compliance with **Public Trust Doctrine and Tribal Trust Obligations** – suggests that reduced flows would occur in Sacramento, Trinity and Klamath rivers and failure to comply with Public Trust doctrine and protect Tribal Trust resources
- Must accommodate **Humboldt County's Trinity River water right** – county may wish to preserve its water right to augment rather than satisfy flows to comply ESA
- Fully analyze the **No Project Alternative** – fails to include operational plans and does not evaluate how No Project Alternative could satisfy consumptive and instream water supply needs
- The Final EIR/EIS must demonstrate that future instream flow requirements will not render Sites Reservoir a 'stranded asset'

Save the American River Association (n/d) #30

- Analysis based on false premise that **current flow and water quality standards** for the river are adequate
- Entire project based on the false premise that there is **excess water in the Sacramento River** not needed for the environment
- Urges **new environmental document** be prepared and released for public review

Sierra Club, Shasta Group Mother Load Chapter (1/14/18) #31

- Sacramento River **water temperature** – reliability of the water temperature model, Sites Reservoir will have extremely poor water quality
- **Recreational opportunities** will be practically nonexistent due to shallow lake levels
- Site-specific **geotechnical data** missing
- The **summary of environmental effects** by resource (Table ES-2) reflects the "opinion" of the writers of the report, should be independent review to confirm if 'opinion' is scientific defensible
- Source of rockfill material for riprap - further field investigation is needed to verify local bedrock is suitable
- Number of saddle dams indicative of poor project feasibility
- Sufficient water for agriculture, more water needs to be used in the Sacramento/San Joaquin Delta to **improve health of the aquatic habitat** – no mention of crop usage and future food types likely to be used in California in the future and associated impacts
- Funds for this project could be used and distributed to improving the health of the Sacramento/San Joaquin Delta
- Unclear if **hydropower** will be part of the project
- **No new facilities** should be constructed in the Sacramento River

- **No Project/No Action Alternative** should be selected

Sacramento Valley Chapter, California Native Plant Society (1/11/18) #122

- Project will destroy 15,000 acres of intact California **natural communities** including oak woodlands, chaparral, California prairie, riparian areas, and fresh and alkaline wetlands
- **Biological surveys**, including rare plants, inadequate

Save California Salmon, California Sportfishing Protection Alliance, California Water Impact Network, Environmental Water Caucus, Southern California Watershed Alliance, Friends of the River, Pacific Coast Federation of Fishermen's Associations & Institute for Fisheries Resources, Safe Alternatives for our Forest Environment, Butte Environmental Council, Sacramento Valley Chapter of the California Native Plant Society, Protect American River Canyons, Fly Fishers of Davis, Coast Action Group, Friends of the River, Sacramento River Council, Planning and Conservation League, The Environmental Justice Coalition for Water, Golden Gate Salmon Association, Conservation Fly Fishers International Northern California Council, The Bay Institute, Winnemem Wintu Tribe, Water Climate Trust, Chico 350, Women's International League for Peace And Freedom Earth Democracy (March 17, 2019) #140

- Foreseeable Impacts to Trinity River Water Temperature Objectives Associated with Sites Project Operations Need to be Evaluated with an Accurate Temperature Model.
- Foreseeable Impacts to Trinity River Water Temperature Objectives Associated with Sites Project Operations Need to be Evaluated with an Accurate Temperature Model.
- Inaccurate Existing (Baseline) TRD Water Operations.
- Incomplete Cumulative Impact Assessment Pertaining to TRD Operations.
- Mitigation for Trinity/Lower Klamath Impacts. Effective mitigation measures must be recommended to ensure that fishery/fish habitat management objectives for the Trinity River and lower Klamath River will be met. The Bureau of Reclamation has used the auxiliary outlet on Trinity Dam to release colder water during drier years, but this action results in the loss of power generation and this impact on CVP power generation needs to be evaluated as it relates to revised Trinity operations as proposed for Sites.
- Narrow Scope of Alternatives.
- No Action Alternative and Existing Conditions. Assuming the existing conditions and No Action alternatives are the same is inappropriate, compromises the ability to compare impacts across alternatives, and may minimize the magnitude of some of the impacts. The faulty assumption that State and Federal water contractors would be projected to use their full contracted water volumes (2030 projected conditions) does not reflect the current water management (existing condition) and likely provides inaccurate impact results. Because of this, the no action alternative minimizes potential impacts and greatly reduces the mitigation responsibilities required under CEQA.
- Sites Project Water Rights and Potential Unforeseen/Undisclosed Impacts.
- Cumulative Impacts.
- Sites Reservoir Operating Procedures/Priorities Absent.
- Compliance with California Endangered Species Act (CESA).
- Tribal Consultation and Mitigation Absent.

- Hydropower Licensing.
- Environmental Baseline/Modeling.
- Bypass Flows and Diversion Rates.
- Reduced Delta Outflows and impacts on Delta Smelt and Other Important Bay-Delta Species.
- Delta and Longfin Smelt Impacts due to Old and Middle River Reverse Flows.
- Water Quality and Beneficial Use Impacts.
- Sacramento River Flow and Temperature Modeling.
- Sacramento River Temperature Effects.
- Impacts to Floodplain Habitat.
- Evaluation of Fishery Impacts Lacking.
- Water Quality
 - Toxic Metals.
 - Methylmercury.
 - Noxious Algal Blooms.
 - Salinity.
- Geomorphology.
- Entrainment Losses of Native Fish.
- Fish Screens.
- Impacts on Funks and Stone Corral creeks.
- Reservoir Fishery Impacts from Pumping Plant Operation:
- Recreation.
- Wildlife Mitigation Actions.
- Need for a Natural Community Conservation Plan (NCCP).
- Nesting Birds.
- Giant Garter Snake.
- Botanical Surveys. Information contained in the DEIS/EIR is insufficient to determine the impacts on botanical resources within the Sites Project area. Botanical surveys must be redone, data included in the DEIS/EIR are from the late 1990's and early 2000's, and must include all areas affected by the project. Accepted scientific protocols should be used to conduct these surveys.
 - Botanical Resources Mitigation.

Letters from Tribal Governments

Colusa Indian Community Council (January 4, 2018) #4

- Project will have a direct impact on the **Indian Trust Assets** of the CICC, Tribal Trust Lands and several Fee Simple Lands owned by the Tribe located downstream
- Need to ensure **water availability** to meet Tribal water demands; Bureau of Reclamation could provide funding to the Tribe to address water supply impacts of the project
- Delevan Intake/Discharge Facility will lead to **increased erosion downstream** which could impact Tribal Water Diversion downstream.
- Impacts to **cultural resources** including burials within the reservoir footprint and the vicinity of the Sacramento River.
- Construction of the Delevan pipeline will require **traffic diversions** that will impact Tribal Fee Land and put Tribal **agricultural land** out of production.

Karuk Tribe (3/6/19) #139

- **Tribal Consultation and Mitigation** absent - no consultation outside of footprint area, need to conduct additional AB 52 consultation
- Need to 'honestly' evaluate **foreseeable impacts to Trinity River water temperature objectives** associated with project operations – revised Trinity River Division (TRD) water operations associated with Sites Projects violates 2000 Trinity Record of Decision (ROD)
- Need to analyze foreseeable impacts to the Trinity River associated with **Trinity Lake carryover storage** – analysis assumes minimum Trinity Reservoir carryover storage, without sufficient carryover storage would not achieve Trinity River temperature objectives
- Inaccurate **baseline associated with TRD** water operations – analysis did not consider use of Humboldt County's 50 TAF water contract included in the Trinity River Division Act
- Effective **mitigation for Trinity River/Lower Klamath impacts** needed
- Incomplete **cumulative impact assessment** pertaining to TRD operations – impact of carryover storage to meet **temperature objectives** during multi-year droughts; impact on **CVP power generation**
- Any adverse impacts on **fishery resources of the Karuk Tribe** need to be thoroughly evaluated and disclose

From: Jerry Brown [jbrown@sitesproject.org]
Sent: 1/22/2021 4:05:46 PM
To: Marcia Kivett [MKivett@sitesproject.org]
Subject: Re: Timeline of Significant NGO Engagement since the 2017 Draft EIR

I'll wait until Monday. thanks

From: Marcia Kivett <MKivett@sitesproject.org>
Date: Friday, January 22, 2021 at 1:25 PM
To: Jerry Brown <jbrown@sitesproject.org>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Thank you, Laurie!

Jerry, do you want me to add these as attachment C. I will have to rename the attachments and then link them. I will not be able to get to this until this evening.

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Friday, January 22, 2021 1:09 PM
To: Marcia Kivett <MKivett@sitesproject.org>; Spranza, John <john.spranza@hdrinc.com>
Cc: Jerry Brown <jbrown@sitesproject.org>
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Hi Marcia,

The letters that we received from NGOs and tribes are summarized in the attached. All were received during the public review period (Aug 14, 2017-January 15, 2018) except Letter #140, which was submitted in 2019.

Have a great weekend !

Laurie

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Friday, January 22, 2021 11:59 AM
To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>

Cc: Jerry Brown <jbrown@sitesproject.org>

Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Laurie/John, this document is looking good. Can you confirm we do not have a January 2018 response letter.
Thanks.

From: Marcia Kivett

Sent: Friday, January 22, 2021 10:22 AM

To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>; Spranza, John <john.spranza@hdrinc.com>

Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Thank you both! I think after I'm final on this project, we should save the information where everyone can access it.

Marcia Kivett

Sites Project Admin

Phone: 561.843.9740

Email: mkivett@sitesproject.org

Web: www.SitesProject.org

P.O. Box 517

122 Old Hwy 99W

Maxwell, CA 95955

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>

Sent: Friday, January 22, 2021 9:27 AM

To: Spranza, John <john.spranza@hdrinc.com>

Cc: Marcia Kivett <MKivett@sitesproject.org>

Subject: Re: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Thanks John !

Sent from my iPhone

On Jan 22, 2021, at 9:19 AM, Spranza, John <John.Spranza@hdrinc.com> wrote:

Here you go. I added a few items.

John Spranza

D 916.679.8858 M 818.640.2487

From: Marcia Kivett <MKivett@sitesproject.org>

Sent: Friday, January 22, 2021 6:53 AM

To: Spranza, John <John.Spranza@hdrinc.com>

Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>

Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hey John, can you let me know if you are able to review this document this morning. I need to finalize it this afternoon.

Marcia Kivett
Sites Project Admin
Phone: 561.843.9740
Email: mkivett@sitesproject.org
Web: www.SitesProject.org
P.O. Box 517
122 Old Hwy 99W
Maxwell, CA 95955

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Wednesday, January 20, 2021 2:42 PM
To: Spranza, John <john.spranza@hdrinc.com>
Cc: Marcia Kivett <MKivett@sitesproject.org>
Subject: FW: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Hi John,

Can you add anything to this, particularly for items I highlighted in yellow?

Thanks,

Laurie

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Wednesday, January 20, 2021 11:33 AM
To: Marcia Kivett <MKivett@sitesproject.org>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: Re: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Friday noon.

Sent from my iPhone

On Jan 20, 2021, at 11:17 AM, Marcia Kivett <MKivett@sitesproject.org> wrote:

No, you did not miss it. I know he is looking for this information as soon as possible.
Jerry, can you provide a deadline?
Thank you, Laurie.

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Wednesday, January 20, 2021 11:12 AM
To: Marcia Kivett <MKivett@sitesproject.org>
Subject: RE: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Hi Marcia –

Sorry I haven't responded earlier. I can try to help research some of the items and will ask John if he can help. There are some items that pre-date all of us joining the project but I know John was tracking as soon as Rob Thomson started working on Sites.

What is your deadline – did I already miss it?

Laurie

From: Marcia Kivett <MKivett@sitesproject.org>

Sent: Tuesday, January 19, 2021 10:17 AM

To: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>

Subject: Timeline of Significant NGO Engagement since the 2017 Draft EIR

Hi Laurie,

I was doing my own research and getting stuck then Kevin said I should reach out to you because you may have all of this. I then thought...duh 😊

Jerry is putting together a time line of NGO engagement. Please see the attached. I'm marked items that you might be able to help me out with.

Sent from Mail for Windows 10

<Timeline of Significant NGO Engagement since the 2017 Draft EIR (002)lwh_JJS_2.docx>

From: Cathy Marcinkevage - NOAA Federal [cathy.marcinkevage@noaa.gov]
Sent: 1/22/2021 4:48:22 PM
To: Spranza, John [john.spranza@hdrinc.com]
CC: Tancy Mill - NOAA Federal [tancy.mill@noaa.gov]; Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Stephen Maurano - NOAA Federal [stephen.maurano@noaa.gov]
Subject: Re: Sites Joint Aquatics Workshop #1

Hi John --

Yes, this had started to gel even before your email, which is good to see. From the updates I've gotten, it seems we do still have some points to work through, which is common for hammering out IAs. I encourage NMFS and Reclamation to continue towards productive discussions in working out an agreement that will allow us to provide a higher level of assistance as the project is developed. Please let me know if it is helpful for me to talk with anyone directly at Reclamation to help this.

Thanks,
Cathy

On Mon, Jan 11, 2021 at 3:50 PM Spranza, John <John.Spranza@hdrinc.com> wrote:

Hi Cathy,

Looks like Reclamation is open to using some of the 2021 WIIN dollars to fund some of NMFS's efforts for this project. We are in the initial stages of discussion, but I wanted to keep you in the loop in case you hear anything. We would expect this to eventually land in your lap as it would be best to have the IA directly between Reclamation and NMFS.

Talk with you soon.

John

John Spranza

D 916.679.8858 M 818.640.2487

From: Cathy Marcinkevage - NOAA Federal <cathy.marcinkevage@noaa.gov>
Sent: Thursday, December 3, 2020 9:27 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Tancy Mill - NOAA Federal <tancy.mill@noaa.gov>
Cc: Spranza, John <John.Spranza@hdrinc.com>; Lecky, Jim <jim.lecky@icf.com>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Subject: Re: Sites Joint Aquatics Workshop #1

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Ali, that is great to hear.

We just completed an IA with Reclamation to support assistance on CVP operations. It went through the (painfully) long lawlerly gamut for both Interior and Commerce; if we can use that as a model, I think it would put us a few steps ahead of starting from scratch. And, we will have a ZP-II hiring bundle certification list coming to us soon....I'm not sure how quickly the IA could be drafted, but if we could get it done to hop onto this hiring bundle, we could get staff on pretty quickly (relatively speaking). That may be wishful thinking, but something to consider.

I've included Tancy Mill, our Division Manager, who helps to draft IAs from our side. Let me know if we need to connect her with anyone on Reclamation's side, or provide a copy of the other IA.

Thanks!

Cathy

On Thu, Dec 3, 2020 at 9:14 AM Alicia Forsythe <aforsythe@sitesproject.org> wrote:

Hi all – Thanks for your patience as I sort through all of my emails. We are initiating discussions with Reclamation about an interagency agreement with NMFS for the Sites Project. I think this would be the fastest and most efficient way to make this happen. Stay tuned.

Ali

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

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From: Spranza, John <John.Spranza@hdrinc.com>
Sent: Thursday, November 19, 2020 11:59 AM
To: Cathy Marcinkevage - NOAA Federal <cathy.marcinkevage@noaa.gov>; Alicia Forsythe <aforsythe@sitesproject.org>; Lecky, Jim <jim.lecky@icf.com>
Cc: Heydinger, Erin <erin.heydinger@hdrinc.com>
Subject: RE: Sites Joint Aquatics Workshop #1

Hi Cathy,

I really appreciate your input on how to best utilize you and your staff's time to allow for more meaningful discussions at future meetings. I have had similar discussions with CDFW and Reclamation, and have already been having internal discussions with our team regarding the lead time we need to provide agencies to review modeling data prior to upcoming meetings. I also completely understand (and empathize with) the workload situation. Ali would need to weigh in on any potential agreements.

We are currently scheduled to have a draft of the PD in mid-December, that might be the best one to send over. I'll also work on getting the analytical approach over as well.

Please feel free to contact us with any additional concerns or questions.

John

John Spranza

D 916.679.8858 M 818.640.2487

From: Cathy Marcinkevage - NOAA Federal [<mailto:cathy.marcinkevage@noaa.gov>]

Sent: Wednesday, November 18, 2020 3:55 PM

To: Spranza, John <John.Spranza@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>; Lecky, Jim <jim.lecky@icf.com>

Subject: Re: Sites Joint Aquatics Workshop #1

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John, Ali, and Jim –

I appreciate the recent efforts to bring NMFS back into the developments on Sites reservoir. We want to work out how we can best engage, but please understand our limited resources and my need to determine our most efficient means to provide meaningful technical assistance.

I do think that our staff feels behind the curve with the recent developments in the project, which makes it hard for us to tell you what we would like to see in the analysis or in mitigation measures or operational constraints.

What would be helpful for us to see now is:

- 1) A project description, as complete as is possible, with understanding for placeholders. This will allow us to get a full picture of the potential effects pathways and therefore what analyses would be worthwhile.
- 2) A description of the proposed analytical approach. I've seen from the email traffic that several analyses/updated science have been entertained (STARS, OBAN, Michel's presentation), but we have not seen a listing of a) the potential anticipated effects and b) the methods by which those effects could be quantified.
- 3) For any meeting, we need at least 2 weeks lead time to schedule, and we'd appreciate at least a few business days to review meeting materials. We strive to come in prepared and need at least a few days to review meeting materials.

Finally, my staff have relayed that Sites would like continued and ongoing NMFS engagement. I will try to incorporate this into our division's workload priorities, but we are simply resource constrained. It's an excuse that I absolutely hate to resort to, but it is the reality, especially with reduced capacity due to COVID impacts

and a reduced budget for hiring. I'm happy to explore an interagency agreement or other funding mechanism if Sites JPA is interested in the same to increase the level of NMFS participation.

Thanks –
Cathy

Cathy Marcinkevage, Ph.D.
(she/her/hers)
Assistant Regional Administrator, California Central Valley Office
NOAA Fisheries | U.S. Department of Commerce
Office: (916) 930-5648
Mobile: (562) 537-8734
www.fisheries.noaa.gov



During the COVID-19 pandemic I am under mandatory telework. I may be working flexible hours to balance family and personal needs. I appreciate your patience if my response time is delayed. If you have a request, please specify important timeframes or deadlines. I will do my best to respond accordingly. Because I have limited ability to retrieve mail, please send any formal correspondence that would normally be sent through the physical mail to ccvo.consultationrequests@noaa.gov. Thank you.

On Tue, Oct 27, 2020 at 9:03 AM Spranza, John <John.Spranza@hdrinc.com> wrote:

Good Morning,

We'd like to thank all of you for attending yesterday's workshop and hope that you found it useful. I have a few action items to follow up on:

1. Diversion Criteria Distribution: Please see attached
2. Coordinate on running the STARS model on the project.
3. Next meeting date: The week of the 23rd of November, very likely 10-12 on the 23rd. I will confirm with the team and send out an invite in the next day or so.
4. Determine the proportion of days and reversal of flows at Georgianna Slough.

We would appreciate your input on the workshop, and comments on the assumptions and effects seen in this model run. We are working on finalizing OBAN results and will have that ready in time for the next workshop.

Please let me know if I missed any action items.

Have a great day.

John

John Spranza, MS, CCN

Senior Ecologist / Regulatory Specialist

HDR

2379 Gateway Oaks Drive, Suite 200
Sacramento, CA 95833
D 916.679.8858 M 818.640.2487
john.spranza@hdrinc.com

hdrinc.com/follow-us

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Sites Reservoir Modeling

OVERVIEW AND STATUS

Metropolitan Water District

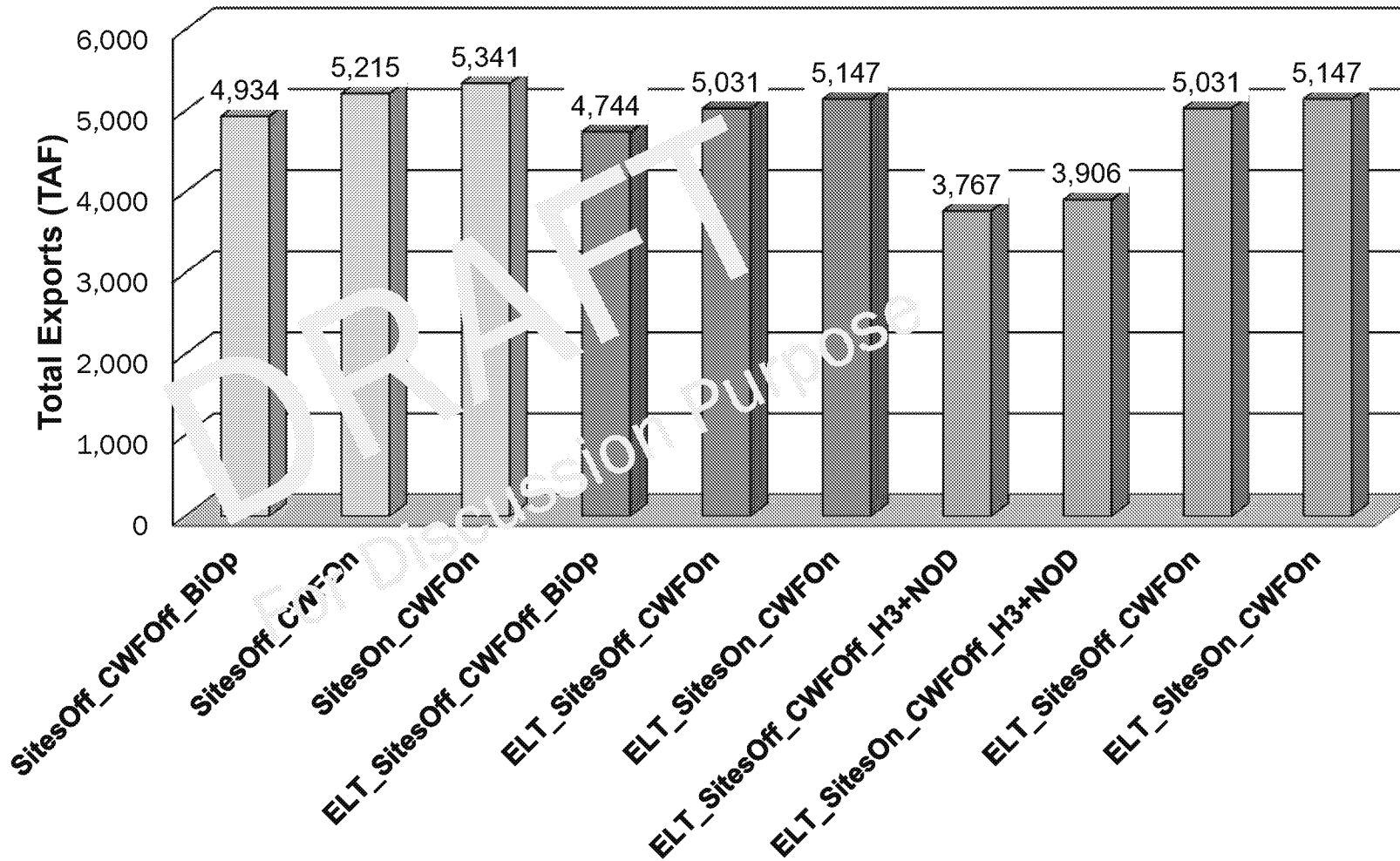
Minimum Modeling Set

	Current	Near Term (2030)	Long Term (2070)
1. Baseline (DCR 2019)	Yes	In progress	Not yet
2. Baseline (Additional Future Regs)	NO	<i>(Thoughts needed)</i>	<i>(Thoughts needed)</i>
3. Sites only	Yes	In progress	Not yet
4. Delta Conveyance only	Not yet	Not yet	Not yet
5. Sites + DCP	Not yet	Not yet	Not yet

	BOC-LTO	SWP-ITP	Fremont Weir	Bypass flow
Regulatory Considerations	Yes	Yes	Yes	Yes

	Optimize Reservoir Yield	Individual Operation
Operation Policy	Yes	No (It is what we want.)

Average Annual Total Exports, TAF (2018 Sites 1.8 MAF/CWF 9Kcfs Analysis)



Sites Reservoir

2018 SWP Export Analysis (Assumes 1.8 maf reservoir)

	Existing Bio Op No Climate Change 4.9 maf SWP/CVP	Alt. H3 NOD No Climate Change 3.9 maf SWP/CVP	Existing Bio Op Early Long Term (ELT) 4.7 maf SWP/CVP	Alt. H3 NOD Early Long Term (ELT) 3.7 maf SWP/CVP
Sites Only	147,000 AF	125,000 AF	134,000 AF	139,000 AF
CWF Only	281,000 AF	1,332,000 AF	288,000 AF	1,264,000 AF
CWF + Sites	407,000 AF	1,458,000 AF	404,000 AF	1,380,000 AF
CWF_v2 + Sites	407,000 AF	1,453,000 AF	397,000 AF	1,374,000 AF

SUMMARY (with CWF priority in model)

- With Cal WaterFix: Sites = 110-116,000 AF/yr. export benefit
- Without Cal WaterFix: Sites = 139,000 AF/yr. export benefit
- Why?
 - CWF is a priority in the model
 - Enough capacity available to export Sites water at south Delta Banks PP under new Bio Op in summer/fall
 - Sites gets charged for carriage water for either proposed northern or existing southern intakes

Sites Reservoir

2020 Modeling Analysis (Based on CEQA Alt. VP7)

Sites Reservoir Diversion & Release (TAF/Annual)

Period	Diversion into Reservoir	Evaporation Loss	Release from Reservoir
Long Term	264	27	243
• Iteration 1 Run	244	28	216
Drier	111	24	308
• Iteration 1 Run	108		337
Wet	457	28	116
Above Normal	464	32	286
Below Normal	151	25	273
Dry	124	26	382
Critical	57	20	237

Sites Reservoir

SAMPLE

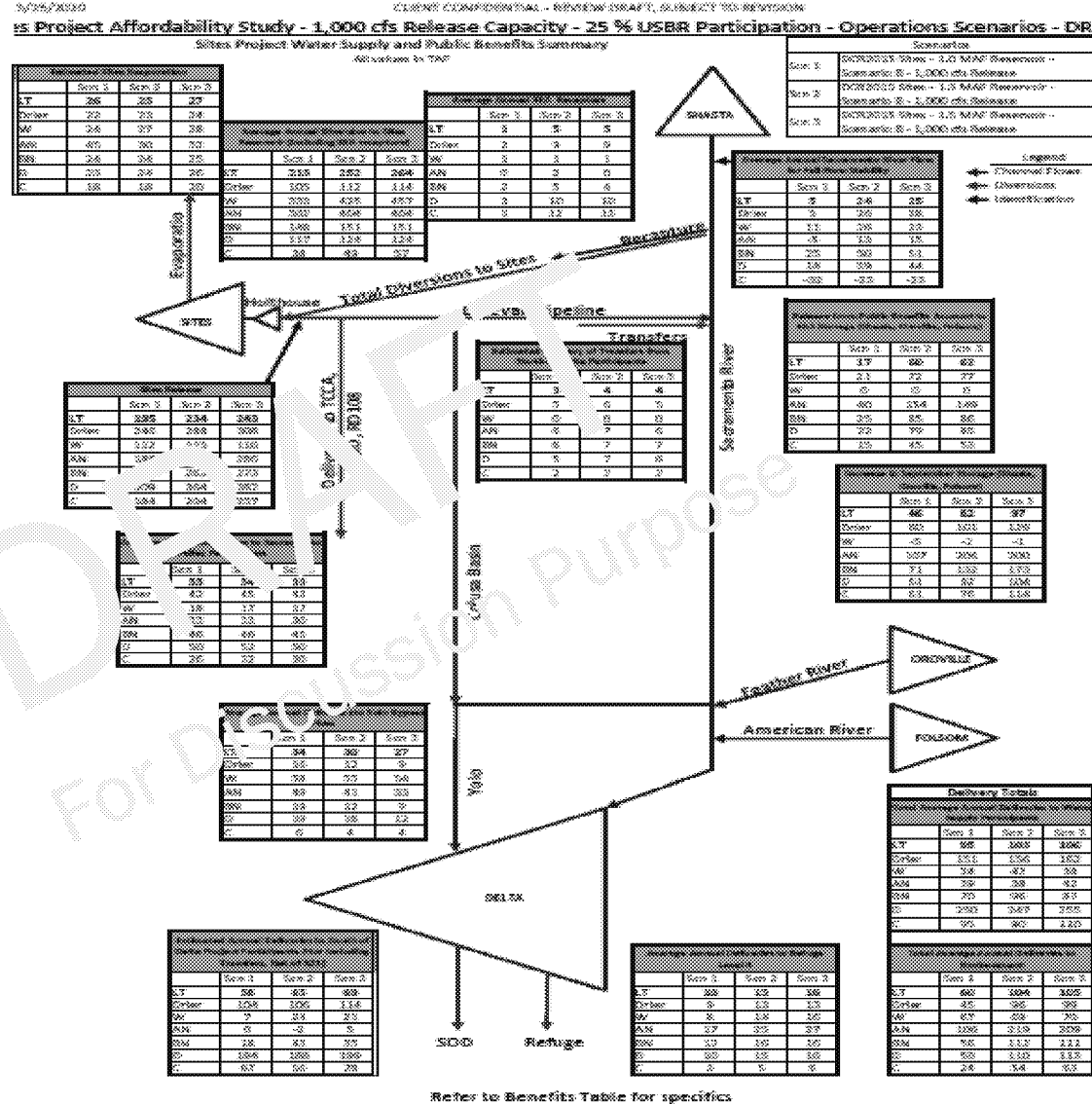
SAMPLE

	Modeling Run 1 Assumptions	Modeling Run 2 Assumptions
Reservoir Size	1.5 MAF	1.5 MAF
GCC Maintenance Window	2 weeks (Jan/Feb)	2 weeks (Jan/Feb)
Tehama Colusa Canal Capacity Available	800 cfs min; 1,250 cfs by mid-August ??	800 cfs min; 1,250 cfs by mid-August ??
Wilkins Slough Bypass Flow	8,000 cfs April/May; 5,000 cfs all other	8,000 cfs April/May; 5,000 cfs all other
Fremont Weir Notch	Priorities flows into Yolo bypass Flow over weir within 5%	Priorities flows into Yolo bypass
Sutter Bypass Flows	No restrictions	No restrictions
Freeport Bypass Flow	Based on CWF Criteria Pulse: _____ Post-Pulse: (3 levels): Jan – Mar Level 1 is initiated by the pulse trigger	
Net Delta Outflow Index	44,500 cfs between 3/1 and 5/31	
SWP Participants Storage Release	SWP < 85% allocation	
Fill	244 TAF/Annual	
Releases	216 TAF/Annual	

Sites Reservoir Modeling Schedule

DRAFT
For Discussion Purpose

Sample Useful Output



From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 1/25/2021 8:39:42 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: Sites - And UWMP Planning

Got it – I'll let Steve know.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Monday, January 25, 2021 8:37 AM
To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Subject: RE: Sites - And UWMP Planning

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Yes. They need something like this week or next. The wholesalers like Zone 7 and MWD are actually looking to finish their plans in the next month or so. So something that we can do quickly. Thanks for keeping on this!

Ali

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

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From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Monday, January 25, 2021 8:33 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: Sites - And UWMP Planning

Hi Ali,

FYI – I am working with Steve and Rob on the losses item and the table showing releases by year type by participant. We could divide it by participation level, but have done a somewhat more detailed approach in the past that they plan to do again with the latest results. You say they need the results quickly – do you know what the timing is on this? I think UWMPs are due in June or July, but I'm sure staff have a big lead time to get the materials together and approved by boards.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Saturday, January 23, 2021 1:08 PM
To: Flores, Amparo <aflores@zone7water.com>
Cc: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Subject: RE: Sites - And UWMP Planning

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Amparo – Thanks for your patience as my work schedule has been a little off this week. Considering how quickly some of the agencies need this information, I think it would be best to continue with the CalSim results that you already have. While this is for a larger project, with different diversion criteria, the largest reduction in “benefits” from the 2017 Project to the right-sizing project was in the environmental benefits (as we were providing more than the State ended up paying for). We have also changed the baseline in the modeling, but we continue to be able to deliver the member benefits.

So, all in all, I think the CalSim modeling from the 2017 Draft EIR/EIS continues to be applicable for this effort as you’re not looking at the whole of the Sites Project – but rather Zone 7’s 10,000 AF subscription and the variability in that subscription.

Ali

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

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From: Flores, Amparo <aflores@zone7water.com>
Sent: Tuesday, January 19, 2021 5:42 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: Sites - And UWMP Planning

Hi Ali,

Following up on our meeting, I wanted to know whether you intend to provide updated CalSim results for use in the 2020 UWMP? At this time, we are prepared to use older modeling results but I wanted to confirm. I’m largely looking for a series of CalSim results that reflects expected deliveries to Zone 7 based on our 10,000 AF participation level. I am not sure if we accounted for carriage losses in our modeling, but I understand that issue hasn’t been resolved yet, so I am somewhat inclined to leave it out. It’s tricky with all of the uncertainty—but we should have more certainty by the 2025 UWMP I suppose.

Thanks,
Amparo

-----Original Appointment-----

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Monday, January 11, 2021 8:23 AM

To: ERIC LEITTERMAN (eleitterman@valleywater.org); Robert Cheng (Rcheng@cvwd.org); Bob Tincer; fhernandez@cityofamericancanyon.org; Flores, Amparo; dmarks@scvwa.org; Jerry Brown; Marcia Kivett; Spranza, John; Laurie Warner Herson
Subject: Sites - And UWMP Planning
When: Thursday, January 14, 2021 11:00 AM-12:00 PM (UTC-08:00) Pacific Time (US & Canada).
Where: Microsoft Teams Meeting

CAUTION – This email came from outside of Zone 7 Water Agency. Do not open attachments or click on links in suspicious emails.

Group discussion on Urban Water Management Planning and how to address Sites in your UWMP

Microsoft Teams meeting

Join on your computer or mobile app

[Click here to join the meeting](#)

Or call in (audio only)

[+1 916-538-7066,458358246#](#) United States, Sacramento

Phone Conference ID: 458 358 246#

[Find a local number](#) | [Reset PIN](#)

[Learn More](#) | [Meeting options](#)

From: Jerry Brown [jbrown@sitesproject.org]
Sent: 1/25/2021 10:57:36 AM
To: Anthony Saracino [anthony@asaracino.com]
Subject: Re: Documents

We're close. Took a little longer than I thought to find the material. My assistant is formatting as we speak and I should be emailing to you within the next couple of hours.

From: Anthony Saracino <anthony@asaracino.com>
Date: Monday, January 25, 2021 at 10:10 AM
To: Jerry Brown <jbrown@sitesproject.org>
Subject: Documents

Hi Jerry,

Just checking on the status of those documents you were going to forward. We have an internal EDF call coming up and it would be good to have those in hand, especially the NGO letter you referenced (which EDF did not sign, I'm told).

Cheers,

Anthony M. Saracino
www.asaracino.com
(916) 952-8573

From: Kevin Spesert [kspesert@sitesproject.org]
Sent: 1/25/2021 3:04:45 PM
To: Jerry Brown [jbrown@sitesproject.org]
CC: Marcia Kivett [MKivett@sitesproject.org]; Yolanda Tirado [ytirado@sitesproject.org]
Subject: FW: FVS voice message from (925) 895-1521 at 2:50:49 PM on 1/25/2021
Attachments: Mb80-271912287-Message221.wav

Hi Jerry,

Got a voicemail this afternoon from Dennis Gambs from the Zone 7 Board.

He said he was going to participate in the Town Hall...but wanted to ask a question about the shared usage of the EBMUD Freeport diversion facility as a way to get water across the Delta...thought you would be the best person to call him back...

Thanks!

Kevin

-----Original Message-----

From: Yolanda Tirado <ytirado@sitesproject.org> On Behalf Of Board Clerk
Sent: Monday, January 25, 2021 2:58 PM
To: Kevin Spesert <kspesert@sitesproject.org>
Subject: FW: FVS voice message from (925) 895-1521 at 2:50:49 PM on 1/25/2021

Hi Kevin,

You need to listen to this voice message from Mr. Dennis Gambs, he's with Zone 7.

-----Original Message-----

From: Freedom Voice Application (5304546811x80) <messages@freedomvoice.com>
Sent: Monday, January 25, 2021 2:52 PM
To: Board Clerk <boardclerk@sitesproject.org>; Kevin Spesert <kspesert@sitesproject.org>
Subject: FVS voice message from (925) 895-1521 at 2:50:49 PM on 1/25/2021

Voice message sent to (530) 454-6811 mailbox 80 at 2:50:49 PM on 1/25/2021 from (925) 895-1521.

We're sorry, we could not transcribe this message. Please listen to your message.

This voice message is sent by FreedomVoice(tm) and intended to be received by our customers.
For technical support, contact support@freedomvoice.com If you have received this message in error,
please contact us at postmaster@freedomvoice.com <http://www.freedomvoice.com>

File Provided Natively

Sites Reservoir

Town Hall Meeting
January 27, 2021

 **Sites**

AGENDA

- Welcome
- Sites Reservoir Overview Presentation
- Resource Panel Introductions
- Participation and Ground Rules
- Q&A/Discussion

Sites

Fritz – would like to further discuss how you want to handle the Brown Act Requirements for Roll Call/Calling the meeting to order and then you walking us through the agenda.

Fritz to make short welcome remarks (see suggested bullets below), followed by Jerry (again, see suggested bullets below). Each will individually be on the screen, solo. Fritz to start and then intro Jerry.

Fritz:

Diligently working to develop project meets current needs, is affordable
Listening to/working with landowners, investors, etc. resulting in a “right-sized” project
Sites is a Project for our communities and the environment
Strength in participants – Sac Valley, SJ Valley, Bay Area, So Cal
Sites – unique, generational opportunity – multi benefit storage
Reliable, flexible, resilient with dedicated water for environment
With new direction, new leadership. Intro Jerry – overview of “right-sized project”

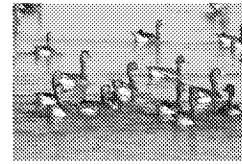
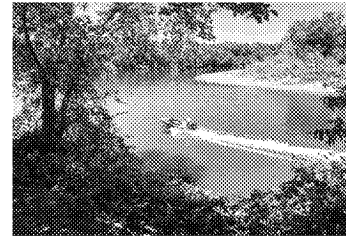
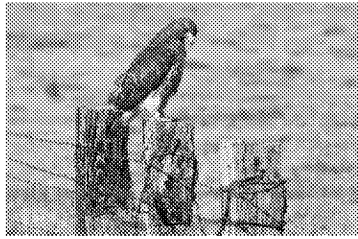
Jerry:

JB – ED for Sites project Authority, JPA of water agencies and irrigation districts throughout state
Joined in March, a lot has changed. Appreciate your interest and participation in this virtual Town Hall
I see tremendous potential for Sites Reservoir to be a generational project w/environmental, water supply and flood benefits
Sites aligns with statewide water priorities – one of two included in Gov’s Water Resilience Portfolio
Multi-benefits
I have a short presentation and we will then move into the discussion/Q&A session of today’s Town Hall

(ERIN ADVANCES TO FIRST PP SLIDE)

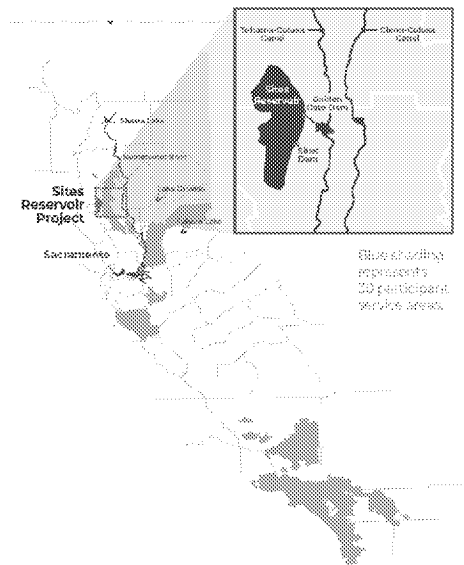
21st Century Solution to California's Water Reliability Challenges

Sites Reservoir is a generational opportunity to construct a multi-benefit water storage project that helps restore flexibility, reliability, and resiliency to our statewide water supply.



Our Strength is in Our Broad Statewide Participation

Diverse statewide representation of public agencies advancing Sites Reservoir



30
participants
span California

24.5+ million
people
500,000+
acres of farmland

Participants include:

9 Sacramento Valley
governing agencies

21 Water agencies



Fritz Slide

Our Strength is in Our Broad Statewide Participation

Sacramento Valley

Carter Mutual Water Company
City of American Canyon
Colusa County
Colusa County Water Agency
Cortina Water District
Davis Water District
Dunnigan Water District
Glenn County
Glenn-Colusa Irrigation District
LaGrande Water District
Placer County Water Agency
Reclamation District 108
City of Roseville
Sacramento County Water Agency
City of Sacramento
Tehama-Colusa Canal Authority
Westside Water District
Western Canal Water District

Bay Area

Santa Clara Valley Water District
Zone 7 Water Agency

San Joaquin Valley

Wheeler Ridge-Maricopa Water Storage District
Rosedale-Rio Bravo Water Storage District

Southern California

Antelope Valley - East Kern Water Agency
Coachella Valley Water District
Desert Water Agency
Irvine Ranch Water District
Metropolitan Water District
San Bernardino Valley Municipal Water District
San Geronio Pass Water Agency
Santa Clarita Valley Water Agency



2020 – A Year of Transition

- ✓ Hired a new Executive Director
- ✓ Completed value planning and unveiled the right-sized project
- ✓ Completed a comprehensive organizational wide strategic plan
- ✓ Named in the state's Water Resilience Portfolio as a project that contributes to resilience water future
- ✓ Brought on two new project participants
- ✓ Received Secretarial Determination of Feasibility from the US Department of Interior



Fritz Slide

Our Vision & Mission

Our Vision

Affordable water sustainably managed for California's farms, cities, and environment for generations to come.

Our Mission

The Authority will build and operate a climate-resilient, 21st Century water storage system to responsibly manage and deliver water, improve the environment, and provide flood control and recreational benefits.



Our Core Values

- ✓ Safety
- ✓ Trust and Integrity
- ✓ Respect for Local Communities
- ✓ Environmental Stewardship
- ✓ Shared Responsibility for Shared Benefits
- ✓ Accountability and Transparency
- ✓ Proactive Innovation
- ✓ Diversity and Inclusivity



Modern Solution to Mounting Challenges

California's current water system is not designed to meet the challenges we are facing today.



Climate Change



Droughts



Declining Fish
Populations



Aging
Infrastructure



Floods



Population
Growth



Jerry starts here

Modern Solution to Mounting Challenges

A modern water storage project designed to create a resilient water supply for California

Sites Reservoir is a unique solution that will restore flexibility, reliability, and resiliency to our statewide water supply. The project:

- ✓ Performs best under most challenging climate change scenarios
- ✓ Captures more water from storms to save for dry periods
- ✓ Offers flexibility to participants
- ✓ Is built off-stream and would not dam a major river system
- ✓ Has net positive impact on statewide water system



Affordable, Permittable, Buildable

Sites underwent a rigorous value planning effort that resulted in a “right-sized” project. The Sites Reservoir of today:

- ✓ Has a smaller footprint than the previous iteration
- ✓ Meets the water supply needs of current participants
- ✓ Comes at a lower cost
- ✓ Supports state's environmental goals
- ✓ Creates flexibility for participants
- ✓ Performs under most challenging climate change scenarios

The right-sized project cuts roughly \$2 billion from the original proposal.

Sites is now more affordable, permittable, and buildable.



[illegible]

JP has map

Adapting to Climate Change

**Sites Reservoir creates resilient and sustainable water supply
in the face of climate change.**

What does climate change mean for our water supply?

- ☒ Increasing temperatures
- ☒ More rain than snow
- ☒ Hampered ability to capture water from runoff
- ☒ Less cold water in upstream reservoirs that's needed to manage temperature for salmon
- ☒ Longer dry periods



Provides Climate Change Resiliency

How does Sites Reservoir address these challenges?

- ✓ Captures excess flows from Sacramento River – rain instead of snowmelt
- ✓ Off-river storage increases environmental benefits by not damming major river system
- ✓ Adds 1.5 million acre-feet of water into the statewide system, easing pressure on other sources during droughts
- ✓ Supplies water for people, farms and environment during the longer dry spells California experiences
- ✓ Allows other reservoirs, like Shasta, to conserve more cold water during dry periods in order to benefit fisheries



Provides a Resilient Supply of Water

SITES PROJECT NEW WATER SUPPLY

Year Type	Water Supply (thousand acre-feet)
Wet	87
Above Normal	154
Below Normal	224
Dry	427
Critically Dry	348
Long-Term Average	232

Just one acre-foot of water supply can serve around three households for one year or 4-6 acres of productive California agriculture.



Provides Statewide Benefits for Generations to Come



Off-stream Storage

Does not create a barrier to native fish migration



Federal and State Agencies Manage Environmental Water

Adaptable to current and future conditions and priorities



Local Leadership and Cooperation

Aligns with Sacramento Valley's values and fosters regional and statewide collaboration



Cooperative Operation

Increases effectiveness and efficiency of existing water storage infrastructure



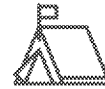
Adaptable to Climate Change

Contributes to system reliability and performance with climate change



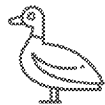
Dry Year Water Supply

Reliable dry year water supply for California communities, farms and businesses



Recreational Opportunities

Provides northern Sacramento Valley with additional opportunities for recreation



Environmental Support

Provides environmental water in drier periods for native fish, and habitat for native species and birds



Provides Important Environmental Benefits

Sites Reservoir provides water dedicated to environmental use

A significant portion of the Sites Reservoir Project's annual water supplies will be dedicated to environment uses:

Preserve cold-water pool in Lake Shasta later into the summer months to support salmon development, spawning and rearing

Provide a reliable supply of refuge water to improve Pacific Flyway habitat for migratory birds and other native species

Provide water dedicated to help improve conditions for the Delta Smelt

Water dedicated for the environment provided by Sites Reservoir will be managed by state resources agency managers who will decide how, and when, this water would be used - creating a water asset for the state that does not currently exist



Environmental Protections

- Diverting during excess conditions, when all senior water rights and water quality and flow requirements are met
- Using existing diversion locations and state-of-the-art fish screens
- Relying to the extent possible on existing infrastructure for releases
- Diversion criteria have been shifted upstream for operations at diversion locations
- Additional pulse protection criteria added to protect migrating juvenile salmon



Environmental Protections

- Additional pulse protection criteria added to protect migrating juvenile salmon
- Initial analysis shows little changes in flows throughout the system
- Certain releases specifically earmarked for ecosystem benefits in the Yolo Bypass and at wildlife refuges north and south of the Delta.
- Operations would not impair the ability for CVP/SWP to meet their own operating requirements:
 - Maintaining minimum instream flow objectives, Sacramento River temperature requirements, and Delta salinity control requirements assigned to CVP and SWP
 - Operation of Fremont Weir Notch to provide juvenile salmonid habitat in the Yolo Bypass
 - Compliance with the Water Quality Objectives for the Delta



EIR Project Alternatives

Facilities / Operations	Alternative 1	Alternative 2	Alternative 3
Reservoir Size	1.5 MAF	1.5 MAF	1.5 MAF
Hydropower	Incidental upon release	Same as Alt 1	Same as Alt 1
Diversion Locations	Red Bluff Pumping Plant and Hamilton City	Same as Alt 1	Same as Alt 1
Conveyance Release / Dunnigan Release	1,000 cubic feet per second (cfs) into new Dunnigan Pipeline to Colusa Basin Drain	1,000 cfs into new Dunnigan Pipeline to Sacramento River. Partial release into the Colusa Basin Drain	Same as Alt 1
Reclamation Involvement	1. Funding Partner 2. Operational Exchanges a. Within Year Exchanges b. Real-time Exchanges	Operational Exchanges a. Within Year Exchanges b. Real-time Exchanges	Same as Alt 1, but up to 25% investment
DWR Involvement	Operational Exchanges with Oroville and storage in SWP facilities South-of-Delta	Same as Alt 1	Same as Alt 1
Route to West Side of Reservoir	Bridge across reservoir	Paved road around southern end of reservoir	Same as Alt 1



Ali has slide to send.

