

# Floodplains Reimagined Program

## Phase I: The Landscape Scale Multi-Benefit Floodplain Feasibility Study Project

### *Opportunities, Constraints, and Considerations*

December 2023

Prepared for  
RD108 in support of Floodplains Reimagined

Prepared by  
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## Table of Contents

Introduction .....	3
Purpose of Document .....	4
Methodology.....	5
Direct Solicitation from Stakeholders .....	6
Review of Related Efforts Opportunities and Constraints .....	7
Program Context.....	9
Principles .....	9
Priorities & Objectives.....	9
<b>Priorities - Phase I Evaluation</b> .....	9
<b>Priorities - Future Phase Evaluation</b> .....	1
Opportunities.....	1
Need.....	1
Floodplain Connectivity .....	2
River Connections .....	2
Water Management Conveyance .....	2
Land Management.....	3
In-River Function.....	4
Enhancements.....	4
Operations & Maintenance .....	4
Fish Passage .....	4
Riparian Habitat Conservation and Restoration .....	5
Groundwater Recharge .....	5
Adaptive Management.....	5
Regulatory and Policy .....	6
Economic.....	6
Regional Constraints & Considerations .....	7
Evaluation Criteria.....	7
Willingness Compatibility .....	8
Agricultural Compatibility.....	8

Cultural and Indigenous Resources Compatibility .....	9
Recreational Compatibility .....	9
Floodplain Wildlife Compatibility.....	10
Birds Compatibility.....	10
Fisheries Compatibility.....	11
Flood Control Compatibility .....	12
Economic Prosperity Compatibility .....	13
Community Way of Life Compatibility.....	13
Regulatory Compatibility .....	14
Subregional Opportunities, and Constraints and Considerations.....	15
Subregional Opportunities.....	15
Colusa Basin .....	15
Sutter Bypass .....	15
Butte Basin .....	15
Subregional Considerations and Constraints.....	17
Colusa Basin .....	17
Sutter Bypass .....	17
Butte Basin .....	18
Areas of Scientific Uncertainty.....	19
Adult and Juvenile Salmon Benefits and Risk.....	19
Juvenile Salmon Rearing on Rice Fields.....	20
Fish Passage.....	20
Flow Measurement to Inform Coordinated Operations.....	21
Sediment Transport.....	21
Flooding Impacts from Riparian Habitat Creation .....	22
Areas of Divergence .....	23
Salmon .....	23
Juvenile Salmon Rearing .....	23
Juvenile Salmon and Adults Tradeoffs.....	23
Science & Data Acquisition .....	25

## Introduction

Floodplains Reimagined aims to improve floodplain connectivity for multiple purposes through voluntary collaborative partnerships with private landowners, sovereign tribal entities, government, and non-government representatives.

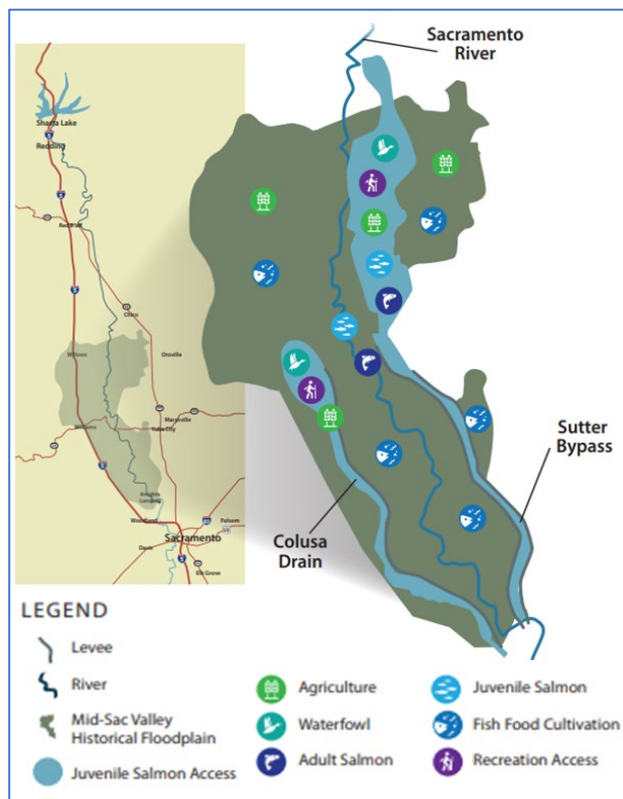
California Natural Resources Agency funded Phase I of the Floodplains Reimagined Program. In Phase I, Floodplains Reimagined began to evaluate the feasibility of improving floodplain functional connectivity by reintroducing low flows during the agricultural off-season, onto lands owned by willing landowners. During Phase I, stakeholders considered the feasibility and benefits of reconnecting the Sacramento River with its floodplains through new or modified river connections, flood conveyance, land-based management, in-river restoration, and fish enhancement activities opportunities.

This Floodplains Reimagined Program is working to coordinate efforts in concert with a constellation of efforts underway in the Colusa, Butte, and Sutter Basins in the Mid-Sacramento River Valley region to improve the floodplain functional connectivity to support salmon, birds, and agriculture.

### Vision

To improve floodplain connectivity for multiple purposes through voluntary collaborative partnerships with private landowners, sovereign tribal entities, government, and non-government representatives.

Figure 1: Geographic Scope



As shown in Figure 1, the geographic scope of the Program includes an area along the Sacramento River corridor from Butte Sink at the north end to the top of the Yolo Bypass at the south end. The defining physical watershed and infrastructure features include: Butte Sink, Sutter Bypass and Colusa Drain.

The Program Team includes:

- Program Director – RD 108
- Program Manager & Engineering – KSN
- Facilitation Team – Kearns & West
- Technical Team – cbec, Cramer Fish Sciences, Point Blue, San Francisco Estuary Institute, and Aquatic Resources Consulting
- Larsen & Wurzel Associates – Process Advisors

## Purpose of Document

This technical memorandum is one of several produced in support of the Floodplains Reimagined Landscape Scale Multi-Benefit Floodplain Feasibility Study Phase I. This specific technical memorandum documents opportunities, considerations and constraints—conditions that might enable or hinder actions—to achieve the priorities and objectives of the Program. The priorities and objectives are described in detail in a separate technical

memorandum. These technical memoranda are among several others that have been prepared as part of the full report: Floodplains Reimagined Phase I. This specific technical memorandum outlines the opportunities, constraints, and considerations that will inform:

- Preliminary concepts for hydrologic modeling
- Scenario development
- Discussion of landowner and resource manager willingness and tradeoffs
- Technical assistance for pilot projects and studies
- Areas of scientific uncertainty

### Technical Memorandums included in Phase I Report:

1. Priorities & Objectives
2. Existing Conditions
3. Outreach and Engagement Plan
4. Hydrodynamic Model Analysis
5. [Opportunities, Constraints & Considerations](#)
6. Evaluation Criteria
7. Scientific Uncertainties and Data Needs

## Methodology

The Floodplains Reimagined Program Team solicited and compiled information related to opportunities, constraints, and considerations from a variety of sources to better understand where underlying conditions might enable or hinder actions to achieve the Priorities and Objectives of Floodplains Reimagined. These sources included both direct engagement with stakeholders through meetings or interviews and an examination of related documents. This technical memo was prepared by Kears & West.

The Facilitation Team led the stakeholder engagement in coordination with the Program Team.

For the purposes of this technical memo, opportunities, constraints, and considerations are defined as follows:

### Opportunities

- Conditions that improve feasibility of meeting a Program Priority and/or Objective. These conditions may be external to the Program or generated by the Program participants themselves.
- Specific actions or combination of actions that support a Program Priority and/or Objective.

### Constraints and Considerations

- Constraining conditions, some of which are fixed and must be accommodated for preliminary concepts to succeed.
- Considerations are more malleable conditions to consider when generating preliminary concepts.
- Could be included as assumptions in the hydrodynamic or benefits models.

### Preliminary Concepts

- Idea for exploration of first round of hydrologic modeling.

### Scenarios

- Combination of Preliminary Concepts that set specific conditions for an analysis

### Program Team

Group of partners including the Program Manager, Facilitation Team, and Technical Team including: Kjeldsen Sinnock Neudeck; Kearns & West; Larsen Wurzel & Associates; cbec; SFEI; Point Blue; Cramer Fish Sciences; and Aquatic Resources Consulting Scientists.

### Program Manager

Reclamation District 108 is the grant recipient and responsible for fiduciary management.

### Facilitation Team

Responsible for facilitation and stakeholder engagement.

### Technical Team

Responsible for development of hydrologic modeling, scenarios, evaluation criteria, and scientific evaluation of benefits.

## Direct Solicitation from Stakeholders

**Stakeholder Assessment Interviews.** The Facilitation Team conducted interviews with a group of stakeholders representative of the geography and interests in the region. Interviewees represented: water management, flood management agencies, federal and state agencies, tribes, NGOs for conservation of wildlife and rivers, private and public landowners, local government, and Groundwater Sustainability Agencies, and Resource Conservation Districts. The interviewees represented the subregions of the Butte Sink, Sutter Bypass, and Colusa Drain. The Facilitation Team collected information about stakeholder interests and concerns, which informed the definition of Priorities & Objectives as well as opportunities and constraints.

**Information Sessions.** The Facilitation Team hosted Information Sessions for groups of stakeholders. In these sessions, the Facilitation Team solicited input on the draft Charter which encapsulated the priorities, objectives, and program structure. The Facilitation Team incorporated input and produced multiple iterations of the Floodplains Reimagined Charter for further review. The Facilitation Team hosted a special information session for the tribes only discussion and incorporated their input as requested.

**Steering Committee, Advisory Committee, and Ad Hoc Group Meetings.** The Facilitation Team and the Technical Team solicited input on opportunities and constraints in various meetings and breakout groups.

**Tribal Ad Hoc Group Meetings.** The Facilitation Team solicited opportunities and constraints from the Yocha Dehe Wintun Nation, Mechoopda Tribe, and Konkow Tribe as part of Tribal Ad Hoc Group meetings as well as Advisory Committee meetings.

**Meetings with Landowners.** The facilitation and Technical Team each met with individual and groups of landowners and presented briefings at water associations and reclamation districts. The Team incorporated input into opportunities, constraints, and considerations as well as into evaluation criteria. The Technical Team used the collected field-level data to inform modeling assumptions, including developing general trends and patterns that define inundation and draining of fields for different types of land use.

### Information Session Participants

#### Tribes

1. Konkow Valley Band of Maidu
2. Yocha Dehe Wintun Nation

#### Session 1

3. Butte County
4. CA Rice Commission
5. Central Valley Flood Protection Board
6. Ducks Unlimited
7. Goose Club and Roosevelt Ranch
8. The Nature Conservancy
9. Trout Unlimited
10. US Bureau of Reclamation
11. Western Canal Water District

#### Session 2

1. CalTrout
2. CA Department of Water Resources, Division of Flood Maintenance
3. Colusa County Groundwater Sustainability Agency
4. Wild Goose Club

## Review of Related Efforts Opportunities and Constraints

There is a constellation of related efforts in and overlapping with the geographic region that provide information on opportunities and constraints. The Program Team worked to build off of and inform related efforts in the following ways.

Related Efforts	Information Used by Floodplains Reimagined	Information Provided by Floodplains Reimagined
<b>Sutter &amp; Tisdale Bypasses Multi-Benefit Management Plan</b>	Scenarios developed in this process used as the basis for scenario development for Sutter Bypass Butte Slough Water Users Association scenario development for mid-Sutter Bypass	Technical Assistance provided to the Sutter Butte Slough Water Users Association to model their scenarios for discussion and refinement and proposal under the Voluntary Agreements
<b>Tisdale Weir Rehabilitation and Fish Passage Project</b>	Informed objectives, hydrologic modeling, and agricultural compatibility evaluation criteria	Results of Sutter Bypass Butte Slough Water Users Association options for increasing floodplain reactivation in the mid-Sutter Bypass
<b>Lower Sutter Bypass Anadromous Fish Habitat Enhancement Report</b>	Informed objectives and scientific uncertainties and data needs	None: project paused.
<b>Lower Butte Creek Project, Phase III Report</b>	Used to inform hydrologic modeling and outstanding opportunities for improvements to support the priorities	None: project complete
<b>Butte Sutter Bypass Coordinated Operations Group (BSBCOG)</b>	Compilation of agreements and operating plans used to inform hydrologic modeling and understand opportunities and constraints related to streamflow gauging in the Butte Creek system	Informed BSBCOG of the drainage system in the Butte Creek; provided water management information supporting 2001 Butte Creek Agreement
<b>Butte Slough Outfall Gates Rehabilitation Project</b>	None.	None.
<b>Mid and Upper Sacramento River Regional Flood Management Plan</b>	Informed objectives	None: project complete



Related Efforts	Information Used by Floodplains Reimagined	Information Provided by Floodplains Reimagined
<b>Yolo Bypass Big Notch Project</b>	Big Notch scientific rationale and criteria referenced for habitat suitability for birds and salmon.	None.
<b>Voluntary Agreements Scientific Basis</b>	Referred to draft scientific basis.	Potential to provide: a) menu of preliminary concepts on a regional basis for fulfilling wetted acre habitat; and, b) target areas of uncertainty and areas of divergence for the VA science program
<b>Cal Rice Commission Fish Studies</b>	Studies of juvenile salmon rearing on ricefields and fish food conservation practices for landowners referenced	Feedback provided on outstanding around uncertainties regarding juvenile salmon rearing on ricefields and opportunities, constraints, and considerations for landowners

## Program Context

This technical memo in support of the Floodplains Reimagined Phase I Report aligns with the vision and objectives of the Program: improve floodplain function that will produce multiple ecological, social, and cultural benefits for the region.

## Principles

The Program's governing principles include:

- Voluntary, locally-driven program that serves as a hub for all floodplain related efforts in the region to ensure efficiency and promote coordinated actions.
- Shared understanding of each other's interests, joint investigation, and collaborative generation of options and evaluation.
- Mutual respect and appreciation cultivated between sovereign tribal entities, private landowners, government and non-government representatives.
- Respect and work within existing land ownership and uses; indigenous land stewardship and cultural resources; and flood management functions, including operations and maintenance.

## Priorities & Objectives

In Phase I, the Program identified opportunities and constraints related to its identified priorities as follows:

### Priorities - Phase I Evaluation

- Agriculture
- Ecosystem Health
- Flood Control
- Floodplain Connectivity
- Floodplain Wildlife
- Indigenous Cultural Values
- Recreation
- Water Quality
- Water Supply

## Priorities - Future Phase Evaluation

- Carbon as a Greenhouse Gas - More specific projects and data is needed to evaluate the effects of change on Carbon as a Greenhouse Gas Priority
- Economic Prosperity - The Priorities of Agriculture and Recreation to a large extent serve as proxies for this Priority.
- Community Way of Life - The Priorities for consideration in Phase I cumulatively serve as a proxy for this overall Priority.