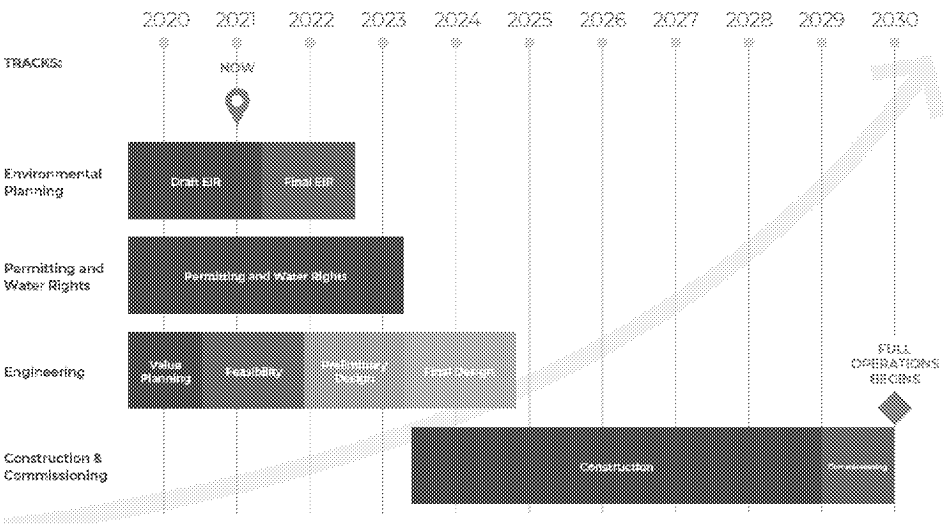
Project Costs and Affordability

Reservoir Size (MAF)	1.5
Project Cost (2019\$, billions)	\$2.4 - \$2.7
Contingency Cost (2019\$, billions)	\$0.6
Total Project Cost (2019\$, billions)	\$3.0 - \$3.3
Annualized AF/year release (AFY)	240,000
Range of Annual Costs During Repayment Without WIFIA Loans (2020\$, \$/AF)	\$650 - \$710
Range of Annual Costs During Repayment With WIFIA Loans (2020\$, \$/AF)	\$600 - \$660



Looking Ahead

Sites Reservoir Project Schedule



Creating an Affordable, Permittable & Buildable Project

2021 Goals

- ✓ Submit key project permits
- ✓ Meet the Proposition 1 (WSIP) requirement for 75% local cost share
- ✓ Update and refine cost estimate to support Water Commission Feasibility Determination
- ✓ Update and refine Master Project Schedule through construction completion
- ✓ Circulate the revised Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement for public review and comments
- ✓ Develop Operating Agreement Term Sheets with DWR, Bureau of Reclamation and local facility partners
- ✓ Continue to collaboratively engage with landowners, tribes and local communities



Resource Panel Discussion and Q&A

Sites

SARA

Joining us today in our question and discussion session we have a resource panel that is looking forward to participating in their respective areas of expertise. I like to ask each member to introduce themselves and their role in the project. (ERIN – PLEASE ADVANCE TO NEXT SLIDE) As both Jerry Brown, the Sites ED and Fritz Durst, Sites Board chair, have already been introduced, I will ask Sites Board Member Jeff Sutton to start the introductions and for other panel members to follow in the order on the screen.

RESOURCE PANEL

- Jerry Brown, Sites Executive Director
- Fritz Durst, Sites Authority Board Chair
- Jeff Sutton, Sites Authority Board Vice Chair
- Thad Bettner, Sites Reservoir Committee Chair
- Jeff Davis, Sites Reservoir Committee Vice Chair
- Ali Forsythe, Environmental Planning and Permitting Manager
- Kevin Spesert, Real Estate and External Affairs Manager
- JP Robinette, Controls Project Manager
- Richard Welsh, Bureau of Reclamation
- Rob Cooke, California Department of Water Resources

Sites

SARA
(ERIN - AFTER ROB INTRODUCES HIMSELF, PLEASE ADVANCE TO NEXT SLIDE)

PARTICIPATION METHODS

- Pre-submitted questions
- WebEx
 - Type in Chat Sidebar
- Phone

Sites

SARA

For today's TH session, there are four ways one can participate. We have received some pre-submitted questions and have consolidated those into select categories to facilitate the process.

Via WebEx, we have the amazing Erin H who will be managing comments in the chat sidebar.

We have the real-time option of calling into the dedicated phone.
(ERIN - PLEASE ADVANCE SLIDE)

TOWN HALL GROUND RULES

- Mute yourself
- When called upon, introduce yourself
- Respect volume of questions asked
- Questions will be answered in the order received
- Repeat questions will be consolidated
- Meeting is being recorded and will be posted

Sites

SARA

As we start, there are some basic ground rules that I am asking we all agree to. And we do appreciate that our newish world of virtual engagement does come with some limitations so we will all do our very best to successfully navigate during this discussion time. Read ground rules. After last ground rule is referenced (ERIN - PLEASE ADVANCE SLIDE)

DISCUSSION CATEGORIES

- Value Planning
- Environmental and Permitting
- Cost, Funding and Affordability
- Project Participation
- Schedule
- Local Impacts and Opportunities

Sites

SARA:

As you think about questions you may want to ask, or clarifications you may want from anything in the presentation or during the discussions, please try to consider which category they may fit into as this will help us know which Resource Panel Member to engage.

Let's start with some questions we received in advance of today's session in the category of Value Planning. ERIN – PLEASE ADVANCE SLIDE.

Sara to read one or two questions – Erin monitors calls/chat/raised hands etc.) If there are no audience questions in the que, I will continue on the Value Planning questions and roll into the Environmental and Permitting questions etc.

Value Planning

- Are you optimistic the project being advanced in 2021 meets the needs of your investors and will be supported by State and the Federal government investors?
- How has the right-sized project changed the construction and operations impacts?
- Sites Reservoir is only one of two named projects in the Governor's Water Resilience Portfolio. Does this mean the State is working to advance the project?



Environmental and Permitting

- With climate change impacts on water reliability and what appears to be looming drought, can you specify how Sites Reservoir will help water agencies in the Sac Valley?
- How will decisions be made on the use and benefits of the environmental water (Proposition 1 water)?
- How have the diversion criteria changed with the revised project?



Environmental and Permitting

- What efforts have been made to engage key stakeholder groups about potential landowner impacts and environmental impacts?
- How are you going to ensure Sites Reservoir provides public benefits consistent with Proposition 1? How is this different from other projects where promises were made and then broken?



Cost, Funding and Affordability

- Can you elaborate on the collaboration with the Federal government in 2021 and how this partnership is helping to advance Sites Reservoir?
- How do we expect the new Federal administration to move forward with Sites Reservoir?



Cost, Funding and Affordability

- The Federal Feasibility Report states that the Bureau of Reclamation would use its water for “Operational Flexibility.” What does that mean?
- The Federal Feasibility Report was released in December 2020 but focuses on the original project from 2017. How is the Sites JPA and the Bureau of Reclamation addressing these differences?



Cost, Funding and Affordability

- Given the ambitious Proposition 1 deadlines for financial participation, are there discussions for possible additional financial support by the State for Sites Reservoir?
- Value Planning resulted in a smaller project with a cost saving of almost \$2 billion. What does that mean in terms of costs per acre-foot? And how much are you projecting to receive in Federal and State dollars in your current calculations?



Project Participation

- How is the State intending to participate in the project and how would the State's share of water be used?
- How will the operations and maintenance charges for the State's share of water be handled?
- What is the "beneficiary pays" principle?
- Is there still room for additional participation in the project?



Project Participation

- This is an expensive project, and it's going to be difficult to get 23 individual agencies to come together to pay for this project. How do you intend to bring this together from a financial point of view?
- What are the near-term funding requirements from local agencies to keep the project going over the next two years, and what does that buy investors?



Schedule

- Value Planning took almost a year. Does this now cause a delay in getting the project permitted, and ultimately when the project would deliver water?
- Getting a surface water storage project permitted in California is almost impossible. Are your expectations realistic for obtaining the permits needed to meet deadlines in 2021?



Local Impacts and Opportunities

- When will the Authority start acquiring property for the project?
- How is the Authority working to address impacts of the project to the local communities and landowners?
- What are the local economic benefits of the project?





Erin – once we have run the course re questions (real time or prepared), we will closely watch the time and ensure we wrap with five minutes to spare.

Jerry/Fritz: If we do have time, I could offer one or both of you to make some closing comments. That would be a nice touch. Let's consider and we can prepare, or you can simply make notes throughout the TH sessions, and plan your individual wrap-ups – 60-90 seconds?

Overall Project Benefits: Sac Valley and Statewide

- How will the project provide flood protection benefits to the region?
- How will the project benefit the local/regional economy?
- What type of recreation opportunities will be created by the project?
- What are the statewide benefits of the project?



Provides Statewide Benefits for Generations to Come

Sites Reservoir will benefit the local and regional economy

Create hundreds of construction-related jobs during each year of the construction period, and long-term jobs related to operations

Creates new recreation opportunities in the Sacramento Valley which adds to the region's economy

Adding resiliency to the water supply will strengthen the statewide economy and business that rely on a reliable source of water for their operations – particularly agriculture



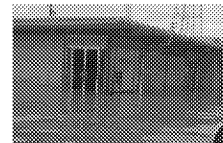
Provides Statewide Benefits for Generations to Come

Sites Reservoir provides regional flood protection benefits

Provides significant regional flood protection benefits for the Sacramento Valley

Will capture and store flood flows that would normally impact the community of Maxwell - protecting homes, business and farms

Will help to limit "down stream" flooding issues by capturing storm flows that sometimes overwhelm the regions flood control facilities



What Participants Are Saying

"Sites Reservoir is the 21st century project we need to adapt to the realities of climate change. It's the water project of the future."

— Zone 7 Water Agency

"While local water projects are essential to our regional sustainability, we also need to invest in forward-thinking statewide projects that can provide much-needed water when we need it most. Sites Reservoir can help sustain people, the environment and farms through future droughts."

— HEATHER DYER, General Manager, San Bernardino Valley Municipal Water District

"Sites Reservoir is a critical part of a greater portfolio of solutions to address California's water supply challenges. It will facilitate a more certain water future for the farms, environment, people and businesses in the Sacramento Valley, and ultimately throughout California."

— JEFF HARRIS,
Vice Mayor, City of Sacramento

"Recent droughts have hit our region hard. Sites Reservoir would soften impacts of future droughts by helping us save more water when it's available."

— Coachella Valley Water District



We need to obtain quote approvals

How it Works

Captures excess stormwater flows from the Sacramento River

Water is stored in an off-stream reservoir in Glenn and Colusa counties

1.5 million acre-feet of water available during dry years for resource agencies and participating members to use when they need it



Water from Sites directly benefits:



From: Pryor, Valerie [vpryor@zone7water.com]
Sent: 1/26/2021 7:25:04 AM
To: Jerry Brown [jbrown@sitesproject.org]
Subject: RE: FVS voice message from (925) 895-1521 at 2:50:49 PM on 1/25/2021

Thanks for talking to him . . . he is adjusting to the role of Director v. employee . . .the transition is taking a while. I'm fine unless you want to discuss further.

-----Original Message-----

From: Jerry Brown <jbrown@sitesproject.org>
Sent: Monday, January 25, 2021 7:42 PM
To: Pryor, Valerie <vpryor@zone7water.com>
Subject: FW: FVS voice message from (925) 895-1521 at 2:50:49 PM on 1/25/2021

CAUTION - This email came from outside of Zone 7 Water Agency. Do not open attachments or click on links in suspicious emails.

Hi Valerie - Just a quick heads up that I had a discussion with Dennis Gambs this evening regarding his questions about Freeport as a potential conveyance for Sites water to Zone 7. I told it was possible but required EBMUD to be willing seller of excess capacity which can be impacted by availability of the aqueduct since they don't mix Delta water with Mok water for water quality and treatment purposes. Told him using Freeport can be expensive, in the \$200/af to \$300/af range to get it to the CCWD/EBMUD intertie. Also I recall EBMUD treatment charges being in the \$1000/af range. He had some comments about the LVE JPA development and asked about the Sites JPA governance. He said he would be attending the Sites Town Hall on Wednesday.

Let me know if you would like to discuss.

From: Kevin Spesert [kspesert@sitesproject.org]
Sent: 1/26/2021 7:39:21 AM
To: Laurie Warner Herson [laurie.warner.herson@phenixenv.com]; Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Re: Revised Sites Reservoir figures

Ali & Laurie...Thanks for following up on this..it completely fell off my radar

From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Tuesday, January 26, 2021 7:33 AM
To: Alicia Forsythe
Cc: Kevin Spesert
Subject: Re: Revised Sites Reservoir figures

I already asked her to overlay on the same base map used by ICF - I'll check in with her.

Sent from my iPhone

On Jan 26, 2021, at 7:07 AM, Alicia Forsythe <aforsythe@sitesproject.org> wrote:

Laurie – Can you send me one of the maps as an example? I'd like to send it onto Janis so we can close this out.

Ali

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

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From: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Sent: Thursday, January 21, 2021 3:01 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>; Kevin Spesert <kspesert@sitesproject.org>
Subject: RE: Revised Sites Reservoir figures

Some of the cultural sites are in or adjacent to existing roadway corridors and I would like to show they are in disturbed areas. I asked Janis to provide an overlay with existing roads but given the USGS base map it got messy. I agree, it would be best to overlay the cultural layer on our updated aerial-based maps.

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Thursday, January 21, 2021 2:47 PM
To: Kevin Spesert <kspesert@sitesproject.org>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: RE: Revised Sites Reservoir figures

Kevin – what do you think about release of these figures? I think these are pretty rough. I appreciate that they show the resources and project footprint, but I just feel like they are a little rough to release. I wonder if Horizon can overlay

the sites onto the project maps that ICF is using that have more labeling and its clearer what the overlying facility is. A site in a road, to me, seems a little different than a site in the reservoir.

Ali

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

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From: Janis Offermann <janis@horizonh2o.com>
Sent: Tuesday, January 19, 2021 10:08 AM
To: Kevin Spesert <kspesert@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>
Cc: Laurie Warner Herson <laurie.warner.herson@phenixenv.com>
Subject: Revised Sites Reservoir figures

Hi, Kevin and Ali

I had my GIS staff update the figures depicting archaeological site and isolate locations with the new project footprints. Laverne had mentioned that he would like to see this. Although I am sure his GIS staff could do it, I told him we would create the figures. I am sending them to you for review prior to passing them along to him. I will also send them to Colusa so that they have the most up-to-date information.

Thanks
janis

Janis Offermann
Cultural Resources Practice Leader
Horizon Water and Environment
400 Capitol Mall, Suite 2500
Sacramento, CA 95814
916.465.8076 – office
530.220.4918 – mobile

1.1 General Description of Facilities

Following is a list of the individual new facilities and existing facilities requiring improvements.

- Improvements to the TCC Authority Red Bluff Pumping Plant on the Sacramento River
- Glenn-Colusa Irrigation District (GCID) Canal Improvements upstream of the TRR
- Terminal Regulating Reservoir (TRR)
- TRR PGP
- TRR Pipelines
- Funks Reservoir – Sediment Removal
- Funks PGP
- Funks Pipelines
- Western Area Power Administration (WAPA) or Pacific Gas and Electric (PG&E) Substation/Switchyard
- Power Transmission Lines
- Dunnigan Pipeline
- Administration and Operations Building
- Maintenance and Storage Building
- Access Roads

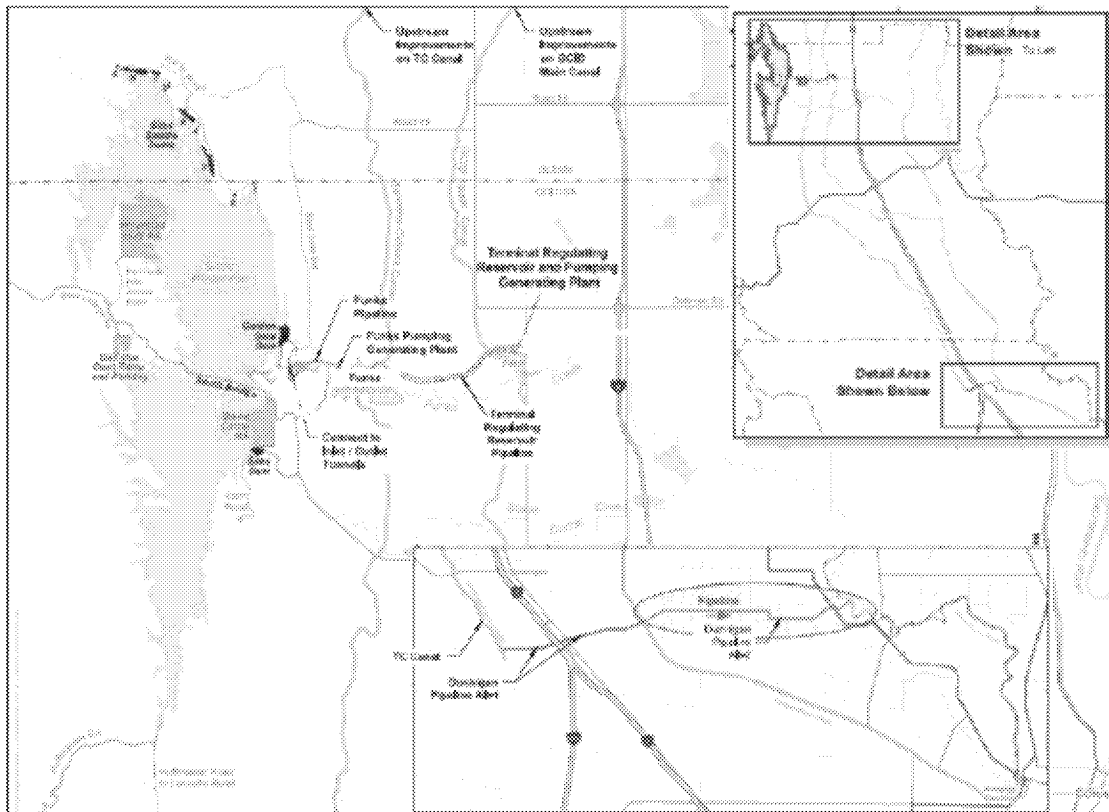


FIGURE 1: PROJECT AREA SITE PLAN

Improvements to the TCC Red Bluff Pumping Plant

The Red Bluff Diversion is located on the Sacramento River in Red Bluff, California. The facility includes a 2,500 cubic feet per second (cfs) capacity 1,180-foot-long fish screen structure, forebay, pumping plant(current capacity 2,000 cfs), an electrical switchyard, and a 660-foot-long access bridge, canal, and siphon under Red Bank Creek, to deliver water from the Sacramento River into the TCC and Corning Canal. This facility was constructed and put into operation in October 2012. The pumping plant was designed to accommodate the Sites Project and includes space to add two additional 250 cfs pumping units, bringing the total pumping capacity to 2,500 cfs.

GCID Main Canal Improvements

The GCID Main Canal delivers water from the Sacramento River to water users along its route, from its diversion point approximately 5 miles northwest of Hamilton City to southeast of the City of Williams. The canal is a 65-mile unlined earthen channel, with capacity varying from

3,000 cfs at the upstream end to 300 cfs at the southern terminus. Water conveyed by the canal is pumped by the Hamilton City Main Pump Station into the GCID Main Canal.

Improvements to the GCID Main Canal will include a 3,000 cfs headworks structure just downstream of the Hamilton City Diversion, two siphon structures (Willow Creek and Walker Creek), a railroad siphon at Willows, canal earthwork, and some canal bank gravel road improvements. The need for replacement of the siphons and railroad crossing will be determined after a canal hydraulic model is completed, as well as a condition assessment anticipated for early 2021.

TRR

This is a new reservoir that will be hydraulically connected to the GCID Main Canal about three miles east of Funks Reservoir. There are two alternative locations for the TRR that will be evaluated named the TRR West and TRR East. This report currently provides information on only the TRR East. Information on TRR West will be forthcoming in future reports.

TRR PGP

This is a pumping and generating plant that will be used to pump water from the TRR to the Sites Reservoir. This facility will also include hydroelectric turbines to generate electricity when flow is released from Sites Reservoir to the TRR and GCID Main Canal. As part of this PGP facility, there will also be an energy-dissipation facility that will allow releases back to the TRR as backup to the hydroelectric turbine facilities.

TRR Pipelines

These are two parallel, 12-foot-diameter pipelines used to convey water between the TRR PGP and the Sites Reservoir. These pipelines will connect from the piping manifold at TRR PGP to the downstream side of the two proposed 23-foot-diameter tunnels connected to the Site Reservoir inlet/outlet structure. The approximate length of these pipelines is 5 miles each.

Funks Reservoir

Reclamation constructed the Funks Reservoir in the mid-1970s with the intent of providing operational flexibility for the TCC. There are check structures on the TCC just upstream and downstream of the reservoir. The TCC is located about 1 mile east of the proposed Sites Reservoir. At the time of construction, the reservoir had a useable capacity of 1,170 acre-feet between operating levels of 199.5- and 205.2-feet elevation, and 1,080 acre-feet of inactive storage below elevation 199.5 feet, for a total capacity of 2,250 acre-feet; however, the addition of sediment from Funks Creek and the TCC have likely reduced the total storage volume.

Additionally, a cofferdam will be constructed within Funks Reservoir to facilitate construction of the TRR pipelines. The resulting storage volume reductions will be offset by sediment removal and excavation where storage capacity can be regained. The spillway has a capacity of 2,500 cfs. The project will remove accumulated sediment to recapture the design storage volume.

Funks PGP

This is a pumping and generating plant that will be used to pump water from Funks Reservoir to the Sites Reservoir. This facility will also include hydroelectric turbines to generate electricity when flow is released from Sites Reservoir to Funks Reservoir and, ultimately, the TCC. There will also be an energy-dissipation facility as part of this PGP facility that will allow releases back to Funks Reservoir as backup to the hydroelectric turbine facilities.

Funks Pipelines

These are 2 parallel, 12-foot-diameter pipelines used to convey water between the Funks PGP and the Sites Reservoir. These pipelines will connect from the piping manifold at Funks PGP to the downstream side of the two proposed 23-foot-diameter tunnels connected to the Site Reservoir inlet/outlet structure. The approximate length of these pipelines is 1 mile each.

Dunnigan Pipeline

The Dunnigan pipeline consists of either a 9-foot-diameter or 10.5-diameter pipeline that will be used to release water from the TCC to the Sacramento River. The concept is to release flow from Sites Reservoir to Funks Reservoir, where the flow will then go south about 40 miles to near the end of the TCC. At this point, flow will be diverted into the Dunnigan pipeline, where flow will head either to the Colusa Basin Drain (CBD, which flows to Sacramento River, or directly to the Sacramento River. If the pipeline discharges directly into the Sacramento River, a portion of the water will also be diverted and discharged in the CBD. The pipeline is about 4 miles long to the CBD, or 10 miles long if it goes directly to the Sacramento River.

WAPA or PG&E Substation/Switchyard

There are 230 kilovolt (kV) electrical transmission lines running near the proposed project area. Specifically, the WAPA transmission lines run very close to Funks Reservoir in a north-south direction, with a parallel 230 kV line owned by PG&E a few miles east of the WAPA transmission lines. It is anticipated that one of these transmission lines will be connected to provide power for the project, as well as receive generated electrical power from the hydroelectric turbines. Switchyards and substations will be needed to provide power to both the TRR and Funks sites.

Electrical Transmission Lines

Electrical transmission lines will be required to connect the WAPA or PGE 230 kV transmission lines to the TRR PGP and the Funks PGP.

Administration and Operations Building

At this time, staffing requirements for operating and maintaining the Sites facilities has not been defined, but an administration and operations building is anticipated to be needed.

Maintenance and Storage Building

A building is also expected to be required to provide maintenance and storage associated with the Project.

Access Roads

Access to the proposed TRR site would likely be from McDermott Road, which lies adjacent to the proposed reservoir. Access to the Funks complex (PGP and Reservoir) is currently accomplished using the O & M road along the TCC. A new access road will be required that allows larger equipment and year-round access. It is also anticipated that roads will be constructed within the TRR and Funks Pipeline easements, both to provide access to the pipelines and electrical power transmission lines but also as a secondary access road to the project facilities.

2.7 Electrical Supply

2.7.1 Point of Interconnection

The Preliminary 230kV Schematic Plan depicts the point of interconnection (POI) looping in and then back out of the new TRR substation (see Section 3). The TRR substation will then connect to the new Funks substation. This interconnection configuration is subject to approval by the Transmission Operator and the system operator, California Independent System Operator.

The POI, transmission and substation design criteria, dependent on the POI option, will incorporate the following references:

- a. California General Order 95, Rules for Overhead Electric Line Construction
 - b. WAPA Service and Generation Interconnection Requirements
 - c. PG&E Interconnection Requirements
 - d. PG&E Substation Design Criteria PG&E and WAPA Transmission Line Design Criteria

The latest edition and addenda of the following publications, as applicable, will be incorporated in the design specifications codes and standards sections.

- ANSI
- IEEE
- Association of Edison Illuminating Companies
- Transmission Interconnections Handbook
- North America Electric Reliability Corporation Standards
- National Fire Protection Agency 70 National Electric Code
- National Electrical Safety Code (ANSI C2)

2.7.2 Transmission Lines

Codes and Standards

In addition to the POI requirements, transmissions lines will be designed in accordance with the latest edition and addenda of the following publications, as applicable, which will be incorporated in the design specifications.

- California Building Code 2016, Title 24 Vol. 2

- ASCE-113, Substation Structure Design Guide
- ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures
- ANSI/AISC 41-10, Seismic Provisions for Structural Steel Buildings

2.7.3 Substations

The transmission operating voltage of 230 kV will be stepped down via transformer, to the 13.8 kV operating voltage of the turbine generators and the pump motors at each new pumping site. The proposed substations will use two 100 megavolt-ampere (MVA) transformers to step down the voltage. The transformers will be threewinding, to reduce nominal current ratings below 3,000 amperes and minimize short-circuit levels to comply with Arc Flash requirements in accordance with Occupational Safety and Health Administration regulations. This configuration will allow two independent, double-ended 13.8 kV switchgear lineups to reliably connect the motors and generators to the transmission system.

The substation design will include that the primary safety equipment, including breakers and utility grade relays, to disconnect the interconnection facilities immediately upon a fault detection on the 230 kV transmission system and the 13.8 kV pumping station systems, to minimize potential loss of life and property. When operating in the generation mode, the facility will automatically trip offline (disconnect from the transmission system) when the relays detect that power has been interrupted on the transmission line into the substation. Transmission line-protective equipment will perform one of the following, as stated anticipated to be in the Interconnection Agreement:

1. Automatically clear a fault and restore power.
2. Rapidly isolate only the faulted section so that the 230 kV system affected by any outage is minimized.

The protection system will be designed with sufficient redundancy such that the failure of any one component will permit the substations to be safely and reliably isolated from the transmission system under fault conditions. Fiberoptic cable will be used for communication protection between each pumping station and the POI.

The substations will include a control enclosure containing power, control, relaying, monitoring and communications. The control enclosure will contain redundant, protective relays and supervisory control and data acquisition (SCADA)/remote telemetry units for transmitting information. The control enclosure will be designed to meet the Bulk Power Protection Criteria of the North America Electric Reliability Corporation Standards, as well Federal Energy Regulatory Commission or Transmission Operator (TO)/California Independent Service Operators (CALISO)-specific requirements.

The TO has standardized their protection requirements; however, system variables will impact the protection requirements, such as generator size and type, number of generators, fault duties, line characteristics (such as, voltage, impedance, and ampacity) and pre-existing protection schemes. For example, high-speed fault clearing may or may not be required to minimize equipment damage and potential impact to system stability.

3.7 Electrical Supply

3.7.1 Point of Interconnection

The point of interconnection (POI) for the project will require that an Application for Interconnection Request be submitted and processed under the CALISO Interconnection Process. The location of the POI to either the WAPA or PG&E 230-kV transmission lines will depend on the results of a system impact study (SIS), which will be required to be performed by the Transmission Operators (TOs), in conjunction with the independent system operator of the transmission system.

The interconnection application process includes that the project enter into a SIS agreement, which requires the project to compensate the TO for its actual costs to undertake the SIS. The TO will include in the agreement a non-binding estimate of the cost and a timeframe for completing the SIS. The SIS report will state the results of the power flow, short circuit, and stability analyses, and will provide the requirements or potential impediments to the requested POI, including a preliminary indication of the cost and length of time necessary to correct any problems identified in the SIS. The SIS report will also provide a preliminary list of facilities required to be upgraded to accommodate the supply of power to the project.

The application process then entails the TO performing a facilities study (FS). The Project will enter into a FS agreement, which requires the project to compensate the TO for its actual costs to perform the FS. The TO will include in the agreement a non-binding estimate of the cost and timeframe for completing the FS. Upon completion of the FS, the TO will provide the FS report. The report will specify the estimated cost of the equipment, engineering, procurement, and construction work needed to implement the conclusions of the SIS. The FS report will also identify the electrical switching configuration of the connection equipment, including: the transformer, switchgear, meters, and other station equipment. The report shall include a +/- 20 percent cost estimate of facilities necessary for the interconnection, and an estimate of the time required to complete the construction and installation of such facilities.

The application process then entails the project entering into the Interconnection Agreement, (IA) with the TO. The IA will require that the actual costs associated with the equipment, environmental, engineering, procurement, construction, and any other work needed to accomplish the interconnection be payable by the project. The IA will specify the interconnection and network facilities that will be required to interconnect the project.

The California Independent System Operator interconnection procedures place applications into groups, known as clusters, for projects that are interconnecting in the same area to be studied together.

This process began in September 2020 with PG&E and will begin with WAPA turbine and generator system designs become more developed.

3.7.2 Transmission Lines

A POI to a high-voltage electric transmission line will be required for the project. Interconnecting to the transmission system is necessary to provide for the supply of power to operate the large-horsepower pumps at both the Funks PGP, and the TRR East PGPt. In addition, the interconnection to the transmission system will allow Funks PGP and TRR PGP to send energy produced to the transmission system during the periods when they are using their turbines/generators.

Several existing high-voltage transmission lines are in the vicinity of the project; all of these run north to south. These transmission lines include two 230 kV lines owned and operated by WAPA, and four 230 kV lines owned and operated by PG&E. WAPA and PG&E are defined as the TO and the Transmission Operator of their respective high-voltage transmission lines. Each of these lines is a potential POI source for the project.

The Transmission Agency of Northern California, (TANC), owns a 500-kV, high-voltage transmission line that runs parallels to the WAPA lines; however, this transmission line is not considered to be a potential POI for the project. See Figures 6 and 7 for schematic sketches showing the WAPA and PG&E alternative POI arrangements, and the required transmission line lengths to the proposed Funks and TRR substations. Under either alternative POI, the power will be delivered to the project via looped (two circuits) 230 kV to the supply power for the pumps. The looped circuits would also receive power from the Funks PGP and TRR pPGP when their turbine/generators are operating. The looped circuits are typically installed on double-circuit steel monopole structures (poles), as shown earlier in Figure 2. The poles would be approximately 100 to 150 feet high and supported atop reinforced concrete foundations that are augured and designed in accordance with the results of the geotechnical investigation. The conductor size will be designed to match or be larger than the existing conductor size of the transmission line, which will be interconnected via the loop. One or two fiberoptic cables can be used as shield wire, the size of which will be determined by fault current requirements and TO telecommunication requirements.

In addition to the loop POI design, there will be two additional 230 kV transmission line radial taps installed between the Funks and TRR substations. The transmission line structures for these lines will be double-circuit, steel monopole structures, as shown in Figure 4. The poles would be approximately 100 to 150 feet high and supported atop reinforced concrete foundations that are designed in accordance with the results of the geotechnical investigation. The conductor size is estimated to be 795 kcmil aluminum conductor steel reinforced (ACSR). In some sections of the transmission line; the double-circuit, monopole tap lines may share a common ROW with the double-circuit, monopole looped circuits (see Section 2.9).

The configuration of the transmission lines will depend on the selected POI, which is described in the following subsections.

WAPA POI Option

This option proposes to loop the existing WAPA 230 kV Keswick-O'Banion transmission line into and out of the Funks substation, as shown schematically on Figure 3. The length of the looped, double-circuit, steel monopole line will be approximately 1 mile, in a generally westerly direction to Funks. Two new, three-pole, single-circuit structures will be cut into the existing transmission line; the existing wires between these two structures will be removed. The new conductors in the first spans toward Funks will be installed low on the poles to achieve the proper clearances as they cross under the existing TANC 500 kV transmission line to two, new, double-pole, single-circuit (or one, new, double-pole, double-circuit) steel H-Frame structures. Minimum phase-to-phase and phase-to-ground clearances will be in accordance with WAPA and TANC standards, and the state of California Public Utility Commission Rules for Overhead Electric Line Construction. Conductors will match or exceed the conductor size of the existing WAPA line.

Two, new, 230 kV, radial lines will also be constructed between the Funks and TRR substations, on double-circuit, steel, monopole structures, for a length of approximately 3.9 miles. H-Frame construction will be used at the crossings below the TANC 500 kV Line, the two WAPA 230 kV lines, and the four PG&E lines.

Although the structures between Funks and TRR will be designed to accommodate two 230 kV circuits, it is possible that only one circuit will be initially installed. The conductor will be 795 kcmil ACSR.

PG&E POI Option

This option proposes to loop the existing PG&E 230 kV Colusa-Vaca-Dixon #3 transmission line into and out of the TRR substation, as shown schematically on Figure 4. The length of the looped, double-circuit, steel monopole line will be approximately 1.7 miles, in a generally easterly direction to TRR. Two, new, monopole-pole, single-circuit structures will be cut into the existing transmission line; and the existing wires between these two structures will be removed. Conductors will match or exceed the conductor size of the existing PG&E line.

Two new 230 kV radial lines will also be constructed between the TRR and Funks substations, on double-circuit, steel monopole structures, for a length of approximately 3.9 miles. Single- or double-circuit, steel, H-Frame pole construction will be used at the crossings below the existing TANC 500 kV Line, the two WAPA 230 kV lines, and the four PG&E lines, to achieve proper minimum phase-to-phase and phase-to-ground clearances, in accordance with WAPA and TANC standards, and the State of California Public Utility Commission Rules for Overhead Electric Line Construction.

Although the structures between Funks and TRR will be designed to accommodate two 230 kV circuits, it is possible that only one circuit will be initially installed. The conductor will be 795 kcmil ACSR.

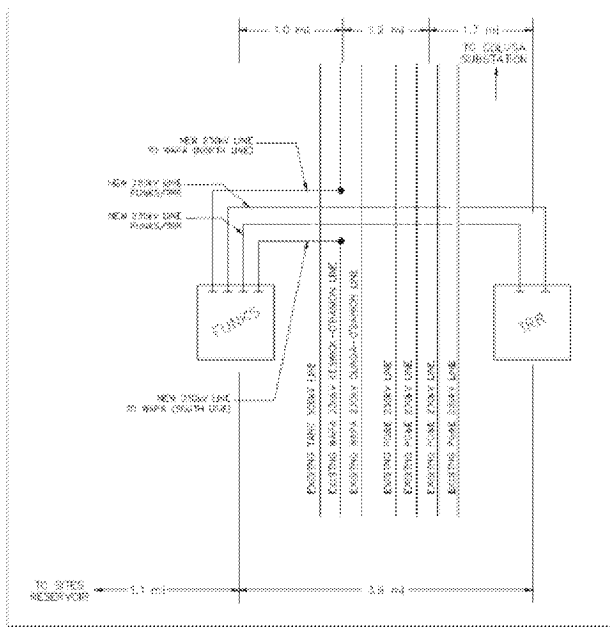


FIGURE 6: SCHEMATIC OF WAPA POI OPTION

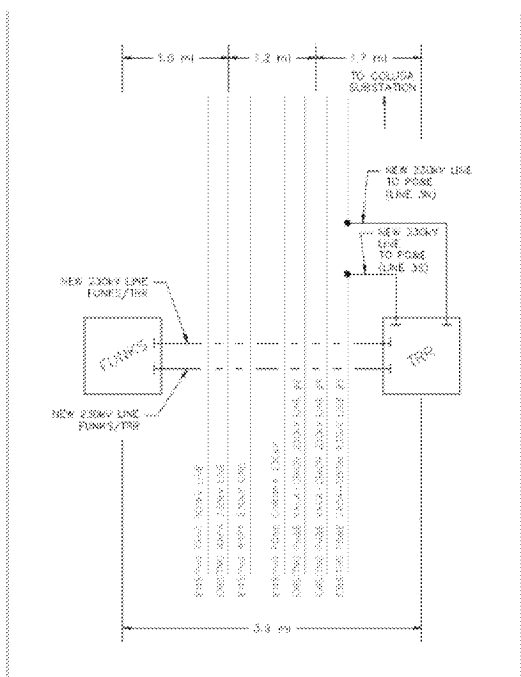


FIGURE 7: SCHEMATIC OF PG&E POI OPTION

3.7.3 Substations

Each pumping/hydroelectric generator substation at TRR and Funks Reservoir will have a new 230 kV to 13.8 kV substation. The substations will service a net pumping energy demand, estimated at 80 MVA at Funks and 90 MVA at the TRR site, totaling 170 MVA of demand load. In terms of generation, estimates indicate that Funks Reservoir will have a net generating capacity of 55.0 MVA and TRR will have 31 MVA. The project's total net generating capacity to the grid is estimated to be 86 MVA. The project estimated pumping energy requirements and power generation are summarized as shown in Tables 10 and 11.

TABLE 10: PROJECT PUMPING SUMMARY

Site	Net Pumping Power (MW)	Other Auxiliary Loads (MW)	Transformer and T Line Losses (MW)	Total Pumping Power (MW)	Total Pumping Power @ 0.85 Power Factor (PF) (MVA)
Funks	67.1	1	0.1	68.2	80.2
TRR	75.4	1	0.1	76.5	90.0
Total	142.4			144.7	170.2

TABLE 11: PROJECT GENERATING SUMMARY

Site	Net Generating Power (MW)	Other Auxiliary Loads (MW)	Transformer and T Line Losses (MW)	Total Power Generation (MW)	Total Power Generation @ 0.85 PF (MVA)
Funks	48.1	1	0.1	47.0	55.3
TRR	27.4	1	0.1	26.3	31.0
Total	75.5			73.3	86.2

The substations will be designed to for the total pumping power requirements (import) or total generation requirements (export).

From: Thayer, Reed/SAC [Reed.Thayer@jacobs.com]
Sent: 1/26/2021 11:57:13 AM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]; Alicia Forsythe [aforsythe@sitesproject.org]
CC: steve.micko@jacobs.com; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Subject: Sites Metrics for Alts 1A, 1B, 2, and 3
Attachments: SitesMetrics_rev08_4scn__ALT1A_011221_vs_ALT1B_011221_vs_ALT2_011221_ALT3_012221.pdf

Erin and Ali,

I have attached the Sites Metrics for Alt 1A (1/12), Alt 1B (1/12), Alt 2 (1/12), and Alt 3 (1/22).

Reed Thayer, PE | [Jacobs](#) | Water Resources Engineer
O: 916.286.0228 | M: 831.233.2141 | reed.thayer@jacobs.com
2485 Natomas Park Dr, Ste 600 | Sacramento, CA 95833 | USA

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Deliveries Table

Deliveries (TAF/year) (above No Project Alternative conditions) ^a	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Authority PWA Deliveries	128	307	119	286	117	277	94	228
NOD	31	64	29	60	29	62	17	34
SOD	97	243	91	226	87	215	77	194
CVP Deliveries	3	10	11	29	2	10	27	55
NOD Ag	-1	2	0	5	-1	2	4	13
NOD M&I	0	0	0	0	0	0	2	4
SOD Ag	3	8	10	24	3	8	20	37
SOD M&I	0	0	1	0	0	0	1	1
Subtotal - CVP Operational Flexibility			8	19			24	45
SWP Deliveries	-1	-2	-2	0	1	-2	12	9
SWP SOD Ag (Table A)	0	0	0	0	0	0	0	0
SWP SOD M&I (Table A)	-4	-3	-1	2	-2	0	3	4
SWP SOD Interruptible (Article 21)	3	0	-1	-1	2	-2	9	6
Sub-Total Supplemental Deliveries for Water Supply	130	315	128	315	119	285	133	292
Refuge Water Supply	22	36	22	35	24	39	21	31
NOD	6	8	6	8	6	8	6	7
SOD	16	28	15	27	18	31	15	25
Yolo Bypass Habitat Water Supply	38	23	36	21	41	25	33	15
Total Deliveries	191	374	186	371	184	349	187	338
Percentage of Total Deliveries								
Authority PWA Deliveries - North of Delta	16%	17%	16%	16%	16%	18%	9%	10%
Authority PWA Deliveries - South of Delta	51%	65%	49%	61%	47%	62%	41%	57%
CVP Deliveries - Operational Flexibility	1%	3%	6%	8%	1%	3%	14%	16%
SWP Deliveries	0%	-1%	-1%	0%	0%	0%	6%	3%
Refuge Water Supply	12%	10%	12%	9%	13%	11%	11%	9%
Yolo Bypass Habitat Water Supply	20%	6%	19%	6%	22%	7%	18%	4%

Notes:

^a Values shown are the net change between the Project Alternative and No Project Alternative
Results are dependent on storage allocations (see storage allocation table)

Storage Table

Storage Increases (TAF) (above No Project Alternative conditions) ^a	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Additional end-of-September storage	28	52	50	72	27	47	109	143
Trinity	0	0	0	0	0	0	0	0
Shasta	12	23	28	39	10	18	71	105
CVP Storage	7	10	25	31	5	6	69	99
Subtotal - CVP OpFlex Storage (Estimated)			18	21			62	89
Storage exchanged from Sites	5	13	3	9	5	13	2	6
Oroville	13	24	12	21	12	19	14	17
SWP Storage	-6	-14	-6	-16	-5	-14	1	-9
Sites Delta Participants Storage	19	38	17	36	17	33	13	27
Folsom	3	5	9	12	5	9	24	21
Percentage of Total Additional End-of-September Storage								
Portion of total additional end-of-September storage	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
Trinity	0%	0%	0%	0%	0%	0%	0%	0%
Shasta	41%	44%	57%	55%	36%	40%	65%	73%
Oroville	47%	46%	24%	29%	44%	40%	13%	12%
Folsom	12%	10%	19%	16%	20%	20%	22%	14%

Notes:

^a Values shown are the net change between the Project Alternative and No Project Alternative
Results are dependent on storage allocations (see storage allocation table)

Sites Releases Table

Releases (TAF/year)	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Releases for Authority PWA Deliveries - North of Delta	31	64	29	60	29	62	17	34
Assumed transfer from North of Delta to South of Delta	7	6	6	6	6	5	1	0
Releases for Authority PWA Deliveries - South of Delta	111	266	105	250	101	238	94	219
Releases for CVP Deliveries - Operational Flexibility	0	0	28	26	0	0	88	86
Releases for Refuge Water Supply	25	39	24	38	27	42	22	32
Releases for Yolo Bypass Habitat Water Supply	44	27	41	24	47	28	38	17
Total Releases	217	402	234	404	209	374	260	387
Percentage of Total Releases from Sites								
Releases for Authority PWA Deliveries - North of Delta	14%	16%	12%	15%	14%	16%	6%	9%
Assumed transfer from North of Delta to South of Delta	3%	2%	3%	2%	3%	1%	0%	0%
Releases for Authority PWA Deliveries - South of Delta	51%	66%	45%	62%	48%	64%	36%	56%
Releases for CVP Deliveries - Operational Flexibility	0%	0%	12%	7%	0%	0%	34%	22%
Releases for Refuge Water Supply	11%	10%	10%	9%	13%	11%	8%	8%
Releases for Yolo Bypass Habitat Water Supply	20%	7%	18%	6%	22%	8%	15%	4%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Fills Table

Fills (TAF/year)	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Fills for Authority PWA Deliveries - North of Delta	45	19	43	16	41	19	21	9
Fills for Authority PWA Deliveries - South of Delta	122	48	115	43	111	43	105	38
Fills for CVP Deliveries - Operational Flexibility	0	0	29	16	0	0	90	37
Fills for Refuge Water Supply	26	11	26	11	28	13	23	8
Fills for Yolo Bypass Habitat Water Supply	46	23	43	18	48	25	39	14
Total Fill	240	101	255	104	229	99	278	106
Percentage of Total Fills								
Fills for Authority PWA Deliveries - North of Delta	19%	19%	17%	15%	18%	19%	8%	8%
Fills for Authority PWA Deliveries - South of Delta	51%	47%	45%	41%	48%	43%	38%	36%
Fills for CVP Deliveries - Operational Flexibility	0%	0%	11%	16%	0%	0%	32%	35%
Fills for Refuge Water Supply	11%	11%	10%	11%	12%	13%	8%	8%
Fills for Yolo Bypass Habitat Water Supply	19%	23%	17%	17%	21%	25%	14%	13%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Storage Allocation Table

Storage Volumes (TAF)	ALT 1A 011221	ALT 1B 011221	ALT 2 011221	ALT 3 012221
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)	1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)
Authority PWA Deliveries - North of Delta	279	256	223	100
TCCA	150	138	120	65
GCID	34	31	27	8
RD108	27	25	22	0
Other Sacramento Valley	68	62	54	27
Authority PWA Deliveries - South of Delta	857	788	683	690
CVP Deliveries - Operational Flexibility	0	91	0	345
Refuge Water Supply	124	124	124	124
Yolo Bypass Habitat Water Supply	120	120	120	120
Dead Pool Storage	120	120	120	120
Total Storage	1500	1499	1270	1499
Percentage of Total Storage Capacity				
Authority PWA Deliveries - North of Delta	19%	17%	18%	7%
Authority PWA Deliveries - South of Delta	57%	53%	54%	46%
CVP Deliveries - Operational Flexibility	0%	6%	0%	23%
Refuge Water Supply	8%	8%	10%	8%
Yolo Bypass Habitat Water Supply	8%	8%	9%	8%
Dead Pool Storage	8%	8%	9%	8%

Notes:
Results are dependent on storage allocations

From: Sarah Rossetto [srossetto@katzandassociates.com]
Sent: 1/26/2021 1:37:03 PM
To: Fritz Durst [fdurst@rd108.org]; 'TBettner@gcid.net' [TBettner@gcid.net]; Jerry Brown [jbrown@sitesproject.org]; Kevin Spesert [kspesert@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; JP Robinette [jrobinette@brwnald.com]; jdavis@sgpwa.com; jsutton@tccanal.com
CC: Fritz Durst (fritz.durst@gmail.com) [fritz.durst@gmail.com]; Boling, Robert M. [Robert.Boling@hdrinc.com]; Marcia Kivett [MKivett@sitesproject.org]; Sara M. Katz [skatz@katzandassociates.com]; Ann Newton [anewton@katzandassociates.com]
Subject: RE: Sites Town Hall PowerPoint with Resource Panel Questions
Attachments: Sites_Overview PPT Full Deck_Town Hall 2021 FINAL_2021-01-26.pptx

Hi everyone,

For reference, attached is the final version of the Town Hall presentation. We updated a few graphics based on the Annual Report and made a few small text edits.