## Opportunities

The Floodplains Reimagined Program participants shared many opportunities with the Facilitation Team, which are compiled below in sections categorized by opportunities related to the overarching region, floodplain connectivity, enhancements.

## Need

The need for reactivation of the floodplain of the Sacramento River issues from a variety of regulatory requirements, preferences for voluntary proactive efforts, and growing evidence that floodplain reactivation could greatly contribute to salmon recovery. The drivers for the need for floodplain reactivation are outlined below:

- Instream Flow Requirements: The state is offering a two pathways to increase watershed health: 1) regulatory and 2) voluntary.
  - Regulatory Pathway: The California State Water Resources Control Board's Water Quality Control Plan which requires unimpaired flows in the San Joaquin and Sacramento watersheds.
  - Voluntary Pathway: Voluntary Agreements between the SWRCB and various water agencies across the state to provide 1) funding, 2) increased habitat, and 3) increased streamflows. This pathway has invited water users to explore ways to provide increased salmon habitat while protecting their livelihoods and property values.
- Groundwater Requirements: The state's requirement for Sustainable Groundwater Management Act and Plans have created a need to coordinate management of surface and groundwater. Overall, groundwater management is focused on creating opportunities to recharge groundwater and maintain sustainable groundwater levels.
- Juvenile Salmon Rearing Needs of Reactivated Floodplain: New science indicates the importance of floodplain function for juvenile salmon rearing and survival of returning adults.
- Planning for Salmon Recovery: State and federal agencies and water users are collaborating to advance salmon recovery and turn around the decline of all races of Chinook salmon.
- Local, Voluntary Stewardship: The Sacramento Valley water agencies and landowners support a culture of local voluntary stewardship and river restoration. Many are willing to invest in proactive, locally generated collaborative bottom up solutions rather than react to state

requirements. Some landowners who observed the Yolo Bypass Cache Slough Big Notch Project are hoping to create a more landowner-led collaborative solution in the Butte, Sutter Bypass, and Colusa region.

## Floodplain Connectivity

Opportunities related to the priority of floodplain connectivity are categorized in four types. These types mirror the Floodplain Forward project types.

### River Connections

River Connections include projects which reconnect rivers to their off-channel lands and historical floodplains. In some areas it is critical that these reconnections are highly managed and predictable when managing for intentional inundation of the floodplain and landowner properties. Infrastructure for modification could include major infrastructure such as outfall gates, weirs and similar man-made infrastructure that connects various parts of a modified river system. Opportunities identified in this sub-category included:

1. Modify overflow flood weirs with operable gates combined with bigger notches to enable greater management options for managed inundation in partnership with willing landowners.
2. Modify outfall gates with operable gates combined with bigger notches to enable greater management options for managed inundation in partnership with willing landowners.
3. Modify existing or add new diversions to intentionally direct river water to areas of managed inundation in partnership with willing landowners.

#### Floodplain Connectivity Opportunity Types

- River Connections
- Floodplain Flow Corridors
- Floodplain Reactivation and Fish Food
- In-River Function

### Water Management Conveyance

Water Management Conveyance are projects which improve or create conveyance from the river connection to the lands that are intended for inundation. The conveyance infrastructure often includes canals and ditches that gravity feed water from the river connection to fields and managed wetlands. Opportunities identified in this sub-category included:

1. Lower or raise land on either side of the Sacramento River Corridor to manage flood conveyance and inundation.
2. Improve field drainage and conveyance of flood waters.
  - 2.1. Design field weirs that allow real-time adjustment
  - 2.2. Develop operable gates for discharge control.
3. Develop conveyance to bypass non-participating landowners

#### Floodplain Forward

A collaborative advocacy group of scientists and growers developing a new path forward for holistic water management that incorporates best available science and practical know-how of farm and refuge managers to reactivate the floodplain.

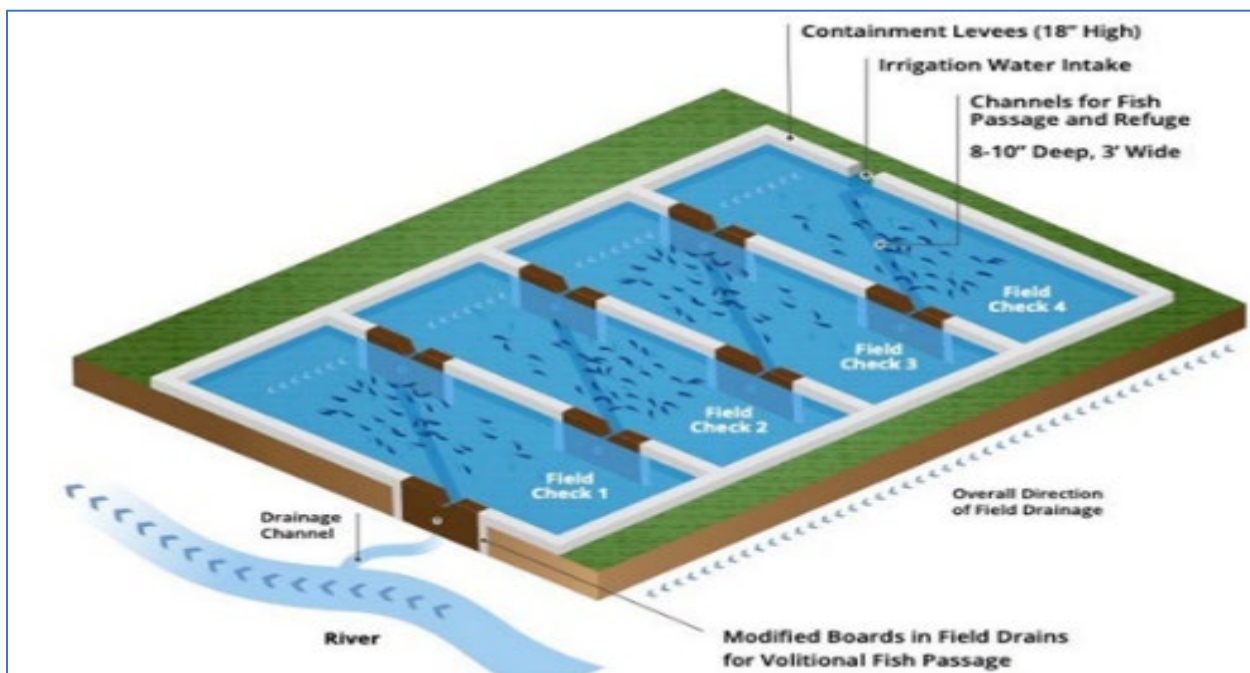
4. Design for flexibility of conveyance under range of flows.

## Land Management

Land Management includes projects which inundate lands and/or generate fish food. Suggested opportunities in this sub-category included:

1. Construct juvenile rearing habitat field units based on the draft pilot standard of practice as illustrated below.
  - 1.1. Manage water, debris, barriers, fish passage, ingress and egress on the field unit.