Erin, please plan to run this version tomorrow during the Town Hall.

See you all when you log into WebEx at 9:30 a.m.

Best regards,
Sarah



Sarah Rossetto
Director
d: 858.926.4007 · c: 530.304.8704
[San Diego](#) · [Los Angeles](#) · [San Francisco](#)

From: Sarah Rossetto
Sent: Monday, January 25, 2021 5:55 PM
To: Fritz Durst <fdurst@rd108.org>; 'TBettner@gcid.net' <TBettner@gcid.net>; Jerry Brown <jbrown@sitesproject.org>; Kevin Spesert <kspesert@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>; Heydinger, Erin <erin.heydinger@hdrinc.com>; JP Robinette <jrobinette@brwnald.com>; jdavis@sgpwa.com; jsutton@tccanal.com
Cc: Fritz Durst (fritz.durst@gmail.com) <fritz.durst@gmail.com>; Boling, Robert M. <Robert.Boling@hdrinc.com>; Marcia Kivett <mkivett@sitesproject.org>; Sara M. Katz <skatz@katzandassociates.com>
Subject: Sites Town Hall PowerPoint with Resource Panel Questions

Hi everyone,

Attached for reference is the Town Hall presentation for Wednesday with updated Resource Panel questions for review. Please plan to log into the WebEx on Wednesday at 9:30 a.m. before the 10 a.m. Town Hall so we can test your audio and video capabilities, and please plan to introduce yourself when called upon by Sara Katz after the presentation by Jerry and Fritz.

In the meantime, don't hesitate to reach out to me with any questions.

Thank you,
Sarah Rossetto



Sarah Rossetto

Director

d: 858.926.4007 • c: 530.304.8704

San Diego • Los Angeles • San Francisco

Sites Reservoir

Town Hall Meeting
January 27, 2021

 **Sites**

AGENDA

- Welcome
- Sites Reservoir Overview Presentation
- Resource Panel Introductions
- Participation and Ground Rules
- Q&A/Discussion

Sites

Fritz:

2020 was important year for the project

Renewed commitment from our partners

Recognition from the state in resilience portfolio

Significant engagement with DWR, Natural Resources (etc.) and BOR

Right-sizing and strategic planning have set the stage for success in 2021

We are a 21st Century water storage project that will help the entire state tackle the impacts of climate change and provide water for the environment

Pleased to be here representing our diverse participants

Jerry:

JB – ED for Sites project Authority, JPA of water agencies and irrigation districts throughout state – unique representation local/state/fed

Joined in March, a lot has changed. Appreciate your interest and participation in this virtual Town Hall

I see tremendous potential for Sites Reservoir as both a water and environmental project – one of a kind in the state of California

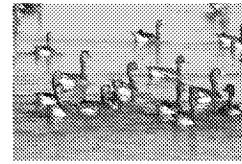
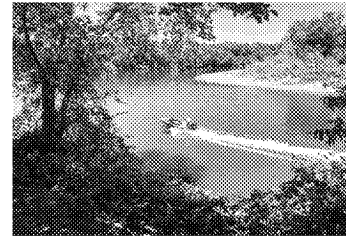
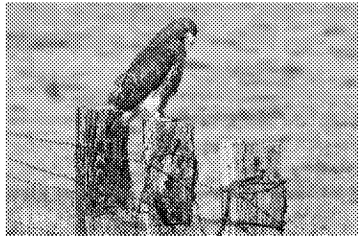
Our goal is for Sites to be affordable, permittable and buildable and we are laser focused on this goal

We have a short presentation and we will then move into the discussion/Q&A session of today's Town Hall

Please be giving thought to questions you would like to ask – we do have some questions that have already been submitted or have been asked in recent stakeholder meetings.

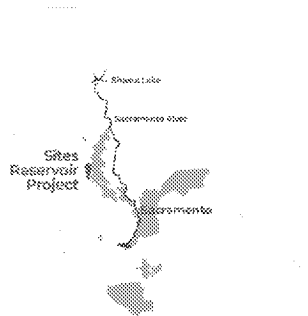
21st Century Solution to California's Water Reliability Challenges

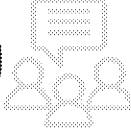
Sites Reservoir is a generational opportunity to construct a multi-benefit water storage project that helps restore flexibility, reliability, and resiliency to our statewide water supply.



Our Strength is in Our Broad Statewide Participation

Diverse statewide representation of public agencies advancing Sites Reservoir



30 
participants
span California

Participants include:

9 Sacramento Valley governing agencies

23 Reservoir Committee members

24.5+ million
people 

500,000+ 
acres of farmland



Fritz Slide

Our Strength is in Our Broad Statewide Participation

Sacramento Valley

Carter Mutual Water Company
City of American Canyon
Colusa County
Colusa County Water Agency
Cortina Water District
Davis Water District
Dunnigan Water District
Glenn County
Glenn-Colusa Irrigation District
LaGrande Water District
Placer County Water Agency
Reclamation District 108
City of Roseville
Sacramento County Water Agency
City of Sacramento
Tehama-Colusa Canal Authority
Westside Water District
Western Canal Water District

Bay Area

Santa Clara Valley Water District
Zone 7 Water Agency

San Joaquin Valley

Wheeler Ridge-Maricopa Water Storage District
Rosedale-Rio Bravo Water Storage District

Southern California

Antelope Valley - East Kern Water Agency
Coachella Valley Water District
Desert Water Agency
Irvine Ranch Water District
Metropolitan Water District
San Bernardino Valley Municipal Water District
San Geronio Pass Water Agency
Santa Clarita Valley Water Agency



2020 – A Year of Transition

- ✓ Hired a new Executive Director
- ✓ Completed value planning and unveiled the right-sized project
- ✓ Completed a comprehensive organizational strategic plan
- ✓ Named in the State's Water Resilience Portfolio as a project that contributes to resilient water future
- ✓ Brought on two new project participants
- ✓ Received Secretarial Determination of Feasibility from the US Department of Interior



Fritz Slide

Our Vision & Mission

Our Vision

Affordable water sustainably managed for California's farms, cities, and environment for generations to come.

Our Mission

The Authority will build and operate a climate-resilient, 21st century water storage system to responsibly manage and deliver water, improve the environment, and provide flood control and recreational benefits.



Our Core Values

- ✓ Safety
- ✓ Trust and Integrity
- ✓ Respect for Local Communities
- ✓ Environmental Stewardship
- ✓ Shared Responsibility for Shared Benefits
- ✓ Accountability and Transparency
- ✓ Proactive Innovation
- ✓ Diversity and Inclusivity



Modern Solution to Mounting Challenges

California's current water system is not designed to meet the challenges we are facing today.



Climate Change



Droughts



Declining Fish
Populations



Aging
Infrastructure



Floods



Population
Growth



Jerry starts here

Modern Solution to Mounting Challenges

A modern water storage project designed to create a resilient water supply for California

Sites Reservoir is a unique solution that will restore flexibility, reliability, and resiliency to our statewide water supply. The project:

- ✓ Performs best under most challenging climate change scenarios
- ✓ Captures more water from storms to save for dry periods
- ✓ Offers flexibility to participants
- ✓ Is built off-stream and would not dam a major river system
- ✓ Has net positive impact on statewide water system



Affordable, Permittable, Buildable

Sites underwent a rigorous value planning effort that resulted in a “right-sized” project. The Sites Reservoir of today:

- ✓ Has a smaller footprint than the previous iteration
- ✓ Meets the water supply needs of current participants
- ✓ Comes at a lower cost
- ✓ Supports State’s environmental goals
- ✓ Creates flexibility for participants
- ✓ Performs under most challenging climate change scenarios

The right-sized project cuts roughly \$2 billion from the original proposal.

Sites is now more affordable, permittable, and buildable.



[illegible]

JP has map

Adapting to Climate Change

**Sites Reservoir creates resilient and sustainable water supply
in the face of climate change.**

What does climate change mean for our water supply?

- ☒ Increasing temperatures
- ☒ More rain than snow
- ☒ Hampered ability to capture water from runoff
- ☒ Less cold water in upstream reservoirs that is needed to manage temperature for salmon
- ☒ Longer dry periods



Provides Climate Change Resiliency

How does Sites Reservoir address these challenges?

- ✓ Captures excess flows from Sacramento River – rain instead of snowmelt
- ✓ Off-river storage increases environmental benefits by not damming major river system
- ✓ Adds 1.5 million acre-feet of water into the statewide system, easing pressure on other sources during droughts
- ✓ Supplies water for people, farms and environment during the longer dry spells California experiences
- ✓ Allows other reservoirs, like Shasta, to conserve more cold water during dry periods in order to benefit fisheries



Provides a Resilient Supply of Water

SITES PROJECT NEW WATER SUPPLY

Year Type	Water Supply (thousand acre-feet)
Wet	87
Above Normal	154
Below Normal	224
Dry	427
Critically Dry	348
Long-Term Average	232

One thousand acre-feet of water supply can serve about 3,000 households for one year, or 4,000-6,000 acres of productive California agriculture.



Provides Statewide Benefits for Generations to Come



Off-stream Storage

Does not create a barrier to native fish migration



Federal and State Agencies Manage Environmental Water

Adaptable to current and future conditions and priorities



Local Leadership and Cooperation

Aligns with Sacramento Valley's values and fosters regional and statewide collaboration



Cooperative Operation

Increases effectiveness and efficiency of existing water storage infrastructure



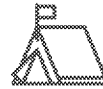
Adaptable to Climate Change

Contributes to system reliability and performance with climate change



Dry Year Water Supply

Reliable dry year water supply for California communities, farms and businesses



Recreational Opportunities

Provides northern Sacramento Valley with additional opportunities for recreation



Environmental Support

Provides environmental water in drier periods for native fish, and habitat for native species and birds



Provides Important Environmental Benefits

Sites Reservoir provides water dedicated to environmental use

A significant portion of the Sites Reservoir Project's annual water supplies will be dedicated to environment uses:

Preserve cold-water pool in Lake Shasta later into the summer months to support salmon development, spawning and rearing

Provide a reliable supply of refuge water to improve Pacific Flyway habitat for migratory birds and other native species

Provide water dedicated to help improve conditions for the Delta Smelt

Water dedicated for the environment provided by Sites Reservoir will be managed by state resources agency managers who will decide how, and when, this water would be used - creating a water asset for the state that does not currently exist



Environmental Protections

- Diverting during excess conditions, when all senior water rights and water quality and flow requirements are met
- Using existing diversion locations and state-of-the-art fish screens
- Relying to the extent possible on existing infrastructure for releases
- Diversion criteria have been shifted upstream for operations at diversion locations
- Additional pulse protection criteria added to protect migrating juvenile salmon



Environmental Protections

- Additional pulse protection criteria added to protect migrating juvenile salmon
- Initial analysis shows little changes in flows throughout the system
- Certain releases specifically earmarked for ecosystem benefits in the Yolo Bypass and at wildlife refuges north and south of the Delta
- Operations would not impair the ability for CVP/SWP to meet their own operating requirements:
 - Maintaining minimum instream flow objectives, Sacramento River temperature requirements, and Delta salinity control requirements assigned to CVP and SWP
 - Operation of Fremont Weir Notch to provide juvenile salmonid habitat in the Yolo Bypass
 - Compliance with the Water Quality Objectives for the Delta



EIR Project Alternatives

Facilities / Operations	Alternative 1	Alternative 2	Alternative 3
Reservoir Size	1.5 MAF	1.5 MAF	1.5 MAF
Hydropower	Incidental upon release	Same as Alt 1	Same as Alt 1
Diversion Locations	Red Bluff Pumping Plant and Hamilton City	Same as Alt 1	Same as Alt 1
Conveyance Release / Dunnigan Release	1,000 cubic feet per second (cfs) into new Dunnigan Pipeline to Colusa Basin Drain	1,000 cfs into new Dunnigan Pipeline to Sacramento River. Partial release into the Colusa Basin Drain	Same as Alt 1
Reclamation Involvement	1. Funding Partner 2. Operational Exchanges a. Within Year Exchanges b. Real-time Exchanges	Operational Exchanges a. Within Year Exchanges b. Real-time Exchanges	Same as Alt 1, but up to 25% investment
DWR Involvement	Operational Exchanges with Croville and storage in SWP facilities South-of-Delta	Same as Alt 1	Same as Alt 1
Route to West Side of Reservoir	Bridge across reservoir	Paved road around southern end of reservoir	Same as Alt 1



Ali has slide to send.

Project Costs and Affordability

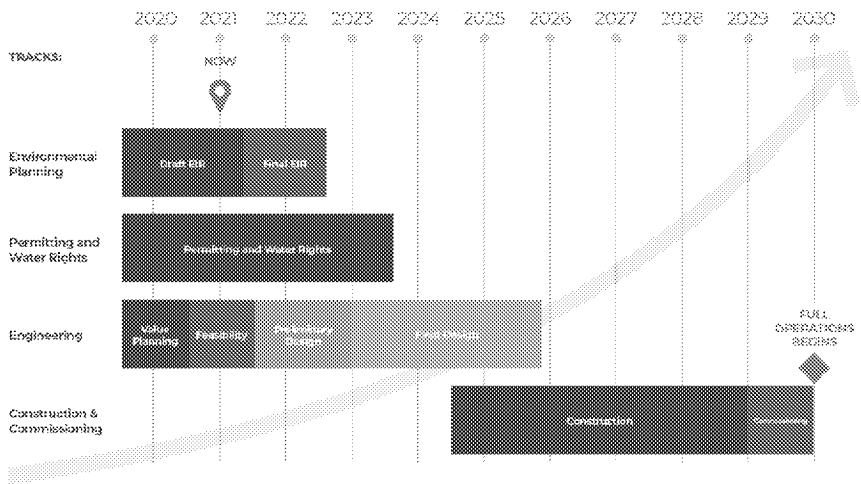
Reservoir Size (MAF)	1.5
Project Cost (2019\$, billions)	\$2.4 - \$2.7
Contingency Cost (2019\$, billions)	\$0.6
Total Project Cost (2019\$, billions)	\$3.0 - \$3.3
Annualized AF/year release (AFY)	240,000
Range of Annual Costs During Repayment Without WIFIA Loans (2020\$, \$/AF)	\$650 - \$710
Range of Annual Costs During Repayment With WIFIA Loans (2020\$, \$/AF)	\$600 - \$660



Looking Ahead

Sites Reservoir Project Schedule

Sites Reservoir Project Schedule



Creating an Affordable, Permittable & Buildable Project

2021 Goals

- ✓ Submit key project permits
- ✓ Meet the Proposition 1 (WSIP) requirement for 75% local cost share
- ✓ Update and refine cost estimate to support Water Commission Feasibility Determination
- ✓ Update and refine Master Project Schedule through construction completion
- ✓ Circulate the revised Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement for public review and comments
- ✓ Develop Operating Agreement Term Sheets with DWR, Bureau of Reclamation and local facility partners
- ✓ Continue to collaboratively engage with landowners, tribes and local communities



Resource Panel Discussion and Q&A

Sites

SARA

Joining us today in our question and discussion session we have a resource panel that is looking forward to participating in their respective areas of expertise. I like to ask each member to introduce themselves and their role in the project. (ERIN – PLEASE ADVANCE TO NEXT SLIDE) As both Jerry Brown, the Sites ED and Fritz Durst, Sites Board chair, have already been introduced, I will ask Sites Board Member Jeff Sutton to start the introductions and for other panel members to follow in the order on the screen.

RESOURCE PANEL

- Jerry Brown, Sites Executive Director
- Fritz Durst, Sites Authority Board Chair
- Jeff Sutton, Sites Authority Board Vice Chair
- Thad Bettner, Sites Reservoir Committee Chair
- Jeff Davis, Sites Reservoir Committee Vice Chair
- Ali Forsythe, Environmental Planning and Permitting Manager
- Kevin Spesert, Real Estate and External Affairs Manager
- JP Robinette, Controls Project Manager
- Richard Welsh, Bureau of Reclamation
- Rob Cooke, California Department of Water Resources

Sites

SARA
(ERIN - AFTER ROB INTRODUCES HIMSELF, PLEASE ADVANCE TO NEXT SLIDE)

PARTICIPATION METHODS

- Pre-submitted questions
- WebEx
 - Type in Chat Sidebar
- Phone

Sites

SARA

For today's TH session, there are four ways one can participate. We have received some pre-submitted questions and have consolidated those into select categories to facilitate the process.

Via WebEx, we have the amazing Erin H who will be managing comments in the chat sidebar.

We have the real-time option of calling into the dedicated phone.
(ERIN - PLEASE ADVANCE SLIDE)

TOWN HALL GROUND RULES

- Mute yourself
- When called upon, introduce yourself
- Respect volume of questions asked
- Questions will be answered in the order received
- Repeat questions will be consolidated
- Meeting is being recorded and will be posted

Sites

SARA

As we start, there are some basic ground rules that I am asking we all agree to. And we do appreciate that our newish world of virtual engagement does come with some limitations so we will all do our very best to successfully navigate during this discussion time. Read ground rules. After last ground rule is referenced (ERIN - PLEASE ADVANCE SLIDE)

DISCUSSION CATEGORIES

- Value Planning
- Environmental and Permitting
- Cost, Funding and Affordability
- Project Participation
- Schedule
- Local Impacts and Opportunities

Sites

SARA:

As you think about questions you may want to ask, or clarifications you may want from anything in the presentation or during the discussions, please try to consider which category they may fit into as this will help us know which Resource Panel Member to engage.

Let's start with some questions we received in advance of today's session in the category of Value Planning. ERIN – PLEASE ADVANCE SLIDE.

Sara to read one or two questions – Erin monitors calls/chat/raised hands etc.) If there are no audience questions in the que, I will continue on the Value Planning questions and roll into the Environmental and Permitting questions etc.

Value Planning

- Are you optimistic the project being advanced in 2021 meets the needs of your investors and will be supported by State and the Federal government investors?
- How has the right-sized project changed the construction and operations impacts?
- Sites Reservoir is only one of two named projects in the Governor's Water Resilience Portfolio. Does this mean the State is working to advance the project?



Environmental and Permitting

- With climate change impacts on water reliability and what appears to be looming drought, can you specify how Sites Reservoir will help water agencies in the Sac Valley?
- How will decisions be made on the use and benefits of the environmental water (Proposition 1 water)?
- How have the diversion criteria changed with the revised project?



Environmental and Permitting

- What efforts have been made to engage key stakeholder groups about potential landowner impacts and environmental impacts?
- How are you going to ensure Sites Reservoir provides public benefits consistent with Proposition 1? How is this different from other projects where promises were made and then broken?



Cost, Funding and Affordability

- Can you elaborate on the collaboration with the Federal government in 2021 and how this partnership is helping to advance Sites Reservoir?
- How do we expect the new Federal administration to move forward with Sites Reservoir?



Cost, Funding and Affordability

- The Federal Feasibility Report states that the Bureau of Reclamation would use its water for “Operational Flexibility.” What does that mean?
- The Federal Feasibility Report was released in December 2020 but focuses on the original project from 2017. How is the Sites JPA and the Bureau of Reclamation addressing these differences?



Cost, Funding and Affordability

- Given the ambitious Proposition 1 deadlines for financial participation, are there discussions for possible additional financial support by the State for Sites Reservoir?
- Value Planning resulted in a smaller project with a cost saving of almost \$2 billion. What does that mean in terms of costs per acre-foot? And how much are you projecting to receive in Federal and State dollars in your current calculations?



Project Participation

- How is the State intending to participate in the project and how would the State's share of water be used?
- How will the operations and maintenance charges for the State's share of water be handled?
- What is the "beneficiary pays" principle?
- Is there still room for additional participation in the project?



Project Participation

- This is an expensive project, and it's going to be difficult to get 23 individual agencies to come together to pay for this project. How do you intend to bring this together from a financial point of view?
- What are the near-term funding requirements from local agencies to keep the project going over the next two years, and what does that buy investors?



Schedule

- Value Planning took almost a year. Does this now cause a delay in getting the project permitted, and ultimately when the project would deliver water?
- Getting a surface water storage project permitted in California is almost impossible. Are your expectations realistic for obtaining the permits needed to meet deadlines in 2021?



Local Impacts and Opportunities

- When will the Authority start acquiring property for the project?
- How is the Authority working to address impacts of the project to the local communities and landowners?
- What are the local economic benefits of the project?





Erin – once we have run the course re questions (real time or prepared), we will closely watch the time and ensure we wrap with five minutes to spare.

Jerry/Fritz: If we do have time, I could offer one or both of you to make some closing comments. That would be a nice touch. Let's consider and we can prepare, or you can simply make notes throughout the TH sessions, and plan your individual wrap-ups – 60-90 seconds?

Overall Project Benefits: Sac Valley and Statewide

- How will the project provide flood protection benefits to the region?
- How will the project benefit the local/regional economy?
- What type of recreation opportunities will be created by the project?
- What are the statewide benefits of the project?



Provides Statewide Benefits for Generations to Come

Sites Reservoir will benefit the local and regional economy

Create hundreds of construction-related jobs during each year of the construction period, and long-term jobs related to operations

Creates new recreation opportunities in the Sacramento Valley which adds to the region's economy

Adding resiliency to the water supply will strengthen the statewide economy and business that rely on a reliable source of water for their operations – particularly agriculture



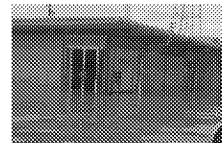
Provides Statewide Benefits for Generations to Come

Sites Reservoir provides regional flood protection benefits

Provides significant regional flood protection benefits for the Sacramento Valley

Will capture and store flood flows that would normally impact the community of Maxwell - protecting homes, business and farms

Will help to limit "down stream" flooding issues by capturing storm flows that sometimes overwhelm the regions flood control facilities



What Participants Are Saying

"Sites Reservoir is the 21st century project we need to adapt to the realities of climate change. It's the water project of the future."

— Zone 7 Water Agency

"While local water projects are essential to our regional sustainability, we also need to invest in forward-thinking statewide projects that can provide much-needed water when we need it most. Sites Reservoir can help sustain people, the environment and farms through future droughts."

— HEATHER DYER, General Manager, San Bernardino Valley Municipal Water District

"Sites Reservoir is a critical part of a greater portfolio of solutions to address California's water supply challenges. It will facilitate a more certain water future for the farms, environment, people and businesses in the Sacramento Valley, and ultimately throughout California."

— JEFF HARRIS,
Vice Mayor, City of Sacramento

"Recent droughts have hit our region hard. Sites Reservoir would soften impacts of future droughts by helping us save more water when it's available."

— Coachella Valley Water District



We need to obtain quote approvals

How it Works

Captures excess stormwater flows from the Sacramento River

Water is stored in an off-stream reservoir in Glenn and Colusa counties

1.5 million acre-feet of water available during dry years for resource agencies and participating members to use when they need it



Water from Sites directly benefits:



From: Davis-Fadtke, Kristal@Wildlife [Kristal.Davis-Fadtke@wildlife.ca.gov]
Sent: 1/26/2021 2:44:05 PM
To: Spranza, John [john.spranza@hdrinc.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Baseline model runs

Hi John,

I hope you are doing well. I am wondering when the updated CalSim baseline runs will be ready for review? Ali and I talked about this a couple of weeks ago and I wanted to follow up with you. Our engineer, Rob Sherrick, is back from paternity leave and ready to dive in!

Thanks,

Kristal

Kristal Davis Fadtke
Environmental Program Manager
Water Branch, Ecosystem Conservation Division
California Department of Fish and Wildlife
P.O. Box 944209
Sacramento, CA 94244-2090
Office: (916) 376-1987
Cell: (916) 701-3226

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 1/26/2021 2:52:55 PM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]; Alicia Forsythe [aforsythe@sitesproject.org]
Subject: FW: Baseline model runs

Hi,
Are we still intending on sharing the Calsim with CDFW? If so, would Steve be able to put a package together like he previously did for CDFW and NMFS?

John Spranza

D 916.679.8858 M 818.640.2487

From: Davis-Fadtke, Kristal@Wildlife <Kristal.Davis-Fadtke@wildlife.ca.gov>
Sent: Tuesday, January 26, 2021 2:44 PM
To: Spranza, John <John.Spranza@hdrinc.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Baseline model runs

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

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Office: (916) 376-1987
Cell: (916) 701-3226

From: Sara M. Katz [skatz@katzandassociates.com]
Sent: 1/26/2021 9:49:07 PM
To: Sarah Rossetto [srossetto@katzandassociates.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Re: Sites Reservoir Virtual Town Hall Meeting Login Information

Thinking outloud: I'd like for us to consider a quick turnaround engagement for anyone who attended the Townhall meeting. A quick response survey. If we have 150 to 200 people, that's a great cross-section of individuals which makes for a self-selected focus group. Maybe a quick survey goes out to them on their key takeaways, what they learned, how they would like to continue engagement, do they have any recommendations of key groups, NGO's etc that we should reach out to etc? Thoughts? Thanks

Sent from my iPhone

On Jan 26, 2021, at 9:20 PM, Sarah Rossetto <srossetto@katzandassociates.com> wrote:

Hi Ali,

Yes, please just forward the email I sent earlier today with the WebEx link and they will have no trouble accessing it tomorrow. The Eventbrite pre-registration already closed.

Thanks,
Sarah

On Jan 26, 2021, at 8:50 PM, Alicia Forsythe <aforsythe@sitesproject.org> wrote:

Thanks Sarah. Apparently people can't register as when they try to, they get a sales are closed. Can I just send them the webex link from below and they don't need to register?

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

From: Sarah Rossetto <srossetto@katzandassociates.com>
Sent: Tuesday, January 26, 2021 2:07:02 PM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Cc: Sara M. Katz <skatz@katzandassociates.com>
Subject: Sites Reservoir Virtual Town Hall Meeting Login Information

Hi Ali,

Below is the login information for the Sites Town Hall meeting tomorrow at 10 a.m. Please feel free to forward this along to anyone who you would like to participate.

Thanks,
Sarah



Sarah Rossetto

Director

d: 858.926.4007 • c: 530.304.8704

[San Diego](#) • [Los Angeles](#) • [San Francisco](#)

[View this email in your browser](#)



JANUARY 2021

Thank you for registering for the Sites Reservoir Virtual Town Hall Meeting on Jan. 27, 2021. Below is the WebEx login information for the meeting. We look forward to connecting with you!

Wednesday, Jan. 27, 2021

10 a.m. to 12 p.m.

<https://meethdr.webex.com/meethdr/j.php?MTID=md1cf3876a2a2db70614a6e5a4e746b19>

Join by meeting number

Meeting number (access code): 146 496 0661

Meeting password: Sites1234

Tap to join from a mobile device (attendees only)

[+1-408-418-9388](tel:+1-408-418-9388), [1464960661##](tel:+1-408-418-9388) United States Toll

Join by phone

+1-408-418-9388 United States Toll

[Global call-in numbers](#)

Join from a video system or application

Dial 1464960661@meethdr.webex.com

You can also dial 173.243.2.68 and enter your meeting number.

Join using Microsoft Lync or Microsoft Skype for Business

Dial [1464960661](tel:1464960661).meethdr@lync.webex.com

Please contact info@sitesproject.org with any questions.

This email was sent to sbrossetto@gmail.com

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Sites Project Authority · P.O. Box 517 · Maxwell, CA 95955 · USA

From: Marcia Kivett [MKivett@sitesproject.org]
Sent: 1/27/2021 9:46:03 AM
To: Hailey Traynham [htraynham@brwnald.com]; Board Clerk [boardclerk@sitesproject.org]
CC: Jerry Brown [jbrown@sitesproject.org]; Kevin Spesert [kspesert@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]; JP Robinette [jrobinette@brwnald.com]
Subject: Presentations for Today's meeting
Attachments: 00-00 Sites Project Authority Agenda.pdf; FLAG.pdf; 00-00 Sites Project Authority Agenda.pdf; 02-01P Posting RDEIR-SDEIS Project Description.pptx; 03-01&02P Financing Action Plan Update.pptx

Hailey, please see the attached presentations and agenda for today's meeting. JP & Ali will present their own PowerPoints.

Yolanda, if the electricity/internet is up and running on time, can you please print the call-in information for the office and have it by the phone for ease of dialing in.

Reservoir Committee Meeting:

1-213-379-5743

Phone Conference ID: 655 034 710#

Closed Session:

1-213-379-5743

Phone Conference ID: 527 987 92#

SITES PROJECT AUTHORITY
P.O. Box 517
122 OLD HIGHWAY 99 WEST
MAXWELL, CALIFORNIA 95955
www.SitesProject.org

JERRY BROWN, EXECUTIVE DIRECTOR
925.260.7417

YOLANDA TIRADO, CLERK
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Boardclerk@SitesProject.org

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Associate Members (NON-VOTING)

GREG JOHNSON, WESTERN CANAL WATER DISTRICT
JAMIE TRAYNHAM, TC 4 DISTRICTS

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January 27, 2021 1:30 p.m.

Sites Project Authority

Agenda

Teleconference: **1-213-379-5743** Conference ID: **655 034 710#**

[Click here to join the meeting](#)

Welcome to a meeting of the Sites Joint Powers Authority. If you are scheduled to address the Board, please state your full name for the record. Regularly numbered items may be considered at any time during the meeting. All items are listed in accordance with the Ralph M. Brown Act. We invite all members of the public to attend.

ROLL CALL & CALL TO ORDER:

- Introductions.
- Pledge of Allegiance.
- Approval of January 27, 2021 Agenda.
- Announcement of Closed Session.
- Period for Public Comment.

1. Consent Agenda:

Approximate start time 1:40 pm

The Executive Director reviewed the following items. To his knowledge, there is no opposition to the action. The items can be acted on in one consolidated motion as recommended or may be removed from the Consent Calendar and separately considered at the request of any person.

- 1.1 Consider Approval of the December 18, 2020 Joint Authority Board & Reservoir Committee Meeting Minutes. **(Attachments A, B & C)**
- 1.2 Consider Acceptance of the Sites Project Authority Treasurer's Report. **(Attachment A)**
- 1.3 Consider Approval of the Payment of Claims. **(Attachments A, B & C)**
- 1.4 Consider Approval of the annual resolution adoption of the Advance Check Approval Policy Number 01-2019. **(Attachment A)**

2. Action Items: Approximate start time 1:45 pm

- 2.1 Consider Approval to release the RDEIR/SDEIS Project Description (with Operations) to regulatory agencies and interested parties, including posting on the Authority's website, to improve Project transparency and facilitate more detailed Project discussions. **(Attachment A)**
- 2.2 Consider Acceptance of the 2021 Sites Project State Agency Legislative Activity Priorities. **(Attachment A)**
- 2.3 Consider approval of the disbursement of funds resulting from increased participation to repay contributed credit. **(Attachment A & B)**

3. Discussion and Information Items: Approximate start time 2:30 pm

- 3.1 Receive a progress update on the development of a Water Storage and Supply Service Contract Term Sheet. **(Attachment A)**
- 3.2 Review and comment on the participant's processes for securing project funding for incorporation into a successor, post-2021, project agreement.

4. Reports: Approximate start time 3:15 pm

4.1 Member's Reports:

4.1.1 Chairpersons' Report:

This time is set aside to allow the Chair/Co-Chair an opportunity to disclose/discuss items related to the Sites Project.

4.1.2 Committee Chairpersons' Report:

This time is set aside to allow the Committee Chairpersons' an opportunity to disclose/discuss items related to the Sites Project.

4.1.3 Authority Board Participant Reports:

This time is set aside to allow Representatives or their Alternates an opportunity to disclose/discuss items related to the Sites Project.

4.2 Executive Director's Reports:

- Monthly status report. **(Attachment A)**
- Work Plan Key Deliverables Report. **(Attachment B)**

- Meetings Action Items Summary. (**Attachment C**)

5. **Closed Session:** Approximate start time 3:30 pm

5.1 Conference with legal counsel regarding significant exposure to litigation or adjudicatory proceedings (Govt. Code 54956.9(d)(2) and (4)) (1items).

6. **Report from Closed Session** Approximate start time 3:50 pm

7. **Recap:** Approximate start time 3:55 pm

7.1 Suggested Future Agenda Items.

7.2 **Upcoming Meetings:**

Joint Authority Board & Reservoir Committee:

Friday, February 19, 2021, 9:00 AM – 12:00 PM

(Virtual Information will be provided prior to the meeting)

Authority Board:

Wednesday, March 24, 2021, 1:30 PM – 4:00 PM

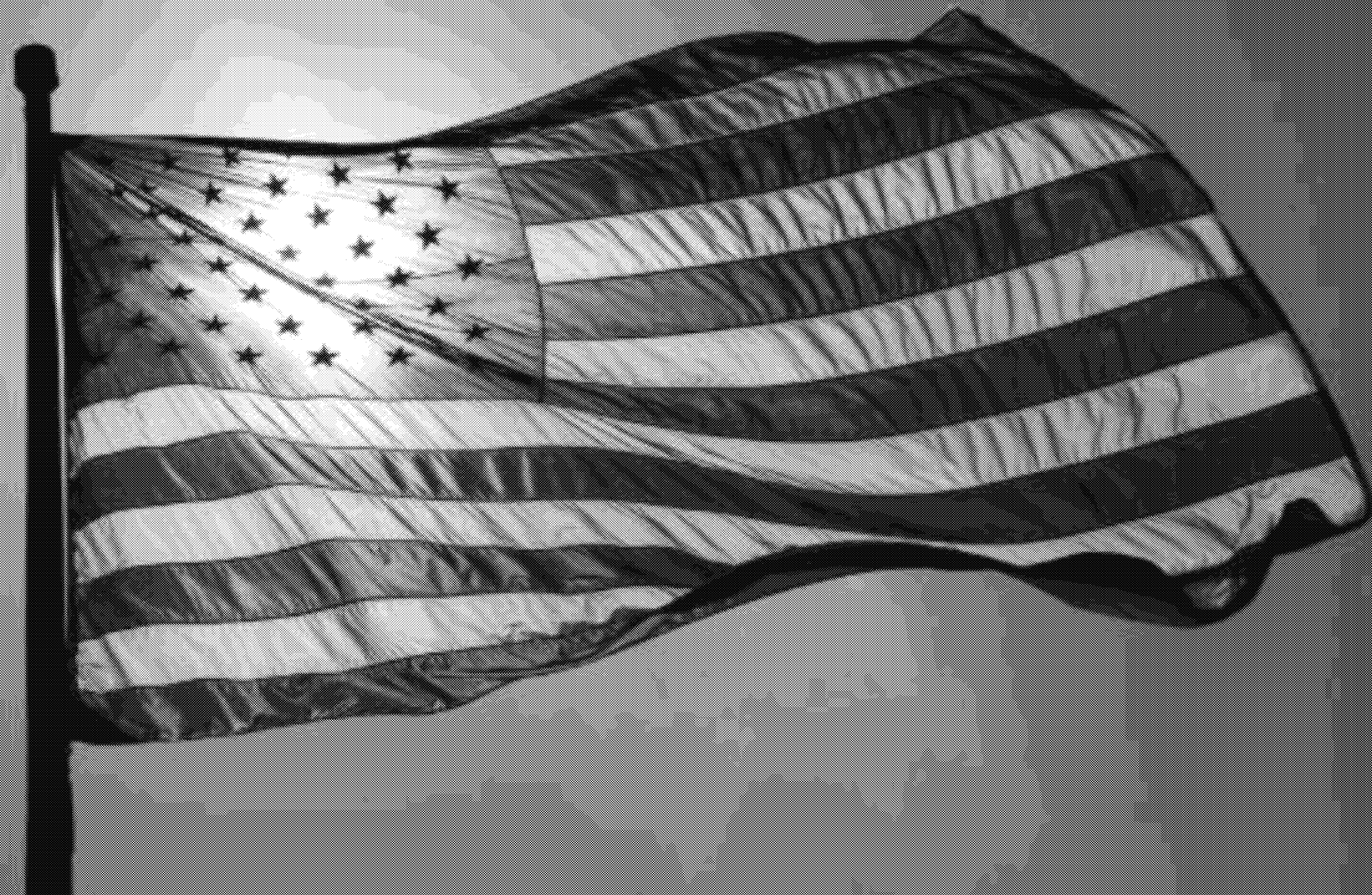
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Authority Board Meeting

Agenda Item 2.1, Approve Release of the
RDEIR/SDEIS Project Description

January 27, 2021



Overview – Action To Be Taken

- Project Description will be Chapter 2 of the Revised Draft EIR/Supplemental Draft EIS
- Foundation of the analysis in the RDEIR/SDEIS and of all of our permitting efforts
- Draft currently under review by team (Sites and Reclamation staff)
- Recommend release of the Draft Project Description
 - For information / discussion purposes with regulatory agencies, NGOs, interested members of the public
 - Continue to refine until release Revised Draft EIR/Supplemental Draft EIS in July

Alternatives Summary

Facilities / Operations	Alternative 1	Alternative 2	Alternative 3
Reservoir Size	1.5 MAF	1.3 MAF	1.5 MAF
Hydropower	incidental upon release	Same as Alt 1	Same as Alt 1
Diversion Locations	Red Bluff Pumping Plant and Hamilton City	Same as Alt 1	Same as Alt 1
Conveyance Release / Dunnigan Release	1,000 cubic feet per second (cfs) into new Dunnigan Pipeline to Colusa Basin Drain	1,000 cfs into new Dunnigan Pipeline to Sacramento River. Partial release into the Colusa Basin Drain	Same as Alt 1
Reclamation involvement	1. Funding Partner 2. Operational Exchanges a. Within Year Exchanges b. Real-time Exchanges	Operational Exchanges a. Within Year Exchanges b. Real-time Exchanges	Same as Alt 1, but up to 25% investment
DWR involvement	Operational Exchanges with Oroville and storage in SWP facilities South-of-Delta	Same as Alt 1	Same as Alt 1
Route to West Side of Reservoir	Bridge across reservoir	Paved road around southern end of reservoir	Same as Alt 1

Draft – Preliminary Working Document – For Discussion Purposes Only

3

More Substantial Project Description Changes Since Previous Updates

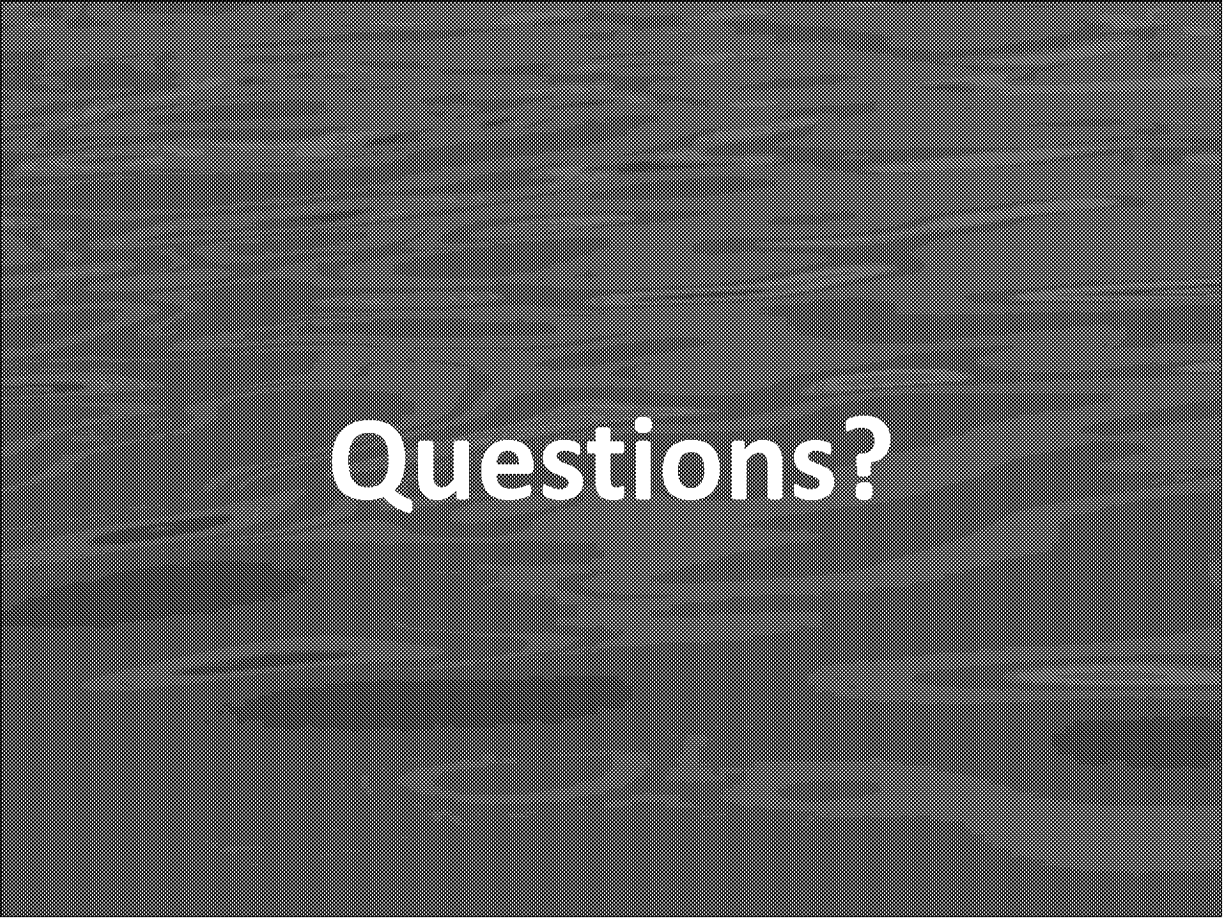
- Hydropower – All alternatives include power generation incidental upon release up to 40 MW at Funks and up to 40 MW at TRR
 - Confirmed with FERC staff that this qualifies for a FERC exemption
- Emergency Release Flows, Alternative 2 – Refinements to emergency release locations
 - Inlet/Outlet Works, Sites Dam, and Saddle Dam 8B into Hunters Creek watershed
- Stored Water Release Location, Alternative 3 – Colusa Basin Drain
- Reclamation Investment, Alternative 2 – Operational exchanges only, not a funding partner

More Substantial Project Description Changes Since Previous Updates (cont)

- Diversion criteria:
 - Refined, shifted upstream for practical operations at diversion locations
 - Additional pulse protection criteria added to protect migrating juvenile salmon
 - Analysis underway, but initial results show little changes in flows throughout the system (including Freeport and Net Delta Outflow Index)
- More details on Operations added

Recommended Action

- Staff is recommending release of the Draft Project Description
 - For information / discussion purposes with regulatory agencies, NGOs, interested members of the public
 - Continue to refine until release Revised Draft EIR/Supplemental Draft EIS in July
 - Post to Authority's website for access and transparency
 - Include preamble clearly identifying that the Authority is not taking public comments / not responding to comments



Questions?



Project Financing Action Plan Progress Update

Authority Board Items 3.1 and 3.2

January 27, 2021



Speaker: JP Robinette (all slides)

Outline

1. Financing Action Plan Schedule and Roadmap
2. Successor Agreement: Participant Financial Processes
3. Contract Term Sheet: Balanced Development
4. Financial Model 2.0 High Level Overview and Timing
 - a) Preliminary Options

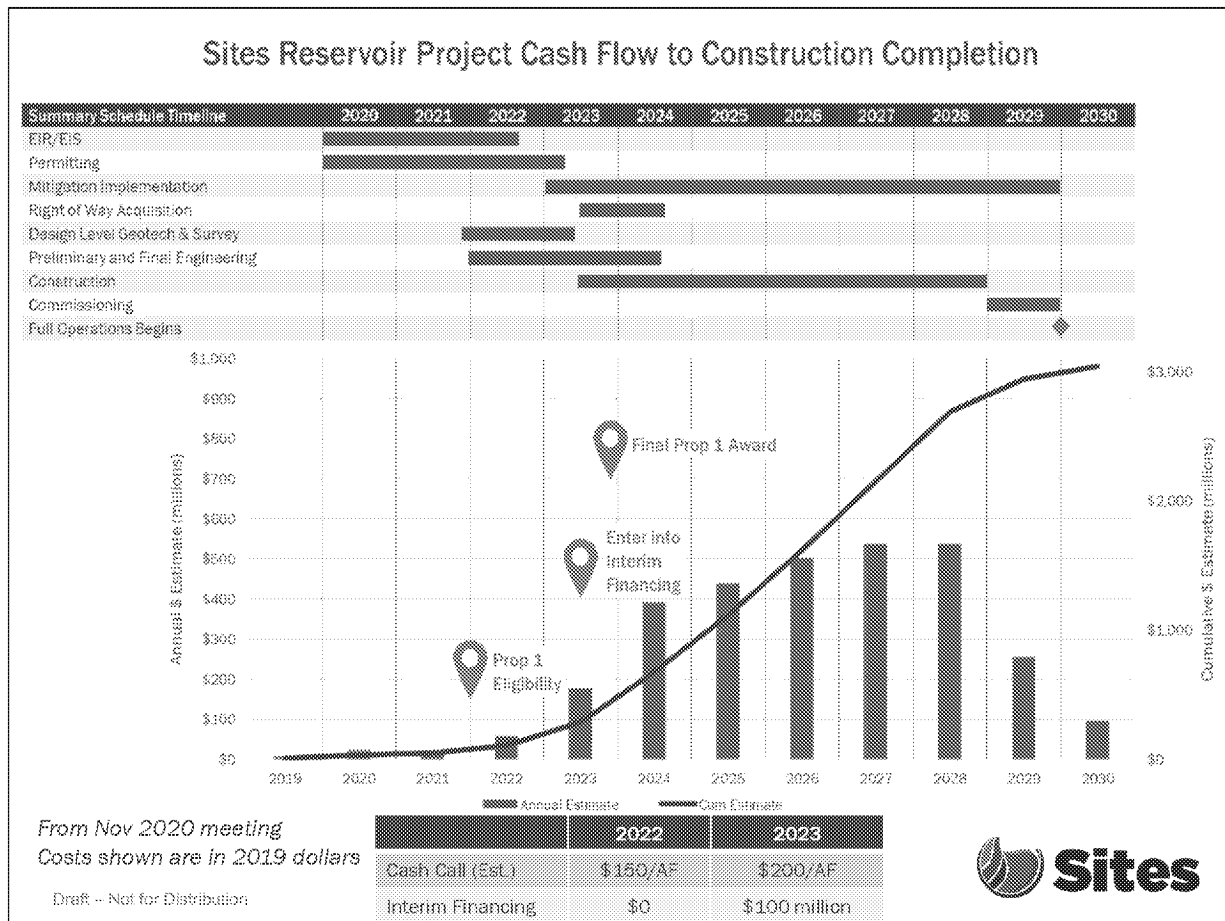
DRAFT: Not For Distribution

2

The team has been hard at work since the approval of the financing action plan in October and its incorporation into the strategic plan in December. We have an updated schedule, based on the preliminary master schedule through 2030 schedule provided in November.

We will discuss two of the critical components of the Authority's strategy for meeting the Prop 1 requirement of 75% local cost share commitment by Jan 1, 2022. The successor agreement and the contract term sheet

This will become part of the monthly routine at the B&F Committee, and we will be tracking action items, so let me know if you have any.



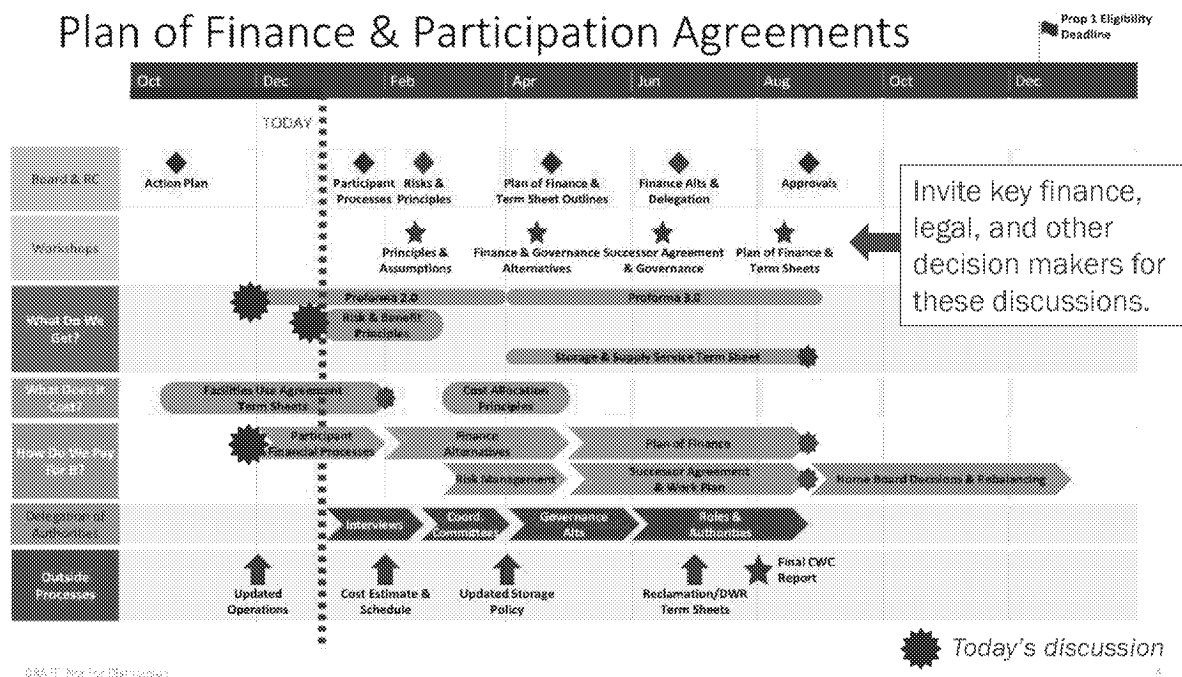
Significant ramp-up is needed from 2022 to 2024 to complete the project by early 2030 and begin operations. Amendment two, our current work plan, culminates in Prop 1 eligibility milestone. It is assumed that interim finance begins immediately following acquisition of a water right and that the Prop 1 final award lags slightly based on the state's process.

Discuss the next agreements

Draft - Predecisional Working Document - For Discussion Purposes Only

Road Map

Plan of Finance & Participation Agreements

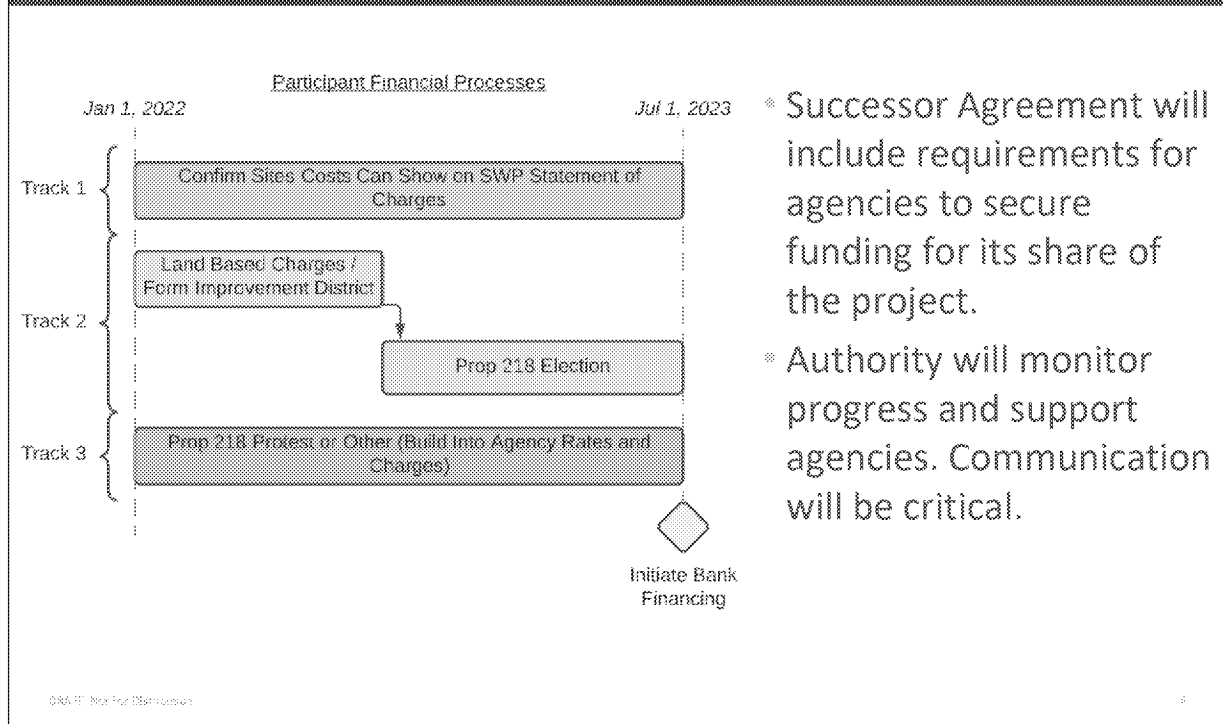


The road map is built around the three big questions. Three deliverables for meeting the Prop 1 requirement of 75% local cost share commitment: Storage and Supply Service Contract Term Sheet, Plan of Finance, and most importantly, the successor agreement. Staff has had a discussion with the CWC staff on the three deliverables and are continuing to communicate staff to make sure this meets the requirements of the statute. No red flags at this point.

Four major workshops to get to agreement on some key issues. Need to invite key finance, legal, and other decision makers for these discussions. This is where the rubber meets the road. Key approvals will be in August and September.

I have starred the items we will be discussing today in red.

Successor Agreement: Preparation for Financing



This slide focuses on the content in item 3.2, but makes sense to discuss in relation to the schedule slides.

There are some participant processes that are necessary predecessors to financing the project for our members, which could impact the project's critical path. These will be a part of the successor agreement for agencies to complete their track. We assume agencies have been setting the table for the technical requirements / necessity of this project in water supply planning, UWMPs, CIPs, etc. Minimum 18-month lead time from approved Plan of Finance to Interim Finance Agreement. Roughly, activities must be started at end of 2021 to meet mid-2023 interim financing target.

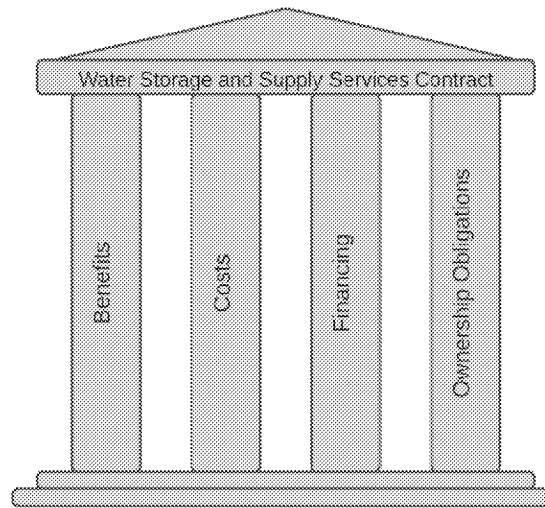
Next month, we will discuss some of the other key assumptions in the successor agreement including the funding mechanism (cash call), the period of performance, off ramps, and of course, the work plan.

Budget and Finance feedback: Track 4 for districts to have individual contracts with investor agencies, still being discussed within the committee.

Contract Term Sheet Elements

- Four pillars of the contract will be explored in the term sheet deliverable:

- Benefits to individual agencies
- Allocating project costs for the benefits received
- Financing the project
- Ownership obligations and responsibilities

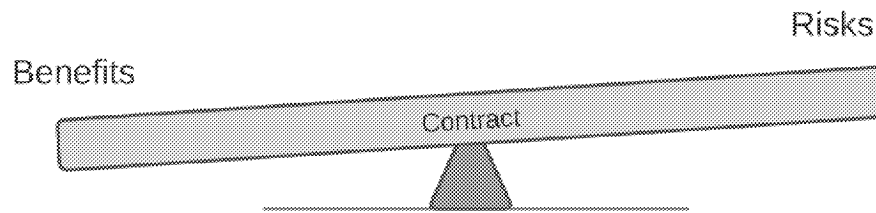


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This slide focuses on the staff report 3.1. Contract will be between the JPA and the participants. These four areas represent key elements of the contract term sheet that will be developed. There is some good prior work on ownership obligations in the Authority's bylaws, mostly related to the development of the project. The contract will focus on development and beyond into operations, allocating benefits, costs, financing conditions, and obligations of ownership.

Balancing Risks and Benefits



- Balancing requires a discussion of project benefits and risks for participants and board members.
- The Water Storage and Supply Services Contract is where a common understanding is manifested in writing.
- Working with B&F Committee to develop the term sheet.

Sample Terms for Development

Term	Description
Water Delivery Priorities	
Hydrologic Conditions	
Allocation of Cost of Services	
Financial Provisions	
Upstream and Downstream Costs	
Offramps	
O&M Responsibilities	
Water Marketplace	

Introduce here, will come back next month to review some topics, may need small groups to discuss some of the specifics. Staff continues to look for input on the development of key terms, including priority items and areas of concerns.

Financial Model 2.0 List of Changes, March 2021

1. Move to cost of financing (vs. w/ and w/o WIFIA)
 - a) Two options – with step-up and without
2. Update costs, estimate due Feb 2021
3. Incorporate beneficiary pays (cost of facilities)
4. Public benefit OM&R accounting (state and federal)
 1. Prop 1 (WSIP) Inflationary Adjustment, 2.5% (\$20.4M)
5. Update finance assumptions, including rates
6. Update operating cost assumptions, OM&R
7. Update participation levels, local, state, fed
8. Update operations

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2

Walk through these.

Preliminary Financing Options

Step-up	No Step-up
Group financing, pooled credit	Pay as you go, individual financing or cash
50-60% debt covered by rated entities, 10-25% step-up for all	Smaller group financing possible
Improved certainty on project payments	Authority responsible for collecting project payments
Lower rate for non-rated participants vs. market	Higher interest rate for non-rated participants vs. market
May be required for WIFIA loan	Leverage programs such as USDA loan for non-rated agencies
Allows for increased participation of non-rated entities	May require a reduction in non-rated participation

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Very preliminary, subject to change. We have organized around two high-level financing options from prior work. We will be bringing these options in March to this committee and in April to a workshop. There are big implications for the financing element of the contract and the options presented are a predecessor to the plan of finance. This element is one key reason we need agencies to bring financial, legal, and other decision-makers to the workshops.

B&F Feedback: review option of using a reserve in place of a step-up and its commercial viability which will be explored as part of the finance options. Additionally, conversations around when Sites could be considered an asset to back debt have begun within the committee.

Questions?

From: jimb@aqualliance.net [jimb@aqualliance.net]
Sent: 1/27/2021 11:33:11 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: water quality discussion sites

Ali,
Thanks for inviting me to participate in these upcoming discussions. It is inappropriate that discussions on naturally occurring heavy metals and salt in the source water and reservoir footprint are not explicitly discussed when investors are tuned in. The high concentrations of metals in the source water and reservoir footprint will adversely impact water quality in the proposed reservoir for most, if not all, the proposed beneficial uses of the stored water.
Jim Brobeck, water policy analyst, aqualliance

From: Lucero, Debra [DLucero@buttecounty.net]
Sent: 1/27/2021 11:43:33 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Jerry Boles Comments
Attachments: SITES Boles, DEIR comments (1).pdf

Dear Ali:

I participated in the Town Hall today and would like to understand why the water quality issues were not addressed on this phone call.

As an elected official from one of the source areas of this project, I would like to hear from you on the attached document.

?

Thank you.

Debra

Debra Lucero
Butte County Supervisor District 2
269 E. 3rd St., Ste. 100
Chico, CA 95928
Appointments: 530-891-7535
Mobile: 530-552-2030

4314 Tuliyani Drive
Chico, CA 95973
October 1, 2017

AquaAlliance
Barbara Vlamis, Executive Director
P.O. Box 4024
Chico, CA 95927

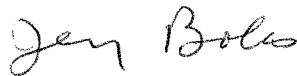
Since your organization has expressed interest in the proposed Sites Reservoir project west of Maxwell, California, I am providing to you the comments that I have submitted in response to the Draft Environmental Impact Report/Environmental Impact Statement for the Sites Reservoir Project, State Clearinghouse #2001112009.

The draft EIR/EIS fails to discuss the high concentrations of a number of metals in the source waters to the proposed project, and, even more important, does not discuss water quality in the proposed reservoir. Water quality in the proposed reservoir will mimic that of the source waters, and hence the reservoir will have concentrations of a large number of metals that exceed many water quality criteria and standards. The high concentrations of metals likely to occur in the proposed reservoir will impact most, if not all, beneficial uses of the proposed project, including agricultural water supply, wildlife and fisheries, and drinking water supplies for communities that divert water from the Sacramento River, making the project potentially infeasible.

I am qualified to provide these comments since my background is in water quality, as former Chief of the Water Quality and Biology Section of the Northern District of DWR in Red Bluff.

If you have any questions, please contact me via email at chicojerry@yahoo.com.

Sincerely,

A handwritten signature in cursive script that reads "Jerry Boles".

Jerry Boles

4314 Tuliyani Drive
Chico, CA 95973
November 17, 2017

Bureau of Reclamation
Attn: Michael Dietle
Draft EIR/EIS Comments
2800 Cottage Way, W-2830
Sacramento, CA 95825

Sites Project Office
Attn: Rob Thomson
Draft EIR/EIS Comments
P.O. Box 517
Maxwell, CA 95955

I am providing to you my comments in response to the Draft Environmental Impact Report/Environmental Impact Statement for the Sites Reservoir Project, State Clearinghouse #2001112009.

The draft EIR/EIS fails to discuss the high concentrations of a number of metals in the source waters to the proposed project, and, even more important, does not discuss water quality in the proposed reservoir. Water quality in the proposed reservoir will mimic that of the source waters, and hence the reservoir will have concentrations of a large number of metals that exceed many water quality criteria and standards. The high concentrations of metals likely to occur in the proposed reservoir will impact most, if not all, beneficial uses of the proposed project, including agricultural water supply, wildlife and fisheries, and drinking water supplies for communities that divert water from the Sacramento River, making the project potentially infeasible.

The water quality section (Chapter 7) must be completely rewritten with an objective analysis of the data and potential adverse impacts to water quality both within the reservoir and to downstream resources in the Sacramento River. Subsequently, the aquatic biological resources (chapter 12), terrestrial biological resources (chapter 14), recreation resources (chapter 21), public health and environmental hazards (chapter 28), and cumulative impacts (chapter 35) sections of the draft EIR/EIS must reassess impacts from the adverse water quality expected from the proposed project. Following these re-analyses, re-circulation of the draft EIR/EIS is necessary with appropriate disclosure information about the potential impacts from metals to water quality and its effects on agricultural water supply, wildlife and fisheries, and drinking water supplies.

I am qualified to provide these comments since my background is in water quality, as former Chief of the Water Quality and Biology Section of the Northern District of DWR in Red Bluff.

If you have any questions, please contact me via email at chicojerry@yahoo.com.

Sincerely,

Jerry Boles

Comments on Draft EIR Sites Reservoir Project: Chapter 7 Surface Water Quality

An EIR is supposed to be a disclosure document that provides information on the benefits as well as potential impacts from a proposed project. Section 7 - Surface Water Quality does not disclose potential significant adverse issues which have serious ramifications for the viability of the proposed project, but rather ignores or misconstrues available data and reports to incorrectly conclude that there are no significant water quality impacts associated with the proposed project. The EIR claims to have evaluated post-project impacts to the Sacramento River, but there are no analyses provided that indicate that this was done. It is apparent that the preparers of the EIR failed to examine or simply ignored the available data that would show potential significant adverse impacts from the proposed project.

The analyses in Section 7 completely left out any evaluation or projection of water quality that may result in Sites Reservoir from diverting high winter flows from the Sacramento River. The EIR fails to point out that due to metals loads in the various source waters, water in the proposed reservoir may not be suitable for the beneficial uses stated for the proposed project, including enhanced water management flexibility, agricultural and urban water supply, water quality improvement, and ecosystem improvement for fish protection, habitat management, and other environmental needs.

A factual evaluation of the available data is presented below, which shows significant potential adverse impacts associated with the proposed project. Some comments on specific sections of Chapter 7 of the EIR are also presented.

Available Data

The EIR cites the DWR Water Data Library (WDL) online database as the source for water quality data used to determine impacts from the proposed project. However, very limited data from the WDL are available for evaluating water quality in source waters for the proposed project. The major source water for the proposed project is the Sacramento River, with potential diversion occurring at the Tehama-Colusa Canal, Glenn-Colusa Irrigation District Main Canal, and at Moulton Weir.

The Sacramento River below the Red Bluff Diversion Dam monitoring station of DWR provides information on the quality of water that would be diverted to the proposed project through the Tehama-Colusa Canal. Metals data are available in the WDL for the Sacramento River below the Red Bluff Diversion Dam beginning in February 2006 (Table 1). However, only 33 samples have been collected since 2006, and only nine of these were from the months in which higher flows most typically occur (December through March) and from which diversions to the proposed project would occur.

Cottonwood Creek contributes the most significant input to the Sacramento River during high runoff events. The Chico-Enterprise Record in an editorial published December 28, 2016 underscored the impact of tributaries on water quality in the Sacramento River. The newspaper stated that of the 100,000 cfs flowing in the river earlier in the month,

only 5,000 cfs was coming from Keswick Dam below Shasta Dam – the rest of the 100,000 cfs (95,000 cfs) was coming from tributaries downstream from Keswick Dam, of which Cottonwood Creek provides the dominant flows.

Data from Cottonwood Creek near Cottonwood are even more sporadic than those for the Sacramento River. Data are available for this station in WDL beginning in October 2004, with only seven samples collected from the Cottonwood Creek monitoring station since 2006, and only four of which were collected during the months of expected higher flows of December through March (Table 2). Data available in the WDL show that only one sample was collected (March 2006) during the same period from both Cottonwood Creek and the Sacramento River below the Red Bluff Diversion Dam since 2006. This one sample shows that metal loads in the Sacramento River are similar to those found in Cottonwood Creek, showing that Cottonwood Creek significantly affects water quality in the Sacramento River. Water quality in Cottonwood Creek will have a significant impact on diversions to the proposed reservoir and water quality data from Cottonwood Creek can be used to approximate and supplement data from the Sacramento River, though the total number of samples from both sites combined are still exceptionally low for a project of this magnitude and potential for adverse effects.

The water quality monitoring station on the Sacramento River at Hamilton City is just downstream from the GCID Main Canal. Data from the WDL is somewhat more extensive at the Hamilton City monitoring site, with metals data available in the WDL beginning in late 2003 to early 2017, though still sporadic with only 78 samples collected in the span of a little more than 13 years (159 months), and only 23 of those collected sometime during the months of expected higher flows of December through March (Table 3). Samples were collected in each of these months only twice, with the rest of the samples during these months only collected in February months each year since 2008.

The WDL shows that metals data are available for the Sacramento River opposite Moulton Weir monitoring station from mid 2003 to early 2011, for a total of 80 samples, with 27 of those from the expected higher flow months (Table 4).

Water quality sampling during the expected months of higher flows of December through March did not target high flow periods (the periods during which diversions to the proposed project would occur) but were based on a rigid and fixed monthly or semi-monthly schedule. Monitoring did not provide any information on the variation in concentrations of metals over the runoff hydrograph. Even higher concentrations of metals would likely occur during the higher flow periods during these months, but were not targeted by the limited monitoring. The relatively low number of samples and lack of samples targeting critical flows (i.e., high runoff events) are nonetheless sufficient to indicate potential significant adverse water quality impacts with the proposed project. These data illustrate the need to collect additional data during appropriate time periods (i.e., during the high flow periods when diversions from the Sacramento River would be occurring) and re-evaluate the potential adverse water quality impacts from the proposed project.

Data Analyses

Some of the analytical results shown in the WDL for metals are reported as “dissolved” and other results as “total” (or total recoverable). “Total” concentrations, which include both dissolved and particulate forms of an analyte, are probably a better representation for the concentrations of metals that will affect water quality in the proposed reservoir. As well, the State Water Resources Control Board makes no distinction between dissolved or total recoverable concentrations when considering whether a criterion is exceeded (SWRCB 2011). The proposed reservoir will thermally stratify and will also be biologically productive due to nutrients brought in from source waters. This in-situ productivity, as well as organic material brought in with the source waters, will result in anoxic conditions (i.e., lack of oxygen) in the hypolimnion (i.e., bottom water layer). While dissolved forms of metals are generally the most bioavailable, the particulate fraction of total recoverable forms will undergo chemical transformation to dissolved forms under the anoxic conditions expected in the hypolimnion of the proposed reservoir. Transformed metals will be mixed throughout the reservoir water column during turnover events, or released downstream with anoxic water from the lower depths during the summer months.

Data from the WDL (Table 1) show that aluminum, arsenic, cadmium, chromium, iron, lead, manganese, and mercury in water samples from the Sacramento River below the Red Bluff Diversion Dam exceed various criteria and standards established to protect beneficial uses, including drinking water, public health, taste and odor for agriculture, and freshwater organisms, which includes fish. Maximum concentrations of some of these metals are many times higher than the corresponding criteria or standard. For example, aluminum, in addition to exceeding the SWRCB Basin Plan Primary Maximum Contaminant Level (MCL) for drinking water by one and half times, also exceeds the secondary drinking water standard in the Basin Plan by seven times and the US Environmental Protection Agency Secondary MCL by 30 times. Even the minimum concentration of arsenic reported in WDL exceeds by more than 10 times nearly all the criteria and standards for protection of human health. The least reported concentration of cadmium from river water samples exceed by five times the incremental cancer risk for drinking water. The least concentration of chromium reported in WDL exceeds the California Public Health Goal by 16 times and incremental cancer risk for drinking water by five times. The maximum concentration of iron that was reported in WDL exceeds the secondary drinking water maximum concentration level in the Basin Plan, as well as National Recommended Water Quality Criteria for taste and odor or welfare by nearly three times. The maximum concentration of lead that was reported exceeds the California Public Health Goal and California Proposition 65 maximum allowable dose level for reproductive toxicity by over four times. The maximum reported concentration of manganese exceeds the National Recommended Water Quality Criteria for taste and odor or welfare by one and a half times. The maximum concentration reported for mercury exceeds the National Recommended Water Quality Criteria for Freshwater Aquatic Life Continuous Concentration by nearly four times, and the Freshwater Aquatic Life Maximum Concentration by two times. An additional concern with these metals is that some metals are taken up by crops (such as arsenic by rice), making the crops

potentially unsuitable for consumption. Plant uptake of metals in the water supply not only affect crops grown for human consumption, but also plants grown for support of wildlife, such as in refuges.

Similarly, data from the WDL for Cottonwood Creek near Cottonwood show that aluminum, arsenic, cadmium, iron, lead, manganese, and nickel exceed various criteria and standards established to protect beneficial uses (Table 2). Similar to the Sacramento River, maximum concentrations of some of these metals are many times higher than the corresponding criteria or standards. Aluminum concentrations exceed the Basin Plan drinking water primary standard MCL by 14 times, the secondary drinking water secondary standard MCL by 70 times, the California Public Health Goal by over 20 times, the National Academy of Sciences Health Advisory and Agriculture Water Quality Goals for taste and odor threshold by nearly three times, the National Recommended Water Quality Criteria for human health and welfare for water and fish consumption by nearly 30 times, and the National Recommended Water Quality Criteria for freshwater aquatic life maximum concentration by 20 times. As with the Sacramento River, even the minimum concentration of arsenic reported in WDL exceeds nearly all the criteria and standards for protection of human health by up to 167 times. The minimum concentration of cadmium reported exceeds the incremental cancer risk for drinking water by over three times, while the maximum concentration is over twice as high as the California Public Health Goal. As with the Sacramento River, the California Public Health Goal is exceeded by the least concentration of chromium reported by 16 times and the incremental cancer risk for drinking water by five times. Iron exceeds the Basin Plan drinking water standard secondary MCL by over five times, the Agricultural Water Quality Goals for taste and odor threshold by nearly five times, the National Recommended Water Quality Criteria for taste and odor or welfare by 78 times, and the National Recommended Water Quality Criteria for freshwater aquatic life maximum concentration by over 23 times. Reported lead concentrations are two and a half times higher than the California Public Health Goal, up to twice as high as the California Proposition 65 maximum allowable dose level for reproductive toxicity, and almost twice as high as the incremental cancer risk estimate for drinking water. Manganese concentrations reported from Cottonwood Creek exceed the Basin Plan Drinking Water Standards secondary MCL by a factor of 10, are nearly twice as high as the USEPA Health Advisory for drinking water, three times as high as the Agricultural Water Quality Goals for taste and odor threshold, and over 10 times higher than the National Recommended Water Quality Criteria for taste and odor or welfare. Reported maximum mercury concentrations exceed the National Recommended Water Quality Criteria for Freshwater Aquatic Life Continuous Concentration by nearly two times, while even the lowest reported concentration is nearly equal to the recommended criterion. Nickel exceeds the California Public Health Goal by nearly five times.

The GCID Main Canal intake is slightly upstream from the Sacramento River at Hamilton City water quality monitoring station. Therefore, water quality in the GCID Main Canal will be similar to that found at the Sacramento River at Hamilton City monitoring station. Metals data for this monitoring station can be found in the WDL from November 2003 to February 2017. Similar to the upstream monitoring station on the

Sacramento River below Red Bluff, the Sacramento River at Hamilton City water quality monitoring station has been identified to contain high levels of aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc (Table 3), which exceed a large number of criteria and standards similar to those upstream at the monitoring station below the Red Bluff Diversion Dam.

High levels of metals have also been identified at the water quality monitoring station opposite the Moulton Weir, including aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc (Table 4). As with the water quality monitoring station on the Sacramento River below the Red Bluff Diversion Dam, concentrations of metals from the Sacramento River monitoring station at the Moulton Weir exceed a large number of water quality criteria designed to protect beneficial uses.

As discussed earlier, Cottonwood Creek is the major source of water to the Sacramento River during higher flow periods, but other tributaries also contribute high levels of metals to the Sacramento River. In addition, local creeks directly tributary to the proposed reservoir, such as Funks Creek and Stone Corral Creek, also carry metals concentrations that will contribute to the metals loading. Leaching from soils beneath the reservoir will also contribute additional metals, as well as nutrients.

The Basin Plan lists other chemicals that adversely affect water quality in the Sacramento River, including chlorpyrifos and diazinon. The California State Water Resources Control Board lists a number of other "constituents of concern" in the study area, including chlordane, DDT, mercury, PCBs, and dieldrin. In addition, sewer outfalls from the cities of Redding and Red Bluff contribute other contaminants, such as pharmaceuticals, to the Sacramento River. No information is provided in the EIR about effects to the proposed project from these chemical contaminants.

Discussion

The data in the WDL for the Sacramento River and Cottonwood Creek demonstrate that high concentrations of metals can be expected during the high flow months of winter (December through March) when diversions would be occurring to the proposed Sites Reservoir. Higher concentrations of metals are likely during the higher flows that can occur during these months. Such higher flows were not targeted by the limited sampling effort presented in the WDL. The high concentrations of metals in the source water will adversely impact water quality in the proposed reservoir for most, if not all, the proposed beneficial uses of the stored water.

Some metals from both the Sacramento River and Cottonwood Creek, whose concentrations did not exceed criteria in the limited sampling effort, had concentrations that nearly exceed the criteria and standards. These and other metals whose concentrations did not exceed the criteria may have higher concentrations during the higher flow periods that the proposed project would be diverting. Again, these higher flow periods were not targeted during the limited sampling effort.

Even some of the minimum concentrations of metals found in the source waters exceed criteria and standards, which means that the source waters never meet these goals and standards – the criteria are always exceeded and the water is never suitable for the beneficial use or uses the criteria or standards were designed to protect. Water quality in the proposed reservoir for these parameters will exceed the criteria and standards all the time.

Since water quality in the proposed reservoir will reflect that of the source waters, the reservoir will have concentrations of numerous metals, including aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc, that exceed a number of criteria and standards developed to protect beneficial uses. In addition, other metals that may not exceed criteria and standards in the source waters may adversely affect reservoir water quality due to synergistic effects. The State Water Resources Control Board (SWRCB 2011) states that “when multiple constituents have been found together in groundwater or surface waters, their combined toxicity should be evaluated” and that “theoretical risks from chemicals found together in a water body shall be considered additive for all chemicals having similar toxicologic effects or having carcinogenic effects.” Thus, the adverse effects from the metals delivered to the proposed reservoir from the source waters may have an even greater adverse impact and pose an unacceptable level of risk. Beneficial uses potentially impacted by metals in the proposed reservoir include agricultural water supply (direct toxicity or uptake by crops making the crops unsuitable for use), wildlife (such as fish-eating birds), fisheries, recreation (including sport fishing and water contact activities such as swimming), and drinking water supplies for communities that divert water from the Sacramento River.

Releases from the proposed reservoir would occur during the summer when metals concentrations in the Sacramento River are much lower due to the majority of flow being from Shasta Reservoir, with much better water quality, though still carrying a metals load. High metals concentrations in the proposed reservoir releases could adversely affect water quality in the Sacramento River during the summer months by increasing metals loads beyond acceptable limits and adversely impact beneficial uses.

Though high concentrations of metals that exceed water quality criteria exist in source waters to the proposed project, they cannot be regulated by governmental entities since they are natural occurrences. However, once contained artificially in a reservoir, they are subject to jurisdictional control by regulatory agencies. Any releases of water from the proposed reservoir will likely be subject to review by water quality regulatory agencies to ensure that such releases do not adversely affect downstream resources due to the heavy metals loads in the releases. The SWRCB has an antidegradation policy that prohibits discharges that would degrade water quality to a level below water quality objectives because no capacity would exist for degradation that will be caused by the next downstream or downgradient uses – the ability to beneficially use the water would have been impaired, even though water quality objectives would not yet have been exceeded (SWRCB 2011). The contribution of additional metal loads from releases from the proposed Sites Reservoir during the summer could cause

concentrations of metals in the Sacramento River to exceed criteria and standards or at least be subject to the antidegradation policy due to an incremental increase in metals in the Sacramento River from the proposed project. Thus, the proposed project may face prohibition of releases if stored water does not meet water quality criteria or standards or if releases can cause criteria or standards to be exceeded by downstream inputs (i.e., antidegradation policy).

During dry years, the adverse impacts associated with the project can be expected to be even greater. Flows in the Sacramento River from upstream reservoirs on the Sacramento River (i.e., Shasta Reservoir, Whiskeytown Reservoir) will be minimized during the winter months in an effort to restore water storage levels in those reservoirs. Likewise, during wet or even normal runoff years, releases from the upstream reservoirs during the winter will be curtailed during high runoff periods to prevent downstream flooding. In any of these scenarios, tributary influences, such as Cottonwood Creek, on water quality in the Sacramento River will be much greater. The proposed project would still attempt to capture as much runoff from the Sacramento River as possible, but the water diverted to the proposed project will have even greater concentrations of metals due to the majority of flow being from tributary streams (e.g., Cottonwood Creek) during dry and possibly even wet or normal runoff years.

Similarly, during the summer in dry years, releases from upstream reservoirs (i.e., Shasta Reservoir, Whiskeytown Reservoir) will be minimized. Releases to the Sacramento River from the proposed project will have a greater impact on water quality in the Sacramento River due to less dilution being available due to curtailed flows in the river from upstream reservoirs (i.e., Shasta and Whiskeytown reservoirs).

Conclusion

The proposed project is, at best, premature. Little or no data have been collected to determine the metals loads in the higher flows of the Sacramento River that would be diverted to the proposed reservoir. An extremely small amount of data have been collected during the months in which higher flows can be expected (December through March), but higher flows during these months were not targeted in the water quality sampling. None the less, the limited data presented in the WDL show high concentrations of a number of metals which exceed numerous water quality criteria and standards in the source waters for the proposed reservoir. Extremely high concentrations of metals are present in the small streams in the reservoir footprint, which occur due to the nature of the soils in the area of the proposed reservoir. Sites Reservoir would inundate these soils resulting in leaching of metals and further incremental loading of metals to the proposed reservoir. There is no discussion in the EIR about the potential impacts of metals leaching from the soils that would be inundated by the proposed reservoir. Prior to moving forward with the project, much additional data are needed during the high flow periods in which diversions would occur from the Sacramento River, metals loading from the smaller tributaries that flow directly into the proposed reservoir, and effects from leaching of metals from soils inundated by the proposed reservoir.

The limited data that are available are sufficient to show that water quality in the proposed reservoir will have concentrations of a large number of metals that exceed many water quality criteria and standards, including those established for the protection of agricultural water supply, wildlife and fisheries, and drinking water. Metals bioaccumulation in the reservoir food web could produce adverse impacts to fish-eating birds and other animals, as well as humans, and adversely affect any potential recreational benefit from the project. Releases from the proposed reservoir could adversely affect downstream resources, including agricultural water supply, wildlife and fisheries, and drinking water supplies for communities that divert water from the Sacramento River.

Also, the EIR does not discuss the physical conditions that can be expected to occur in the proposed reservoir. Like other nearby reservoirs, the proposed reservoir will thermally stratify during the summer months, with a warm upper water layer and a cooler lower water layer. The proposed reservoir will also be biologically productive due to nutrients brought in with source waters. The biological productivity will lead to anoxic conditions (i.e., lack of oxygen) in the hypolimnion (i.e., bottom water layer). Depending on the depth from which downstream releases are made from the proposed reservoir, water released will either be warm and unsupportive of cold water fisheries in the Sacramento River (i.e., migrating salmon) or cooler but devoid of oxygen. As releases from the reservoir progress during the summer, or in years in which the reservoir is not completely filled, the reservoir will be warm from surface to bottom as the cooler lower water strata is depleted from releases or wind mixing of the upper warm water layer. Under these conditions, only warm water would be available for release from the proposed reservoir, which would not be supportive of the cold water fishery in the Sacramento River.

An EIR is a disclosure document meant to disclose pertinent project information to planners, regulatory agencies, and other interested parties and the public. This EIR did not disclose the potential impacts from metals, other contaminants, nor the physical conditions likely to exist in the proposed reservoir. The little analyses presented in the EIR misconstrues, misinterprets, and ignores water quality data that amply demonstrate significant potential adverse impacts from the proposed project. The water quality section (Chapter 7) must be completely rewritten with an objective analysis of the data and potential adverse impacts to water quality both within the reservoir and to downstream resources in the Sacramento River. Subsequently, the aquatic biological resources (chapter 12), terrestrial biological resources (chapter 14), recreation resources (chapter 21), public health and environmental hazards (chapter 28), and cumulative impacts (chapter 35) sections of the EIR must reassess impacts from the adverse water quality expected from the proposed project. Whether any of the projected beneficial uses from the proposed project can be realized, and its feasibility to meet project objectives, purpose, and need, also needs to be reconsidered in light of the potential significant adverse water quality impacts from metals. Following these re-analyses, re-circulation of the EIR is necessary with appropriate disclosure information about the potential impacts from metals to water quality and its effects on agricultural

water supply, wildlife and fisheries, and drinking water supplies for communities that divert water from the Sacramento River.

EIR Needs:

- Obtain additional metals data from source waters targeting high flows from which diversions would occur
- Provide information on the water quality impacts from other chemical contaminants that adversely affect water quality in the Sacramento River (including chlorpyrifos, diazinon, chlordane, DDT, mercury, PCBs, and dieldrin) and contaminants in sewer outfalls (such as pharmaceuticals) and other discharges (such as industrial discharges)
- Evaluate the contributions of metals from local tributaries (i.e., Funks Creek and Stone Corral Creek) to the proposed reservoir
- Provide information on the contribution from leaching of metals from the inundation area of the proposed reservoir
- Evaluate effects of metals to beneficial uses within the proposed reservoir
 - fisheries,
 - wildlife (including state and federal species listed as threatened or endangered),
 - recreation
- Evaluate effects of metals to beneficial uses due to releases from the reservoir
 - agricultural supply water,
 - effects of metals on crops including incorporation of metals by crops (e.g., arsenic uptake in rice),
 - effects of metals on plants grown for support of wildlife (such as in wildlife refuges),
 - drinking water supplies,
 - fisheries,
 - wildlife (including state and federal species listed as threatened or endangered),
- Evaluate combined toxicity of multiple metals
- Evaluate contributions of metals in reservoir releases related to the SWRCB antidegradation policy
- Evaluate impacts from mercury bioaccumulation in aquatic life (especially fish) in the proposed reservoir, and effects to wildlife that feed on fish from the reservoir and recreational opportunities (i.e., sport fishing)
- Evaluate physical conditions expected in the reservoir, including thermal stratification and hypolimnetic anoxia, and effects on reservoir and downstream aquatic resources
- Conduct re-analysis of impacts due to metals, other contaminants, and physical conditions in the proposed reservoir on:
 - water quality (chapter 7),
 - aquatic biological resources (chapter 12),
 - terrestrial biological resources (chapter 14),
 - recreation resources (chapter 21),

- public health and environmental hazards (chapter 28), and
- cumulative impacts (chapter 35).

Comments on Specific Sections of EIR

7.2.1.5 Other Heavy Metals

“In addition to mercury and selenium, other heavy metals, including cadmium, copper, and zinc, impair beneficial uses of water bodies. Cadmium, copper, and zinc enter the water bodies with the sediment from eroded soils and discharges from abandoned mines, and in stormwater runoff from municipal areas (SWRCB, 2011a). The primary source in the Central Valley appears to be tailing piles located at abandoned mine sites. Many of these mines are located upstream of reservoirs; therefore, the sediment that includes the heavy metal constituents is generally captured upstream of the dam. Heavy metals appear to cause health concerns in aquatic resources and in humans that consume the fish from these water bodies.”

Abandoned mines, which contribute heavy metals to area streams, are also found downstream from Shasta and Keswick dams. In addition, natural erosion and soil leaching also contribute to metals loads found in area streams, such as Cottonwood Creek, which make up the bulk of the flow in the Sacramento River during high runoff events during which flows would be diverted to the proposed reservoir. It is not that “heavy metals appear to cause health concerns in aquatic resources and humans,” it is well known that they do.

7.2.4 Primary Study Area

7.2.4.1 Overview and Methodology

“DWR began monthly sampling of streams in the Primary Study Area in 1997, including physical parameters, nutrients, minerals, and metals in the water column (DWR, 2012), as well as mercury analysis of sport fish tissues collected from nearby existing reservoirs, including East Park, Stony Gorge, and Black Butte (DWR, 2007a). Routine water quality monitoring by DWR was periodically suspended due to funding limitations during portions of 2008 and 2009, and ended following the January 2010 monitoring run. Sampling results were then compared to Central Valley Basin Plan water quality criteria (CVRWQCB, 2011) (Appendix 7A California State Water Resources Control Board Constituents of Concern of Water Bodies in the Study Area) and USEPA ambient water quality criteria to prevent nuisance algal growth in streams (USEPA, 2001b).”

DWR does not indicate any data for metals in its Water Data Library until 2006 for the Sacramento River below the Red Bluff Diversion Dam, and 2003 for the Sacramento River at Hamilton City and opposite the Moulton Weir, as well as Stone Corral Creek. Funding for water quality monitoring by DWR was curtailed shortly after the 1997 date indicated in the EIR, after the project manager in the Red Bluff office was informed of potential adverse impacts from metals by the then Chief of the Water Quality and Biology Section. If additional data are available, that data should be made available in the WDL so that reviewers of this EIR can verify claims about lack of water quality issues made in the EIR. However, the data that are in the WDL adequately demonstrate significant adverse water quality issues with the proposed project. Any additional data that has not been shared will just confirm these issues.

Appendix 7A - California State Water Resources Control Board Constituents of Concern of Water Bodies in the Study Area – lists a large number of parameters for which no information is contained in this EIR. For example, chlorpyrifos, diazinon, chlordane, DDT, mercury, PCBs, and dieldrin are constituents of concern from Keswick Dam to the Delta. The EIR should assess how these constituents will impact water quality in the proposed reservoir.

7.2.4.2 East Park and Stony Gorge Reservoirs

“East Park and Stony Gorge reservoirs were sampled during the summer of 2000 to evaluate the extent of mercury contamination in fish because these reservoirs are representative of conditions that could be expected in the proposed Sites Reservoir. DWR analyses of total recoverable mercury indicate that levels in samples collected near the bottom of the water column at Stony Gorge and Black Butte reservoirs, exceeded the California Toxics Rule for protection of human health.

Fish tissue samples were collected by DWR from East Park and Stony Gorge reservoirs during 2000 to 2001. Neither catfish nor bass composites collected from East Park Reservoir exceeded the OEHHA screening value or USEPA criterion, although mercury levels in the small-sized bass approached these values, and a very large channel catfish that was analyzed individually contained tissue mercury at over twice the level of the screening value and criterion limits. Mercury concentrations in tissues of channel catfish collected from Stony Gorge Reservoir contained levels less than the screening value and criterion (DWR, 2007a).”

Mercury sampling in fish from East Park and Stony Gorge reservoirs was conducted to contribute to the knowledge of mercury contamination in a number of northern California lakes and reservoirs, not simply because these reservoirs are representative of conditions that could be expected in the proposed Sites Reservoir, though they well might. As noted, the bass from East Park Reservoir that were used for the composite analysis were small in size (about one foot long), yet approached the screening value and criterion. Larger fish can be expected to exceed these values since mercury is accumulated and magnified in fish tissues. The large catfish which contained mercury at over twice the screening value and criterion is probably representative of mercury concentrations that can be found in this species.

The EIR fails to mention that mercury contamination exceeded the screening value and criterion in a relatively small largemouth bass collected from Stony Gorge Reservoir. Though the catfish analyzed from Stony Gorge Reservoir did not exceed the screening value and criterion, the cited report states that “larger channel catfish from Stony Gorge Reservoir, therefore, may be expected to contain mercury concentrations that exceed the screening value and criterion.”

Since mercury contamination in excess of criteria occurs in lakes that the EIR states are representative of conditions that could be expected in the proposed Sites Reservoir, the EIR should discuss the probability of mercury contamination in the proposed reservoir and ramifications to recreational fishing and wildlife that would consume fish from the reservoir.

7.2.4.3 Salt Lake

"Saline water has been observed to seep from underground salt springs in the vicinity of the Salt Lake fault along the slopes above the valley and along the valley floor within the proposed inundation area of Sites Reservoir. These areas are generally located in the Funks Creek watershed. The water from the underground springs accumulates along the trough of the valley and forms Salt Lake (USGS, 1915). The size of Salt Lake and adjacent seasonal brackish wetlands varies with time. The wetted area appears to vary from 0 to 30 acres. The deeper water appears to be approximately 15 acres based on observations in 2017. The depth of the water has not been monitored.

Salt Lake was only sampled on a few occasions from 1997 to 1998. In August 1997, the Salt Lake was dry. In September 1997, the springs were bubbling and the EC was 194,100 micromhos per centimeter ($\mu\text{mhos/cm}$) as compared to 3,490 $\mu\text{mhos/cm}$ for the nearby Stone Corral Creek. In January 1998, there was less than 1 cfs of flow from the springs, and the EC was 7,200 $\mu\text{mhos/cm}$ as compared to 540 $\mu\text{mhos/cm}$ for the nearby Stone Corral Creek. From these samples, it was found that waters from this location are extremely high in minerals. The EC value on one occasion reached 194,100 micromhos per centimeter. The TDS measurement at this time was 258,000 mg/L. EC, TDS, sodium, and boron exceeded all Central Valley Basin Plan criteria. A few metals also were noted at very high concentrations (aluminum, iron, and manganese) and exceeded all criteria, and a few others exceeded some criteria (arsenic, copper, lead, and nickel). Levels of ammonia and orthophosphate also were noted at high levels and exceeded criteria. Temperatures from this site were variable, and probably depend on seasonal conditions. Concentrations present in water from this site likely depend on the season and flow."