Figure 2: Draft Pilot Standard of Practice for Juvenile Rearing on Ricefields (CA Rice Commission)



2. Cultivate fish food and make available to juvenile salmon on ricefields and managed wetlands.
  - 2.1. Deliver to juvenile salmon rearing onsite on ricefields and managed wetlands.
  - 2.2. Deliver to juvenile salmon instream in Sacramento River.
3. Lower land and floodplains elevation to allow for intentional inundation.
4. Improve roads to improve and maintain access during inundation including:
  - 4.1. Update and elevate walkways, roads, and bridges.
  - 4.2. Install bigger culverts under roads and reinforce against erosion.
5. Update infrastructure to accommodate higher flows, including:
  - 5.1. Checks running in direction to avoid wave wash.

5.2. Large stop boxes to handle higher water.

5.3. Improve ditches for fish ingress and egress to reduce stranding.

## In-River Function

In-river function involves projects that enhance, restore, and/or create ecosystem function and/or habitat. Opportunities identified in this sub-category included:

1. Restore riparian corridors and floodplains.
2. Reduce potential stranding areas.

## Enhancements

Enhancement opportunities are activities that would complement any of the other opportunities to enhance the benefits of that opportunity. Stakeholder engagement identified five sub-categories of enhancement opportunities.

## Operations & Maintenance

This sub-category speaks to adjustments in how existing water infrastructure projects are operated and maintained. Specific activities noted in this sub-category, included:

1. Coordinate operations planning.
2. Adjust water releases.
  - 2.1. Releasing water at multiple locations may produce a greater, overall benefit rather than focusing on a singular location.
  - 2.2. Sutter Water Extension Water Transfer – transfer water from Sacramento River through Butte Creek to Sutter Wildlife Refuge
3. Reduce and remove debris for water conveyance, fish passage, and flood management, and reduction of risk to infrastructure.
4. Improve flow measurements and gauging.

## Fish Passage

For this sub-category, focused on increasing opportunities for fish to move more freely in modified water systems, the following actions were identified:

1. Install fish screens in diversions and water conveyance structures.
2. Remove barriers and improve fish passage at existing barriers.
3. Improve and maintain ditches for fish egress and reduction of adult stranding.
4. Install and operate new and improved ricefield and flood drainage and conveyance infrastructure on field level.

## Riparian Habitat Conservation and Restoration

This sub-category focused on opportunities to enhance, restore, and/or create ecosystem function and/or habitat in riparian areas, which would complement in-river opportunities identified above.

1. Restore streambanks.
  - 1.1. Remove or place riparian riprap as part of streambank restoration.
  - 1.2. Enhance shade of riverine aquatic habitat.
2. Complement in-river restoration through Tribes' collection and cultivation of ceremonial plants.
3. Prevent and control aquatic invasive plant species in riparian zones.

## Groundwater Recharge

This sub-category highlights opportunities that recognize connectivity between groundwater and surface water as important and complementary to overall ecosystem function of floodplains. Discrete opportunities identified included:

1. Inundate lands where Groundwater Sustainability Agencies (GSAs) have indicated needs for groundwater recharge.
2. Inundate lands to recharge known groundwater-dependent ecosystems.
3. Use inundation to recharge groundwater for conjunctive use.

## Adaptive Management

Adaptive management is a structured approach to decision making that emphasizes accountability and explicitness in decision making. The U.S. Department of the Interior's Adaptive Management Technical Guide defines adaptive management as "ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself".<sup>1</sup>

An adaptive approach actively engages stakeholders in all phases of a project over its timeframe, facilitating mutual learning and

### Nine Steps of Adaptive Management

1. Stakeholder involvement
2. Management objectives
3. Management alternatives
4. Predictive models
5. Monitoring plans
6. Decision making
7. Monitoring responses to management
8. Assessment
9. Adjustment to management actions

reinforcing the commitment to learning-based management. <sup>2</sup> Opportunities identified in this sub-category included:

1. Measure flows to support coordinated operations and monitoring.
2. Develop workforce to operate, maintain, and implement, and monitor multi-benefit actions.
3. Monitoring of stranding conditions.
4. Invite Tribes to monitor cultural sites during construction.
5. Proactive coordinated operations and partnerships to adapt.
6. Management Plans for duck clubs for significant inflows.
7. Develop salmon population models.

## Regulatory and Policy

Regulatory and policy opportunities involve new or adjustments to existing policies and regulations, including non-enforceable policy guidance as well as enforceable regulations at all levels of government. The policies of non-governmental entities could also fall into this group. Opportunities identified in this sub-category included:

1. Programmatic and permitting assurances to protect landowners from incidental take.
  - 1.1. Programmatic take coverage through Section 7 consultation.
2. Systemwide, transparent safe harbor agreements.

## Economic

Economic opportunities include direct and indirect financial incentives. This includes new programs or modification of existing programs to provide or enhance monetary incentives for undertaking specific activities that support Priorities and Objectives. It could also include undertaking analyses that illuminate financial benefits and costs. Specific activities identified for this sub-category included:

1. Financial incentive programs
2. Technical Assistance to landowners and operators
3. Cost analysis

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<sup>1</sup> *Technical Guide*. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC. ISBN: 978-1-4133-2478-7

<sup>2</sup> Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. *Adaptive Management: The U.S. Department of the Interior*



## Regional Constraints & Considerations

Considerations and constraints are conditions that are important to acknowledge and incorporate into management decisions to ensure optimum outcomes. Advisory Committee members acknowledged that there are different kinds of constraints and considerations. While a few are fixed and immutable, most of these are “soft” with the potential to be mitigated or addressed if landowners and water users are willing and a common ground of compatibility can be achieved. For some considerations and constraints, the Advisory Committee identified possible solutions. These are provided in a separate table. These constraints and considerations are reported in relation to the Program Priorities.

The Floodplains Reimagined Program Partners will work with landowners and water managers to determine the action(s) to address these constraints and concerns around compatibility of generation of concepts for floodplain reactivation with the Priorities.

### Evaluation Criteria

Importantly, the constraints and considerations informed a suite of Evaluation Criteria for evaluating the performance of potential concepts against the Priorities and Objectives. For more information, please see Technical Memorandum listed in the side panel.

The Program Team is planning to develop additional Evaluation Criteria related to the Floodplain Wildlife priority. These are listed in the Technical Memorandum as next steps.

The Program has not developed evaluation criteria for some of the Priorities including Cultural and Indigenous Resources, Economic Prosperity and Community Way of Life priorities. The tribes stated that they would evaluate the potential options against their own Cultural and Indigenous Resources priority. The Economic Prosperity and Community Way of Life priorities rely almost entirely on the evaluation of the other priorities, so it has no independent evaluation criteria.

#### Governing Program Principle Compatibility

- Landowner Willingness

#### Priorities Compatibility

- Agricultural
- Cultural and Indigenous Resources
- Recreation
- Floodplain Connectivity
- Floodplain Wildlife
- Community Way of Life
- Economic Prosperity

#### Other Compatibility Considerations

- Regulatory

#### Evaluation Criteria

- Juvenile Salmon Rearing Habitat Suitability Criteria
- Bird Habitat Suitability Criteria
- Zooplankton Productivity and Export Suitability Criteria
- Agricultural Compatibility Suitability Criteria
- Managed Wetlands and Waterfowl Hunting Impacts Suitability Criteria

## Willingness Compatibility

The following constraints and considerations were identified related to private landowner willingness.

1. Neighboring landowner potential risk for maintaining and modifying ricefield and wetland barriers to avoid inundation of their lands, particularly for orchards
2. Water user and operator willingness
3. Water rights

## Agricultural Compatibility

The agricultural landowners contributed to discussions of agricultural compatibility with increased floodplain reactivation and reconnection.

The Technical Team brought resources and criteria from other related efforts to inform the discussions of agricultural compatibility. Landowner Ad Hoc Groups and individual interviews with landowners contributed to the development of Agricultural Compatibility Evaluation Criteria, which is provided in a Technical Memorandum in the Appendices.

Discussions revealed a suite of considerations for developing preliminary concepts for meeting the priorities of the Program. For agricultural compatibility, these considerations included:

1. Maintain seasonal start and end points.
  - 1.1. Start inundation no earlier than October 1 to November 5 to beginning of May 1 or May 14. Various landowners gave different input depending on their subregion, drainage timing of their field, crops, managed wetland needs.
  - 1.2. Support operational flexibility. There was a suggestion for rolling inundation schedule flexibility for start and end of the winter inundation period to allow for different crop planting and harvesting times in different fields as well as different year types.
  - 1.3. Field saturation and magnitude of inundation and potential related damage or delay for planting.
2. Maintain cropping flexibility.
3. Maintain or improve access.
4. Minimize needs for maintenance on levee and water control and delivery infrastructure for irrigation.
5. Maintain crop insurance coverage eligibility.
6. Improve financial incentive programs.
7. Maintain or improve water quality for crops.
8. Maintain or improve water supply for agriculture.

## Cultural and Indigenous Resources Compatibility

Some regional tribes participated in the Advisory Committee and Tribal Ad-Hoc Groups to contribute to identification of opportunities, constraints, and considerations.

Under federal law, any landowner or agency embarking on formal project planning and implementation will need to consult with the Tribes. The tribes requested early planning and consultation with them.

The following reflects the tribes considerations for compatibility with cultural and indigenous resources compatibility. The Facilitation Team documented these considerations in the Tribal Ad-Hoc Working Group and reflected them back to the participants. The Yocha Dehe Wintun Nation invited the Program to view this as an opportunity for problem solving.

Considerations for compatibility collected from participants include:

1. Access to riparian areas populations for gathering of ceremonial plants and ceremonial materials from wildlife.
2. Improvement of wildlife populations that provide ceremonial materials.
3. Access to burial sites and ceremonial grounds.
4. Protection of burial sites and ceremonial grounds.
5. Protection from public knowledge of cultural sites with best management practices for mapping. Tribes requested that the team comport with DWR's agreement with tribes around mapping to protect.

## Recreational Compatibility

Floodplain improvements also need to consider waterfowl hunting recreation. The Hunting and Managed Wetland Ad Hoc Group discussed and contributed to the development of Managed Wetlands and Waterfowl Hunting Evaluation Criteria, which is provided in a Technical Memorandum in the Appendices.

Discussions among hunting clubs, wetland managers, and public refuge managers revealed a desire to ensure that floodplain improvement activities maintain or improve recreational hunting opportunities. With this objective in mind, some specific considerations included:

1. Timing, Depth, Rate, and Duration affecting Opportunity Days
  - 1.1. Frequency and timing of exceeding targeted inundation levels.
  - 1.2. Rate of inflow and drainage.
2. Maintain # hunting opportunity days and timing.
  - 2.1. Duration of inundation effects on hunting season opportunity days; an increase in inundation frequency and magnitude between October and May may limit hunting

opportunity days, decrease concentration of waterfowl at hunting clubs, and affect access along hunting club roads that get inundated.

3. Maintain shoot level depths
  - 3.1. Preferred shoot levels are within inches of target inundation levels for juvenile salmon rearing.
4. Maintain access.
5. Maintain or improve waterfowl density and species type diversity by managing habitat conditions.
6. Minimize need for maintenance on levee and water control and delivery infrastructure for managed wetlands.
7. Maintain safety of recreational hunting structures: docks, cabins on stilts, duck blinds
8. Maintain or improve predictability of hunting opportunities.
9. Maintain or improve ability to conduct off-season and on-season vegetation management.
10. Maintain or improve safety related to depth, velocity, timing, predictability.

## Floodplain Wildlife Compatibility

Ensuring floodplain improvements are compatible with broader fish, wildlife and ecological restoration objectives received robust input on a variety of elements for consideration. The group identified overarching considerations as well as considerations for birds and fisheries.

Overarching considerations for all wildlife included:

1. Avoiding negative impacts to restoration sites.
2. Avoiding flooding damage to wetland infrastructure and easements for fish and migratory birds.
3. Management area mandates.
4. Meeting incentive program goals for shorebirds, cranes, and other bird species.

## Birds Compatibility

Participants identified many considerations for compatibility of reactivating floodplain with birds including waterfowl, shorebirds, and cranes. The list below reflects input collected and reflected in the Advisory Committee meetings. The Bird Ad Hoc Group discussed and contributed to the development of Bird Habitat Suitability Evaluation Criteria. For more information see the Bird Habitat Suitability Evaluation Criteria Technical Memorandum.

1. Prey presence and density.
2. Species diversity.

3. Shorebirds and waterfowl depend on shallow-flooded open water habitat for foraging in the area.
4. Limited habitat for shorebirds during shoulder seasons (Aug-Sept, Mar-May).
5. A large proportion of winter habitat is voluntarily created by post-harvest flooding in rice, but is at risk of loss in drought years or due to crop conversions.
6. Depth limits access for shorebirds and dabbling ducks.
7. Conservation objectives for shorebirds and waterfowl have been established by the Central Valley Joint Venture.
8. Cranes depend on shallow-flooded open water habitat for roosting, and forage in nearby dry fields or on the leading edge of flood-up.
9. Depth limits overnight thermoregulation in winter.
10. Bird habitat management compatibility.
  - 10.1. Fall and spring bird habitat inundation levels.
  - 10.2. Impacts to foraging habitat for shorebirds and foraging and roosting habitat for cranes.
  - 10.3. Impacts to breeding habitat for waterfowl, shorebirds, landbirds, and other special status bird species particularly if changes to land use and land cover or other restoration actions are anticipated.

## Fisheries Compatibility

Agencies, landowners, tribes, and water districts have all expressed various considerations for compatibility with fisheries. It is important to note the divergence of viewpoints around system management compatibility with fisheries which is listed first below. This compilation reflects input from participants at various Advisory and Steering Committee meetings. See the resulting Juvenile Salmon Habitat Suitability Evaluation Criteria Technical Memorandum.

1. System Management
  - 1.1. Divergence of viewpoints
    - 1.1.1. Increased complexity of management – potential unintended consequences or current management has wrought unintended consequences and improvements can be made to benefit fisheries. Increased human intervention, management, and infrastructure and management is prone to failure and detrimental to long-term survival of salmon population.
    - 1.1.2. Improving and adding to the current managed system to benefit salmon would be better than the current system and contribute to salmon survival on a population scale.
2. Adult and juvenile salmon exposure to poor conditions and stressors such as high temperatures, low dissolved oxygen, predation, and poor water quality.