Though the EIR states that water quality data used in the analyses are available in the WDL, data for Salt Lake could not be found. However, the EIR states that several metals (aluminum, iron, and manganese) were found in concentrations that exceed all Basin Plan criteria, while others (arsenic, copper, lead, and nickel) exceed some criteria. These metals from the springs feeding Salt Lake will add to the metals load in the proposed reservoir.

7.2.4.4 Funks Creek

"Funks Creek originates at approximately 850 feet elevation in the foothills west of Antelope Valley. The banks of this intermittent stream are heavily eroded and the gravel bed is highly disturbed and compacted by cattle. Along the north end of Antelope Valley, Funks Creek receives underground drainage from Salt Lake. Funks Creek widens as it cuts through Logan Ridge and enters the western side of the Sacramento Valley, although flows are still intermittent. Approximately 1 mile downstream of Logan Ridge, Funks Creek is impounded by Funks Reservoir. This reservoir is fed mainly from waters of the Tehama-Colusa Canal. Downstream of the reservoir, Funks Creek is bordered by agricultural lands, and much of this reach is channelized before emptying into Stone Corral Creek. This portion of Funks Creek likely has some flow year round, due to leakage from the dam at Funks Reservoir.

DWR observed aluminum, arsenic, copper, iron, manganese, mercury, nickel, and phosphorus in Funks Creek at the Glenn-Colusa Irrigation District (GCID) Main Canal station during intermittent water quality sampling. The concentrations appeared to be higher during and immediately following storm events."

As with Salt Lake, data for Funks Creek could not be found in the WDL. The data used in the analyses in the EIR must be made available for review. It is likely that the reported metals exceed various criteria, as with Salt Lake, and thus add to the metals load in the proposed reservoir.

7.2.4.5 Stone Corral Creek

“Stone Corral Creek originates at approximately 700 feet elevation in the foothills west of Antelope Valley. As the intermittent stream flows into the grasslands of Antelope Valley, the channel is narrow and the banks eroded. The much larger Antelope Creek flows into Stone Corral Creek from the south near the town of Sites. Stone Corral Creek flows through the gap in the foothills and into the western Sacramento Valley.

DWR observed aluminum, arsenic, copper, iron, manganese, nickel, and phosphorus during intermittent sampling in Stone Corral Creek near Sites station during intermittent water quality sampling. The concentrations appeared to be higher during and immediately following storm events.”

Data for Stone Corral Creek are available in the WDL. These data show that not only are high concentrations of aluminum, arsenic, copper, iron, manganese, and nickel present, as reported in the EIR, but also cadmium, chromium, lead, mercury, selenium, silver, and zinc, as well as boron (Table 5). The EIR does not disclose the fact that, not only are the concentrations higher during and immediately following storm events, the resulting metals concentration in Stone Corral Creek exceed a large number of criteria and standards including those to protect drinking water, public health, freshwater aquatic life, and agricultural uses. These metals will also contribute to the metals load in the proposed reservoir.

The metals concentrations found in Stone Corral Creek, Salt Lake, and Funks Creek are a result of leaching from the soils through which these water bodies flow. Inundation of these soils by the proposed reservoir will result in an additional metals load to the reservoir.

7.2.4.6 Tehama-Colusa Canal

“The intake for the Tehama-Colusa Canal occurs at the southeast end of the City of Red Bluff at River Mile (RM) 243. The intake occurs downstream of the mouth of Red Bank Creek. The Tehama-Colusa Canal is approximately 111 miles long and extends from Red Bluff in Tehama County to downstream of Dunnigan in Yolo County. Funks Reservoir is approximately 66 canal miles downstream of the intake at the Sacramento River.

DWR observed aluminum, arsenic, cadmium, and iron during intermittent sampling in the Tehama-Colusa Canal downstream of the siphon under Stony Creek during intermittent water quality sampling.”

The intake for the Tehama-Colusa Canal is at the Sacramento River below Red Bluff Diversion Dam water quality monitoring station. Therefore, water quality in the Tehama-Colusa Canal will be exactly that found at the Sacramento River below Red Bluff Diversion Dam monitoring station. Data for this monitoring station can be found in the WDL.

This is another example where the EIR is less than forthcoming. Not only are aluminum, arsenic, cadmium, and iron present in water diverted from the river into the canal, but, as discussed earlier, so are chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc (Table 1). The highest concentrations were found during the higher flow months (December through March). As discussed earlier, many of these metals exceed a large number of criteria and standards, including those developed to protect drinking water, public health, freshwater aquatic life, and agricultural uses. Water quality in the proposed reservoir will reflect that in the Sacramento River below the Red Bluff Diversion Dam and other source waters, and exceed many of the criteria developed to protect beneficial uses of the water.

7.2.4.7 Glenn-Colusa Irrigation District Main Canal

“The intake for the GCID Main Canal is on a side channel off the Sacramento River at RM 205.5, north of the town of Hamilton City. GCID’s Hamilton City pump station, located at the intake, diverts water into the GCID Main Canal from the Sacramento River for distribution within the GCID service area. The canal is an unlined earthen channel that stretches approximately 65 miles from the system diversion point near Hamilton City to its downstream southern terminus at the CBD near Williams, in Colusa County.

DWR observed aluminum, arsenic, cadmium, copper, iron, mercury, manganese, and phosphorus during intermittent sampling in the GCID Main Canal intake during intermittent water quality sampling.”

The intake for the GCID Main Canal is slightly upstream from the Sacramento River at Hamilton City water quality monitoring station. Therefore, water quality in the GCID Main Canal will be similar to that found at the Sacramento River at Hamilton City monitoring station. Data for this monitoring station can be found in the WDL.

Not only are aluminum, arsenic, cadmium, copper, iron, manganese, and mercury present in the Sacramento River in the vicinity of the diversion into the GCID Main Canal, but so are chromium, lead, nickel, selenium, silver, and zinc (Table 3). Aluminum, arsenic, cadmium, iron, lead, manganese, mercury, and nickel are present in concentrations that exceed various criteria and standards. The highest concentrations are generally found during the higher flow months of December through March, when the proposed project may be diverting water from this area of the Sacramento River.

7.2.4.9 Sacramento River Opposite Moulton Weir

“DWR monitored water quality at the Sacramento River along the western bank opposite Moulton Weir station from 2000 to 2010. The water quality samples included aluminum, arsenic, copper, iron, mercury, manganese, lead, and phosphorus. Total aluminum levels in the Sacramento River at this location frequently exceeded aquatic life criteria during associated high flow conditions in the river, but rarely exceeded drinking water criteria and the agricultural goal. Arsenic levels exceeded human toxicity thresholds in all samples collected, and the criterion for protection of aquatic life for cadmium was occasionally exceeded. Copper levels frequently exceeded hardness-dependent aquatic life protection criteria during high flow conditions in the river, and iron levels frequently exceeded drinking water and aquatic life protection criteria, as well as the agricultural goal during the same river conditions. Dissolved iron levels exceeded the Central Valley Basin Plan level occasionally. Mercury levels approached, but did not exceed, the CTR criterion during the highest flows in the river. Manganese levels

occasionally exceeded drinking water standards and the agricultural goal, and lead levels rarely exceeded drinking water criteria. All samples contained total phosphorus at levels at or above the recommended criteria range to prevent nuisance algal growth in streams."

Monitored metals also included cadmium, chromium, nickel, selenium, silver, and zinc (Table 4). Contrary to the statement in the EIR, aluminum concentrations frequently exceed drinking water criteria and on several occasions the agricultural goal during the high flow months of December through March. With reported concentrations up to 38 ug/L, mercury not only approached but greatly exceeded the California Toxics Rule (CTR) criterion (0.05 ug/L) for sources of drinking water as well as the National Recommended Water Quality for freshwater aquatic life continuous concentration (0.77 ug/L) and maximum concentration (1.8 ug/L). Reported lead concentrations frequently exceed the California Public Health Goal of 0.02 ug/L, and had a median value of 0.058 ug/L. Reported nickel concentrations also exceed the California Public Health Goal.

Environmental Impacts/Environmental Consequences

7.3.1 Section 303 Evaluation Criteria and Significance Thresholds

"Significance criteria represent the thresholds that were used to identify whether an impact would be potentially significant. Appendix G of the CEQA Guidelines suggests the following evaluation criteria for water quality:

Would the Project:

- Violate any water quality standards or waste discharge requirements?*
- Create or contribute runoff water that would exceed the capacity of existing or planned stormwater*

drainage systems or provide substantial additional sources of polluted runoff?

- Otherwise substantially degrade water quality?*

The evaluation criteria used for this impact analysis represent a combination of the Appendix G criteria and professional judgment that considers current regulations, standards, and/or consultation with agencies, knowledge of the area, and the context and intensity of the environmental effects, as required pursuant to NEPA. For the purposes of this analysis, an alternative would result in a potentially significant impact if it would cause the following:

** A violation of any water quality standard or waste discharge requirement, or otherwise substantially degrade water quality*

If a water quality constituent declines under the action alternatives as compared to the Existing Conditions/No Project/No Action Condition, the changes are not considered to be adverse.

Qualitative Analysis of Constituents

The qualitative analysis of changes in other constituents (e.g., mercury, selenium, nutrients) was based upon an analysis of potential changes in loadings from sources of the constituent and related changes in flows that would occur from implementation of the Project as compared to the Existing Conditions/No Project/No Action Condition. For example, the qualitative analysis of changes in mercury is based upon changes in flow patterns from the major sources of mercury in the Sacramento River watershed (e.g., tributaries to the Sacramento River)."

What the heck does this last paragraph mean? It makes absolutely no sense. The analysis of potential impacts should be based on an assessment of the expected water quality in the proposed reservoir, whether that water quality exceeds any criteria or standards, and the adverse effects that would occur if criteria or standards are exceeded, both within the reservoir and in downstream areas subject to releases from the reservoir.

7.3.4 Section 303 Impacts Associated with Alternative A

Shasta Lake and Sacramento River from Shasta Lake and Keswick Reservoir to Freeport

Impact SW Qual-1: A Violation of Any Water Quality Standard or Waste Discharge Requirement, or Otherwise Substantially Degrade Surface Water Quality

Mercury and Other Heavy Metals

"As described in Section 7.2, the sources of mercury and other heavy metals in Shasta Lake are located upstream of the lake and accumulate within Shasta Lake. Mercury in the Sacramento River downstream of Keswick Reservoir is generated along the tributaries to the Sacramento River. The generation rate and the accumulation rates of mercury and other heavy metals in Shasta Lake or along the Sacramento River would not be affected by implementation of Alternative A because there would be no new facilities constructed upstream of Shasta Lake or along the tributaries. Operations of Shasta Lake under Alternative A, as reflected by end-of-month Shasta Lake storage, would be similar to conditions under the Existing Conditions/No Project/No Action Condition, as described in Chapter 6 Surface Water Resources."

Accumulation of mercury would indeed be affected by Alternative A (and all the other alternatives) since water from the Sacramento River, containing mercury concentrations in excess of various criteria, would be diverted into the proposed reservoir. Releases from the reservoir could adversely affect downstream resources and beneficial uses due to the mercury contained in the reservoir. In addition, fisheries, wildlife, and recreation that utilize the reservoir could be adversely affected from mercury accumulation in the reservoir food web.

Summary

"Concentrations of mercury, other heavy metals, and salinity would be similar in the Sacramento River under Alternative A as compared to the Existing Conditions/No Project/No Action Condition; therefore, there would be **no impact** related to these constituents."

Again, there are potential very significant adverse impacts associated with diverting water from the Sacramento River during higher flow periods to the proposed reservoir. The Sacramento River contains concentrations of a large number of metals, including aluminum, arsenic, cadmium, chromium, iron, lead, manganese, and mercury, that significantly exceed various criteria and standards designed to protect beneficial uses. Water in the reservoir will reflect that of the water diverted from the Sacramento River, and will also exceed a number of criteria developed to protect beneficial uses. The metals may adversely affect aquatic resources in the reservoir and terrestrial resources that may utilize the reservoir (such as fish-eating birds), as well as reservoir recreation.

The metals in releases from the reservoir may adversely affect downstream resources, including drinking water supply, agricultural supply, wildlife, and fisheries, and may violate the SWRCB antidegradation policy. These are definite “impacts related to these constituents,” contrary to what is stated above in this EIR. All the alternatives suffer from the exact same significant adverse impacts due to metals in the source waters.

7.4 Mitigation Measures

“Because no potentially significant direct water quality impacts were identified, no mitigation is required or recommended.”

The EIR failed to identify any impacts, though significant potential adverse impacts are painfully obvious. The EIR completely ignores any assessment of the proposed project – Sites Reservoir, as well as any assessment of the adverse impacts the reservoir may pose to beneficial uses within the reservoir (i.e., fisheries, wildlife, recreation) and those adverse impacts attributable to releases from the reservoir (i.e., drinking water supply, agricultural water supply, fisheries, wildlife, recreation). As shown throughout this discussion, a number of metals significantly exceed water quality criteria and standards in the water sources to the proposed reservoir. The EIR completely ignores potential chemical contaminants (such as chlorpyrifos, diazinon, chlordane, DDT, mercury, PCBs, and dieldrin). Water quality in the reservoir will reflect that of the source waters. Therefore, the reservoir will contain a number of metals, including aluminum, arsenic, cadmium, chromium, iron, lead, manganese, and mercury, and possibly other chemical contaminants that exceed a number of water quality criteria designed to protect beneficial uses. Both water resources within the reservoir and downstream resources that receive reservoir releases may be adversely affected by the metals and chemical contaminants. The EIR also fails to address the physical properties that will exist in the reservoir (such as thermal stratification and hypolimnetic anoxia), and how they will affect both reservoir and downstream resources. The EIR needs to address how these significant adverse impacts are going to be mitigated.

References

SWRCB 2011. State Water Resources Control Board. A Compilation of Water Quality Goals, 16th Edition. April 2011.

Table 1. Sacramento River below Red Bluff Diversion Dam, Part 1 of 2

Station Name	Sample Date	Dissolved Aluminum µg/L	Total Aluminum µg/L	Dissolved Arsenic µg/L	Total Arsenic µg/L	Dissolved Cadmium µg/L	Total Cadmium µg/L	Dissolved Chromium µg/L	Total Chromium µg/L	Dissolved Copper µg/L	Total Copper µg/L	Dissolved Iron µg/L	Total Iron µg/L
SACRAMENTO R BL RED BLUFF DIV DM	2/21/06 10:45	131	154	0.702	0.789	0.013	0.016	0.97	0.98	1.08	1.21	76	162
SACRAMENTO R BL RED BLUFF DIV DM	3/1/06 11:00	1459	2240	0.857	1.06	0.017	0.055	2.75	6.1	2.59	6.09	878	2854
SACRAMENTO R BL RED BLUFF DIV DM	4/18/06 9:25	462	729	0.874	0.951	<0.1	<0.1	0.95	1.57	2.36	3.42	277	677
SACRAMENTO R BL RED BLUFF DIV DM	5/16/06 6:45	131	206	0.915	0.959	<0.1	<0.1	0.55	0.58	1.45	1.84	86.8	181
SACRAMENTO R BL RED BLUFF DIV DM	6/26/06 10:05	220	399	1.04	1.09	<0.1	<0.1	0.67	0.98	1.12	1.6	66.2	233
SACRAMENTO R BL RED BLUFF DIV DM	7/25/06 8:20	318	794	1.03	1.1	<0.1	<0.1	1	1.31	1.31	2.18	82	323
SACRAMENTO R BL RED BLUFF DIV DM	8/21/06 13:30	194	778	0.884	0.993	<0.1	<0.1	1.1	1.37	1.03	1.55	132	259
SACRAMENTO R BL RED BLUFF DIV DM	9/21/06 7:15	320	730	0.9	0.933	<0.1	<0.1	0.65	1.01	1.07	1.67	85.3	300
SACRAMENTO R BL RED BLUFF DIV DM	10/25/06 12:30	84.1	214	0.917	0.964	<0.1	<0.1	0.61	0.89	1.28	1.6	51	218
SACRAMENTO R BL RED BLUFF DIV DM	12/13/06 9:20	1238	2010	0.977	1.22	<0.1	<0.1	0.61	1.56	2.3	3.91	235	621
SACRAMENTO R BL RED BLUFF DIV DM	1/10/07 12:25	41.7	91.4	1.42	1.5	<0.1	<0.1	0.55	0.59	0.92	1.01	34.9	54.3
SACRAMENTO R BL RED BLUFF DIV DM	2/26/07 10:45	212	322	0.929	0.987	<0.1	<0.1	1.2	1.61	2.55	2.8	293	376
SACRAMENTO R BL RED BLUFF DIV DM	3/21/07 10:30	9.58	51	1.41	1.46	<0.1	<0.1	0.44	0.59	1.47	1.74	21.5	85.5
SACRAMENTO R BL RED BLUFF DIV DM	4/17/07 10:30	12.3	41	1.53	1.62	<0.1	<0.1	0.45	0.58	1.71	1.93	13.4	51.1
SACRAMENTO R BL RED BLUFF DIV DM	5/29/07 9:45	5.52	15.9	1.68	1.87	<0.1	<0.1	0.53	0.59	1.27	1.53	4.2	32.2
SACRAMENTO R BL RED BLUFF DIV DM	6/26/07 9:45	5.47	56.6	1.59	1.72	<0.1	<0.1	0.55	0.74	1.1	1.41	12.3	75.5
SACRAMENTO R BL RED BLUFF DIV DM	7/18/07 10:10	6.45	50.2	1.63	1.73	<0.1	<0.1	0.5	0.62	0.88	1.25	4.5	73.4
SACRAMENTO R BL RED BLUFF DIV DM	8/27/07 12:10	14.2	26.6	1.55	1.75	<0.1	<0.1	0.47	0.6	0.75	0.97	8.8	33.8
SACRAMENTO R BL RED BLUFF DIV DM	9/12/07 10:40	2.04	24	1.4	1.59	<0.1	<0.1	0.42	0.55	0.67	0.82	3.8	24.6
SACRAMENTO R BL RED BLUFF DIV DM	10/30/07 10:40	5.66	34.5	1.5	1.64	<0.1	<0.1	0.42	0.46	0.99	1.14	12	73
SACRAMENTO R BL RED BLUFF DIV DM	11/26/07 13:40	1.11	18	1.96	2.01	<0.1	<0.1	0.5	0.52	0.66	0.92	5.5	51.2
SACRAMENTO R BL RED BLUFF DIV DM	1/22/08 8:40	6.82	284	1.5	1.71	<0.1	<0.1	0.53	1.15	1.45	2.04	9.5	259
SACRAMENTO R BL RED BLUFF DIV DM	2/26/08 10:40	14.2	846	0.799	0.932	<0.1	<0.1	0.33	2.49	1.97	3.88	24.6	790
SACRAMENTO R BL RED BLUFF DIV DM	3/25/08 7:25	2.25	35	1.31	1.37	<0.1	<0.1	0.42	0.55	1.7	2.09	7.8	62
SACRAMENTO R BL RED BLUFF DIV DM	4/22/08 13:55	4.86	89.3	1.58	1.63	<0.1	<0.1	0.43	0.51	1.63	1.84	9.1	94.6
SACRAMENTO R BL RED BLUFF DIV DM	7/23/08 13:50	2.29	84.5	1.5	1.55	<0.1	<0.1	0.44	0.56	0.9	1.14	7.1	72.4
SACRAMENTO R BL RED BLUFF DIV DM	4/21/09 13:20	6.61	107	1.73	2.06	<0.1	<0.1	0.39	0.65	2.53	2.72	21.6	144
SACRAMENTO R BL RED BLUFF DIV DM	5/27/09 14:30	5.07	89.8	1.27	1.32	<0.1	<0.1	0.39	0.54	1.82	1.95	7.4	87.8
SACRAMENTO R BL RED BLUFF DIV DM	6/24/09 14:00	12.5	66.4	1.26	1.28	<0.1	<0.1	0.39	0.5	1.68	1.72	8.9	72.1
SACRAMENTO R BL RED BLUFF DIV DM	7/27/09 14:07	9.61	168	1.49	1.56	<0.1	<0.1	0.49	0.79	1.11	1.51	11.2	130
SACRAMENTO R BL RED BLUFF DIV DM	8/25/09 9:55	2.86	80.4	1.18	1.25	<0.1	<0.1	0.39	0.54	0.91	1.08	5.8	71.9
SACRAMENTO R BL RED BLUFF DIV DM	9/23/09 8:50	4.04	72.6	1.27	1.33	<0.1	<0.1	0.38	0.48	1.04	1.09	9.6	79.8
SACRAMENTO R BL RED BLUFF DIV DM	10/26/09 13:15	7.2	87.1	1.44	1.52	<0.1	<0.1	0.44	0.6	1.26	1.49	16.1	84.8
SWRCB Basin Plan - Drinking Water Standards -Primary MCL			1000		10								
SWRCB Basin Plan - Drinking Water Standards -Secondary MCL			200										300
Cal EPA/OEHHA - California Public Health Goal					0.004				0.02				
USEPA Secondary MCL			50				0.0023						
Cal EPA - One in a million incremental cancer risk estimate for drinking water					0.023				0.07				
USEPA Health Advisory for drinking water					0.02								
California Proposition 65 Safe Harbor Level - Max. Allowable dose level for reproductive toxicity					0.05								
Agriculture Water Quality Goals - Taste and odor threshold												300	
National Recommended WQ Criteria - Taste and Odor or Welfare													
National Recommended WQ Criteria - Human Health and Welfare protection - water and fish consumption													
National Recommended WQ Criteria - Freshwater Aquatic Life Continuous			87		0.018								
National Recommended WQ Criteria - Freshwater Aquatic Life Maximum			750									1000	

Table 1. Sacramento River below Red Bluff Diversion Dam, Part 2 of 2

Station Name	Sample Date	Dissolved Lead µg/L	Total Lead µg/L	Dissolved Manganese µg/L	Total Manganese µg/L	Total Mercury ng/L	Dissolved Nickel µg/L	Total Nickel µg/L	Dissolved Selenium µg/L	Total Selenium µg/L	Dissolved Zinc µg/L	Total Zinc µg/L
SACRAMENTO R BL RED BLUFF DIV DM	2/21/06 10:45	<0.045	0.049	2.37	5.71	N/A	1.53	1.62	<0.149	0.15	1.45	1.89
SACRAMENTO R BL RED BLUFF DIV DM	3/1/06 11:00	0.274	1.1	13.5	78.9	N/A	2.84	8.57	<0.149	0.16	4.49	13.2
SACRAMENTO R BL RED BLUFF DIV DM	4/18/06 9:25	0.086	0.271	6.94	19.6	N/A	1.69	2.84	0.24	0.31	2.95	5.81
SACRAMENTO R BL RED BLUFF DIV DM	5/16/06 6:45	<0.04	0.075	1.64	7.63	N/A	1.14	1.34	<0.2	<0.2	0.49	1.78
SACRAMENTO R BL RED BLUFF DIV DM	6/26/06 10:05	<0.04	0.092	1.1	7.92	N/A	1.6	2.1	<0.2	<0.2	0.72	2.31
SACRAMENTO R BL RED BLUFF DIV DM	7/25/06 8:20	<0.04	0.15	1.49	11.7	1.7	1.8	3.01	<0.2	0.26	1.02	4.39
SACRAMENTO R BL RED BLUFF DIV DM	8/21/06 13:30	<0.04	0.102	1.65	5.98	0.89	1.84	2.55	<0.2	0.24	1.51	3.22
SACRAMENTO R BL RED BLUFF DIV DM	9/21/06 7:15	<0.04	0.102	1.88	12.8	1.4	1.88	2.85	<0.2	0.24	1.18	5.92
SACRAMENTO R BL RED BLUFF DIV DM	10/25/06 12:30	<0.04	0.1	0.91	6.93	0.58	1.78	2.19	<0.2	0.26	0.69	4.16
SACRAMENTO R BL RED BLUFF DIV DM	12/13/06 9:20	0.103	0.546	3.08	38.6	0.84	1.3	2.32	<0.2	0.24	2.07	9.17
SACRAMENTO R BL RED BLUFF DIV DM	1/10/07 12:25	<0.04	<0.04	1.37	3.13	0.59	0.97	1.02	<0.2	<0.2	0.71	2.82
SACRAMENTO R BL RED BLUFF DIV DM	2/26/07 10:45	0.149	0.234	6.41	10.2	2.6	1.14	1.49	0.2	0.28	3.09	5.68
SACRAMENTO R BL RED BLUFF DIV DM	3/21/07 10:30	<0.04	0.04	1.27	4.8	0.9	0.84	0.97	<0.2	0.2	0.38	3.58
SACRAMENTO R BL RED BLUFF DIV DM	4/17/07 10:30	<0.04	<0.04	1.71	5.08	1.2	0.57	0.72	<0.2	<0.2	0.48	3.46
SACRAMENTO R BL RED BLUFF DIV DM	5/29/07 9:45	<0.04	<0.04	0.39	2.95	N/A	0.65	0.76	<0.2	0.23	0.31	3.01
SACRAMENTO R BL RED BLUFF DIV DM	6/26/07 9:45	<0.04	0.058	3.41	7.57	0.74	0.97	1.22	<0.2	0.25	1.19	4.35
SACRAMENTO R BL RED BLUFF DIV DM	7/18/07 10:10	<0.04	<0.04	0.2	4.47	0.98	0.76	1.08	<0.2	<0.2	0.31	3.37
SACRAMENTO R BL RED BLUFF DIV DM	8/27/07 12:10	<0.04	<0.04	0.33	3.8	N/A	1.25	1.4	<0.2	0.23	2	2.22
SACRAMENTO R BL RED BLUFF DIV DM	9/12/07 10:40	<0.04	0.058	0.18	3	0.58	0.89	1	<0.2	<0.2	0.5	2.34
SACRAMENTO R BL RED BLUFF DIV DM	10/30/07 10:40	<0.04	0.052	0.19	4.66	0.48	0.92	1.2	<0.2	<0.2	0.71	3.12
SACRAMENTO R BL RED BLUFF DIV DM	11/26/07 13:40	<0.04	0.078	0.32	4.71	1.2	0.63	0.93	<0.2	<0.2	0.34	2.59
SACRAMENTO R BL RED BLUFF DIV DM	1/22/08 8:40	<0.04	0.13	0.73	12.9	N/A	0.91	1.08	<0.2	<0.2	1.33	4.99
SACRAMENTO R BL RED BLUFF DIV DM	2/26/08 10:40	<0.04	0.388	0.68	23.4	N/A	1.58	3	<0.2	0.21	0.97	6.85
SACRAMENTO R BL RED BLUFF DIV DM	3/25/08 7:25	<0.04	<0.04	0.36	6.12	N/A	0.71	0.95	<0.2	0.25	0.44	3.11
SACRAMENTO R BL RED BLUFF DIV DM	4/22/08 13:55	<0.04	0.051	1.48	5.43	N/A	0.72	0.88	0.25	0.26	1.11	3.47
SACRAMENTO R BL RED BLUFF DIV DM	7/23/08 13:50	<0.04	0.073	0.26	4.64	0.65	1.2	1.24	<0.2	<0.2	0.51	2.87
SACRAMENTO R BL RED BLUFF DIV DM	4/21/09 13:20	<0.04	<0.04	0.57	5.35	N/A	0.8	0.88	<0.2	<0.2	1.07	4.06
SACRAMENTO R BL RED BLUFF DIV DM	5/27/09 14:30	<0.04	<0.04	0.43	2.32	N/A	0.82	0.96	<0.2	<0.2	0.48	2.28
SACRAMENTO R BL RED BLUFF DIV DM	6/24/09 14:00	<0.04	<0.04	0.3	3.26	N/A	0.91	1.05	0.23	0.27	1.25	3.27
SACRAMENTO R BL RED BLUFF DIV DM	7/27/09 14:07	<0.04	0.063	1.86	6.71	N/A	1.17	1.24	<0.2	<0.2	1.32	4.09
SACRAMENTO R BL RED BLUFF DIV DM	8/23/09 9:55	<0.04	<0.04	0.35	4.54	N/A	1.13	1.21	<0.2	<0.2	0.81	2.67
SACRAMENTO R BL RED BLUFF DIV DM	9/23/09 8:50	<0.04	<0.04	0.32	4.77	N/A	1.01	1.16	<0.2	<0.2	0.63	2.79
SACRAMENTO R BL RED BLUFF DIV DM	10/26/09 13:15	<0.04	0.076	2.55	7.5	N/A	0.97	1.03	<0.2	<0.2	0.94	3.12

Maximum 0.274 1.1 13.5 78.9 2.6 2.84 8.57 0.25 0.31 4.49 13.2
Median 0.126 0.085 1.1 5.71 0.89 1.01 1.21 0.235 0.245 0.94 3.27
Minimum 0.086 0.04 0.18 2.32 0.43 0.57 0.72 0.15 0.31 1.78

SWRCB Basin Plan - Drinking Water Standards - Primary MCL

SWRCB Basin Plan - Drinking Water Standards - Secondary MCL

Cal EPA/OEHHA - California Public Health Goal

USEPA Secondary MCL

Cal EPA - One in a million incremental cancer risk estimate for drinking water

USEPA Health Advisory for drinking water

California Proposition 65 Safe Harbor level - Max. Allowable dose level for

Agriculture Water Quality Goals - Taste and odor threshold

National Recommended WQ Criteria - Taste and Odor or Welfare

National Recommended WQ Criteria - Human Health and Welfare protection -

National Recommended WQ Criteria - Freshwater Aquatic Life Continuous

National Recommended WQ Criteria - Freshwater Aquatic Life Maximum

0.25

0.2

50

50

0.77

1.4

Table 2. Cottonwood Creek near Cottonwood, Part 1 of 2

Station Name	Sample Date	Dissolved Aluminum µg/L	Total Aluminum µg/L	Dissolved Arsenic µg/L	Total Arsenic µg/L	Dissolved Cadmium µg/L	Total Cadmium µg/L	Dissolved Chromium µg/L	Total Chromium µg/L	Dissolved Copper µg/L	Total Copper µg/L	Dissolved Iron µg/L	Total Iron µg/L
COTTONWOOD C NR COTTONWOOD	10/5/04 11:30	5.21	10.5	0.662	0.668	<0.011	<0.008	0.65	0.68	0.47	0.58	10.2	39
COTTONWOOD C NR COTTONWOOD	11/8/04 11:20	3.98	6.42	0.684	0.723	<0.008	<0.007	1.51	1.75	0.48	0.72	3.6	26
COTTONWOOD C NR COTTONWOOD	12/7/04 10:40	7.02	31.3	0.524	0.612	<0.012	0.081	2.04	2.33	0.66	0.7	<4.5	42
COTTONWOOD C NR COTTONWOOD	1/10/05 7:35	208	448	0.517	0.549	<0.011	<0.007	1.73	1.9	1.29	1.67	137	522
COTTONWOOD C NR COTTONWOOD	2/2/05 13:00	87.1	157	0.396	0.417	<0.011	<0.066	1.05	1.14	0.63	0.85	57.1	218
COTTONWOOD C NR COTTONWOOD	3/10/05 13:50	34.7	95.6	0.46	0.468	<0.033	<0.011	1.6	1.63	0.5	0.67	13.7	128
COTTONWOOD C NR COTTONWOOD	4/19/05 8:10	40.2	88	0.413	0.484	<0.022	<0.009	1.02	1.52	0.42	0.59	29.3	114
COTTONWOOD C NR COTTONWOOD	5/18/05 11:20	1358	14345	0.863	3.04	<0.058	0.085	2.94	36.5	4.43	39.2	963	23594
COTTONWOOD C NR COTTONWOOD	6/28/05 7:30	63.9	86.1	0.455	0.465	<0.009	<0.012	1.7	1.14	0.42	0.46	23.8	62.6
COTTONWOOD C NR COTTONWOOD	7/26/05 6:45	1.55	7.51	0.682	0.72	<0.011	<0.004	0.47	0.78	0.48	0.52	<1.51	8.6
COTTONWOOD C NR COTTONWOOD	8/22/05 11:45	2.65	32.9	0.657	0.691	<0.009	<0.009	1.7	1.98	0.5	0.54	<4.16	72.4
COTTONWOOD C NR COTTONWOOD	9/26/05 11:20	10.2	152	0.779	0.795	0.003	0.016	1.03	1.1	1.03	1.28	20.2	294
COTTONWOOD C NR COTTONWOOD	10/24/05 8:30	12.9	47.2	0.705	0.708	<0.009	<0.009	0.9	0.99	0.57	0.69	17.8	83.7
COTTONWOOD C NR COTTONWOOD	11/14/05 9:00	5.42	11.9	0.537	0.579	<0.005	<0.007	0.9	0.91	0.6	0.62	9	26.2
COTTONWOOD C NR COTTONWOOD	12/15/05 9:15	4.38	10.2	0.343	0.434	<0.005	0.015	1.04	1.24	0.41	0.41	<1.51	17.2
COTTONWOOD C NR COTTONWOOD	1/24/06 9:10	202	380	0.42	0.46	0.009	0.015	1.71	2.26	0.75	1.22	123	512
COTTONWOOD C NR COTTONWOOD	3/1/06 9:15	2533	3739	0.889	1.16	0.009	0.023	8.2	15.7	3.22	7.63	1760	5793
COTTONWOOD C NR COTTONWOOD	4/24/06 10:03	151	1225	0.394	0.569	<0.1	<0.1	1.11	4.58	0.6	2.63	122	1174
COTTONWOOD C NR COTTONWOOD	8/16/06 11:00	1.91	20.8	0.703	0.806	<0.1	<0.1	0.33	0.35	0.73	0.84	7.2	29.5
COTTONWOOD C NR COTTONWOOD	11/14/06 9:05	24.8	75.7	0.467	0.594	<0.1	<0.1	0.54	0.68	0.51	0.61	37.4	96.2
COTTONWOOD C NR COTTONWOOD	12/6/06 13:20	4.8	6.62	0.438	0.539	<0.1	<0.1	0.45	1.14	0.5	0.54	6.1	11.7
COTTONWOOD C NR COTTONWOOD	2/20/07 8:45	47.5	52.3	0.3	0.344	<0.1	<0.1	1.38	1.91	0.57	0.62	35.2	50.4
	Maximum	2533	14345	0.889	3.04	0.009	0.085	8.2	36.5	4.43	39.2	1760	23594
	Mean	18.85	64	0.5205	0.5865	0.009	0.0195	1.08	1.38	0.57	0.68	26.55	78.05
	Minimum	1.55	6.42	0.3	0.344	0.003	0.007	0.33	0.35	0.41	0.41	3.6	8.6
SWRCB Basin Plan - Drinking Water Standards -Primary MCL		1000											
SWRCB Basin Plan - Drinking Water Standards -Secondary MCL		200										300	
Cal EPA/OEHHA - California Public Health Goal		600				0.04		0.02					
USEPA Secondary MCL													
Cal EPA - One in a million incremental cancer risk estimate for drinking water				0.023		0.0023		0.07					
USEPA Health Advisory for drinking water				0.02									
California Proposition 65 Safe Harbor Level - Max. Allowable dose level for reproductive toxicity													
National Academy of Sciences Health Advisory		5000		0.05									
Agriculture Water Quality Goals - Taste and odor threshold		5000										5000	
National Recommended WQ Criteria - Taste and Odor or Welfare												300	
National Recommended WQ Criteria - Human Health and Welfare protection - water and fish consumption		87		0.018									
National Recommended WQ Criteria - Freshwater Aquatic Life		750										1000	
National Recommended WQ Criteria - Freshwater Aquatic Life													

Table 2. Cottonwood Creek near Cottonwood, Part 2 of 2

Station Name	Sample Date	Dissolved Lead µg/L	Total Lead µg/L	Dissolved Manganese µg/L	Total Manganese µg/L	Total Mercury ng/L	Dissolved Nickel µg/L	Total Nickel µg/L	Dissolved Selenium µg/L	Total Selenium µg/L	Dissolved Silver µg/L	Total Silver µg/L	Dissolved Zinc µg/L	Total Zinc µg/L
COTTONWOOD C NR COTTONWOOD	10/5/04 11:30	0.008	<0.017	2.58	11.3	N/A	1.34	1.34	0.18	<0.204	<0.077	<0.054	0.19	0.42
COTTONWOOD C NR COTTONWOOD	11/8/04 11:20	<0.001	0.008	3.06	4.36	N/A	0.86	1.53	0.33	0.35	<0.006	<0.063	0.05	0.09
COTTONWOOD C NR COTTONWOOD	12/7/04 10:40	0.012	0.028	0.46	4.09	N/A	1.07	1.2	<0.163	0.28	<0.011	<0.04	0.31	0.65
COTTONWOOD C NR COTTONWOOD	1/10/05 7:35	0.048	0.166	1.79	12.6	N/A	1.59	2.61	0.74	0.81	<0.003	0.006	0.55	1.58
COTTONWOOD C NR COTTONWOOD	2/2/05 13:00	0.017	0.063	2.87	7.91	N/A	1.41	1.93	<0.222	0.18	<0.001	<0.002	0.22	0.73
COTTONWOOD C NR COTTONWOOD	3/10/05 13:50	0.008	0.044	0.79	4.71	N/A	1.28	1.64	<0.245	0.32	<0.001	<0.036	0.16	0.44
COTTONWOOD C NR COTTONWOOD	4/19/05 8:10	0.015	0.034	1.51	5.07	N/A	0.98	1.47	0.31	0.44	<0.003	<0.005	0.2	0.53
COTTONWOOD C NR COTTONWOOD	5/18/05 11:20	0.475	7.26	8.76	563	N/A	3.38	57.9	<0.399	0.39	0.039	0.101	3.31	72
COTTONWOOD C NR COTTONWOOD	6/28/05 7:30	<0.009	<0.027	3.47	3.93	N/A	0.66	1.16	<0.14	<0.354	<0.002	<0.027	0.14	0.36
COTTONWOOD C NR COTTONWOOD	7/26/05 6:45	<0.019	<0.063	0.32	2.51	N/A	0.43	0.82	<0.145	<0.176	<0.002	<0.04	<0.083	0.15
COTTONWOOD C NR COTTONWOOD	8/22/05 11:45	<0.004	0.024	1.05	13.7	N/A	0.79	1.07	<0.227	<0.227	<0.001	<0.001	0.18	0.56
COTTONWOOD C NR COTTONWOOD	9/26/05 11:20	0.006	0.111	0.76	24.9	N/A	1.31	2.36	0.17	0.19	<0.003	<0.003	0.88	1.97
COTTONWOOD C NR COTTONWOOD	10/24/05 8:30	0.008	0.028	1.93	15.4	N/A	1.18	1.45	0.11	0.19	<0.002	<0.002	0.31	0.48
COTTONWOOD C NR COTTONWOOD	11/14/05 9:00	0.01	0.017	1.78	5.95	N/A	1.37	1.38	<0.186	<0.186	<0.009	<0.009	0.39	0.71
COTTONWOOD C NR COTTONWOOD	12/15/05 9:15	0.006	0.008	0.79	2.59	N/A	1.41	1.48	0.16	0.29	<0.001	<0.001	<0.177	<0.177
COTTONWOOD C NR COTTONWOOD	1/24/06 9:10	0.033	0.146	6.19	16.7	N/A	1.95	3.38	0.23	0.28	<0.005	<0.005	0.43	1.44
COTTONWOOD C NR COTTONWOOD	3/1/06 9:15	0.491	1.53	30.8	138	N/A	7.35	20.9	<0.149	0.15	<0.009	<0.009	3.64	13.6
COTTONWOOD C NR COTTONWOOD	4/24/06 10:03	0.04	0.444	2.06	40.8	N/A	1.51	6.9	0.21	0.32	<0.03	<0.03	0.47	4.32
COTTONWOOD C NR COTTONWOOD	8/16/06 11:00	<0.04	<0.04	1.13	5.41	0.72	1.14	1.32	0.42	0.6	<0.03	<0.03	0.14	0.73
COTTONWOOD C NR COTTONWOOD	11/14/06 9:05	<0.04	<0.04	4.82	10.7	N/A	1.56	1.77	0.56	0.63	<0.03	<0.03	<0.1	1.07
COTTONWOOD C NR COTTONWOOD	12/6/06 13:20	<0.04	<0.04	2.55	4.44	N/A	0.87	1.24	0.33	0.59	<0.03	<0.03	0.79	2.02
COTTONWOOD C NR COTTONWOOD	2/20/07 8:45	<0.04	<0.04	5	5.57	1.2	0.16	1.66	0.35	0.51	<0.03	<0.03	0.18	1.65
SWRCB Basin Plan - Drinking Water Standards -Primary MCL		Maximum	0.491	7.26	30.8	563	1.2	7.35	57.9	0.74	0.81	0.039	0.101	3.64
SWRCB Basin Plan - Drinking Water Standards -Secondary MCL		Mean	0.0135	0.044	1.995	6.93	0.96	1.295	1.505	0.31	0.32	0.039	0.0535	0.31
Cal EPA/OEHHA - California Public Health Goal		Minimum	0.006	0.008	0.32	2.51	0.72	0.16	0.82	0.11	0.15	0.039	0.006	0.05
USEPA Secondary MCL														
Cal EPA - One in a million incremental cancer risk estimate for drinking w			4.1											
USEPA Health Advisory for drinking water														
California Proposition 65 Safe Harbor Level - Max.														
Allowable dose level for reproductive toxicity			0.25											
National Academy of Sciences Health Advisory														
Agriculture Water Quality Goals - Taste and odor threshold														
National Recommended WQ Criteria - Taste and Odor or Welfare														
National Recommended WQ Criteria - Human Health and Welfare														
National Recommended WQ Criteria - Freshwater Aquatic Life														
National Recommended WQ Criteria - Freshwater Aquatic Life														