- 2.1.1. Divergence of viewpoints around the risks and benefits of increased juvenile residence time on wetted habitat. Some participants express concern that residence time on wetted areas may expose fish to the stressors listed above. Others hold that residence time on wetted acres will be beneficial to fish growth and survival and is worth the tradeoff.
- 2.2. Residence time on wetted habitat will push out juvenile salmon outmigration to later, potentially resulting in exposure to lower flows associated with the above stressors, potentially resulting in decreased survival.
- 3. Fish Passage barriers
  - 3.1. Identification and reduction of fish passage barriers or chokepoints.
  - 3.2. Support for fish passage at chokepoints created by infrastructure and aquatic invasive species.
  - 3.3. Management and protection against aquatic invasive species choking channels and fish passage infrastructure.
- 4. Inundation management
  - 4.1. Depth of inundation.
    - 4.1.1. Divergence of viewpoints around optimal and tolerable range of depths for juvenile rearing.
  - 4.2. Recession rates and timing of inundation
- 5. Ingress, Egress and Routing
  - 5.1. Juvenile salmon ingress and egress from wetted habitat.
  - 5.2. Adult salmon restriction from ingress and egress from wetted habitat.
  - 5.3. Potential tradeoffs between adults and juveniles.
    - 5.3.1. Potential increase in stranding sites due to sediment transport deposition and scour.
  - 5.4. Increased juvenile access to wetted habitat may increase stranding sites for juveniles and adults.
    - 5.4.1. Unscreened diversions
- 6. Food availability on wetted area

## Flood Control Compatibility

Existing water and transportation infrastructure was an additional area which could present constraints to floodplain improvement activities. Considerations relevant to this topic included:

- 1. Integrity of infrastructure

2. Long-term maintenance costs including staffing and resources.
3. Ability to meet operations and maintenance goals.
4. Flood management and conveyance.
5. Ability to modify overflow weirs to be operable gates with lower notches to support inundation at higher frequency, magnitude, and depth.
6. Fine control to allow compatibility and reduce risk.
7. Off-season vegetation management.

## Economic Prosperity Compatibility

Landowners raised economic prosperity and compatibility of any concepts with maintaining their livelihoods, value of property, and financial opportunity. Economic prosperity is strongly dependent on the agricultural and recreational compatibility.

Considerations relevant to this topic included:

1. Loss of income resulting from restricted farming capacity.
2. Costs of additional facilities maintenance, staffing, and other resources.
3. Costs associated with road and infrastructure damage from too much water inundation leading to road washout.
4. Costs of delayed crop cycle for the coming growing season.
5. Cost of road and infrastructure repairs resulting from inundation damages would need to be completed before the land could be utilized resulting in a loss of the incentive payment because due to not being able to meet Program goals.
6. Loss of property value due to unpredictable or limited use of land for intended for economic gain.

## Community Way of Life Compatibility

Landowners in particular raised the issues of roads and access that affect community way of life as well as economic prosperity.

Though compatibility with agriculture, recreational hunting, floodplain wildlife are all part of the community way of life, they have been addressed individually.

Considerations relevant to this topic included:

1. Roads and road access
  - 1.1. Access for private landowners, workers, and guests.

1.2. Emergency access for first responders and for infrastructure repair and maintenance.

1.3. Road integrity, erosion and sedimentation into nearby receiving waters.

## Regulatory Compatibility

The compatibility with current regulations came up in various meetings with agencies and landowners alike.

Considerations relevant to this topic included:

1. Regulations and permitting
  - 1.1. Threat of arrest and fines
  - 1.2. Loss of autonomy and decision making
  - 1.3. Incidental take
2. Water rights
  - 2.1. Compliance with and protection of water rights
3. Management Mandates
  - 3.1. Public refuges existing management mandates



# Subregional Opportunities, and Constraints and Considerations

## Subregional Opportunities

It is important to note that the opportunities listed are a compilation of input from a range of stakeholders. The options do not enjoy agreement, nor have they been evaluated for benefits. In fact, some landowners and agencies have expressed their views that they would not support some of these options or would need further analysis of benefits and development of mitigations for associated negative impacts.

### Colusa Basin

- Modify diversion operations.
- Modify diversion infrastructure.

### Sutter Bypass

- Notch and make operable gates on overflow and flood weirs.
- Modify existing or add new diversions.
- Modify operations of gates and weirs.
- Potential to modify the internal on-field diversion structures and split the flow to redirect water to the high side of the Sutter Bypass.

### Butte Basin

- Notch and make operable gates on overflow and flood weirs.
- Modify existing or add new diversions.
- Modify operations of gates and weirs.

### Timing of Inundation

- Treat different land uses with different inundation timing, if possible. Consider that areas served by RD1004 and Butte Sink are hydrologically connected and may not be able to be inundated at different times.
  - Hunting Clubs could be inundated in September and February
  - Agriculture cannot be inundated in September and October
  - Managed Wetlands could be inundated in February and March

### Duration of Inundation

- Provide water to Butte Sink when Sacramento River is at 20 K cfs rather than 60 K cfs through Moulton and Colusa operable weirs.

- Fill in dry periods between inundation events, smooth out hydrologic dips between precipitation events to extend the duration of inundation and make Butte Sink accessible to Sacramento juvenile fish.

#### Depth of Inundation

- Increase depth of inundation in Butte Sink east and west of Butte Creek to meet preferred shooting level.
  - Lands outside the 1922 agreement or higher in elevation that may want water in some year types when the 1922 agreement parties have enough water.

#### Geographic Extent and Depth of Inundation

- Increase depth on fields that are higher in elevation and further from Butte Sink that typically stay drier.

#### Options Proposed for Further Exploration

##### Conveyance

- Build a canal from Moulton Weir to Butte Creek to convey Sacramento River juvenile fish to the Butte Sink for rearing when Sac River is flowing 20k cfs or over.
- Build a canal to convey fish food from Butte Sink to the Sacramento River for juvenile salmon.

##### Drainage

- Any increase in water to Butte Sink should also include improving drainage at bottom of Butte Sink where the elevations are lowest and flows pool and drain back into Butte Creek. Includes Sacramento Outing and El Anzar Hunting Clubs.
- Improve management of drainage of lands along Butte Creek such that the drainage flows where they combine at any point or independently are always significantly less than the Butte Creek's flows. This reduces the risk of false attraction flows for adult spring-run Chinook migration. Focus coordinated management practices during the spring-run Chinook migration which can vary depending on the water year from March – June.

Again, participants in Floodplains Reimagined hold diverging viewpoints on the aforementioned options. They are listed here as a reflection of option generation and should not be viewed as enjoying support.

## Subregional Considerations and Constraints

### Colusa Basin

In the Colusa Basin, participants raised particular considerations and expressed diverging viewpoints around the existing conditions in the Colusa Basin and therefore, the objectives and options. The areas of consideration for this subregion are as follows:

1. Agricultural Compatibility
2. Managed Wetlands Compatibility
  - 2.1. Sutter Wildlife Refuge to manage for birds
3. Fisheries Compatibility
  - 3.1. Water Quality
    - 3.1.1. Diverging viewpoints on whether water quality is a stressor to juvenile and adult salmon in Colusa Basin Drain.
      - 3.1.1.1. Some parties say that the basin TMDL indicates poor water quality.
      - 3.1.1.2. Other parties say that the Water Quality Coalition or Exchange reports adequate water quality.
    - 3.2. Stranding of adult salmon
      - 3.2.1. Diverging viewpoints about whether stranding of adult salmon is a tolerable risk in comparison with the benefits to juvenile salmon and ecosystem benefits of reconnecting the floodplain with the Sacramento River through modification and reoperation of flood conveyance structures and land management.
        - 3.2.1.1. Some parties state that the risk of stranding adult salmon by the increased engineering of the system does not

### Sutter Bypass

With regard to Sutter Bypass, participants raised the following issues particular to Sutter Bypass. This list includes for consideration the Lower Sutter Bypass Report recommendations.