Table 3. Sacramento River at Hamilton City, Part 1 of 2

Station Name	Sample Date	Dissolved Aluminum µg/L	Total Aluminum µg/L	Dissolved Arsenic µg/L	Total Arsenic µg/L	Dissolved Cadmium µg/L	Total Cadmium µg/L	Dissolved Chromium µg/L	Total Chromium µg/L	Dissolved Copper µg/L	Total Copper µg/L	Dissolved Iron µg/L	Total Iron µg/L
SACRAMENTO R A HAMILTON CITY	11/25/03 9:10	N/A	12.8	N/A	1.93	N/A	<0.005	N/A	0.61	N/A	1.28	N/A	15.3
SACRAMENTO R A HAMILTON CITY	3/8/04 13:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	172
SACRAMENTO R A HAMILTON CITY	5/20/04 15:00	N/A	110	N/A	1.81	N/A	0.011	N/A	0.84	N/A	1.87	N/A	223
SACRAMENTO R A HAMILTON CITY	8/12/04 10:20	N/A	189	N/A	1.36	N/A	0.016	N/A	0.75	N/A	1.65	N/A	134
SACRAMENTO R A HAMILTON CITY	10/5/04 10:05	14.5	113	1.3	1.32	<0.011	<0.008	0.9	0.94	0.72	1.43	9.6	87.4
SACRAMENTO R A HAMILTON CITY	11/9/04 11:40	23.6	36.1	2.49	2.52	<0.008	<0.007	1	1	0.85	1.77	15.5	7.8
SACRAMENTO R A HAMILTON CITY	12/7/04 10:40	2.54	12.5	2.38	2.54	<0.012	0.034	0.54	0.84	0.55	0.73	<4.5	443
SACRAMENTO R A HAMILTON CITY	1/10/05 12:15	352	413	1.48	1.55	<0.011	<0.007	1.06	1.44	1.98	2.45	225	273
SACRAMENTO R A HAMILTON CITY	2/2/05 7:35	77.5	163	1.42	1.51	<0.011	<0.066	1.67	1.88	1.53	1.73	71.5	118
SACRAMENTO R A HAMILTON CITY	3/10/05 7:30	11	75.7	2.03	2.08	<0.033	<0.011	1.29	1.39	1.09	1.37	<3.34	55.8
SACRAMENTO R A HAMILTON CITY	4/20/05 12:00	15.9	39.3	1.99	2.09	<0.022	<0.009	1.02	1.02	1.13	1.25	14.1	10052
SACRAMENTO R A HAMILTON CITY	5/19/05 9:30	1075	6686	1.66	3.17	<0.058	0.076	2.69	18.9	3.11	18.7	726	142
SACRAMENTO R A HAMILTON CITY	6/28/05 7:15	106	121	1.37	1.58	<0.009	<0.012	0.52	1.1	1.15	1.2	136	37.8
SACRAMENTO R A HAMILTON CITY	7/26/05 12:45	1.65	31.4	1.31	1.34	<0.011	0.007	0.63	0.69	0.73	0.81	<1.51	66.9
SACRAMENTO R A HAMILTON CITY	8/23/05 11:20	14.1	44.8	1.39	1.47	<0.009	0.016	0.46	0.68	0.85	1.13	<4.26	174
SACRAMENTO R A HAMILTON CITY	9/27/05 10:00	27.7	98.8	1.41	1.43	<0.007	0.011	0.54	0.64	0.85	1.14	16.5	65.4
SACRAMENTO R A HAMILTON CITY	10/25/05 12:40	30.9	61.6	1.54	1.56	<0.009	<0.009	0.63	0.72	1	1.1	17.2	102
SACRAMENTO R A HAMILTON CITY	11/15/05 11:00	30.8	67.6	1.84	1.92	<0.009	0.014	0.79	0.82	1.07	1.22	28	58.1
SACRAMENTO R A HAMILTON CITY	12/14/05 11:45	6.67	36.7	1.94	2.1	<0.005	0.008	0.79	0.89	0.81	0.84	2.6	4787
SACRAMENTO R A HAMILTON CITY	1/4/06 7:30	866	3462	1.61	2.35	0.014	0.092	2.61	9.71	2.47	11.2	56.9	923
SACRAMENTO R A HAMILTON CITY	1/24/06 7:30	359	709	1.41	1.49	0.011	0.042	1.51	2.4	1.62	2.92	234	913
SACRAMENTO R A HAMILTON CITY	2/21/06 12:45	222	733	1.3	1.47	0.014	0.029	1.18	2.31	1.12	2.55	139	6116
SACRAMENTO R A HAMILTON CITY	3/1/06 7:30	2887	4955	1.36	1.85	0.021	0.087	4.99	11.2	4.26	11.5	1773	2497
SACRAMENTO R A HAMILTON CITY	4/17/06 6:00	914	2219	1.06	1.47	<0.1	<0.1	1.69	5.11	2.51	6.68	556	258
SACRAMENTO R A HAMILTON CITY	5/17/06 6:40	163	285	1.42	1.57	<0.1	<0.1	0.59	0.74	1.25	1.71	114	236
SACRAMENTO R A HAMILTON CITY	6/27/06 6:30	200	398	1.27	1.4	<0.1	<0.1	0.74	1.29	1.09	1.49	38.8	138
SACRAMENTO R A HAMILTON CITY	7/25/06 5:40	255	570	1.24	1.32	<0.1	<0.1	0.72	1.01	1.14	1.66	65.1	276
SACRAMENTO R A HAMILTON CITY	8/22/06 6:40	195	298	1.12	1.15	<0.1	<0.1	0.67	0.84	1.09	1.41	180	374
SACRAMENTO R A HAMILTON CITY	9/20/06 6:30	591	882	1.12	1.23	<0.1	<0.1	0.61	1.35	1.07	1.84	81.4	292
SACRAMENTO R A HAMILTON CITY	10/24/06 7:00	36.8	201	0.859	1.37	<0.1	<0.1	0.56	0.83	0.75	1.47	57.3	794
SACRAMENTO R A HAMILTON CITY	12/12/06 6:40	181	905	1.98	2.33	<0.1	<0.1	0.52	1.31	1.18	1.89	34.5	916
SACRAMENTO R A HAMILTON CITY	1/9/07 7:15	61.6	138	2.08	2.23	<0.1	<0.1	0.66	0.91	0.9	1.04	48.3	151
SACRAMENTO R A HAMILTON CITY	2/26/07 14:00	478	657	1.31	1.42	<0.1	<0.1	1.81	1.91	2.99	5.9	591	65.8
SACRAMENTO R A HAMILTON CITY	3/20/07 6:50	16.1	91.6	2.17	2.36	<0.1	<0.1	0.41	0.71	1.22	1.55	26.6	77.2
SACRAMENTO R A HAMILTON CITY	4/17/07 7:30	12.8	52	1.93	1.94	<0.1	<0.1	0.43	0.58	1.54	1.84	13.4	135
SACRAMENTO R A HAMILTON CITY	5/29/07 12:15	3.21	37.2	1.9	2.11	<0.1	<0.1	0.52	0.72	1.26	1.65	4.6	66.8
SACRAMENTO R A HAMILTON CITY	6/26/07 12:30	6.11	50.1	1.6	1.67	<0.1	<0.1	0.52	0.75	1.07	1.39	11.4	36.3
SACRAMENTO R A HAMILTON CITY	7/18/07 7:00	10.8	114	1.62	1.69	<0.1	<0.1	0.47	0.84	1.15	1.53	6.2	65.2
SACRAMENTO R A HAMILTON CITY	8/28/07 7:05	18.4	49.2	1.37	1.58	<0.1	<0.1	0.45	0.6	0.92	1.12	6.2	46.6
SACRAMENTO R A HAMILTON CITY	9/13/07 7:55	2.26	37.9	1.47	1.55	<0.1	<0.1	0.45	0.59	0.63	0.83	5.7	24.7
SACRAMENTO R A HAMILTON CITY	11/7/07 10:30	0.83	10.5	1.96	2.06	<0.1	<0.1	0.4	0.41	0.64	0.75	<0.1	7.4
SACRAMENTO R A HAMILTON CITY	2/20/08 12:15	5.62	85.8	2.04	2.27	<0.1	<0.1	0.49	0.78	1.09	1.26	7.4	105
SACRAMENTO R A HAMILTON CITY	5/6/08 13:05	2.94	85.3	2.14	2.16	<0.1	<0.1	0.35	0.67	1.43	1.87	10.4	117
SACRAMENTO R A HAMILTON CITY	8/6/08 9:40	2.82	70	1.6	1.68	<0.1	<0.1	0.42	0.54	0.96	1.11	10.2	84
SACRAMENTO R A HAMILTON CITY	11/5/08 7:20	10.2	95.6	2.06	2.17	<0.1	<0.1	0.31	0.51	1.49	1.95	16.4	143
SACRAMENTO R A HAMILTON CITY	2/24/09 10:40	51.1	3110	1.62	4.07	<0.1	<0.1	0.47	7.07	2.03	8.21	68.6	3210
SACRAMENTO R A HAMILTON CITY	5/5/09 8:50	14.7	439	1.83	2.05	<0.1	<0.1	0.35	1.15	1.74	3.09	27.5	428
SACRAMENTO R A HAMILTON CITY	8/11/09 8:40	2.75	35.1	1.31	1.35	<0.1	<0.1	0.36	0.46	0.88	1.05	2.3	36.3
SACRAMENTO R A HAMILTON CITY	11/3/09 7:50	2.94	47	1.87	1.94	<0.1	<0.1	0.38	0.49	1.13	1.35	10.6	66.8
SACRAMENTO R A HAMILTON CITY	2/2/10 8:45	12	340	1.37	1.43	<0.1	<0.1	0.36	1.05	1.76	3.05	17.1	383
SACRAMENTO R A HAMILTON CITY	5/4/10 7:45	10.2	160	1.31	1.85	<0.1	<0.1	0.47	0.96	1.56	2.3	12.1	236
SACRAMENTO R A HAMILTON CITY	8/3/10 11:00	7.55	24	1.4	1.42	<0.1	<0.1	0.47	0.58	1.29	1.35	10.4	51.3
SACRAMENTO R A HAMILTON CITY	11/2/10 8:30	4.63	67.4	1.97	2.06	<0.1	<0.1	0.66	1.27	1.35	1.58	15.3	130
SACRAMENTO R A HAMILTON CITY	2/1/11 9:30	5.73	53.6	1.9	1.96	<0.1	<0.1	0.43	0.55	1.29	1.41	12	59.6
SACRAMENTO R A HAMILTON CITY	5/3/11 8:55	3	24.6	1.6	1.73	<0.1	<0.1	0.45	0.52	1.4	1.59	6	32.9
SACRAMENTO R A HAMILTON CITY	8/2/11 8:10	116	159	1.41	1.45	<0.1	<0.1	0.65	0.76	1.11	1.36	87.6	176
SACRAMENTO R A HAMILTON CITY	11/1/11 8:45	56	91.5	1.21	1.58	<0.1	<0.1	0.64	0.76	0.95	1.11	43	138
SACRAMENTO R A HAMILTON CITY	1/31/12 8:25	178	276	2.04	2.2	<0.1	<0.1	0.52	0.6	1	1.33	94.1	162
SACRAMENTO R A HAMILTON CITY	5/8/12 8:30	88.3	125	2.11	2.64	<0.1	<0.1	0.3	0.45	1.6	1.69	74.9	126
SACRAMENTO R A HAMILTON CITY	8/7/12 8:00	10	28.6	1.25	1.28	<0.1	<0.1	0.39	0.5	0.67	0.95	11	45.3
SACRAMENTO R A HAMILTON CITY	11/6/12 9:35	11.6	12.5	2.09	2.17	<0.1	<0.1	0.48	0.82	0.65	0.81	34.4	41
SACRAMENTO R A HAMILTON CITY	2/6/13 9:15	3.6	127	1.98	2	<0.1	<0.1	0.32	0.75	1.1	1.32	8.2	124
SACRAMENTO R A HAMILTON CITY	5/7/13 8:05	19.2	29.5	1.74	1.77	<0.1	<0.1	0.53	0.93	1.07	1.55	32.6	68.6
SACRAMENTO R A HAMILTON CITY	8/6/13 7:30	1.05	20	1.18	1.48	<0.1	<0.1	0.45	0.66	0.53	0.86	4.3	30.1
SACRAMENTO R A HAMILTON CITY	11/5/13 9:10	1.69	24.4	2.06	2.17	<0.1	<0.1	0.39	0.46	0.5	0.82	10.6	55.2
SACRAMENTO R A HAMILTON CITY	2/4/14 9:05	0.19	6.03	2.7	2.88	<0.1	<0.1	0.52	1.31	0.72	0.85	6.2	26.2
SACRAMENTO R A HAMILTON CITY	5/6/14 8:30	4.3	37.2	2.36	2.5	<0.1	<0.1	0.37	0.46	1.48	2.03	10.6	74.5
SACRAMENTO R A HAMILTON CITY	8/12/14 9:50	1.91	18.7	1.93	2.12	<0.1	<0.1	0.44	0.52	0.72	0.87	13	38.3
SACRAMENTO R A HAMILTON CITY	11/5/14 8:50	2.57	62.4	2.05	2.12	<0.1	<0.1	0.48	11.7	0.8	4.03	13.1	264
SACRAMENTO R A HAMILTON CITY	2/10/15 9:30	21.2	1960	1	2.14	<0.1	<0.1	0.33	5.3	1.99	8	63.2	2108
SACRAMENTO R A HAMILTON CITY	5/11/15 10:00	21.9	42.4	1.76	1.81	<0.1	<0.1	0.5	0.64	1.7	2.24	25.3	53.4
SACRAMENTO R A HAMILTON CITY	8/11/15 10:20	13.4	32.2	1.65	1.72	<0.1	<0.1	0.33	0.42	0.99	1.18	17.5	40.6
SACRAMENTO R A HAMILTON CITY	11/4/15 11:27	12.6	18.9	2.43	2.61	<0.1	<0.1	0.43	0.53	0.77	0.94	73.6	36.9
SACRAMENTO R A HAMILTON CITY	2/3/16 12:10	39.7	352	1.26	1.49	<0.1	<0.1	0.44	1.73	1.15	2.14	42.8	349
SACRAMENTO R A HAMILTON CITY	5/9/16 12:15	42.5	183	2.05	2.38	<0.1	<0.1	0.41	1.12	1.75	3	45.2	186
SACRAMENTO R A HAMILTON CITY	8/8/16 8:15	45	100	1.32	1.42	<0.1	<0.1	0.43	0.55	1.26	1.58	48.9	116
SACRAMENTO R A HAMILTON CITY	11/7/16 11:00	35.3	78	1.97	2.1	<0.1	<0.1	0.41	0.5	1.06	1.29	29.8	78.3
SACRAMENTO R A HAMILTON CITY	2/6/17 13:00	136	1020	1.16	1.67	<0.1	<0.1	0.52	3.85	1.79	5.78	138	1100
Maximum		2887	6686	2.7	4.07	0.021	0.092	4.99	18.9	4.26	18.7	1773	10052
Median		16	91.5	1.615	1.81	0.014	0.016	0.51	0.76	1.115	1.49	25.3	117
Minimum		0.19	6.03	0.859	1.15	0.007	0.007	0.3	0.41	0.5	0.73	2.3	7.5
SWRCB Basin Plan - Drinking Water Standards -Primary MCL		1000											
SWRCB Basin Plan - Drinking Water Standards -Secondary MCL		200										360	
Cal EPA/OEHHA - California Public Health Goal		600		0.004				0.02					
USEPA Secondary MCL		50											
Cal EPA - One in a million incremental cancer risk estimate for drinking water				0.023		0.0023		0.07					
USEPA Health Advisory for drinking water				0.02									
USEPA IRIS Reference Dose Drinking Water Health Advisories				2.1									
California Proposition 65 Safe Harbor Level - Max. Allowable dose level for reproductive toxicity				0.05									

Table 3. Sacramento River at Hamilton City, Part 2 of 2

Station Name	Sample Date	Dissolved Lead µg/L	Total Lead µg/L	Dissolved Manganese µg/L	Total Manganese µg/L	Total Mercury ng/L	Dissolved Nickel µg/L	Total Nickel µg/L	Dissolved Selenium µg/L	Total Selenium µg/L	Dissolved Silver µg/L	Total Silver µg/L	Dissolved Zinc µg/L	Total Zinc µg/L
SACRAMENTO R A HAMILTON CITY	11/25/03 9:10	N/A	0.118	N/A	1.61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SACRAMENTO R A HAMILTON CITY	3/8/04 13:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SACRAMENTO R A HAMILTON CITY	5/20/04 15:00	N/A	0.027	N/A	6.14	N/A	N/A	1.31	N/A	0.12	N/A	<0.034	N/A	1.53
SACRAMENTO R A HAMILTON CITY	8/12/04 10:20	N/A	0.08	N/A	6.88	N/A	N/A	1.84	N/A	0.28	N/A	<0.145	N/A	2.07
SACRAMENTO R A HAMILTON CITY	10/5/04 10:05	0.018	0.067	1.13	6.34	N/A	1.25	1.62	<0.144	<0.204	<0.077	<0.054	0.48	1.56
SACRAMENTO R A HAMILTON CITY	11/9/04 11:40	0.004	0.024	1.55	5.42	N/A	1.11	1.33	<0.149	0.25	<0.006	<0.063	0.52	0.88
SACRAMENTO R A HAMILTON CITY	12/7/04 10:40	<0.01	0.011	0.2	1.8	N/A	0.57	0.59	<0.163	0.28	<0.011	<0.04	0.35	0.44
SACRAMENTO R A HAMILTON CITY	1/10/05 12:15	0.064	0.168	2.22	12.4	N/A	1.39	1.98	0.3	0.34	<0.003	<0.002	1.54	3.1
SACRAMENTO R A HAMILTON CITY	2/2/05 7:35	0.029	0.084	2.54	10.6	N/A	1.02	1.53	<0.222	0.27	0.002	0.003	0.95	1.96
SACRAMENTO R A HAMILTON CITY	3/10/05 7:30	0.008	0.049	0.98	6.37	N/A	0.87	1.24	<0.245	<0.19	<0.001	<0.036	0.36	1.06
SACRAMENTO R A HAMILTON CITY	4/20/05 12:00	0.01	0.023	3.12	6.03	N/A	0.76	0.94	0.14	0.35	<0.003	<0.005	0.41	0.75
SACRAMENTO R A HAMILTON CITY	5/19/05 9:30	0.202	3.24	7.33	272	N/A	2.75	30.7	<0.399	<0.317	0.018	0.041	2.46	35
SACRAMENTO R A HAMILTON CITY	6/28/05 7:15	<0.009	<0.027	4.71	5.17	N/A	0.95	1.41	<0.14	<0.354	<0.002	<0.027	0.8	1.65
SACRAMENTO R A HAMILTON CITY	7/26/05 12:45	<0.019	<0.063	0.16	2.07	N/A	0.85	0.95	<0.145	<0.176	<0.002	<0.04	0.36	0.85
SACRAMENTO R A HAMILTON CITY	8/23/05 11:20	<0.004	0.048	0.58	3.38	N/A	0.81	1.16	<0.227	0.29	<0.001	<0.001	0.27	1.09
SACRAMENTO R A HAMILTON CITY	9/27/05 10:00	<0.004	0.047	0.51	4.61	N/A	0.99	1.35	0.23	0.23	<0.003	<0.003	0.38	1.56
SACRAMENTO R A HAMILTON CITY	10/25/05 12:40	0.011	0.028	0.69	2.88	N/A	1.13	1.22	0.11	0.23	<0.002	<0.002	0.52	1.03
SACRAMENTO R A HAMILTON CITY	11/15/05 11:00	0.04	0.047	0.98	4.81	N/A	1.02	1.24	<0.186	<0.186	<0.009	<0.009	0.56	1.25
SACRAMENTO R A HAMILTON CITY	12/14/05 11:45	0.003	0.023	0.53	4.17	N/A	0.9	1.09	<0.149	0.15	<0.001	<0.001	0.5	0.93
SACRAMENTO R A HAMILTON CITY	1/4/06 7:30	0.191	1.89	9.75	134	N/A	2.67	15.4	<0.149	0.22	<0.001	0.021	2.24	20.8
SACRAMENTO R A HAMILTON CITY	1/24/06 7:30	0.062	0.306	9.24	32.4	N/A	1.68	3.32	<0.186	0.19	<0.005	<0.005	1.55	4.71
SACRAMENTO R A HAMILTON CITY	2/21/06 12:45	0.046	0.299	5.83	27.5	N/A	1.53	3.32	<0.149	0.3	<0.009	<0.009	1	3.94
SACRAMENTO R A HAMILTON CITY	3/1/06 7:30	0.648	2.04	23.2	146	N/A	4.69	15.7	<0.149	0.29	<0.009	<0.009	5.79	21.7
SACRAMENTO R A HAMILTON CITY	4/17/06 6:00	0.188	1.01	9.56	70.9	N/A	2.31	8.02	0.23	0.27	<0.03	<0.03	2.57	12.5
SACRAMENTO R A HAMILTON CITY	5/17/06 6:40	<0.04	0.1	2.1	10.1	N/A	1.12	1.46	<0.2	<0.2	<0.03	<0.03	0.67	1.78
SACRAMENTO R A HAMILTON CITY	6/27/06 6:30	<0.04	0.079	0.69	8.87	N/A	1.29	1.87	<0.2	<0.2	<0.03	0.063	0.41	1.71
SACRAMENTO R A HAMILTON CITY	7/25/06 5:40	<0.04	0.094	1.01	9.35	1.8	1.7	2.5	<0.2	<0.2	<0.03	<0.03	0.77	2.04
SACRAMENTO R A HAMILTON CITY	8/22/06 6:40	<0.04	0.077	1.6	7.18	0.89	1.7	2.33	0.25	0.26	<0.03	<0.03	1.02	1.94
SACRAMENTO R A HAMILTON CITY	9/20/06 6:30	<0.04	0.111	2.01	14.2	1.5	1.67	2.76	0.23	0.26	<0.03	<0.03	0.65	4.79
SACRAMENTO R A HAMILTON CITY	10/24/06 7:00	<0.04	0.078	0.87	9.44	0.28	1.01	2.02	0.25	0.28	<0.03	<0.03	0.16	3.3
SACRAMENTO R A HAMILTON CITY	12/12/06 6:40	<0.04	0.186	1.04	16.9	0.72	0.96	1.75	0.25	0.29	<0.03	<0.03	0.55	4.77
SACRAMENTO R A HAMILTON CITY	1/9/07 7:15	<0.04	<0.04	2.22	5.24	0.68	1.01	1.08	<0.2	<0.2	<0.03	<0.03	0.64	2.57
SACRAMENTO R A HAMILTON CITY	2/26/07 14:00	0.262	0.581	10.3	28.8	2.8	2.22	2.99	<0.2	0.23	<0.03	<0.03	3.68	8.39
SACRAMENTO R A HAMILTON CITY	3/20/07 6:50	<0.04	0.056	7.01	8.22	1.6	0.85	1.22	<0.2	<0.2	<0.03	<0.03	0.31	2.82
SACRAMENTO R A HAMILTON CITY	4/17/07 7:30	<0.04	<0.04	3.44	8.78	1	0.8	0.9	0.24	0.33	<0.03	<0.03	0.4	2.84
SACRAMENTO R A HAMILTON CITY	5/29/07 12:15	<0.04	0.044	0.36	5.99	N/A	0.8	1.04	<0.2	0.22	<0.03	<0.03	0.55	2.96
SACRAMENTO R A HAMILTON CITY	6/26/07 12:30	<0.04	0.066	2.52	7.29	0.59	0.9	1.12	<0.2	0.21	<0.03	<0.03	0.73	3.38
SACRAMENTO R A HAMILTON CITY	7/18/07 7:00	<0.04	0.07	0.21	7.42	1.3	0.88	1.27	<0.2	<0.2	<0.03	<0.03	0.3	3.87
SACRAMENTO R A HAMILTON CITY	8/28/07 7:05	<0.04	<0.04	0.46	5.33	N/A	1.07	1.22	<0.2	<0.2	<0.03	<0.03	2	2.29
SACRAMENTO R A HAMILTON CITY	9/13/07 7:55	<0.04	0.055	0.33	4.66	1.7	0.89	1.02	<0.2	<0.2	<0.03	2.11	0.36	<0.1
SACRAMENTO R A HAMILTON CITY	11/7/07 10:30	<0.04	<0.04	0.08	3.01	0.32	0.58	0.82	<0.2	<0.2	<0.03	<0.03	0.17	2.09
SACRAMENTO R A HAMILTON CITY	2/20/08 12:15	<0.04	0.041	0.7	8.15	N/A	0.88	0.95	<0.2	0.22	<0.03	<0.03	0.71	3.31
SACRAMENTO R A HAMILTON CITY	5/6/08 13:05	<0.04	0.061	0.27	8.38	N/A	1	1.12	<0.2	<0.2	<0.03	<0.03	0.22	3.21
SACRAMENTO R A HAMILTON CITY	8/6/08 9:40	<0.04	0.044	0.39	4.98	N/A	1.04	1.2	<0.2	<0.2	<0.03	<0.03	0.45	2.43
SACRAMENTO R A HAMILTON CITY	11/5/08 7:20	<0.04	0.09	0.35	10.4	N/A	1.22	1.6	<0.2	<0.2	<0.03	<0.03	0.93	3.51
SACRAMENTO R A HAMILTON CITY	2/24/09 10:40	<0.04	1.47	1.28	101	N/A	2.59	11	0.2	0.25	<0.03	<0.03	0.52	14.3
SACRAMENTO R A HAMILTON CITY	5/5/09 8:50	<0.04	0.289	0.53	17.7	N/A	0.85	1.76	<0.2	<0.2	<0.03	<0.03	1.07	6.22
SACRAMENTO R A HAMILTON CITY	8/11/09 8:40	<0.04	<0.04	0.22	2.36	N/A	0.74	0.84	<0.2	<0.2	<0.03	<0.03	0.45	2.26
SACRAMENTO R A HAMILTON CITY	11/3/09 7:50	<0.04	0.071	0.38	7.29	N/A	0.74	0.93	<0.2	<0.2	<0.03	<0.03	0.65	3.08
SACRAMENTO R A HAMILTON CITY	2/2/10 8:45	<0.04	0.188	1.01	17.1	N/A	1.78	2.08	<0.2	<0.2	<0.03	<0.03	1.39	5.43
SACRAMENTO R A HAMILTON CITY	5/4/10 7:45	<0.04	0.11	0.52	14	N/A	0.79	1.32	<0.2	<0.2	<0.03	<0.03	0.62	2.91
SACRAMENTO R A HAMILTON CITY	8/3/10 11:00	<0.04	<0.04	0.62	4.15	N/A	0.85	1.11	<0.2	<0.2	<0.03	<0.03	0.62	2.51
SACRAMENTO R A HAMILTON CITY	11/2/10 8:30	<0.04	0.09	0.73	12.5	N/A	1.34	1.82	<0.2	0.228	<0.03	<0.03	2.32	3.33
SACRAMENTO R A HAMILTON CITY	2/1/11 9:30	<0.04	<0.04	0.67	6.4	N/A	0.71	0.9	<0.2	<0.2	<0.03	<0.03	0.76	2.68
SACRAMENTO R A HAMILTON CITY	5/3/11 8:55	<0.04	<0.04	0.49	5.05	N/A	0.6	0.65	<0.2	<0.2	<0.03	<0.03	0.28	0.51
SACRAMENTO R A HAMILTON CITY	8/2/11 8:10	<0.04	0.061	1.47	6.38	N/A	1.1	1.37	<0.2	<0.2	<0.03	<0.03	0.77	1.63
SACRAMENTO R A HAMILTON CITY	11/1/11 8:45	<0.04	<0.04	1.44	4.4	N/A	1.37	1.68	<0.2	<0.2	<0.03	<0.03	0.59	2.11
SACRAMENTO R A HAMILTON CITY	1/31/12 8:25	<0.04	<0.04	1.87	9.58	N/A	0.68	1.11	<0.2	<0.2	<0.03	<0.03	1.17	2.32
SACRAMENTO R A HAMILTON CITY	5/8/12 8:30	<0.04	<0.04	5.73	7.97	N/A	0.68	0.79	<0.2	<0.2	<0.03	<0.03	0.48	1.79
SACRAMENTO R A HAMILTON CITY	8/7/12 8:00	<0.04	<0.04	0.41	2.81	0.8	0.79	1.36	<0.2	<0.2	<0.03	<0.03	0.41	1.83
SACRAMENTO R A HAMILTON CITY	11/6/12 9:35	<0.04	<0.04	2.19	3.12	3.4	0.96	1.08	<0.2	<0.2	<0.03	<0.03	0.67	1.34
SACRAMENTO R A HAMILTON CITY	2/6/13 9:15	<0.04	<0.04	0.35	5.45	1.3	0.44	0.65	<0.2	<0.2	<0.03	<0.03	0.93	1.45
SACRAMENTO R A HAMILTON CITY	5/7/13 8:05	<0.04	<0.04	1.2	3.14	0.9	0.85	1.03	<0.2	<0.2	<0.03	<0.03	0.52	1.11
SACRAMENTO R A HAMILTON CITY	8/6/13 7:30	<0.04	<0.04	0.12	2.4	0.6	1.27	1.63	<0.2	<0.2	<0.03	<0.03	<0.1	1.09
SACRAMENTO R A HAMILTON CITY	11/5/13 9:10	<0.04	<0.04	0.58	3.53	<0.5	0.6	0.89	<0.2	<0.2	<0.03	<0.03	0.45	1.16
SACRAMENTO R A HAMILTON CITY	2/4/14 9:05	<0.04	<0.04	0.35	2.17	0.8	0.54	0.69	<0.2	0.21	<0.03	<0.03	0.21	0.97
SACRAMENTO R A HAMILTON CITY	5/6/14 8:30	<0.04	<0.04	0.74	6.62	2.5	0.47	0.7	<0.2	<0.2	<0.03	<0.03	0.38	1.24
SACRAMENTO R A HAMILTON CITY	8/12/14 9:50	<0.04	<0.04	0.99	2.82	N/A	0.76	0.84	<0.2	<0.2	<0.03	<0.03	0.37	0.74
SACRAMENTO R A HAMILTON CITY	11/5/14 8:50	<0.04	0.173	0.79	9.25	N/A	1.58	7.22	<0.2	<0.2	<0.03	<0.03	0.37	34
SACRAMENTO R A HAMILTON CITY	2/10/15 9:30	<0.04	1.52	0.96	59.6	29.1	1.36	6.88	0.26	0.31	<0.03	0.037	0.38	13.9
SACRAMENTO R A HAMILTON CITY	5/11/15 10:00	<0.04	0.048	1.15	6.15	1.1	0.92	1.27	<0.2	<0.2	<0.03	<0.03	0.62	1.37
SACRAMENTO R A HAMILTON CITY	8/11/15 10:20	<0.04	<0.04	0.91	3.21	4.4	0.88	1.36	0.34	0.35	<0.03	<0.03	<0.1	0.4
SACRAMENTO R A HAMILTON CITY	11/4/15 11:27	<0.04	<0.04	1.16	2.67	<0.5	0.66	0.92	<0.2	<0.2	<0.03	<0.03	0.5	1.06
SACRAMENTO R A HAMILTON CITY	2/3/16 12:10	<0.04	0.204	0.62	17.7	3.5	1.26	2.47	0.21	0.28	<0.03	<0.03	0.75	2.98
SACRAMENTO R A HAMILTON CITY	5/9/16 12:15	<0.04	0.194	2.28	16.8	N/A	1.05	1.78	<0.2	<0.2	<0.03	<0.03	0.49	3.45
SACRAMENTO R A HAMILTON CITY	8/8/16 8:15	<0.04	0.046	0.24	4.35	N/A	1.29	1.63	<0.2	0.21	<0.03	<0.03	0.84	1.48
SACRAMENTO R A HAMILTON CITY	11/7/16 11:00	<0.04	<0.04	0.41	2.91	N/A	1.12	1.46	<0.2	<0.2	<0.03	<0.03	0.75	

Table 4. Sacramento River op Moulton Weir, Part 1 of 2

Station Name	Sample Date	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
		Aluminum µg/L	Aluminum µg/L	Arsenic µg/L	Arsenic µg/L	Cadmium µg/L	Cadmium µg/L	Chromium µg/L	Chromium µg/L	Copper µg/L	Copper µg/L	Iron µg/L	Iron µg/L	Lead µg/L	Lead µg/L
SACRAMENTO R OPP MOULTON WR	5/14/03 14:15	22.6	584	1.46	1.67	0.01	0.078	1.34	2.25	0.93	3.17	4.1	813		
SACRAMENTO R OPP MOULTON WR	6/10/03 9:00	15.8	180	1.83	1.88	<0.031	<0.031	0.84	0.91	0.71	1.52	<2.08	214		
SACRAMENTO R OPP MOULTON WR	7/10/03 10:40	36.4	116	1.58	1.69	<0.031	<0.009	0.65	0.83	1.29	1.3	17.1	137		
SACRAMENTO R OPP MOULTON WR	8/13/03 11:45	4.42	215	1.45	1.5	<0.004	<0.049	0.77	0.95	0.79	1.45	<2.45	317		
SACRAMENTO R OPP MOULTON WR	9/3/03 12:30	5.91	304	1.43	1.51	<0.01	<0.01	0.73	1.02	1.23	2.24	<3.1	449		
SACRAMENTO R OPP MOULTON WR	10/8/03 12:40	33.5	117	0.879	1.3	<0.011	0.009	0.17	0.78	0.97	1.32	25.1	172		
SACRAMENTO R OPP MOULTON WR	11/5/03 11:00	64	131	1.47	1.63	<0.02	<0.004	<0.209	1.9	1.06	1.59	61.6	151		
SACRAMENTO R OPP MOULTON WR	12/8/03 10:45	1193	3448	1.63	2.84	0.019	0.175	2.3	9.75	4.25	16.4	852	5589		
SACRAMENTO R OPP MOULTON WR	1/6/04 9:30	262	1248	1.73	2.13	<0.008	0.045	1.04	4.56	2.21	7.17	193	2131		
SACRAMENTO R OPP MOULTON WR	2/4/04 12:20	1614	1950	1.04	1.44	<0.011	0.037	2.17	5.11	3.82	8.17	1062	2748		
SACRAMENTO R OPP MOULTON WR	2/17/04 12:00	2521	8733	1.59	2.8	<0.015	0.232	9.17	24.8	7.64	27.7	2045	13032		
SACRAMENTO R OPP MOULTON WR	3/8/04 11:40	184	1478	1.44	1.83	0.011	0.053	0.8	4.63	1.93	6.89	135	2133		
SACRAMENTO R OPP MOULTON WR	4/7/04 9:45	26.9	160	1.61	1.74	0.009	0.013	0.54	1.16	1.46	1.99	16.6	238		
SACRAMENTO R OPP MOULTON WR	5/5/04 11:00	6.14	289	1.77	1.83	0.004	0.027	0.74	1.8	0.78	2.83	<3.73	396		
SACRAMENTO R OPP MOULTON WR	6/9/04 10:00	185	302	1.75	1.84	0.011	0.013	0.6	1.53	1.65	2.43	123	349		
SACRAMENTO R OPP MOULTON WR	7/29/04 10:40	100	155	1.4	1.43	0.005	0.011	0.63	0.91	1.06	1.74	52.7	162		
SACRAMENTO R OPP MOULTON WR	10/5/04 11:00	14.3	89	1.22	1.34	<0.011	<0.008	0.8	0.94	0.73	1.28	9.8	116		
SACRAMENTO R OPP MOULTON WR	11/9/04 13:00	20	76.2	2.34	2.4	<0.008	<0.007	0.9	0.93	0.89	1.38	14.5	99.3		
SACRAMENTO R OPP MOULTON WR	12/7/04 10:20	3.4	82.6	2.25	2.27	<0.012	<0.034	1.85	1.93	0.89	1.67	<4.5	114		
SACRAMENTO R OPP MOULTON WR	1/10/05 11:00	459	1259	1.36	1.6	<0.011	<0.007	1.81	3.91	2.41	4.96	304	1706		
SACRAMENTO R OPP MOULTON WR	2/2/05 12:25	170	582	1.51	1.58	<0.011	<0.066	2.92	2.95	1.7	3.21	143	886		
SACRAMENTO R OPP MOULTON WR	3/10/05 14:45	10.2	133	1.91	1.97	<0.033	<0.011	1.52	1.74	1.17	1.62	13	222		
SACRAMENTO R OPP MOULTON WR	4/20/05 10:50	20.7	130	1.97	2.07	<0.022	<0.009	1.08	1.32	1.16	1.48	13.4	182		
SACRAMENTO R OPP MOULTON WR	5/19/05 11:15	314	5936	1.34	3.07	<0.058	0.138	1.37	18	1.81	20.9	196	9164		
SACRAMENTO R OPP MOULTON WR	6/28/05 15:05	103	126	1.42	1.65	<0.009	<0.012	0.62	1.1	1.32	1.34	96.3	14		
SACRAMENTO R OPP MOULTON WR	7/26/05 11:00	7.14	197	1.45	1.46	0.007	0.014	0.48	0.98	0.93	1.42	<3.27	270		
SACRAMENTO R OPP MOULTON WR	8/23/05 9:30	8.08	84.1	1.52	1.57	<0.009	<0.009	0.5	0.59	0.89	1.08	<4.16	130		
SACRAMENTO R OPP MOULTON WR	9/28/05 8:30	17.3	82.5	1.41	1.46	0.007	0.017	1	1.31	0.88	1.18	10.6	125		
SACRAMENTO R OPP MOULTON WR	10/25/05 10:30	21.8	190	1.5	1.52	0.013	0.019	0.57	1.08	1.06	1.59	13.8	258		
SACRAMENTO R OPP MOULTON WR	11/14/05 12:00	18.3	297	1.93	2.16	0.012	0.033	0.79	1.35	1.22	2.24	15.8	453		
SACRAMENTO R OPP MOULTON WR	12/14/05 11:40	9.4	71.4	1.84	2.04	0.01	0.017	0.77	1.03	0.92	1.24	5.2	114		
SACRAMENTO R OPP MOULTON WR	1/4/06 10:40	2779	4845	1.84	2.53	0.024	0.096	6.91	14.1	5.21	14.3	1670	6695		
SACRAMENTO R OPP MOULTON WR	1/24/06 13:10	413	1419	1.45	1.85	0.013	0.062	1.53	4.53	1.77	5.63	283	2016		
SACRAMENTO R OPP MOULTON WR	2/22/06 11:40	263	848	1.37	1.68	0.018	0.05	1.75	2.94	1.15	3.99	176	1189		
SACRAMENTO R OPP MOULTON WR	3/1/06 12:10	4357	6132	1.58	1.99	0.029	0.105	6.51	13.4	5.76	14.6	2579	7577		
SACRAMENTO R OPP MOULTON WR	4/17/06 11:10	1232	2222	1.06	1.56	<0.1	<0.1	2.25	5.68	2.73	7.09	782	2269		
SACRAMENTO R OPP MOULTON WR	5/17/06 11:35	129	511	1.48	1.64	<0.1	<0.1	0.81	1.74	1.18	2.32	98.3	446		
SACRAMENTO R OPP MOULTON WR	6/27/06 10:25	47.7	677	1.37	1.67	<0.1	<0.1	1.22	2.05	1.04	1.78	9.9	392		
SACRAMENTO R OPP MOULTON WR	7/26/06 8:20	228	793	1.28	1.38	<0.1	<0.1	0.5	1.39	1.22	2.1	80.9	436		
SACRAMENTO R OPP MOULTON WR	8/22/06 10:50	157	272	1.1	1.16	<0.1	<0.1	0.61	0.93	1.11	1.44	111	271		
SACRAMENTO R OPP MOULTON WR	9/20/06 11:35	351	633	1.06	1.15	<0.1	<0.1	0.55	1.23	1.07	1.6	56.5	285		
SACRAMENTO R OPP MOULTON WR	10/24/06 12:15	31.7	226	1.23	1.44	<0.1	<0.1	0.66	1.09	1.29	1.55	58.7	208		
SACRAMENTO R OPP MOULTON WR	12/12/06 12:35	103	1584	2.6	2.74	<0.1	<0.1	0.49	3.25	1.44	2.86	133	593		
SACRAMENTO R OPP MOULTON WR	1/9/07 13:00	81.8	284	1.93	2.11	<0.1	<0.1	1.66	1.74	1.02	1.4	55.9	287		
SACRAMENTO R OPP MOULTON WR	2/27/07 10:00	457	524	1.27	1.38	<0.1	<0.1	1.91	2.02	2.93	3.62	464	829		
SACRAMENTO R OPP MOULTON WR	3/20/07 11:15	17.6	96.9	2.13	2.36	<0.1	<0.1	0.49	0.72	1.18	1.59	26.2	166		
SACRAMENTO R OPP MOULTON WR	4/18/07 10:15	16.6	105	1.9	1.98	<0.1	<0.1	0.45	0.76	1.53	2.13	15.1	159		
SACRAMENTO R OPP MOULTON WR	5/30/07 9:00	3.42	99.8	2.07	2.22	<0.1	<0.1	0.5	0.94	1.28	2.09	4.7	179		
SACRAMENTO R OPP MOULTON WR	6/27/07 8:00	5.35	110	1.66	1.75	<0.1	<0.1	0.5	0.95	1.09	1.68	15.4	136		
SACRAMENTO R OPP MOULTON WR	7/19/07 10:05	6.46	107	1.77	1.81	<0.1	<0.1	0.47	0.86	1.02	1.49	4.4	159		
SACRAMENTO R OPP MOULTON WR	8/28/07 10:40	1.04	34.3	1.69	1.72	<0.1	<0.1	0.42	0.99	0.86	1.01	2.7	51.4		
SACRAMENTO R OPP MOULTON WR	9/13/07 11:40	2.77	33.8	1.44	1.61	<0.1	<0.1	0.46	0.57	0.81	0.88	5.4	46.1		
SACRAMENTO R OPP MOULTON WR	10/31/07 10:55	2.04	41.1	2.18	2.23	<0.1	<0.1	0.4	0.59	0.81	1.13	9.1	112		
SACRAMENTO R OPP MOULTON WR	11/27/07 11:50	0.87	27.8	2.27	2.44	<0.1	<0.1	0.48	0.54	0.78	0.9	7.3	65.7		
SACRAMENTO R OPP MOULTON WR	1/23/08 12:40	3.9	218	2.63	2.75	<0.1	<0.1	0.54	1.47	1.12	1.89	5.2	273		
SACRAMENTO R OPP MOULTON WR	2/27/08 10:50	10.4	1710	1.06	1.73	<0.1	<0.1	0.41	6.45	2.06	6.7	20.4	1852		
SACRAMENTO R OPP MOULTON WR	3/26/08 10:10	2	56.4	2.27	2.36	<0.1	<0.1	0.42	0.73	1.26	1.61	4.9	121		
SACRAMENTO R OPP MOULTON WR	4/23/08 10:30	4.59	121	2.14	2.2	<0.1	<0.1	0.43	0.88	1.35	1.95	5	188		
SACRAMENTO R OPP MOULTON WR	7/24/08 11:15	2.02	62.8	1.65	1.78	<0.1	<0.1	0.41	0.6	1.07	1.25	5.1	92.9		
SACRAMENTO R OPP MOULTON WR	4/22/09 11:10	3.89	66.2	2.14	2.29	<0.1	<0.1	0.38	0.58	1.67	2.11	10.1	98.6		
SACRAMENTO R OPP MOULTON WR	5/28/09 12:15	2.79	86.6	1.89	1.97	<0.1	<0.1	0.35	0.57	1.81	1.96	8.6	95.8		
SACRAMENTO R OPP MOULTON WR	6/25/09 9:25	3.27	101	1.43	1.52	<0.1	<0.1	0.36	0.61	1.37	1.7	6.4	126		
SACRAMENTO R OPP MOULTON WR	7/28/09 10:30	7.77	142	1.39	1.53	<0.1	<0.1	0.45	0.69	1.07	1.5	11.8	146		
SACRAMENTO R OPP MOULTON WR	8/27/09 9:30	1.66	30.7	1.19	1.24	<0.1	<0.1	0.35	0.46	0.88	1.06	3	38.7		
SACRAMENTO R OPP MOULTON WR	9/24/09 9:50	2.09	35.9	1.34	1.36	<0.1	<0.1	0.34	0.45	0.96	1.05	4.3	40.2		
SACRAMENTO R OPP MOULTON WR	10/27/09 11:40	5.31	98.5	1.76	1.85	<0.1	<0.1	0.39	0.4	1.04	1.5	17.1	123		
SACRAMENTO R OPP MOULTON WR	11/18/09 11:30	2.56	60	1.94	2.14	<0.1	<0.1	0.4	0.7	0.98	1.45	8	113		
SACRAMENTO R OPP MOULTON WR	12/9/09 8:15	1.73	25.8	2.53	2.64	<0.1	<0.1	0.45	0.53	0.92	1.02	3.1	51.7		
SACRAMENTO R OPP MOULTON WR	1/26/10 8:45	87.7	3953	1.3	2.43	<0.1	0.144	0.59	14.7	3.45	20.2	114	4700		
SACRAMENTO R OPP MOULTON WR	3/2/10 13:15	13.9	793	1.15	1.51	<0.1	<0.1	0.39	3.19	1.56	4.3	29.5	947		
SACRAMENTO R OPP MOULTON WR	3/24/10 7:10	1.83	54.6	1.72	1.76	<0.1	<0.1	0.53	0.65	0.95	1.29	5.6	94.2		
SACRAMENTO R OPP MOULTON WR	4/21/10 7:00	3.67	780	2.45	1.69	<0.1	<0.1	0.46	3.47	1.43	3.93	8.3	1018		
SACRAMENTO R OPP MOULTON WR	5/26/10 7:00	3.46	49.6	1.2	1.26	<0.1	<0.1	0.4	0.54	1.61	1.75	1.4	69.7		
SACRAMENTO R OPP MOULTON WR	6/30/10 7:00	6.01	52.4	1.28	1.46	<0.1	<0.1	0.35	0.51	1.17	1.46	5.5	71.9		
SACRAMENTO R OPP MOULTON WR	7/28/10 8:40	3.8	29	1.4	1.45	<0.1	<0.1	0.44	0.56	1.33	1.45	3.8	68.8		
SACRAMENTO R OPP MOULTON WR	8/31/10 10:10	6.25	34.7	1.22	1.24	<0.1	<0.1	0.27	0.6	1.19	1.26	3.5	76.2		
SACRAMENTO R OPP MOULTON WR	10/26/10 8:00	12.9	682	1.55	3.49	<0.1	<0.1	0.42	3.07	1.79	3.95	25.6	836		
SACRAMENTO R OPP MOULTON WR	11/30/10 8:50	4.11	48.3	1.67	1.89	<0.1	<0.1	0.58	0.73	1.19	1.29	6.9	75.1		
SACRAMENTO R OPP MOULTON WR	12/13/10 11:20	2.71	93.3	1.46	1.52	<0.1	<0.1	0.44	0.91	1.21	1.66	9.1	154		
SACRAMENTO R OPP MOULTON WR	1/18/11 10:45	6.13	500	1.48	1.6	<0.1	<0.1	0.47	2.8</						

Table 4. Sacramento River op Moulton Weir, Part 2 of 2

Station Name	Sample Date	Dissolved Lead µg/L	Total Lead µg/L	Dissolved Manganese µg/L	Total Manganese µg/L	Total Mercury ng/L	Dissolved Nickel µg/L	Total Nickel µg/L	Dissolved Selenium µg/L	Total Selenium µg/L	Dissolved Silver µg/L	Total Silver µg/L	Dissolved Zinc µg/L	Total Zinc µg/L	
SACRAMENTO R OPP MOULTON WR	5/14/03 14:15	<0.025	0.299	0.17	20.7	N/A	0.65	3.17	0.11	0.2	<0.025	<0.273	0.4	4.5	
SACRAMENTO R OPP MOULTON WR	6/10/03 9:00	<0.017	0.068	0.14	7.15	N/A	0.52	1.38	0.18	<0.296	<0.001	<0.251	0.3	1.5	
SACRAMENTO R OPP MOULTON WR	7/10/03 10:40	0.012	0.055	2.05	5.66	N/A	0.92	1.26	<0.129	0.17	<0.011	<0.123	0.35	1.6	
SACRAMENTO R OPP MOULTON WR	8/13/03 11:45	<0.003	0.124	0.48	9.98	N/A	0.95	1.8	<0.163	0.21	<0.015	<0.122	0.46	2.24	
SACRAMENTO R OPP MOULTON WR	9/3/03 12:30	<0.007	0.183	0.1	18.6	N/A	1.1	2.29	<0.21	0.26	<0.144	<0.144	0.41	3.16	
SACRAMENTO R OPP MOULTON WR	10/8/03 12:40	0.028	0.085	4.96	9.5	N/A	1.16	1.64	<0.327	<0.162	<0.01	<0.131	0.62	1.47	
SACRAMENTO R OPP MOULTON WR	11/5/03 11:00	0.029	0.057	6.6	8.03	N/A	1.33	1.61	0.17	0.22	<0.02	<0.04	0.9	1.3	
SACRAMENTO R OPP MOULTON WR	12/8/03 10:45	0.385	2.93	9.6	218	N/A	3.19	15.7	0.12	0.28	0.037	0.049	10.4	31.6	
SACRAMENTO R OPP MOULTON WR	1/6/04 9:30	0.085	0.877	4.62	52.9	N/A	1.53	7.62	0.1	<0.248	<0.007	<0.014	0.9	10.9	
SACRAMENTO R OPP MOULTON WR	2/4/04 12:20	0.306	1.2	11.3	83.1	N/A	3.16	8.72	0.11	<0.282	<0.015	0.088	4.09	14.4	
SACRAMENTO R OPP MOULTON WR	2/17/04 12:00	0.677	4.8	31.2	381	N/A	6.92	44.5	<0.121	0.26	<0.016	0.06	7.53	56.8	
SACRAMENTO R OPP MOULTON WR	3/8/04 11:40	0.054	0.541	3.02	59.7	N/A	1.28	7.41	0.2	0.31	0.04	<0.065	1.04	10.6	
SACRAMENTO R OPP MOULTON WR	4/7/04 9:45	<0.022	0.09	2.06	10	N/A	1.14	1.76	<0.112	0.53	0.02	<0.031	0.5	1.54	
SACRAMENTO R OPP MOULTON WR	5/5/04 11:00	<0.007	0.13	1.58	12.3	N/A	0.87	2.16	<0.166	0.23	<0.001	<0.044	0.19	2.57	
SACRAMENTO R OPP MOULTON WR	6/9/04 10:00	0.082	0.112	4.82	10.2	N/A	1.3	1.99	<0.121	<0.226	<0.014	<0.081	1.22	2.38	
SACRAMENTO R OPP MOULTON WR	7/29/04 10:40	0.017	0.059	1.81	4.98	N/A	1.02	1.46	0.15	0.27	<0.008	<0.057	0.47	1.11	
SACRAMENTO R OPP MOULTON WR	10/5/04 11:00	0.011	0.049	2.04	7.22	N/A	1.16	1.44	<0.144	<0.204	<0.077	<0.054	0.45	1.09	
SACRAMENTO R OPP MOULTON WR	11/9/04 13:00	0.008	0.04	1.69	8.14	N/A	1.09	1.24	<0.149	0.19	<0.006	<0.063	0.46	0.89	
SACRAMENTO R OPP MOULTON WR	12/7/04 10:20	<0.01	0.054	0.68	7.19	N/A	0.61	0.84	<0.163	0.37	<0.011	<0.04	0.2	0.88	
SACRAMENTO R OPP MOULTON WR	1/10/05 11:00	0.091	0.609	2.64	43.2	N/A	1.79	6.19	0.31	0.46	0.005	0.01	1.11	7.93	
SACRAMENTO R OPP MOULTON WR	2/2/05 12:25	0.058	0.404	2.79	23.2	N/A	1.45	4.05	<0.222	0.36	0.002	0.007	0.77	4.12	
SACRAMENTO R OPP MOULTON WR	3/10/05 14:45	0.011	0.094	0.78	7.17	N/A	0.83	1.6	<0.245	0.29	<0.001	<0.036	0.24	1.26	
SACRAMENTO R OPP MOULTON WR	4/20/05 10:50	0.021	0.079	2.74	10.8	N/A	0.8	1.42	0.25	0.28	<0.003	<0.005	0.56	1.37	
SACRAMENTO R OPP MOULTON WR	5/19/05 11:15	0.04	3.35	2.73	268	N/A	1.38	31.5	<0.399	<0.317	<0.009	0.045	1.14	39.4	
SACRAMENTO R OPP MOULTON WR	6/28/05 15:05	<0.009	0.041	4.35	4.85	N/A	0.72	1.18	0.31	0.38	<0.002	<0.027	1	1.28	
SACRAMENTO R OPP MOULTON WR	7/26/05 11:00	<0.018	0.039	0.63	7.35	N/A	0.69	1.55	<0.222	<0.222	<0.013	<0.013	0.55	1.86	
SACRAMENTO R OPP MOULTON WR	8/23/05 9:30	<0.004	0.045	0.66	5.73	N/A	0.69	1.11	<0.227	<0.227	<0.001	<0.001	0.14	0.88	
SACRAMENTO R OPP MOULTON WR	9/28/05 8:30	<0.004	0.048	0.45	4.75	N/A	0.88	1.25	0.18	0.22	<0.003	<0.003	0.23	1.13	
SACRAMENTO R OPP MOULTON WR	10/25/05 10:30	0.021	0.114	1.28	10.6	N/A	1.04	1.77	<0.063	0.18	<0.002	<0.002	0.53	1.81	
SACRAMENTO R OPP MOULTON WR	11/14/05 12:00	0.013	0.212	1.27	26.9	N/A	1.04	2.36	<0.186	<0.186	<0.009	<0.009	0.73	3.62	
SACRAMENTO R OPP MOULTON WR	12/14/05 11:40	0.008	0.079	0.68	6.17	N/A	1.05	1.33	<0.149	0.19	<0.001	<0.001	0.66	1.78	
SACRAMENTO R OPP MOULTON WR	1/4/06 10:40	0.626	2.64	24.9	164	N/A	5.91	22.2	<0.149	0.15	0.011	0.028	4.66	22.9	
SACRAMENTO R OPP MOULTON WR	1/24/06 13:10	0.105	0.749	13.6	60.3	N/A	1.78	6.85	0.23	0.28	<0.005	<0.005	1.54	9.49	
SACRAMENTO R OPP MOULTON WR	2/22/06 11:40	0.058	0.538	6.68	40.1	N/A	1.44	4.63	0.16	0.23	<0.009	<0.009	0.83	5.22	
SACRAMENTO R OPP MOULTON WR	3/1/06 12:10	0.852	2.81	35.8	207	N/A	6.24	19.6	<0.149	0.2	<0.009	<0.009	7.67	27.9	
SACRAMENTO R OPP MOULTON WR	4/17/06 11:10	0.271	1.27	13.8	83.2	N/A	2.88	9.26	<0.2	0.22	<0.03	<0.03	2.99	12.8	
SACRAMENTO R OPP MOULTON WR	5/17/06 11:35	<0.04	0.183	2.83	19.1	N/A	1.08	2.15	0.22	0.26	<0.03	<0.03	0.39	2.53	
SACRAMENTO R OPP MOULTON WR	6/27/06 10:25	<0.04	0.133	0.32	13.6	N/A	1	2.08	<0.2	<0.2	<0.03	0.066	0.19	2.06	
SACRAMENTO R OPP MOULTON WR	7/26/06 8:20	<0.04	0.149	1.11	14	N/A	1.26	2.6	<0.2	<0.2	<0.03	<0.03	0.69	2.39	
SACRAMENTO R OPP MOULTON WR	8/22/06 10:50	<0.04	0.081	1.89	8.01	N/A	0.67	1.38	0.25	0.26	<0.03	<0.03	0.55	1.5	
SACRAMENTO R OPP MOULTON WR	9/20/06 11:35	<0.04	0.096	2.46	11.8	N/A	1.5	1.42	<0.2	<0.2	<0.03	<0.03	0.54	8.42	
SACRAMENTO R OPP MOULTON WR	10/24/06 12:15	<0.04	0.105	2.1	12.3	N/A	0.39	1.45	0.23	0.21	<0.03	<0.03	0.16	3.21	
SACRAMENTO R OPP MOULTON WR	12/12/06 12:35	<0.04	0.264	3.24	22	N/A	1.8	2.21	<0.2	<0.2	<0.03	<0.03	1.65	6.62	
SACRAMENTO R OPP MOULTON WR	1/9/07 13:00	<0.04	0.067	2.75	11	N/A	1.5	1.08	0.61	<0.2	<0.2	<0.03	<0.03	0.52	3.05
SACRAMENTO R OPP MOULTON WR	2/27/07 10:00	0.254	0.501	10.7	24.6	N/A	0.95	2.31	2.83	<0.2	<0.2	<0.03	<0.03	3.33	7.25
SACRAMENTO R OPP MOULTON WR	3/20/07 11:15	<0.04	0.071	2.35	9.98	N/A	1.7	0.85	1.21	<0.2	0.31	<0.03	<0.03	0.36	2.78
SACRAMENTO R OPP MOULTON WR	4/18/07 10:15	<0.04	0.078	3.59	11.1	N/A	1.3	0.79	1.17	<0.2	<0.2	<0.03	<0.03	0.46	3.33
SACRAMENTO R OPP MOULTON WR	5/30/07 9:00	<0.04	0.147	0.45	12.5	N/A	0.73	1.32	<0.2	<0.2	<0.03	<0.03	0.2	3.66	
SACRAMENTO R OPP MOULTON WR	6/27/07 8:00	<0.04	0.092	5.8	12.7	N/A	1.1	0.79	1.19	<0.2	<0.2	<0.03	<0.03	0.49	3.4
SACRAMENTO R OPP MOULTON WR	7/19/07 10:05	<0.04	0.066	0.22	8.58	N/A	0.98	0.56	1.2	<0.2	<0.2	<0.03	<0.03	0.28	3.2
SACRAMENTO R OPP MOULTON WR	8/28/07 10:40	<0.04	<0.04	0.21	4.92	N/A	0.89	1.02	<0.2	<0.2	<0.03	<0.03	0.46	1.99	
SACRAMENTO R OPP MOULTON WR	9/13/07 11:40	<0.04	0.051	0.22	4.64	N/A	0.91	0.95	<0.2	<0.2	<0.03	<0.03	0.46	2.04	
SACRAMENTO R OPP MOULTON WR	10/31/07 10:55	<0.04	0.054	0.23	8.41	N/A	0.77	1.09	1.2	<0.2	<0.2	<0.03	<0.03	0.31	2.42
SACRAMENTO R OPP MOULTON WR	11/27/07 11:50	<0.04	0.082	0.31	5.67	N/A	0.75	0.89	0.92	<0.2	<0.2	<0.03	<0.03	0.29	2.33
SACRAMENTO R OPP MOULTON WR	1/23/08 12:40	<0.04	0.134	1.7	16.3	N/A	1.17	1.49	<0.2	<0.2	<0.03	<0.03	0.77	3.76	
SACRAMENTO R OPP MOULTON WR	2/27/08 10:50	<0.04	0.979	0.79	61.7	N/A	1.98	8.93	0.32	0.45	<0.03	<0.03	0.46	11	
SACRAMENTO R OPP MOULTON WR	3/26/08 10:10	<0.04	0.061	0.55	11.3	N/A	1	1.13	0.28	0.29	<0.03	<0.03	0.2	2.39	
SACRAMENTO R OPP MOULTON WR	4/23/08 10:30	<0.04	0.095	4.21	14.4	N/A	0.92	1.36	<0.2	0.25	<0.03	<0.03	0.66	3.67	
SACRAMENTO R OPP MOULTON WR	7/24/08 11:15	<0.04	0.048	0.28	5.01	N/A	0.65	0.85	0.24	0.28	<0.03	<0.03	0.3	2.53	
SACRAMENTO R OPP MOULTON WR	4/22/09 11:10	<0.04	0.057	0.53	9.11	N/A	0.82	0.92	<0.2	0.23	<0.03	<0.03	0.28	2.66	
SACRAMENTO R OPP MOULTON WR	5/28/09 12:15	<0.04	0.062	0.41	7.18	N/A	0.78	0.89	<0.2	<0.2	<0.03	<0.03	0.53	2.72	
SACRAMENTO R OPP MOULTON WR	6/25/09 9:25	<0.04	0.094	0.33	6.95	N/A	0.93	1.06	0.23	0.26	<0.03	<0.03	0.94	4.54	
SACRAMENTO R OPP MOULTON WR	7/28/09 10:30	<0.04	0.062	1.39	7.1	N/A	1.02	1.06	<0.2	<0.2	<0.03	<0.03	0.47	2.72	
SACRAMENTO R OPP MOULTON WR	8/27/09 9:30	<0.04	<0.04	0.36	2.63	N/A	0.78	0.86	<0.2	<0.2	<0.03	<0.03	0.33	1.79	
SACRAMENTO R OPP MOULTON WR	9/24/09 9:50	<0.04	<0.04	0.33	4.98	N/A	0.84	0.96	<0.2	<0.2	<0.03	<0.03	0.33	1.99	
SACRAMENTO R OPP MOULTON WR	10/27/09 11:40	<0.04	0.117	4.35	12.7	N/A	0.94	1.13	<0.2	<0.2	<0.03	<0.03	0.57	2.83	
SACRAMENTO R OPP MOULTON WR	11/18/09 11:30	<0.04	0.07	0.44	7.87	N/A	0.89	0.99	<0.2	<0.2	<0.03	<0.03	0.32	2.59	
SACRAMENTO R OPP MOULTON WR	12/9/09 8:15	<0.04	<0.04	0.32	7.77	N/A	0.57	0.71	<0.2	<0.2	<0.03	<0.03	0.5	2.41	
SACRAMENTO R OPP MOULTON WR	1/26/10 8:45	0.077	4.39	1.92	204	N/A	3.62	25.6	0.23	0.26	<0.03	0.071	0.59	35.9	
SACRAMENTO R OPP MOULTON WR	3/2/10 13:15	<0.04	0.604	0.96	45.5	N/A	2.53	4.77	0.24	0.27	<0.03	<0.03	0.84	7.53	
SACRAMENTO R OPP MOULTON WR	3/24/10 7:10	<0.04	0.05	0.58	7.08	N/A	0.71	0.8	<0.2	<0.2	<0.03	<0.03	0.23	2.29	
SACRAMENTO R OPP MOULTON WR	4/21/10 7:00	0.313	0.56	0.44	37.7	N/A	0.72	4.76	<0.2	0.21	<0.03	<0.03	0.24	7.17	
SACRAMENTO R OPP MOULTON WR	5/26/10 7:00	0.048	0.05	0.32	4.64	N/A	0.6	0.73	<0.2	<0.2	<0.03	<0.03	0.42	2.29	
SACRAMENTO R OPP MOULTON WR	6/30/10 7:00	<0.04	<0.04	0.28	5.87	N/A	0.73	0.87	<0.2	<0.2	<0.03	<0.03	0.56	2.17	
SACRAMENTO R OPP MOULTON WR	7/28/10 8:40	<0.04	0.066	0.33	5.81	N/A	0.86	1.01	<0.2	<0.2	<0.03	<0.03	0.73	2.23	
SACRAMENTO R OPP MOULTON WR	8/31/10 10:10	<0.04	0.043	0.5	6.58	N/A	0.8	1.04	<0.2	<0.2	<0.03	<0.03	0.51	1.99	

Table 5. Stone Corral C nr SI, Part 1 of 2

Station Name	Sample Date	Dissolved Aluminum µg/L	Total Aluminum µg/L	Dissolved Arsenic µg/L	Total Arsenic µg/L	Dissolved Boron mg/L	Dissolved Cadmium µg/L	Total Cadmium µg/L	Dissolved Chromium µg/L	Total Chromium µg/L	Dissolved Copper µg/L	Total Copper µg/L	Dissolved Iron µg/L	Total Iron µg/L
STONE CORRAL CNR SI	5/27/98 10:20	N/A	N/A	N/A	N/A	0.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	3/5/01 15:45	N/A	N/A	N/A	N/A	<0.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	4/9/01 9:00	N/A	N/A	N/A	N/A	0.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	2/20/02 11:30	N/A	N/A	N/A	N/A	0.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	3/7/02 9:30	N/A	N/A	N/A	N/A	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	3/18/02 11:20	N/A	N/A	N/A	N/A	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	4/10/02 16:45	N/A	N/A	N/A	N/A	0.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	5/13/02 8:45	N/A	N/A	N/A	N/A	0.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	12/18/02 15:15	N/A	N/A	N/A	N/A	0.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	1/9/03 12:15	N/A	N/A	N/A	N/A	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	1/23/03 10:50	N/A	N/A	N/A	N/A	0.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	2/6/03 10:00	N/A	N/A	N/A	N/A	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	3/11/03 14:25	N/A	N/A	N/A	N/A	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	3/17/03 11:45	N/A	N/A	N/A	N/A	0.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	4/8/03 13:10	N/A	N/A	N/A	N/A	0.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	4/28/03 11:00	N/A	N/A	N/A	N/A	0.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	5/14/03 12:40	3.68	51.9	1.94	2.34	0.6	0.079	0.03	8.1	6.51	4.46	4.69	<3.31	59.5
STONE CORRAL CNR SI	1/6/04 11:30	143	559	1.4	1.45	0.2	<0.008	<0.016	3.4	3.64	2.25	3.28	92.3	691
STONE CORRAL CNR SI	2/4/04 13:00	1399	2065	1.34	1.46	0.2	<0.011	0.016	2.76	3.06	4.71	4.75	1289	1505
STONE CORRAL CNR SI	2/17/04 13:30	1280	6149	1.26	1.91	<0.1	<0.015	0.025	5.74	11	5.45	14.9	966	7420
STONE CORRAL CNR SI	3/8/04 12:45	42.5	55.5	0.719	0.97	0.3	0.006	0.013	1.62	1.86	1.56	1.95	15.5	59
STONE CORRAL CNR SI	4/7/04 10:15	4.17	49.5	1.01	1.27	0.4	<0.005	<0.006	3.6	3.62	2.36	3.01	<2.76	67.1
STONE CORRAL CNR SI	5/5/04 11:50	1.75	3.71	2.21	2.25	0.6	0.011	0.021	6.05	6.49	3.18	3.24	<3.73	10.5
STONE CORRAL CNR SI	10/5/04 14:30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	11/8/04 9:50	5.18	19.8	8.84	9.86	1	0.187	0.195	7	7.37	3	2.65	23.9	67.3
STONE CORRAL CNR SI	12/7/04 12:45	21.9	134	5.05	5.2	0.6	0.176	0.36	5.97	8.43	3.75	4.94	11.8	179
STONE CORRAL CNR SI	1/10/05 13:30	458	1369	1.06	1.23	0.2	0.035	0.037	2.74	3.67	2.72	3.74	331	1285
STONE CORRAL CNR SI	2/2/05 10:45	121	182	1.19	1.19	0.3	0.104	0.524	2.72	2.87	1.84	2.03	73.3	178
STONE CORRAL CNR SI	3/10/05 13:00	4.5	23.6	1.19	1.26	<0.1	0.082	0.13	3.28	3.72	1.86	2.21	<8.34	12.1
STONE CORRAL CNR SI	4/19/05 7:20	4.24	4.98	1.25	1.36	0.5	0.028	0.031	4.9	4.92	1.79	2.56	<5.67	<3.58
STONE CORRAL CNR SI	5/19/05 9:50	2.52	6.37	1.65	1.8	0.4	<0.058	<0.015	3.47	4.86	1.93	2.69	<4.53	11.1
STONE CORRAL CNR SI	6/28/05 13:30	4	4.44	2.01	2.57	0.7	0.036	0.04	0.93	4.4	2.21	3.3	10.5	12.2
STONE CORRAL CNR SI	7/24/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	8/22/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	9/26/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	10/24/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	11/14/05 9:35	2.27	2.66	8.32	8.66	0.8	<0.009	<0.009	3.78	3.87	4	6.13	76	36.7
STONE CORRAL CNR SI	12/14/05 10:15	2.94	3.44	6.79	7.14	0.7	0.011	0.014	5.18	8.08	1.88	4.38	33.1	41
STONE CORRAL CNR SI	1/24/06 11:45	23.1	28.1	1.76	1.81	0.4	<0.002	<0.002	5.42	5.65	1.65	7.96	14.3	30
STONE CORRAL CNR SI	2/22/06 9:45	7.08	9.09	1.79	1.84	0.5	<0.009	<0.009	7.91	8.93	2.49	2.75	7.9	70.6
STONE CORRAL CNR SI	3/1/06 10:25	1991	2268	1.41	1.49	0.2	0.011	0.051	4.32	4.57	5	5.77	1370	2282
STONE CORRAL CNR SI	4/17/06 8:30	206	265	0.77	0.774	0.2	<0.1	<0.1	1.27	1.42	1.38	1.48	121	236
STONE CORRAL CNR SI	5/17/06 10:00	2.37	4.04	1.75	1.81	0.4	<0.1	<0.1	4.05	4.28	1.78	1.98	9.7	4.4
STONE CORRAL CNR SI	6/27/06 9:00	1.39	34	3.08	3.53	0.6	<0.1	<0.1	1.05	1.48	1.26	1.99	22.9	70.5
STONE CORRAL CNR SI	7/26/06 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	10/24/06 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	12/12/06 10:30	135	598	6.74	9.96	0.8	<0.1	<0.1	5.1	9.95	4.32	6.1	53.2	222
STONE CORRAL CNR SI	1/9/07 11:30	11.1	74.1	5.49	5.7	0.7	<0.1	<0.1	4	4.83	1.82	1.94	42.7	114
STONE CORRAL CNR SI	2/27/07 8:30	34.6	36.9	3.41	3.86	0.6	<0.1	<0.1	0.98	1.69	3.9	3.96	57.9	81.1
STONE CORRAL CNR SI	3/20/07 9:50	5.74	64.1	3.26	3.49	0.7	<0.1	<0.1	0.66	1.03	1.1	1.35	61.1	215
STONE CORRAL CNR SI	4/18/07 8:00	4.48	16.4	4.19	4.38	0.7	<0.1	<0.1	0.93	0.97	0.69	0.83	47.3	89.4
STONE CORRAL CNR SI	5/30/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	8/28/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	9/13/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	10/31/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	1/23/08 11:30	9.77	3188	1.41	2.23	0.1	<0.1	<0.1	0.41	8.39	5.11	10.8	42.3	3247
STONE CORRAL CNR SI	2/27/08 10:05	1.94	770	1.12	1.4	0.2	<0.1	<0.1	0.21	1.87	2.49	3.5	4.1	634
STONE CORRAL CNR SI	3/26/08 9:10	0.94	33.5	1.57	2.15	0.4	<0.1	<0.1	0.36	0.49	2.97	3.01	2.7	62.7
STONE CORRAL CNR SI	4/23/08 9:50	1.73	50.6	2.63	2.97	0.6	<0.1	<0.1	0.53	0.55	3.82	3.86	7.9	78.1
STONE CORRAL CNR SI	7/23/08 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	4/22/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	5/28/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	6/25/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	7/28/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	8/27/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	9/24/09 9:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	10/21/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	11/18/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	12/9/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	1/26/10 10:45	27.1	3100	0.682	1.42	0.1	<0.1	<0.1	0.26	7.11	3.01	9.95	54.6	33.5
STONE CORRAL CNR SI	3/2/10 12:20	3.34	960	1.16	1.45	0.2	<0.1	<0.1	0.27	2.29	2.85	4.4	11.5	854
STONE CORRAL CNR SI	3/24/10 9:05	0.66	8.66	1.85	1.87	0.5	<0.1	<0.1	0.43	0.47	2.34	2.41	3	13.2
STONE CORRAL CNR SI	4/21/10 9:00	3.61	175	0.961	1.12	0.4	<0.1	<0.1	0.48	0.73	2.21	2.86	3.8	225
STONE CORRAL CNR SI	5/26/10 8:50	1.45	1.46	4.07	4.12	0.6	<0.1	<0.1	0.62	0.68	2.28	2.39	1.4	5.1
STONE CORRAL CNR SI	6/29/10 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	8/31/10 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	10/26/10 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL CNR SI	11/30/10 10:30	2.35	6.7	6.04	6.24	0.8	<0.1	<0.1	2.2	2.44	2.79	3.04	9.9	48.4
STONE CORRAL CNR SI	12/13/10 10:10	1.23	2.25	6	6.22	0.7	<0.1	<0.1	3.55	3.73	4.11	4.22	5.2	19.6
STONE CORRAL CNR SI	1/18/11 12:25	3.06	105	2.07	2.14	0.4	<0.1	<0.1	0.74	0.91	2.82	2.99	9.7	131
	Maximum	1991	6149	8.84	9.96	1	0.187	0.524	8.1	11	5.45	14.9	1370	7420
	Median	4.36	50.05	1.775	2.025	0.5	0.0355	0.034	2.75	3.895	2.49	3.14	23.15	73.5
	Minimum	0.66	1.46	0.682	0.774	0.1	0.006	0.013	0.2	0.47	0.69	0.83	0.7	4.3
SWRCB Basin Plan - Drinking Water Standards -Primary MCL		1000												
SWRCB Basin Plan - Drinking Water Standards -Secondary MCL		200											300	
Cal CPA/OEHHA - California Public Health Goal		600		0.004			0.04							
USEPA Secondary MCL														
Cal EPA - One in a million incremental cancer risk estimate for drinking water				0.023			0.0023							
USEPA Health Advisory for drinking water	50			0.02										
California Proposition 65 Safe Harbor Level - Max. Allowable dose level for reproductive toxicity				0.05										
California Toxics Rule Sources of Drinking Water														
California Toxics Rule Freshwater Aquatic Life Protection Continuous Concentration														
California Toxics Rule Freshwater Aquatic Life Protection Maximum Concentration														
Agriculture Water Quality Goals - Taste and odor threshold				100		0.7							5000	
California Notification Level - Drinking Water						1								
National Academy of Sciences Health Advisory for Drinking Water	5000													
USEPA IRIS Reference Dose Drinking Water Health Advisory				2.1										
National Recommended WQ Criteria - Taste and Odor or Welfare													300	
National Recommended WQ Criteria - Human Health and Welfare protection														
- water and fish consumption														
National Recommended WQ Criteria - Freshwater Aquatic Life Continuous Concentration														

Table 5. Stone Corral Cnr SL Part 2 of 2

Table 5. Stone Corral Cnr Sl, Part 2 of 2														
Station Name	Sample Date	Dissolved Lead µg/L	Total Lead µg/L	Dissolved Manganese µg/L	Total Manganese µg/L	Total Mercury ng/L	Dissolved Nickel µg/L	Total Nickel µg/L	Dissolved Selenium µg/L	Total Selenium µg/L	Dissolved Silver µg/L	Total Silver µg/L	Dissolved Zinc µg/L	Total Zinc µg/L
STONE CORRAL C NR SI	5/27/98 10:20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	3/5/01 15:45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	4/9/01 9:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	2/20/02 11:30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	3/7/02 9:30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	3/18/02 11:20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	4/10/02 16:45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	5/13/02 8:45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	12/18/02 15:15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	1/9/03 12:15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	1/23/03 10:50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	2/6/03 10:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	3/11/03 14:25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	3/17/03 11:45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	4/8/03 13:10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	4/28/03 11:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	5/14/03 12:40	0.058	0.042	0.17	9.03	N/A	2.57	3.14	7.33	7.37	0.131	<0.197	0.86	1.25
STONE CORRAL C NR SI	1/6/04 11:30	0.036	0.256	9.48	42.9	N/A	2.32	3.56	3.02	3.07	<0.007	<0.014	0.46	2.74
STONE CORRAL C NR SI	2/4/04 13:00	0.266	0.507	13.1	32.3	N/A	3.27	3.79	0.66	1.25	<0.015	0.207	4.24	5.21
STONE CORRAL C NR SI	2/17/04 13:30	0.782	2.91	36.1	203	N/A	3.58	15.8	0.26	0.38	<0.016	0.056	4.53	24.9
STONE CORRAL C NR SI	3/8/04 12:45	0.009	0.094	1.66	3.57	N/A	2.11	2.32	1.34	2.38	0.054	0.09	0.82	1.05
STONE CORRAL C NR SI	4/7/04 10:15	0.05	0.065	1.15	4.6	N/A	2.4	2.58	4.26	4.48	0.03	<0.031	1.3	1.65
STONE CORRAL C NR SI	5/5/04 11:50	0.035	0.038	0.85	2.41	N/A	2.82	2.85	8.2	8.22	0.09	<0.044	1.38	1.4
STONE CORRAL C NR SI	10/5/04 14:30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	11/8/04 9:50	0.059	0.142	27.2	43.1	N/A	4.98	9.72	30	30.4	0.082	0.107	1.78	1.81
STONE CORRAL C NR SI	12/7/04 12:45	0.244	0.293	1.07	30.6	N/A	3.29	3.49	10.5	10.6	0.05	0.086	0.99	1.44
STONE CORRAL C NR SI	1/10/05 13:30	0.111	0.428	2.61	32.1	N/A	2.24	3.48	1.69	1.84	0.009	0.015	1.46	4.64
STONE CORRAL C NR SI	2/2/05 10:45	0.095	0.117	7.35	19.8	N/A	2.15	2.63	2.32	2.87	0.004	0.007	0.99	1.45
STONE CORRAL C NR SI	3/10/05 13:00	0.05	0.057	1.17	6.21	N/A	1.53	2.29	3	3	<0.001	<0.036	0.73	3.86
STONE CORRAL C NR SI	4/19/05 7:20	0.054	0.147	2.44	3.02	N/A	2.12	2.15	4.22	5.06	<0.003	<0.005	0.81	0.88
STONE CORRAL C NR SI	5/19/05 9:50	0.006	0.038	0.7	2.1	N/A	1.43	2.09	4.07	4.46	<0.009	0.021	0.7	0.74
STONE CORRAL C NR SI	6/28/05 13:30	0.094	0.099	2.4	6.88	N/A	1.96	2.45	5.68	5.9	0.05	0.173	0.91	1.72
STONE CORRAL C NR SI	7/24/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	8/22/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	9/26/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	10/24/05 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	11/14/05 9:35	0.007	0.008	20.3	21.2	N/A	7.73	8.27	20.6	20.7	<0.009	<0.009	1.55	1.57
STONE CORRAL C NR SI	12/14/05 10:15	0.008	0.014	17.1	19	N/A	8	8.64	21.4	22.6	<0.001	0.041	1.04	1.36
STONE CORRAL C NR SI	1/24/06 11:45	0.013	0.021	29.4	32.6	N/A	3.34	3.9	5.53	5.63	<0.005	0.011	0.84	0.87
STONE CORRAL C NR SI	7/22/06 9:45	<0.045	0.009	8.96	13.9	N/A	3.57	3.39	6.31	7.05	<0.009	<0.009	0.91	1.03
STONE CORRAL C NR SI	3/1/06 10:25	0.536	1.38	29.8	46.9	N/A	4.79	5.55	0.8	1.06	<0.009	<0.009	6.47	7.11
STONE CORRAL C NR SI	4/17/06 8:30	0.054	0.089	9.99	14.1	N/A	2.65	3.23	1.75	1.99	<0.03	<0.03	1.27	1.61
STONE CORRAL C NR SI	5/17/06 10:00	<0.04	<0.04	1.65	1.73	N/A	1.59	1.98	5.38	5.93	<0.03	<0.03	0.9	0.93
STONE CORRAL C NR SI	6/27/06 9:00	<0.04	<0.04	8.27	39.4	N/A	2.15	3.46	3.58	3.97	0.087	0.165	0.6	0.64
STONE CORRAL C NR SI	7/26/06 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	10/24/06 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	12/12/06 10:30	<0.04	0.122	18.5	71.3	N/A	4.37	6.92	15.6	21.8	<0.03	<0.03	0.79	3.78
STONE CORRAL C NR SI	1/9/07 11:30	0.2	0.215	32.8	80.2	0.29	3.07	3.23	19.6	20.6	<0.03	<0.03	1.04	2.53
STONE CORRAL C NR SI	2/27/07 8:30	0.05	0.121	28	29.3	N/A	2.59	3.79	9.75	13.7	<0.03	<0.03	1.32	3.01
STONE CORRAL C NR SI	3/20/07 9:50	<0.04	0.062	35.3	89.4	0.92	1.2	1.44	6.1	7.26	<0.03	<0.03	0.97	2.79
STONE CORRAL C NR SI	4/18/07 8:00	0.06	0.068	25.6	41.4	2.3	1.3	1.38	5.73	5.93	<0.03	<0.03	1.03	2.42
STONE CORRAL C NR SI	5/30/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	8/28/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	9/13/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	10/31/07 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	1/23/08 11:30	0.06	2.04	2.41	92.6	N/A	3.43	9.39	0.65	0.9	<0.03	0.033	0.5	16.3
STONE CORRAL C NR SI	2/27/08 10:05	<0.04	0.272	0.54	30.8	N/A	1.66	2.46	2.2	2.5	<0.03	<0.03	0.64	4.66
STONE CORRAL C NR SI	3/26/08 9:10	<0.04	0.064	1.63	27.9	N/A	2.13	3.1	3.53	4.02	<0.03	<0.03	0.8	2.42
STONE CORRAL C NR SI	4/23/08 9:50	0.046	0.059	8.33	19.1	N/A	3.77	3.86	9.54	9.75	<0.03	<0.03	1.28	2.94
STONE CORRAL C NR SI	7/23/08 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	4/22/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	5/28/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	6/25/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	7/28/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	8/27/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	9/24/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	10/21/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	11/18/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	12/9/09 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	1/26/10 10:45	<0.04	1.91	1.52	106	N/A	4.36	8.87	0.59	0.63	<0.03	<0.03	0.86	16.1
STONE CORRAL C NR SI	3/2/10 12:20	<0.04	0.438	0.69	46.6	N/A	2.29	2.98	2.02	2.54	<0.03	<0.03	1.08	5.48
STONE CORRAL C NR SI	3/24/10 9:05	<0.04	<0.04	2.65	14.4	N/A	1.57	2.33	4.97	5.56	<0.03	<0.03	1.04	2.44
STONE CORRAL C NR SI	4/21/10 9:00	<0.04	0.087	1.64	12.6	N/A	1.51	1.98	2.93	3	<0.03	<0.03	1.06	2.7
STONE CORRAL C NR SI	5/26/10 8:50	<0.04	<0.04	0.14	1.34	N/A	2	2.06	4.31	4.4	<0.03	<0.03	1.85	2.52
STONE CORRAL C NR SI	6/29/10 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	8/31/10 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	10/26/10 0:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STONE CORRAL C NR SI	11/30/10 10:30	<0.04	<0.04	63.4	75.9	N/A	2.04	2.1	1.36	1.42	<0.03	<0.03	2.7	3.76
STONE CORRAL C NR SI	12/13/10 10:10	<0.04	<0.04	0.29	16	N/A	1.93	2.61	1.74	1.88	0.089	0.12	2.17	2.5
STONE CORRAL C NR SI	1/18/11 12:25	<0.04	0.057	38.2	78.8	N/A	1.25	1.72	3.43	3.5	0.064	0.347	1.42	1.79

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 1/27/2021 12:03:12 PM
To: Marcia Kivett [MKivett@sitesproject.org]
Subject: Town Hall Chat

FYI – here's a copy/paste of everything I received in the chat:

to RWelsh (privately): 9:48 AM
Hi Richard, you are muted in Webex
from Frederick Durst (privately): 9:55 AM
We will be recording this correct?
to Frederick Durst (privately): 10:00 AM
Hi Fritz - yes, it's being recorded
to Jerry Gladbach (privately): 10:00 AM
Hi Jerry - FYI, I turned your video off so we are just showing our panelists. Thank you!
to Frederick Durst (privately): 10:03 AM
Fritz would you prefer I advance the slide based on the talking points or do you want to tell me when to advance?
from Frederick Durst (privately): 10:05 AM
I'll let you know verbally
to Frederick Durst (privately): 10:05 AM
sounds good
from ESimmen (privately): 10:13 AM
For Q&A: Will the States share be dedicated to fish to offset the need to provide fish flows in the delta from this or other projects?
to ESimmen (privately): 10:25 AM
Thank you.
from MKivett (privately): 10:25 AM
So weird, I am not able to see the chat, only send private chats.
from james Brobeck to everyone: 10:30 AM
EIR Needs:

- Obtain additional metals data from source waters targeting high flows from which diversions would occur
- Provide information on the water quality impacts from other chemical contaminants that adversely affect water quality in the Sacramento River (including chlorpyrifos, diazinon, chlordane, DDT, mercury, PCBs, and dieldrin) and contaminants in sewer outfalls (such as pharmaceuticals) and other discharges (such as industrial discharges)
- Evaluate the contributions of metals from local tributaries (i.e., Funks Creek and Stone Corral Creek) to the proposed reservoir
- Provide information on the contribution from leaching of metals from the inundation area of the proposed reservoir

from james Brobeck to everyone: 10:31 AM
EIR needs

- Evaluate effects of metals to beneficial uses within the proposed reservoir
 - o fisheries,
 - o wildlife (including state and federal species listed as threatened or endangered),
 - o recreation

from james Brobeck to everyone: 10:33 AM

- Evaluate effects of metals to beneficial uses due to releases from the reservoir
 - o agricultural supply water,
 - o effects of metals on crops including incorporation of metals by crops (e.g., arsenic uptake in rice),
 - o effects of metals on plants grown for support of wildlife (such as in wildlife refuges),
 - o drinking water supplies,
 - o fisheries,

o wildlife (including state and federal species listed as threatened or endangered),

from James Brobeck to everyone: 10:33 AM

- Evaluate combined toxicity of multiple metals
- Evaluate contributions of metals in reservoir releases related to the SWRCB antidegradation policy
- Evaluate impacts from mercury bioaccumulation in aquatic life (especially fish) in the proposed reservoir, and effects to wildlife that feed on fish from the reservoir and recreational opportunities (i.e., sport fishing)
- Evaluate physical conditions expected in the reservoir, including thermal stratification and hypolimnetic anoxia, and effects on reservoir and downstream aquatic resources

from Frederick Durst (privately): 10:38 AM

A WIFA loan is a federally backed loan at a favorable interest rate, currently 35 years at about 1.8%

to Frederick Durst (privately): 10:40 AM

Was this in response to a question? I might have missed it.

from James Brobeck to everyone: 10:40 AM

"Saline water has been observed to seep from underground salt springs in the vicinity of the Salt Lake fault along the slopes above the valley and along the valley floor within the proposed inundation area of Sites Reservoir. The water from the underground springs accumulates along the trough of the valley and forms Salt Lake" (USGS, 1915).

from Katja Townsend (privately): 10:42 AM

Hi Erin- This is Katja with Asm. Gallagher's office. I have to log off for another meeting. Would you be able to send the slides over? Thanks! katja.townsend@asm.ca.gov

to Katja Townsend (privately): 10:43 AM

Hi Katja - will do. We will also be posting a recording of the townhall afterwards.

from Katja Townsend (privately): 10:43 AM

Awesome- thank you!

from rstork@friendsoftheriver.org to everyone: 10:46 AM

Will there be alternatives in the EIS/EIR that reflect a range of diversion criteria/thresholds from the Sacramento River through the two canals? Ron Stork

from Edgar Benitez (privately): 10:47 AM

good morning, can you please give a description of the Dunnigan Pipeline? Can you mention who is in charge of that part of the design?

from MKivett to everyone: 10:48 AM

The slide presentation will be posted to our website after today's discussion (<https://sitesproject.org/meetings/january-27-2021/>).

from James Brobeck to everyone: 10:48 AM

Extremely high concentrations of metals are present in the small streams in the reservoir footprint, which occur due to the nature of the soils in the area of the proposed reservoir. Sites Reservoir would inundate these soils resulting in leaching of metals and further incremental loading of metals to the proposed reservoir. There is no discussion in the EIR about the potential impacts of metals leaching from the soils that would be inundated by the proposed reservoir.

from Dennis and Joe to everyone: 10:48 AM

What is the status of the discussions with DWR for use of the SWP facilities to convey water south of the Delta?

to Edgar Benitez (privately): 10:48 AM

Thank you.

from Dennis and Joe to everyone: 10:51 AM

What is the status of the discussions with the Regulatory Agencies for use of the water allocated for environmental purposes.

from James Brobeck to everyone: 10:51 AM

Will the environmental review present detailed analysis of the metal and salt loads in the source water (flood flows from Cottonwood Creek and other coast range streams) and leaching from the inundation footprint?

from Edgar Benitez (privately): 10:52 AM

thank you, my questions were answered.

from Sarah Rossetto to everyone: 10:52 AM

Thank you - James Brobeck's comments and question, and Ron Stork's question will be addressed during the environmental section of the Q&A.

from debra lucero to everyone: 11:01 AM

Has this project taken into consideration Jerry Boles (former DWR employee) comments about high concentrations of metals - both in the river and possibly at the storage site. I sent this question in via email after reading his lengthy comments to the current EIR.

from debra lucero to everyone: 11:02 AM

Who will oversee the water quality of this project?

from Eric Christen (privately): 11:03 AM

In your presentation you mentioned your support for "diversity" and "inclusion" as it relates to this project. Will a Project Labor Agreement cover work on this project? If so PLAs openly discriminate against union free workers by forcing those allowed to work on it to pay into union pension funds they'll never vest in and explicitly exclude young men and women who are in union-free apprentice programs? If a PLA will be used how does that square with your push for diversity and inclusion when 85% of the CA construction workforce is non-union?

to Eric Christen (privately): 11:05 AM

Thanks Eric, I received your question.

from james Brobeck to everyone: 11:09 AM

Please do not avoid the questions on salts and heavy metals presented by Jerry Boles and others.

from james Brobeck to everyone: 11:11 AM

Investors on this webinar need to be made aware of the metal/salt loading in the source water and the inundation footprint soils.

from Peer Swan (privately): 11:11 AM

Explain the decision to use the Drain to move the water back to the River at Knights Landing. How does this affect the water quality?

to Peer Swan (privately): 11:14 AM

Thank you, question received.

from james Brobeck to everyone: 11:14 AM

Jerry Boles, retired Chief of the Water Quality and Biology Section of the Northern District of the Department of Water Resources in Red Bluff, submitted comments on the proposed Sites Reservoir Draft Environmental Impact Report.

from james Brobeck to everyone: 11:14 AM

Boles explains that during his tenure with DWR he collected data that showed elevated levels of aluminum, arsenic, cadmium, iron, chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc in the Sacramento River with the highest levels coming from tributary flows.

from james Brobeck to everyone: 11:16 AM

The poor quality of the source water will certainly be further degraded if the water is impounded in the proposed off-stream reservoir. Boles explains, "Extremely high concentrations of metals are present in the small streams in the reservoir footprint, which occur due to the nature of the soils in the area of the proposed reservoir. Sites Reservoir would inundate these soils resulting in leaching of metals and further incremental loading of metals to the proposed reservoir."

from Ali Forsythe to everyone: 11:22 AM

Jim Brobeck - Thank you for all this great information. We are working to address all of these considerations, really based off of Jerry Boles' comments on the 2017 EIR/EIS as part of the Revised Draft EIR/Supplemental Draft EIS. I also expect water quality to be a small group topic. Please feel free to contact me at aforsythe@sitesproject.org if you'd like to part of the upcoming water quality small group discussions.

from james Brobeck to everyone: 11:24 AM

The "right size" does not change the metal/salt comments by Boles and others. I would be happy to forward the Boles comments to interested parties including investors. jimb@aqualliance.net

from Ali Forsythe to everyone: 11:25 AM

I should clarify that the offer of participating in the small group is open to anyone interested.

from Kim Witten to everyone: 11:40 AM

How can we get into the waiting room to possibly become a participant?

from Eric Christen to everyone: 11:49 AM

Thank you for staffs response to my union PLA question. So just to be clear, when you put in your presenations that you have as a goal "divirsity" anbd "inclusion

from Kim Witten to everyone: 11:49 AM

Can you put your email here so I can contact you. Thanks

from Sarah Rossetto to everyone: 11:50 AM

jbrown@sitesproject.org

from Eric Christen to everyone: 11:50 AM

that you really do not.

from Eric Christen to everyone: 11:50 AM

Non-union workers and apprentices ar enot welcome on your projects.

from Frederick Durst (privately): 11:56 AM

Eric please provide me with your contact info. I'd like to chat with you

from Regina Chichizola to everyone: 11:56 AM

Hey just letting everyone know that the power is out on and off throughout most of Northern California today. It is on for a second now but it might be good to have another town hall for rural people who could not make it.

from Marguerite Patil - CCWD to everyone: 11:59 AM

Thanks Sites Team! Great Town Hall.

from Anjanette Shadley to everyone: 12:00 PM

Very imformative, thank you! Great job! #BuildSites

Erin Heydinger, PE, PMP

Asst. Project Manager

Water/Wastewater

HDR

2379 Gateway Oaks Dr, #200

Sacramento, CA 95833

D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Spranza, John [John.Spranza@hdrinc.com]
Sent: 1/27/2021 12:05:53 PM
To: Alicia Forsythe [aforsythe@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]
Subject: Re: Sites - Townhall - Chat Questions and Messages

Thanks!

Great job!!! Super impressed by the whole panel. It really shows this is a different group with a different approach to project transparency and public participation.

John
818-640-2487
Sent from my iPhone

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Wednesday, January 27, 2021 12:01:25 PM
To: Spranza, John <John.Spranza@hdrinc.com>; Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Subject: Sites - Townhall - Chat Questions and Messages

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Heres a copy from the chat from todays town hall – lots of questions to address on water quality

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EIR Needs:

- Obtain additional metals data from source waters targeting high flows from which diversions would occur
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Non-union workers and apprentices ar enot welcome on your projects.

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

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From: Sarah Rossetto [srossetto@katzandassociates.com]
Sent: 1/27/2021 1:02:38 PM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]
CC: Marcia Kivett [MKivett@sitesproject.org]; Karen Franco [kfranco@katzandassociates.com]
Subject: FW: Stats and Chat Room Comments

Hi Erin,

Thank you for everything you did for the Town Hall! Let us know when we can receive the WebEx meeting recording, and we will complete the meeting summary and post the video on the Sites website.

Thanks,
Sarah



Sarah Rossetto

Director

d: 858.926.4007 • c: 530.304.8704

[San Diego](#) • [Los Angeles](#) • [San Francisco](#)

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Wednesday, January 27, 2021 12:10 PM
To: Jerry Brown <jbrown@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>; Kevin Spesert <kspesert@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Sara M. Katz <skatz@katzandassociates.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Sarah Rossetto <srossetto@katzandassociates.com>; JP Robinette <jrobinette@brwnclad.com>
Cc: Henry Luu <Henry.Luu@hdrinc.com>; Robert Boling <Robert.Boling@HDRinc.com>; mmaltby@brwnclad.com
Subject: Stats and Chat Room Comments

GREAT JOB!

Approximately (with counting the phone numbers as independent individuals)

- 154 attendees in the beginning
- 137 at 11:20
- 19 participants
- 18 Agent/Consultants

from James Brobeck (Aqualliance) to everyone: 10:30 AM

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- Provide information on the water quality impacts from other chemical contaminants that adversely affect water quality in the Sacramento River (including chlorpyrifos, diazinon, chlordane, DDT, mercury, PCBs, and dieldrin) and contaminants in sewer outfalls (such as pharmaceuticals) and other discharges (such as industrial discharges)
- Evaluate the contributions of metals from local tributaries (i.e., Funks Creek and Stone Corral Creek) to the proposed reservoir
- Provide information on the contribution from leaching of metals from the inundation area of the proposed reservoir

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Jerry Boles, retired Chief of the Water Quality and Biology Section of the Northern District of the Department of Water Resources in Red Bluff, submitted comments on the proposed Sites Reservoir Draft Environmental Impact Report. Boles explains that during his tenure with DWR he collected data that showed elevated levels of aluminum, arsenic, cadmium, iron, chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc in the Sacramento River with the highest levels coming from tributary flows.

from james Brobeck to everyone: 11:16 AM

The poor quality of the source water will certainly be further degraded if the water is impounded in the proposed off-stream reservoir. Boles explains, "Extremely high concentrations of metals are present in the small streams in the reservoir footprint, which occur due to the nature of the soils in the area of the proposed reservoir. Sites Reservoir would inundate these soils resulting in leaching of metals and further incremental loading of metals to the proposed reservoir."