1. Agricultural Compatibility
  - 1.1. Sediment deposition from Feather River (Lower Sutter Bypass Report)
  - 1.2. Pumping high salinity groundwater is not compatible with agriculture nor managed wetlands.
2. Flood Control Compatibility
  - 2.1. Flood freeboard levels are sensitive to amount, location, and type of riparian habitat in Lower Sutter Bypass (Lower Sutter Bypass Report)
3. Fisheries Compatibility

- 3.1. Fish passage barriers for adult and juvenile salmon in the Lower Sutter Bypass (LSBR) including aquatic vegetation and infrastructure.
- 3.2. Adult and juvenile entrainment and stranding into unscreened diversions.
- 3.3. Adult and juvenile exposure to predation.
- 3.4. Exposure to too stressful water temperatures.

## Butte Basin

In the Butte Basin, characterized by hunting clubs, agriculture, lowlands, and managed wetlands, certain types of considerations arose repeatedly.

- 1. Recreational Compatibility
  - 1.1. Reduced recreational hunting access during waterfowl hunting season – especially related to potential Moulton Weir modifications to allow increased frequency of inundation.
  - 1.2. Road failure that could reduce access.
  - 1.3. Rate of drainage of water off hunting clubs to maintain optimal shooting level for recreational waterfowl hunting.
- 2. Agricultural Compatibility
  - 2.1. Need to respect unwilling landowners who might not want more frequent inundation of lands, even with incentives. In particular, orchards and row crops in the Upper Butte Basin would be damaged by inundation.
  - 2.2. Groundwater substitution for surfacewater in dry years, negatively affects bird habitat and agricultural production.
- 3. Managed Wetland Compatibility
- 4. Fisheries Compatibility
  - 4.1. Spring drainage off of hunting clubs on the East side of Butte Sink and off of hunting clubs and rice fields on the West side of Butte Creek may be creating false attraction flows when drainage flows are relative to the Butte Creek flows, which could be causing spring-run Chinook adults to migrate upstream into dead-end sloughs and drainage areas, get stranded, and die. Cumulative drainage, timing, magnitude of drainage in relation to Butte Creek flows should be taken into consideration.
  - 4.2. Management of fish access to the floodplain and back into Butte Creek during different year types

## Areas of Scientific Uncertainty

This section reflects areas of scientific uncertainty documented in the Advisory Committee Meetings. For further detail, please see Fisheries Areas of Scientific Uncertainty Technical Memorandum.

### Adult and Juvenile Salmon Benefits and Risk

Participants identified uncertainty around the limiting factors and benefits of various options to races of salmon as well as to the population. Participants also expressed diverging viewpoints on their tolerance for risk and interpretation of tradeoffs. The following list of uncertainties reflects input collected and reflected in the Advisory and Steering Committee meetings. For further discussion, please see the Chinook Science Uncertainties and Data Needs Technical Memorandum.

- 4.3. Uncertainty around benefits to juvenile salmon
  - 4.3.1. Number of juvenile salmon in the geographic region and available for entrainment into new juvenile rearing habitat on ricefields or restored natural floodplain
  - 4.3.2. Number of juvenile salmon entrained in relation to magnitude of water passing through the modified operable gated weirs to inundate ricefields, floodplain, or wetland preserves (see Lower Sutter Bypass Report)
- 4.4. Uncertainty around sensitivity of flow-juvenile salmon proportionality ratio as modeled in Lower Sutter Bypass
- 4.5. Uncertainty over what should count as meaningful benefits of floodplain access for juvenile fish. We lack examples showing wild fish volitional access to flooded agricultural fields. Without this information we're making assumptions about connectivity.
- 4.6. Uncertainty over likely survival and growth rates in flooded agricultural fields vs natural floodplain habitats. Disagreement over predation, food production, importance of habitat complexity, and access between these habitat types.
5. Uncertainty of risk to adult salmon and evaluation of tradeoffs between benefits to juvenile salmon rearing and risks of entrainment and mortality for adult salmon
  - 5.1. Tradeoffs between adult spring-run Chinook stranding and juvenile rearing on managed floodplains. Entrainment and stranding risk to adult salmon when intentionally moving juvenile salmon onto managed floodplains including ricefields, hunting clubs. and/or wetland preserves
  - 5.2. Influence of drainage magnitude and timing on spring-run Chinook adult attraction and stranding during spring migration. Ricefield, hunting club, and wetland drainage magnitudes, timing, flexibility, and infrastructure capacity to control drainage flows and timing.
    - 5.2.1. Various adult spring-run Chinook incidents in the spring around sloughs in Butte Creek in the Butte Sink in which fish have been found stranded and dead during their spring migration. There is a hypothesis that false attraction flows from

ricefield and hunting club drainage are higher in proportion to the Butte Creek flows and causing stranding.

## Juvenile Salmon Rearing on Rice Fields

Similarly, participants also raised uncertainty around the science indicating benefits and risk of rearing juvenile salmon on rice fields. Some participants would like to see more analysis to reduce this uncertainty to inform decision making.

1. Relationship between survival rates for hatchery v. wild juvenile salmon for on-field juvenile rearing practice standard
  - 1.1. Divergence of viewpoints around whether this distinction is important
2. Management needs
  - 2.1. Level of management needs for maintaining clear holes for juvenile fish passage in rice checks given debris in the water and number of holes, and likelihood of participation
  - 2.2. Level of management needs for pulling boards to prevent fish stranding, and likelihood of participation
  - 2.3. Level of management needs for prohibiting undesirable fish egress through unknown or undesirable water pathways

## Fish Passage

Based on the Lower Sutter Bypass Report, exploration of increased reactivation of floodplain should consider reducing uncertainty around fish passage. The Report recommends:

Although not identified as a specific constraint to the project, the resolution of the project element designs was not sufficient to complete an adequate fish passage analysis. Therefore, as part of continued project and pilot-project design development, structure/element-specific passage criteria should be used for comparison to HD model hydraulic output. Quantitative and qualitative fish passage criteria should; (1) be agreed upon by the technical team and stakeholder biologists; (2) address both juvenile and adult target species; and (3) be evaluated through future HD modeling. (Lower Sutter Bypass Report p. 55)

## Flow Measurement to Inform Coordinated Operations

Participants in Butte Basin and Sutter Bypass identified real-time flow measurements as a reduceable uncertainty. This uncertainty is informed by the Butte Sutter Bypass Coordinated Operations Group led by CDFW and the Northern California Water Association.

1. Uncertainty of flow and stage measurements in Butte Creek year-round
  - 1.1. Flow and Stage Measurement Unavailability in Butte Creek (see BSBCOG flow measurements importance and challenges)

## Sediment Transport

Participants identified that sediment management is an area of uncertainty to consider when proposing reactivating and reconnecting floodplains. Two major uncertainties arose:

- Sediment transport through modified weirs and with increased inundation depth, timing, and frequency.
- Sediment load and deposition from the Feather River and potential management options.

Based on the Lower Sutter Bypass Report, exploration of increased reactivation of floodplain should consider sediment deposition from the Feather River.