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Can you put your email here so I can contact you. Thanks

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jbrown@sitesproject.org

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Non-union workers and apprentices are not welcome on your projects.

from Marguerite Patil - CCWD to everyone: 11:59 AM

Thanks Sites Team! Great Town Hall.

from Anjanette Shadley to everyone: 12:00 PM

Very informative, thank you! Great job! #BuildSites

▼ Participants (154)

Q Search

M  MKivett
Cohost, me

  Erin Heydinger
Host

SR  Sarah Rossetto
Cohost

  +15303****08

1  1460475334

5  5303****30

5  5306****10

5  5306****71

5  5307****12

5  5307****18

5  5307****83

5  5308****03

6  6613****48

6  6614****84

6  6616****72

9  9162****35

9  9166****73

9  9167****92

9  9512****48

AB  Adam Borchard

AS  Ajay Singh

AF  Ali Forsythe

AL  Amy Lyons

AH  Angela Ramirez Holmes

A  aniekr

AN  Ann Newton

AH  Annie Hoagland

B  bbarker

B  Bill

CG  Cameron Gurley

  Cathy Westcot

CV  Charlene Vaughn

CG  Charles Gardiner

CH  Cheyanne Harris

CD  Chris Duke

CM  Conner McDonald

DJ  Dan Jagers

DR  ☐ Dan Ruiz

DY  Dan York

DL  Dana Lee

DR  Darin Reintjes

DB  David Bruzzzone

DO  David Oro

DS  ☐ david schaad

DE  Dawn Edwards

D  ddunmoyer@cbia.org

DL  debra lucero

DB  Dee Bradshaw

DJ  Dennis and Joe

DS  Derya Sumer

DC ↻ Denise Carter

DJ ↻ Dennis and Joe

DW ↻ Deryk Walcott

D ↻ DGosling

DM ☐ Dirk Marks

D ↻ dmerkley

D ↻ Doug

DW ↻ DSRSD Webex

DC 📞 dwayne chisam

EC ↻ Ed Colley

EB ↻ Edgar Benitez

EW ↻ Ellen Wehr

EC ↻ Emil Cavagnolo

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EM ↻ ERIC MISCHE

E ↻ ESimmen

FM ☐ Farid Motamed

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GZ 📞 Greg Zlotnick

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JC ↻ Juleah Cordi

K ↻ Karen

KW ↻ Kellie Welch

KW ↻ Kim Witten

LN ↻ Laura Nicholson

LG ↻ Laurene Green

LW Laurie Warner

LR ↻ Lee Renger

LX ↻ Lillian Xie

LH ↻ Lisa Hunter

MM ↻ Marcus Maltby

MM ↻ Margaret Monroe

MC  Marguerite Patil - CCWD

MF  Mary Fahey

MM  Mel Machado

MP  mike potter

NA  Nik Sokol - Arup

NH  Nina Haw

N  NWolder

PW  Paul Weghorst

PS  Peer Swan

PV  petya vasileva

RN  Randall Neudeck

RF  RANDY FLETCHER

RC  Rob Cooke

RB  Robert barra

RK  Robert Kunde

RS  Rod Stiefvater

RL  Ron Lee

R  rstork@friendsoftheriver.org

RR  Russ Ryan

R  RWelsh

RD  Ryan Davis

SK  Sara Katz

SP  Sarah Palmer

SB  Scott Brown

SC  shannon cohen

S  Sheba.Hafiz

S  SL

SH  Steve Hartwig

SJ  Steve Johnson

SL  Steve LaMar

S  Summer

SW  Susan Woods

TB  Thad Bettner

T  ttrimble

V  Valerie

WV  William Vanderwaal

From: Sara M. Katz [skatz@katzandassociates.com]
Sent: 1/27/2021 1:16:07 PM
To: Marcia Kivett [MKivett@sitesproject.org]; Jerry Brown [jbrown@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]; Kevin Spesert [kspesert@sitesproject.org]; Joe Trapasso [jtrapasso@sitesproject.org]; Heydinger, Erin [erin.heydinger@hdrinc.com]; Sarah Rossetto [srossetto@katzandassociates.com]; JP Robinette [jrobinette@brwnald.com]
CC: Henry Luu [Henry.Luu@hdrinc.com]; Robert Boling [Robert.Boling@HDRinc.com]; mmaltby@brwnald.com
Subject: RE: Stats and Chat Room Comments

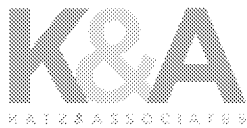
Thanks so much. Overcoming mother nature and IT challenges -- #SitesTeamRocks

Thanks for the data Marcia. Sarah Rossetto will be drafting a TY for expressing interest email to come from Jerry/Fritz to all that signed-up (regardless if they signed on) as well as Marcia's 250 VIP list. We will include a copy of the slides and then encourage interested parties to go to our website if they want to listen to the session real time. We will also produce a meeting "highlights" doc that can go out later or be embedded as part of our next Sites Reservoir Eblast.

Thanks again everyone.

Cheers

Sara



Sara M. Katz
Founder/CEO
mobile: 619.813.9551
[San Diego](#) · [Los Angeles](#) · [San Francisco](#)

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▼ Participants (154)

Q Search

- | | | |
|--|--|--|
| M  MKivett
Cohost, me | 9  9167****92 | CD  Chris Duke |
|  Erin Heydinger
Host | 9  9512****48 | CM  Conner McDonald |
| SR  Sarah Rossetto
Cohost | AB  Adam Borchard | DJ  Dan Jagers |
|   +15303****08 | AS  Ajay Singh | DR  Dan Ruiz |
| 1  1460475334 | AF  Ali Forsythe | DY  Dan York |
| 5  5303****30 | AL  Amy Lyons | DL  Dana Lee |
| 5  5306****10 | AH  Angela Ramirez Holmes | DR  Darin Reintjes |
| 5  5306****71 | A  aniekr | DB  David Bruzzone |
| 5  5307****12 | AN  Ann Newton | DO  David Oro |
| 5  5307****18 | AH  Annie Hoagland | DS  david schaad |
| 5  5307****83 | B  bbarker | DE  Dawn Edwards |
| 5  5308****03 | B  Bill | D  ddunmoyer@cbia.org |
| 6  6613****48 | CG  Cameron Gurley | DL  debra lucero |
| 6  6614****84 |  Cathy Westcot | DB  Dee Bradshaw |
| 6  6616****72 | CV  Charlene Vaughn | DJ  Dennis and Joe |
| 9  9162****35 | CG  Charles Gardiner | DS  Derya Sumer |
| 9  9166****73 | CH  Cheyanne Harris | |

DC ↻ Denise Carter

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D ↻ DGosling

DM ☐ Dirk Marks

D ↻ dmerkley

D ↻ Doug

DW ↻ DSRSD Webex

DC 📞 dwayne chisam

EC ↻ Ed Colley

EB ↻ Edgar Benitez

EW ↻ Ellen Wehr

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JC ↻ Juleah Cordi

K ↻ Karen

KW ↻ Kellie Welch

KW ↻ Kim Witten

LN ↻ Laura Nicholson

LG ↻ Laurene Green

LW laurie Warner

LR ↻ Lee Renger

LX ↻ Lillian Xie

LH ↻ Lisa Hunter

MM ↻ Marcus Maltby

MM ↻ Margaret Monroe

MC  Marguerite Patil - CCWD

MF  Mary Fahey

MM  Mel Machado

MP  mike potter

NA  Nik Sokol - Arup

NH  Nina Haw

N  NWolder

PW  Paul Weghorst

PS  Peer Swan

PV  petya vasileva

RN  Randall Neudeck

RF  RANDY FLETCHER

RC  Rob Cooke

RB  Robert barra

RK  Robert Kunde

RS  Rod Stiefvater

RL  Ron Lee

R  rstork@friendsoftheriver.org

RR  Russ Ryan

R  RWelsh

RD  Ryan Davis

SK  Sara Katz

SP  Sarah Palmer

SB  Scott Brown

SC  shannon cohen

S  Sheba.Hafiz

S  SL

SH  Steve Hartwig

SJ  Steve Johnson

SL  Steve LaMar

S  Summer

SW  Susan Woods

TB  Thad Bettner

T  ttrimble

V  Valerie

WV  William Vanderwaal

From: Board Clerk [boardclerk@sitesproject.org]
Sent: 1/27/2021 2:31:03 PM
To: Marcia Kivett [MKivett@sitesproject.org]
Subject: Re: Voting for the AB Meeting

Thank you!

On Jan 27, 2021 2:23 PM, Marcia Kivett <MKivett@sitesproject.org> wrote:

Agenda approval – First Bruce Houdesheldt/Roseville and Second - Gary Evans/Colusa County

1. Consent Agenda: First - Gary Evans/Colusa Second - Don Bransford/Glenn Colusa
- 2.1 Consider Approval to release the RDEIR/SDEIS Project Description (with Operations) to regulatory agencies and interested parties, including posting on the Authority's website, to improve Project transparency and facilitate more detailed Project discussions. First - Don Bransford/Glenn Colusa, Second - Kerry Schmitz/Sac City/County
- 2.2 Consider Acceptance of the 2021 Sites Project State Agency Legislative Activity Priorities. First – Gary Evans/Colusa County, Second – Don Bransford/Glenn County
- 2.3 Consider approval of the disbursement of funds resulting from increased participation to repay contributed credit. First – Jeff Sutton/Tehama, Second – Gary Evans/Colusa County

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 1/27/2021 4:14:26 PM
To: Jerry Brown [jbrown@sitesproject.org]; Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: Alt 3 Reclamation
Attachments: StorageBreakdown-ReclamationSites-Alts.pdf

See attached for storage breakdown with the alternatives from the federal feasibility and the proposed breakdown for the EIR/EIS alternatives. Note that the federal feasibility didn't include a 1.5 MAF reservoir, so we'd need to interpolate between the 1.3 and 1.8 options to figure out where they would have landed.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Heydinger, Erin
Sent: Wednesday, January 27, 2021 8:08 AM
To: Jerry Brown <jbrown@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: Alt 3 Reclamation

Yes, I will look into and reach out to CH if needed.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

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From: Jerry Brown <jbrown@sitesproject.org>
Sent: Wednesday, January 27, 2021 6:22 AM
To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>; Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Alt 3 Reclamation

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Erin – For our meeting tomorrow with Reclamation to decide on Alt 3 configuration for modeling, can you review the feasibility report and try to identify the SOD/NOD spilt in how they use their water? I heard them say yesterday that their interest is to align with that output as closely as possible because that eases their process for ROD, BA, Sect 106 etc. If this is the criteria they need, then we could probably communicate that back to our participants and they may be okay with it. Let Ali and I know what you find. Thanks

	FFR Alt D1	FFR Alt A1	EIR/EIS Alt 1A	EIR/EIS Alt 1B	EIR/EIS Alt 2	EIR/EIS Alt 3 50/50 reduction	EIR/EIS Alt 3 Proportional Reduction
Reservoir Size (MAF)	1.8	1.3	1.5	1.5	1.3	1.5	1.5
Total Storage	1810	1270	1500	1500	1270	1500	1500
Dead Pool	120	120	120	120	120	120	120
Total PWA	1064	668	1136	1045	906	791	792
CVP/NOD	250	170	279	257	223	101	195
SWP/SOD	814	498	857	788	683	690	597
Federal - OpFlex	390	264	0	91	0	345	345
Total Prop 1	236	218	244	244	244	244	244
Refuge	116	98	124	124	124	124	124
Yolo Bypass	120	120	120	120	120	120	120

NOD %	15%	15%	20%	19%	19%	7%	14%
SOD %	48%	43%	62%	57%	59%	50%	43%
Federal %	23%	23%	0%	7%	0%	25%	25%
State %	14%	19%	18%	18%	21%	18%	18%

From: Thayer, Reed/SAC [Reed.Thayer@jacobs.com]
Sent: 1/27/2021 5:14:06 PM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]; Steve Micko [steve.micko@jacobs.com]; Leaf, Rob/SAC [Rob.Leaf@jacobs.com]
Subject: RE: CalSim Alt 3
Attachments: NODOS_Trend_Reporting_rev38dpcy_DV6_HistClim_CALSIM_NAA_ALT1A_011221_ALT1B_011221_ALT2_011221_ALT3_012221_ALT3_012221_SA_Proportional.xlsm;
SitesMetrics_rev08_5scn__ALT1A_011221_vs_ALT1B_011221_vs_ALT2_011221_vs_ALT3_012221_vs_ALT3_012221_SA_Proportional.pdf

Erin,

I have prepared a CalSim study with the storage account sizes that we discussed in this thread. Since it is a sensitivity analysis, I am calling it "Alternative 3 012221 SA Proportional" since it tests the sensitivity of proportionally reducing account sizes to accommodate CVP Op Flex storage. I have attached a Sites Metrics report and a Trend Reporting spreadsheet. The original Alt 3 012221 is included in the reports.

Please let me know if you have any questions.

Reed Thayer, PE | Jacobs | Water Resources Engineer
O: 916.286.0228 | M: 831.233.2141 | reed.thayer@jacobs.com
2485 Natomas Park Dr, Ste 600 | Sacramento, CA 95833 | USA

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
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To: Thayer, Reed/SAC <Reed.Thayer@jacobs.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>; Micko, Steve/SAC <Steve.Micko@jacobs.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>
Subject: [EXTERNAL] RE: CalSim Alt 3

Looks good to me, thanks. Sorry for the slow response, we successfully lassoed the branch above our house 😊 😊

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

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To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>

Cc: Alicia Forsythe <aforssythe@sitesproject.org>; Micko, Steve/SAC <Steve.Micko@jacobs.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>

Subject: RE: CalSim Alt 3

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Erin,

I rebalanced Alt 3 using the same procedure as Alt 1B where I took the Alt 1A account sizes and reduced the PWA accounts by the CVP Op Flex storage proportional to participation.

	Alt 1A	Alt 1B	Alt 2	Alt 3
Total Storage	1500	1500	1270	1500
Dead Pool	120	120	120	120
Total PWA Storage	1136	1045	906	791
TCCA	150	138	120	105
GCID	34	31	27	24
RD108	27	25	22	19
Other Sac Valley	68	62	54	47
Delta	857	788	683	597
Federal	0	91	0	345
CVP Op Flex	0	91	0	345
State	244	244	244	244
Refuge L4	124	124	124	124
Yolo Bypass	120	120	120	120

Please let me know if you agree.

Reed Thayer, PE | Jacobs | Water Resources Engineer
O: 916.286.0228 | M: 831.233.2141 | reed.thayer@jacobs.com
2485 Natomas Park Dr, Ste 600 | Sacramento, CA 95833 | USA

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>

Sent: Tuesday, January 26, 2021 4:11 PM

To: Micko, Steve/SAC <Steve.Micko@jacobs.com>; Leaf, Rob/SAC <Rob.Leaf@jacobs.com>; Thayer, Reed/SAC <Reed.Thayer@jacobs.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: [EXTERNAL] CalSim Alt 3

Hi all,

I just had a chance to check in with Steve. Please hold off on sending Alt 3 results to ICF. Reclamation is having some heartburn over our proposed storage allocation for Alt 3 and wants to see more of a reduction come from our SOD members. Could you please run CalSim with a proportional reduction in participation for Alt 3? Let me know what questions you have.

Thanks,
Erin

Erin Heydinger, PE, PMP
Asst. Project Manager
Water/Wastewater

HDR
2379 Gateway Oaks Dr, #200
Sacramento, CA 95833
D 916.679.8863 M 651.307.9758

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File Provided Natively

Deliveries Table

Deliveries (TAF/year) (above No Project Alternative conditions) ^a	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221		ALT 3 012221 SA Proportional	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Authority PWA Deliveries	128	307	119	286	117	277	94	228	95	226
NOD	31	64	29	60	29	62	17	34	25	52
SOD	97	243	91	226	87	215	77	194	70	174
CVP Deliveries	3	10	11	29	2	10	27	55	28	62
NOD Ag	-1	2	0	5	-1	2	4	13	4	14
NOD M&I	0	0	0	0	0	0	2	4	2	3
SOD Ag	3	8	10	24	3	8	20	37	21	43
SOD M&I	0	0	1	0	0	0	1	1	1	1
Subtotal - CVP Operational Flexibility			8	19			24	45	25	52
SWP Deliveries	-1	-2	-2	0	1	-2	12	9	13	12
SWP SOD Ag (Table A)	0	0	0	0	0	0	0	0	0	0
SWP SOD M&I (Table A)	-4	-3	-1	2	-2	0	3	4	1	3
SWP SOD Interruptible (Article 21)	3	0	-1	-1	2	-2	9	6	11	8
Sub-Total Supplemental Deliveries for Water Supply	130	315	128	315	119	285	133	292	136	300
Refuge Water Supply	22	36	22	35	24	39	21	31	21	33
NOD	6	8	6	8	6	8	6	7	6	7
SOD	16	28	15	27	18	31	15	25	15	25
Yolo Bypass Habitat Water Supply	38	23	36	21	41	25	33	15	32	14
Total Deliveries	191	374	186	371	184	349	187	338	189	347
Percentage of Total Deliveries										
Authority PWA Deliveries - North of Delta	16%	17%	16%	16%	16%	18%	9%	10%	13%	15%
Authority PWA Deliveries - South of Delta	51%	65%	49%	61%	47%	62%	41%	57%	37%	50%
CVP Deliveries - Operational Flexibility	1%	3%	6%	8%	1%	3%	14%	16%	15%	18%
SWP Deliveries	0%	-1%	-1%	0%	0%	0%	6%	3%	7%	3%
Refuge Water Supply	12%	10%	12%	9%	13%	11%	11%	9%	11%	9%
Yolo Bypass Habitat Water Supply	20%	6%	19%	6%	22%	7%	18%	4%	17%	4%

Notes:

^a Values shown are the net change between the Project Alternative and No Project Alternative
Results are dependent on storage allocations (see storage allocation table)

Storage Table

Storage Increases (TAF) (above No Project Alternative conditions) ^a	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221		ALT 3 012221 SA Proportional	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Additional end-of-September storage	28	52	50	72	27	47	109	143	112	145
Trinity	0	0	0	0	0	0	0	0	0	0
Shasta	12	23	28	39	10	18	71	105	74	110
CVP Storage	7	10	25	31	5	6	69	99	72	104
Subtotal - CVP OpFlex Storage (Estimated)			18	21			62	89	65	94
Storage exchanged from Sites	5	13	3	9	5	13	2	6	2	6
Oroville	13	24	12	21	12	19	14	17	13	14
SWP Storage	-6	-14	-6	-16	-5	-14	1	-9	1	-8
Sites Delta Participants Storage	19	38	17	36	17	33	13	27	12	22
Folsom	3	5	9	12	5	9	24	21	25	21
Percentage of Total Additional End-of-September Storage										
Portion of total additional end-of-September storage	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
Trinity	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shasta	41%	44%	57%	55%	36%	40%	65%	73%	66%	76%
Oroville	47%	46%	24%	29%	44%	40%	13%	12%	11%	9%
Folsom	12%	10%	19%	16%	20%	20%	22%	14%	22%	15%

Notes:
^a Values shown are the net change between the Project Alternative and No Project Alternative
Results are dependent on storage allocations (see storage allocation table)

Sites Releases Table

Releases (TAF/year)	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221		ALT 3 012221 SA Proportional	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Releases for Authority PWA Deliveries - North of Delta	31	64	29	60	29	62	17	34	25	52
Assumed transfer from North of Delta to South of Delta	7	6	6	6	6	5	1	0	3	3
Releases for Authority PWA Deliveries - South of Delta	111	266	105	250	101	238	94	219	83	193
Releases for CVP Deliveries - Operational Flexibility	0	0	28	26	0	0	88	86	89	86
Releases for Refuge Water Supply	25	39	24	38	27	42	22	32	23	34
Releases for Yolo Bypass Habitat Water Supply	44	27	41	24	47	28	38	17	37	16
Total Releases	217	402	234	404	209	374	260	387	260	383
Percentage of Total Releases from Sites										
Releases for Authority PWA Deliveries - North of Delta	14%	16%	12%	15%	14%	16%	6%	9%	10%	14%
Assumed transfer from North of Delta to South of Delta	3%	2%	3%	2%	3%	1%	0%	0%	1%	1%
Releases for Authority PWA Deliveries - South of Delta	51%	66%	45%	62%	48%	64%	36%	56%	32%	50%
Releases for CVP Deliveries - Operational Flexibility	0%	0%	12%	7%	0%	0%	34%	22%	34%	22%
Releases for Refuge Water Supply	11%	10%	10%	9%	13%	11%	8%	8%	9%	9%
Releases for Yolo Bypass Habitat Water Supply	20%	7%	18%	6%	22%	8%	15%	4%	14%	4%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Fills Table

Fills (TAF/year)	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221		ALT 3 012221 SA Proportional	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Fills for Authority PWA Deliveries - North of Delta	45	19	43	16	41	19	21	9	34	14
Fills for Authority PWA Deliveries - South of Delta	122	48	115	43	111	43	105	38	92	33
Fills for CVP Deliveries - Operational Flexibility	0	0	29	16	0	0	90	37	91	37
Fills for Refuge Water Supply	26	11	26	11	28	13	23	8	24	9
Fills for Yolo Bypass Habitat Water Supply	46	23	43	18	48	25	39	14	38	12
Total Fill	240	101	255	104	229	99	278	106	279	105
Percentage of Total Fills										
Fills for Authority PWA Deliveries - North of Delta	19%	19%	17%	15%	18%	19%	8%	8%	12%	13%
Fills for Authority PWA Deliveries - South of Delta	51%	47%	45%	41%	48%	43%	38%	36%	33%	31%
Fills for CVP Deliveries - Operational Flexibility	0%	0%	11%	16%	0%	0%	32%	35%	33%	36%
Fills for Refuge Water Supply	11%	11%	10%	11%	12%	13%	8%	8%	9%	9%
Fills for Yolo Bypass Habitat Water Supply	19%	23%	17%	17%	21%	25%	14%	13%	14%	11%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Storage Allocation Table

Storage Volumes (TAF)	ALT 1A 011221	ALT 1B 011221	ALT 2 011221	ALT 3 012221	ALT 3 012221 SA Proportional
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)	1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)
Authority PWA Deliveries - North of Delta	279	256	223	100	195
TCCA	150	138	120	65	105
GCID	34	31	27	8	24
RD108	27	25	22	0	19
Other Sacramento Valley	68	62	54	27	47
Authority PWA Deliveries - South of Delta	857	788	683	690	597
CVP Deliveries - Operational Flexibility	0	91	0	345	345
Refuge Water Supply	124	124	124	124	124
Yolo Bypass Habitat Water Supply	120	120	120	120	120
Dead Pool Storage	120	120	120	120	120
Total Storage	1500	1499	1270	1499	1501
Percentage of Total Storage Capacity					
Authority PWA Deliveries - North of Delta	19%	17%	18%	7%	13%
Authority PWA Deliveries - South of Delta	57%	53%	54%	46%	40%
CVP Deliveries - Operational Flexibility	0%	6%	0%	23%	23%
Refuge Water Supply	8%	8%	10%	8%	8%
Yolo Bypass Habitat Water Supply	8%	8%	9%	8%	8%
Dead Pool Storage	8%	8%	9%	8%	8%

Notes:
Results are dependent on storage allocations

From: Heydinger, Erin [Erin.Heydinger@hdrinc.com]
Sent: 1/27/2021 6:23:05 PM
To: Jerry Brown [jbrown@sitesproject.org]
CC: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Alt 3 - Additional Info
Attachments: SitesMetrics_Alt3Comparison_20210127.pdf; Alternative 3 Agenda_1.28.2021.docx

Hi Jerry,

See attached for preliminary results with Alt 3 “targeted” reduction and Alt 3 “proportional” reduction. These haven’t been QC’d yet so probably should not be shared with Reclamation. They’re just for our reference. Our preferred Alt 3 results in a reduction to SOD members of about 16 TAF per year and their preferred results in a reduction to SOD member of about 25 TAF (when compared with Alt 1 w/ \$200M federal investment and including transfers from NOD to SOD participants). Our preferred Alt 3 results in a reduction to NOD members of 12 TAF and theirs 4 TAF.

I don’t think this changes our earlier discussion, just some more detail. My thought is we could live with the proportional reduction if that will allow us to move forward.

Ali, what are your thoughts on this? I also attached the meeting agenda for your reference.

Erin

Erin Heydinger, PE, PMP
Asst. Project Manager
Water/Wastewater

HDR
2379 Gateway Oaks Dr, #200
Sacramento, CA 95833
D 916.679.8863 M 651.307.9758

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Sites Releases Table

Releases (TAF/year)	ALT 1A 011221		ALT 1B 011221		ALT 2 011221		ALT 3 012221		ALT 3 012221 SA Proportional	
	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical	Average	Dry and Critical
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)		1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)		1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	
Releases for Authority PWA Deliveries - North of Delta	31	64	29	60	29	62	17	34	25	52
Assumed transfer from North of Delta to South of Delta	7	6	6	6	6	5	1	0	3	3
Releases for Authority PWA Deliveries - South of Delta	111	266	105	250	101	238	94	219	83	193
Releases for CVP Deliveries - Operational Flexibility	0	0	28	26	0	0	88	86	89	86
Releases for Refuge Water Supply	25	39	24	38	27	42	22	32	23	34
Releases for Yolo Bypass Habitat Water Supply	44	27	41	24	47	28	38	17	37	16
Total Releases	217	402	234	404	209	374	260	387	260	383
Percentage of Total Releases from Sites										
Releases for Authority PWA Deliveries - North of Delta	14%	16%	12%	15%	14%	16%	6%	9%	10%	14%
Assumed transfer from North of Delta to South of Delta	3%	2%	3%	2%	3%	1%	0%	0%	1%	1%
Releases for Authority PWA Deliveries - South of Delta	51%	66%	45%	62%	48%	64%	36%	56%	32%	50%
Releases for CVP Deliveries - Operational Flexibility	0%	0%	12%	7%	0%	0%	34%	22%	34%	22%
Releases for Refuge Water Supply	11%	10%	10%	9%	13%	11%	8%	8%	9%	9%
Releases for Yolo Bypass Habitat Water Supply	20%	7%	18%	6%	22%	8%	15%	4%	14%	4%

Notes:
Results are dependent on storage allocations (see storage allocation table)

Sites Storage Allocation Table

Storage Volumes (TAF)	ALT 1A 011221	ALT 1B 011221	ALT 2 011221	ALT 3 012221	ALT 3 012221 SA Proportional
	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to CBD)	1.27 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)	1.5 MAF Reservoir Dunnigan Pipeline (outlet to Sac R)
Authority PWA Deliveries - North of Delta	279	256	223	100	195
TCCA	150	138	120	65	105
GCID	34	31	27	8	24
RD108	27	25	22	0	19
Other Sacramento Valley	68	62	54	27	47
Authority PWA Deliveries - South of Delta	857	788	683	690	597
CVP Deliveries - Operational Flexibility	0	91	0	345	345
Refuge Water Supply	124	124	124	124	124
Yolo Bypass Habitat Water Supply	120	120	120	120	120
Dead Pool Storage	120	120	120	120	120
Total Storage	1500	1499	1270	1499	1501
Percentage of Total Storage Capacity					
Authority PWA Deliveries - North of Delta	19%	17%	18%	7%	13%
Authority PWA Deliveries - South of Delta	57%	53%	54%	46%	40%
CVP Deliveries - Operational Flexibility	0%	6%	0%	23%	23%
Refuge Water Supply	8%	8%	10%	8%	8%
Yolo Bypass Habitat Water Supply	8%	8%	9%	8%	8%
Dead Pool Storage	8%	8%	9%	8%	8%

Notes:
Results are dependent on storage allocations

Alternative 3 Sites Reservoir Project



— BUREAU OF —
RECLAMATION

January 28, 2021

Time: 7:30 a.m. – 9:00 a.m.

Location: [Join Microsoft Teams Meeting](#)

Purpose: Finalize the proposed description of EIS operation and modeling for Alternative 3.

Attendees:

- | | | |
|---|--|--|
| ☐ Vince Barbara, Reclamation | ☐ Melissa Dekar, Reclamation | ☐ Michael Mosley, Reclamation |
| ☐ David Brick, Reclamation | ☐ Laurie Warner Herson, Sites JPA | ☐ Derya Sumer, Reclamation |
| ☐ Jerry Brown, Sites JPA | ☐ Erin Heydinger, Sites JPA | ☐ Richard Welsh, Reclamation |
| ☐ Ryan Davis, Reclamation | ☐ Stacey Leigh, Reclamation | ☐ Kristin White, Reclamation |
| ☐ Don Bader, Reclamation | ☐ Natalie Wolder, Reclamation | |

Agenda:

Discussion Topic	Time Allotted
1. Introductions	5 min
2. Purpose and goals of Alt 3	10 min
3. Review of SPA and Reclamation Alt 3 proposals to date	10 min
4. Reclamation concerns	15 min
5. SPA concerns	15 min
6. Items to resolve	60 min
a. NOD participation levels for all alternatives	
b. Alt 3 being the preferred alternative; Timelines for consultations without Alt 3 as preferred alt	
c. Alt 3 storage allocations for joint EIR/EIS	
7. Review of Action Items and Next Steps	5 min

Grey = SPA Proposals
 Blue = Reclamation Proposals

					SPA Proposal	Reclamation Proposal 1	Reclamation Proposal 2
	Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 3 Non- Proportional Decrease	Alt 3 Proportional Decrease	Alt 3 WSIP- CVP Merge
Total Storage	1500	1500	1270	1270	1500	1500	1500
Dead Pool	120	120	120	120	120	120	120
Total SPA Storage	1136	1045	906	618	791	791	1045
<i>Sac Valley</i>	<i>279</i>	<i>257</i>	<i>223</i>	<i>204</i>	<i>101</i>	<i>194</i>	<i>257</i>
<i>South of Delta</i>	<i>857</i>	<i>788</i>	<i>683</i>	<i>414</i>	<i>690</i>	<i>597</i>	<i>788</i>
Federal	0	91	0	288	345	345	335
State	244	244	244	244	244	244	

Reductions from initial discussion between CVP contractors and SPA:

GCID = 1,500 AFY (currently at 5,000)
 TCCA = 15,000 AFY (currently at 22,200)
 RD108 = 0 AFY (currently at 4,000)
 Colusa County = 5,000 AFY (currently at 10,000)

From: Lucero, Debra [DLucero@buttecounty.net]
Sent: 1/28/2021 11:12:07 AM
To: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: Re: Jerry Boles Comments

Yes, please.

Am I to understand the proposed EIR (release date July 2021) will address Mr. Boles concerns? And you'll be able to scientifically address these between now and July?

Thank you.

Debra Lucero
Butte County Supervisor District 2
269 E. 3rd St., Ste. 100
Chico, CA 95928
Appointments: 530-891-7535
Mobile: 530-552-2030

From: Alicia Forsythe <aforsythe@sitesproject.org>
Sent: Thursday, January 28, 2021 8:04 AM
To: Lucero, Debra
Subject: RE: Jerry Boles Comments

.ATTENTION: This message originated from outside Butte County. Please exercise judgment before opening attachments, clicking on links, or replying..

Debra - Thank you for your follow up email and for joining us at the Townhall meeting yesterday. The Townhall was intended to provide a broad overview of the status of the Project efforts and our upcoming priorities for 2021. As I mentioned on the phone and in the chat, we are hosting small technical group meetings to dive deeper into technical issues. As part of this, we will be hosting a water quality small group to address these water quality concerns -- likely starting first with Mr. Boles' letter but also diving into other topics as the group would like.

The technical analysis is underway and I don't have specific responses to Mr. Boles' comments at this time. However, we will address all of his comments and concerns through the small group and as we revise the environmental document (target release to the public is July 2021).

I'd be happy to add you to the small group if you'd like.

Ali

Alicia Forsythe | Environmental Planning and Permitting Manager | Sites Reservoir Project | 916.880.0676
| aforsythe@sitesproject.org |
[https://urldefense.com/v3/__http://www.SitesProject.org__;!!KNMwiTCp4spf!XawavmzxHU1joggC2hbEVqimcy7ivmO2-CORSpCZ2u4MMbw71VKNNPC5ChX97_dbmTI\\$](https://urldefense.com/v3/__http://www.SitesProject.org__;!!KNMwiTCp4spf!XawavmzxHU1joggC2hbEVqimcy7ivmO2-CORSpCZ2u4MMbw71VKNNPC5ChX97_dbmTI$)

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-----Original Message-----

From: Lucero, Debra <DLucero@buttecounty.net>
Sent: Wednesday, January 27, 2021 11:44 AM
To: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Jerry Boles Comments

Dear Ali:

I participated in the Town Hall today and would like to understand why the water quality issues were not addressed on this phone call.

As an elected official from one of the source areas of this project, I would like to hear from you on the attached document.

?

Thank you.

Debra

Debra Lucero
Butte County Supervisor District 2
269 E. 3rd St., Ste. 100
Chico, CA 95928
Appointments: 530-891-7535
Mobile: 530-552-2030

From: Davis-Fadtke, Kristal@Wildlife [Kristal.Davis-Fadtke@wildlife.ca.gov]
Sent: 1/28/2021 1:03:59 PM
To: Spranza, John [john.spranza@hdrinc.com]
CC: Alicia Forsythe [aforsythe@sitesproject.org]
Subject: RE: Baseline model runs

Thanks John.

From: Spranza, John <John.Spranza@hdrinc.com>
Sent: Thursday, January 28, 2021 12:31 PM
To: Davis-Fadtke, Kristal@Wildlife <Kristal.Davis-Fadtke@wildlife.ca.gov>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: RE: Baseline model runs

Warning: This email originated from outside of CDFW and should be treated with extra caution.

Hi Kristal,
I'm working with the modeling team to find a date for delivery to you, as well as NMFS and USFWS. I will circle back soon.

John Spranza

D 916.679.8858 M 818.640.2487

From: Davis-Fadtke, Kristal@Wildlife <Kristal.Davis-Fadtke@wildlife.ca.gov>
Sent: Tuesday, January 26, 2021 2:44 PM
To: Spranza, John <John.Spranza@hdrinc.com>
Cc: Alicia Forsythe <aforsythe@sitesproject.org>
Subject: Baseline model runs

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi John,

I hope you are doing well. I am wondering when the updated CalSim baseline runs will be ready for review? Ali and I talked about this a couple of weeks ago and I wanted to follow up with you. Our engineer, Rob Sherrick, is back from paternity leave and ready to dive in!

Thanks,

Kristal

Kristal Davis Fadtke
Environmental Program Manager
Water Branch, Ecosystem Conservation Division
California Department of Fish and Wildlife
P.O. Box 944209
Sacramento, CA 94244-2090

Office: (916) 376-1987

Cell: (916) 701-3226

From: Sarah Rossetto [srossetto@katzandassociates.com]
Sent: 1/28/2021 1:34:01 PM
To: Heydinger, Erin [erin.heydinger@hdrinc.com]
CC: Marcia Kivett [MKivett@sitesproject.org]; Karen Franco [kfranco@katzandassociates.com]
Subject: RE: Stats and Chat Room Comments

Thanks, Erin. We will proceed with posting this on the website and completing a meeting summary.



Sarah Rossetto
Director
d: 858.926.4007 • c: 530.304.8704
San Diego • Los Angeles • San Francisco

From: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Sent: Wednesday, January 27, 2021 6:28 PM
To: Sarah Rossetto <srossetto@katzandassociates.com>
Cc: Marcia Kivett <mkivett@sitesproject.org>; Karen Franco <kfranco@katzandassociates.com>
Subject: RE: Stats and Chat Room Comments

Hi Sarah,

I put the recording on SharePoint:

<https://sitesreservoirproject.sharepoint.com/:f/r/CommsTeam/Working%20Documents/MEETINGS/PUBLIC%20MEETING%20OPEN%20HOUSES/January%202021%20Town%20Hall?csf=1&web=1&e=Y8YvPN>

The other file besides the mp4 that's in there is an automatically generated transcript, in case that's helpful.

Thanks!

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Heydinger, Erin
Sent: Wednesday, January 27, 2021 1:40 PM
To: Sarah Rossetto <srossetto@katzandassociates.com>
Cc: Marcia Kivett <mkivett@sitesproject.org>; Karen Franco <kfranco@katzandassociates.com>
Subject: RE: Stats and Chat Room Comments

Sounds good – it takes up to 24 hours for webex to “prepare” the recording. I’ll upload it to SharePoint and send you the link when I’m done.

Erin

Erin Heydinger PE, PMP
D 916.679.8863 M 651.307.9758

hdrinc.com/follow-us

From: Sarah Rossetto <srossetto@katzandassociates.com>
Sent: Wednesday, January 27, 2021 1:03 PM
To: Heydinger, Erin <Erin.Heydinger@hdrinc.com>
Cc: Marcia Kivett <mkivett@sitesproject.org>; Karen Franco <kfranco@katzandassociates.com>
Subject: FW: Stats and Chat Room Comments

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Erin,

Thank you for everything you did for the Town Hall! Let us know when we can receive the WebEx meeting recording, and we will complete the meeting summary and post the video on the Sites website.

Thanks,
Sarah



Sarah Rossetto
Director
d: 858.926.4007 · c: 530.304.8704
[San Diego](#) · [Los Angeles](#) · [San Francisco](#)

From: Marcia Kivett <MKivett@sitesproject.org>
Sent: Wednesday, January 27, 2021 12:10 PM
To: Jerry Brown <jbrown@sitesproject.org>; Alicia Forsythe <aforsythe@sitesproject.org>; Kevin Spesert <kspesert@sitesproject.org>; Joe Trapasso <jtrapasso@sitesproject.org>; Sara M. Katz <skatz@katzandassociates.com>; Heydinger, Erin <erin.heydinger@hdrinc.com>; Sarah Rossetto <srossetto@katzandassociates.com>; JP Robinette <jrobinette@brwncauld.com>
Cc: Henry Luu <Henry.Luu@hdrinc.com>; Robert Boling <Robert.Boling@HDRinc.com>; mmaltby@brwncauld.com
Subject: Stats and Chat Room Comments

GREAT JOB!

Approximately (with counting the phone numbers as independent individuals)

- 154 attendees in the beginning
- 137 at 11:20
- 19 participants
- 18 Agent/Consultants

from James Brobeck (Aqualliance) to everyone: 10:30 AM

EIR Needs:

- Obtain additional metals data from source waters targeting high flows from which diversions would occur
- Provide information on the water quality impacts from other chemical contaminants that adversely affect water quality in the Sacramento River (including chlorpyrifos, diazinon, chlordane, DDT, mercury, PCBs, and dieldrin) and contaminants in sewer outfalls (such as pharmaceuticals) and other discharges (such as industrial discharges)
- Evaluate the contributions of metals from local tributaries (i.e., Funks Creek and Stone Corral Creek) to the proposed reservoir

- Provide information on the contribution from leaching of metals from the inundation area of the proposed reservoir

EIR needs

- Evaluate effects of metals to beneficial uses within the proposed reservoir
 - o fisheries,
 - o wildlife (including state and federal species listed as threatened or endangered),
 - o recreation
- Evaluate effects of metals to beneficial uses due to releases from the reservoir, agricultural supply water,
 - o effects of metals on crops including incorporation of metals by crops (e.g., arsenic uptake in rice),
 - o effects of metals on plants grown for support of wildlife (such as in wildlife refuges),
 - o drinking water supplies, fisheries, wildlife (including state and federal species listed as threatened or endangered),
- Evaluate combined toxicity of multiple metals
- Evaluate contributions of metals in reservoir releases related to the SWRCB antidegradation policy
- Evaluate impacts from mercury bioaccumulation in aquatic life (especially fish) in the proposed reservoir, and effects to wildlife that feed on fish from the reservoir and recreational opportunities (i.e., sport fishing)
- Evaluate physical conditions expected in the reservoir, including thermal stratification and hypolimnetic anoxia, and effects on reservoir and downstream aquatic resources

Saline water has been observed to seep from underground salt springs in the vicinity of the Salt Lake fault along the slopes above the valley and along the valley floor within the proposed inundation area of Sites Reservoir. The water from the underground springs accumulates along the trough of the valley and forms Salt Lake" (USGS, 1915). Extremely high concentrations of metals are present in the small streams in the reservoir footprint, which occur due to the nature of the soils in the area of the proposed reservoir. Sites Reservoir would inundate these soils resulting in leaching of metals and further incremental loading of metals to the proposed reservoir. There is no discussion in the EIR about the potential impacts of metals leaching from the soils that would be inundated by the proposed reservoir. Please do not avoid the questions on salts and heavy metals presented by Jerry Boles and others. Investors on this webinar need to be made aware of the metal/salt loading in the source water and the inundation footprint soils.

Jerry Boles, retired Chief of the Water Quality and Biology Section of the Northern District of the Department of Water Resources in Red Bluff, submitted comments on the proposed Sites Reservoir Draft Environmental Impact Report. Boles explains that during his tenure with DWR he collected data that showed elevated levels of aluminum, arsenic, cadmium, iron, chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc in the Sacramento River with the highest levels coming from tributary flows.

from James Brobeck to everyone: 11:16 AM

The poor quality of the source water will certainly be further degraded if the water is impounded in the proposed off-stream reservoir. Boles explains, "“Extremely high concentrations of metals are present in the small streams in the reservoir footprint, which occur due to the nature of the soils in the area of the proposed reservoir. Sites Reservoir would inundate these soils resulting in leaching of metals and further incremental loading of metals to the proposed reservoir."

from Ali Forsythe to everyone: 11:22 AM

Jim Brobeck - Thank you for all this great information. We are working to address all of these considerations, really based off of Jerry Boles' comments on the 2017 EIR/EIS as part of the Revised Draft EIR/Supplemental Draft EIS. I also expect water quality to be a small group topic. Please feel free to contact me at aforsythe@sitesproject.org if you'd like to part of the upcoming water quality small group discussions.

from James Brobeck to everyone: 11:24 AM

The "right size" does not change the metal/salt comments by Boles and others. I would be happy to forward the Boles comments to interested parties including investors. jimb@aqualliance.net

from Dennis and Joe to everyone: 10:51 AM

What is the status of the discussions with the Regulatory Agencies for use of the water allocated for environmental purposes.

Will there be alternatives in the EIS/EIR that reflect a range of diversion criteria/thresholds from the Sacramento River through the two canals? Ron Stork

from debra lucero to everyone: 11:01 AM

Has this project taken into consideration Jerry Boles (former DWR employee) comments about high concentrations of metals - both in the river and possibly at the storage site. I sent this question in via email after reading his lengthy comments to the current EIIR.

from debra lucero to everyone: 11:02 AM

Who will oversee the water quality of this project?

from Eric Christen to everyone: 11:49 AM

Thank you for staffs response to my union PLA question. So just to be clear, when you put in your presenations that you have as a goal "divirsity" anbd "inclusion

from Kim Witten to everyone: 11:49 AM

Can you put your email here so I can contact you. Thanks

from Sarah Rossetto to everyone: 11:50 AM

jbrown@sitesproject.org

to Kim Witten (privately): 11:50 AM

jbrown@sitesproject.org or call him at 925-260-7417

from Eric Christen to everyone: 11:50 AM

that you really do not.

from Eric Christen to everyone: 11:50 AM

Non-union workers and apprentices ar enot welcome on your projects.

from Marguerite Patil - CCWD to everyone: 11:59 AM

Thanks Sites Team! Great Town Hall.

from Anjanette Shadley to everyone: 12:00 PM

Very imformative, thank you! Great job! #BuildSites

▼ Participants (154)

Q Search

M  MKivett
Cohost, me

  Erin Heydinger
Host

SR  Sarah Rossetto
Cohost

  +15303****08

1  1460475334

5  5303****30

5  5306****10

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5  5307****12

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5  5307****83

5  5308****03

6  6613****48

6  6614****84

6  6616****72

9  9162****35

9  9166****73

9  9167****92

9  9512****48

AB  Adam Borchard

AS  Ajay Singh

AF  Ali Forsythe

AL  Amy Lyons

AH  Angela Ramirez Holmes

A  aniekr

AN  Ann Newton

AH  Annie Hoagland

B  bbarker

B  Bill

CG  Cameron Gurley

  Cathy Westcot

CV  Charlene Vaughn

CG  Charles Gardiner

CH  Cheyanne Harris

CD  Chris Duke

CM  Conner McDonald

DJ  Dan Jagers

DR  Dan Ruiz

DY  Dan York

DL  Dana Lee

DR  Darin Reintjes

DB  David Bruzzzone

DO  David Oro

DS  david schaad

DE  Dawn Edwards

D  ddunmoyer@cbia.org

DL  debra lucero

DB  Dee Bradshaw

DJ  Dennis and Joe

DS  Derya Sumer

DC ↻ Denise Carter

DJ ↻ Dennis and Joe

DW ↻ Deryk Walcott

D ↻ DGosling

DM ☐ Dirk Marks

D ↻ dmerkley

D ↻ Doug

DW ↻ DSRSD Webex

DC 📞 dwayne chisam

EC ↻ Ed Colley

EB ↻ Edgar Benitez

EW ↻ Ellen Wehr

EC ↻ Emil Cavagnolo

EC ↻ Eric Christen

EM ↻ ERIC MISCHE

E ↻ ESimmen

FM ☐ Farid Motamed

FD ↻ Frederick Durst

GT ↻ Gavin Tasker

GP ☐ Glen Peterson

GZ 📞 Greg Zlotnick

HT ↻ Hailey Traynham

HW 📞 Halina Wojnicz

HW ↻ Heather Waldrop

 ↻ Henry Luu

HD Holly Dawley

JK ☐ Jake Kalfsbeek

JB ↻ james Brobeck

JT ↻ Jamie Traynham

JD ↻ Jeff Davis

JL 📞 Jeff Looker

JB ↻ Jerry Brown

JG ☐ Jerry Gladbach

JE ↻ Jim Earley

JD ↻ Joanne Delgado

JL 📞 Joe's Lenovo

 ↻ John Buttz

J ↻ JP

J ☐ Judy

JC ↻ Juleah Cordi

K ↻ Karen

KW ↻ Kellie Welch

KW ↻ Kim Witten

LN ↻ Laura Nicholson

LG ↻ Laurene Green

LW Laurie Warner

LR ↻ Lee Renger

LX ↻ Lillian Xie

LH ↻ Lisa Hunter

MM ↻ Marcus Maltby

MM ↻ Margaret Monroe

MC 📞 Marguerite Patil - CCWD

MF 📞 Mary Fahey

MM 📞 Mel Machado

MP 📞 mike potter

NA 📞 Nik Sokol - Arup

NH 📞 Nina Haw

N 📞 NWolder

PW 📞 Paul Weghorst

PS 📞 Peer Swan

PV 📞 petya vasileva

RN 📞 Randall Neudeck

RF 📞 RANDY FLETCHER

RC 📞 Rob Cooke

RB 📞 Robert barra

RK 📞 Robert Kunde

RS 📞 Rod Stiefvater

RL 📞 Ron Lee

R 📞 rstork@friendsoftheriver.org

RR 📞 Russ Ryan

R 📞 RWelsh

RD 📞 Ryan Davis

SK 📞 Sara Katz

SP 📞 Sarah Palmer

SB 📞 Scott Brown

SC 📞 shannon cohen

S 📞 Sheba.Hafiz

S 📞 SL

SH 📞 Steve Hartwig

SJ 📞 Steve Johnson

SL 📞 Steve LaMar

S 📞 Summer

SW 📞 Susan Woods

TB 📞 Thad Bettner

T 📞 ttrimble

V 📞 Valerie

WV 📞 William Vanderwaal



From: Jerry Brown [jbrown@sitesproject.org]
Sent: 1/28/2021 7:01:49 PM
To: Marcia Kivett [MKivett@sitesproject.org]
Subject: FW: Jerry Boles Comments

I have not heard anything back yet. Please remind me to reach back out to her next Friday if no response. thanks

On 1/27/21, 1:15 PM, "Jerry Brown" <jbrown@sitesproject.org> wrote:

Hi Debra - Thanks for reaching out and attending the town hall today. I'd like to find a time to discuss these and any other concerns you have with the Sites project when convenient for you. Can I have my assistant Marcia reach out to someone or yourself to get this scheduled?

Jerry

On 1/27/21, 11:59 AM, "Lucero, Debra" <DLucero@buttecounty.net> wrote:

Please see my comments to Ali below.

?

I've not yet heard from anyone on this topic.

Thank you!

Debra

Debra Lucero
Butte County Supervisor District 2
269 E. 3rd St., Ste. 100
Chico, CA 95928
Appointments: 530-891-7535
Mobile: 530-552-2030

From: Lucero, Debra
Sent: Wednesday, January 27, 2021 11:43 AM
To: aforsythe@sitesproject.org
Subject: Jerry Boles Comments

Dear Ali:

I participated in the Town Hall today and would like to understand why the water quality issues were not addressed on this phone call.

As an elected official from one of the source areas of this project, I would like to hear from you on the attached document.

?

Thank you.

Debra

Debra Lucero
Butte County Supervisor District 2
269 E. 3rd St., Ste. 100
Chico, CA 95928
Appointments: 530-891-7535
Mobile: 530-552-2030