A significant constraint to implementation of the project is the high sediment load carried by the Feather River. Sediment deposition within created project channels, wetlands, and other diversion structures (esp. within the Nelson Slough Unit) will have to be managed on a routine basis for project elements to function as intended. Sediment deposition within the LSB floodplain and agricultural fields will also occur. A cost-benefit analysis of the long-term operations and maintenance (O&M) costs associated with sediment removal will help inform the final selection and implementation of project actions. It is recommended that sediment transport analyses be completed as part of further project design to better quantify the depositional patterns and volumes of sediment within or in response to project elements. This information along with a cost-benefit analysis will better inform the long-term sediment management operations and maintenance required for implementation of a sustainable project. (Lower Sutter Bypass Report p. 55)

## Flooding Impacts from Riparian Habitat Creation

The Lower Sutter Bypass Report also recommends identifying long-term O&M to maintain flood freeboard criteria. The Report recommends:

Preliminary modeling results indicate that on- and off-site flood freeboard levels are highly sensitive to the amount, location, and type of riparian/wetland habitat creation that occurs in the Lower Sutter Bypass. The maximum riparian conversion scenario evaluated under this study likely leads to undesirable impacts on flood levels that don't satisfy the associated project means objective. Therefore, it is recommended that further analyses be completed to determine the amount of riparian area creation that is feasible without adversely impacting flood hazards in the LSB. This analysis would likely involve a HD model sensitivity analysis to evaluate smaller riparian creation footprints and how they satisfy the flood and habitat means objectives. It is also recommended that the long-term O&M needs be identified to maintain the area of riparian habitat in a manner that satisfies required flood freeboard criteria. (Lower Sutter Bypass Report p. 55)



## Areas of Divergence

In many discussions, participants learned from each other's knowledge and expertise and accepted each other's views or converged around considerations and associated evaluation criteria. However, participants expressed various diverging viewpoints around certain areas. What follows is a summary compilation of divergence as documented in the Advisory Committee meetings.

The participants discussed and contributed to a conceptual identification of Chinook Scientific Uncertainties, which informed the Technical Team development of the associated Technical Memorandum in the Appendices of this report.

### Salmon

#### Juvenile Salmon Rearing

In Advisory Committee and Ad-Hoc Group meetings, participants converged around many points of compatibility with juvenile salmon rearing. However, participants expressed diverging viewpoints around 1) the optimal and tolerable ranges of depths and 2) habitat cover benefits in relation to each other.

These diverging viewpoints are captured in detail in the Juvenile Salmon Rearing Habitat Suitability Evaluation Criteria Technical Memorandum. The Memo also includes next steps for reducing uncertainty that could resolve these divergence of viewpoints and contribute to updating the Juvenile Salmon Rearing Habitat Suitability Evaluation Criteria.

#### Juvenile Salmon and Adults Tradeoffs

Participants expressed divergence of viewpoints around risk and tolerance of risk around tradeoffs between adult and juvenile salmon. The scientific uncertainties related to these tradeoffs and risks are reflected in the Chinook Salmon Scientific Uncertainties and Data Needs Memorandum in the Appendices of this report.

The views expressed in the Advisory Committee, Steering Committee, and Ad-Hoc Groups are reflected below. The Facilitation Team has paraphrased the distinct views expressed for each issue.

#### Divergence

1. Increasing juvenile rearing survival with ricefield rearing will have meaningful benefits on the population scale. The risk to adults is tolerable and the benefits outweigh the risk given the urgency and the current managed system.
2. It is uncertain whether juvenile survival will increase with ricefield rearing and uncertain whether such projects will have meaningful benefits on a population scale. The risk is relatively high and should be understood and tested more before planning to implement these concepts.

#### Divergence

1. It is more important to support increasing juvenile production than protect against relatively lower numbers of individual adult stranding. Higher numbers of juveniles represent higher probability of survival to adult spawning life stage.

2. It is more important to protect against any adult stranding because adults represent the most probable and most immediate opportunity for reproduction.

The following are uncertainties around risk that interrogate the level of risk and benefit tradeoffs between juvenile and adult salmon life stages:

3. Risk of negative impacts or negligible impacts on population scale tradeoff with potential for positive net impact of increasing inundation frequency and duration on salmon population at scale.
4. Risk of adult stranding due to entrainment onto wetted fields and wetland preserves
5. Risk of adult stranding due to false attraction flows created by spring field drainage. In particular risk is high when the proportion of drainage is high relative to the flows in Butte Creek. This can cause salmon to follow the greater magnitude of water and get stranded and die in sloughs in the Butte Sink.
6. Risk to adult salmon posed by introduction of new juvenile rearing on ricefields. Some question whether these risks are worth the benefit to juveniles. There are diverging viewpoints on whether science already indicates meaningful benefits of juvenile rearing on ricefields on a population scale. While some participants interpret the science to indicate that there is strong meaningful benefit for population level salmon recovery. Others question whether there is meaningful benefit to juveniles that outweighs the risk to adults:
  - 6.1. Does juvenile rearing on ricefields can provide meaningful benefits to wild juvenile fish with volitional access? Need examples demonstrating benefit to wild fish volitional access to flooded agricultural fields. There are diverging viewpoints on whether science already indicates meaningful benefits of juvenile rearing on ricefields on a population scale.
  - 6.2. Does juvenile rearing on ricefields offer meaningful difference between survival and growth rates on managed ricefields vs. natural floodplain habitats?
  - 6.3. Does juvenile rearing on ricefields provide meaningful benefits to wild and hatchery fish?
7. Risk to salmon of new options that would affect predation, food production, importance of habitat complexity, and access between these habitat types. There are diverting viewpoints on the relative importance of each of these stressors in relation to floodplain reactivation options.
8. Risk of high level of human intervention dependent on human behavior, which can be inconsistent. Management would include: pulling boards, maintaining holes in boards for juvenile fish passage and maintaining field barriers to prohibit fish from undesired water pathways.
9. Risk of reducing genetic purity of wild origin fish tradeoff with increasing juvenile fall-run salmon rearing to increase overall population
  - 9.1. Risk of reducing genetic purity of spring-run, winter-run, and fall-run tradeoff with considering releasing fall-run juvenile salmon from Sacramento River and hatcheries into Butte Creek watershed system for rearing.

## Water Quality in the Colusa Basin

The Advisory Committee members expressed diverging viewpoints at multiple times around the existing conditions and associated opportunities and considerations around water quality in the Colusa Basin. There seems to be diverging viewpoints between the fish agencies and the reclamation districts around the current state of water quality and its compatibility for introducing salmon to the Colusa Drain.

The diverging viewpoints are as follows:

1. NMFS and CDFW stated the water quality in the subregion is not fit for salmon due to high salinity and poor water quality according to SWRCB TMDL for Colusa. This viewpoint is supported by the SWRCB TMDL.
2. RD108 says the area has done water quality testing and restoration that has improved water quality to standard. This viewpoint is supported by the Water Quality Coalition monitoring.

To achieve a shared understanding of the data and interpretations, participants could convene to jointly review and understand the data supporting each view. They could identify science that supports optimal and tolerable ranges of water quality standards for salmon life stages. These discussions could inform the opportunity and constraints for floodplain reactivation and different types of preliminary concepts exploration in Colusa Basin.

## Science & Data Acquisition

Participants proposed efforts to reduce uncertainty and improve the knowledge base through research, experimentation, and data collection. Science and data acquisition could help address several constraints, considerations risks and uncertainties that participants raised throughout these discussions.

Regarding data needs around salmon, the participants discussed and contributed to a conceptual identification of Chinook Scientific Uncertainties, which informed the Technical Team development of the associated Technical Memorandum in the Appendices of this report.

The Facilitation Team captured the following input from participants for additional research and analysis that could address some of the uncertainties identified throughout this memo.

1. Inventory of properties at risk, their ancillary infrastructure, and potential improvements
2. Cost analysis of erosion to landowners
3. Study of managed floodplain systems that function well. Suggestion that Butte Sink be a model.
4. Water quality monitoring
5. Research and mapping to determine groundwater-dependent ecosystems
6. Information sharing, data collection and analysis, and monitoring of implementation strategies.