

# LINKING COMPENSATORY MITIGATION AND RESTORATION OF RIPARIAN WETLAND FUNCTIONS AND VALUES

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MASTER'S PROJECT

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# WHY SHOULD WE CARE?

- **In California's Central Valley, approximately 95% of riparian habitat has been lost due to human impact**
- **Compensatory mitigation is typically not successful at restoring important functions**
- **Results in overall loss of wetland functions that provide important ecosystem services**

**Sources: Griggs 2009, Ambrose et al. 2006, Sudol and Ambrose 2002**

# RESEARCH OBJECTIVES

## Main Objective:

- Provide recommendations to improve compensatory mitigation plans for riparian restoration projects to ensure restoration of riparian wetland functions and values.

## Research Questions:

- What are the important and measurable riparian wetland functions?
- What assessment methods are effective at assessing riparian wetland functions?
- How can mitigation performance standards be improved to be linked to riparian wetland functions?

# METHODS

- Literature review
- Evaluated the effectiveness of three assessment methods
- Compared assessment methods to agency requirements
- Identified the functions and assessment methods most appropriate to use to develop performance standards
- Compared performance standards for three riparian mitigation banks in the Central Valley

# CALIFORNIA'S CENTRAL VALLEY

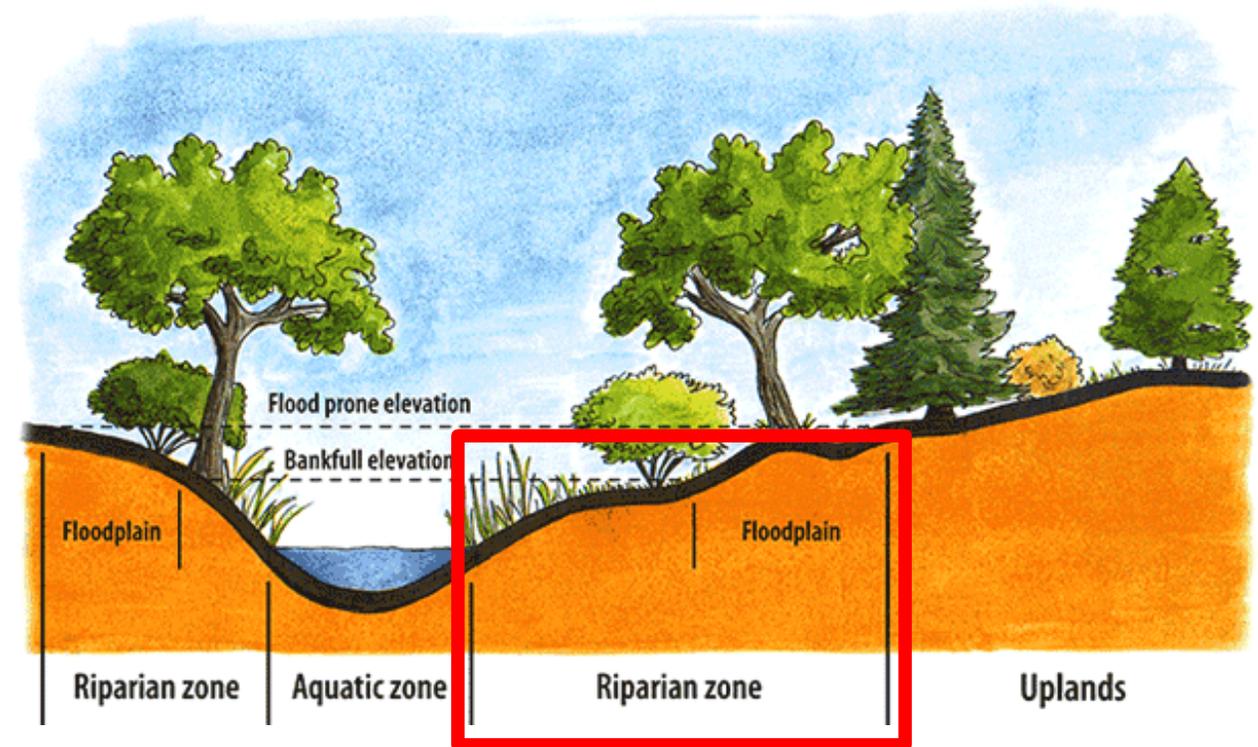
- Riparian wetlands of the Central Valley include areas influenced by major rivers and tributaries that are bound by:
  - the Coast Range to the west,
  - the Sierra Nevada range to the east,
  - the Klamath Mountains and Cascade Range to the north,
  - and the Tehachapi Range to the south.



Source: Barbour et al. 2007

# RIPARIAN WETLANDS

- Transitional zone between the terrestrial and aquatic ecosystems
- Hydrology is driven by the flood-pulse concept
- Vegetation is adapted to flooding (pulse) events and other terrestrial events



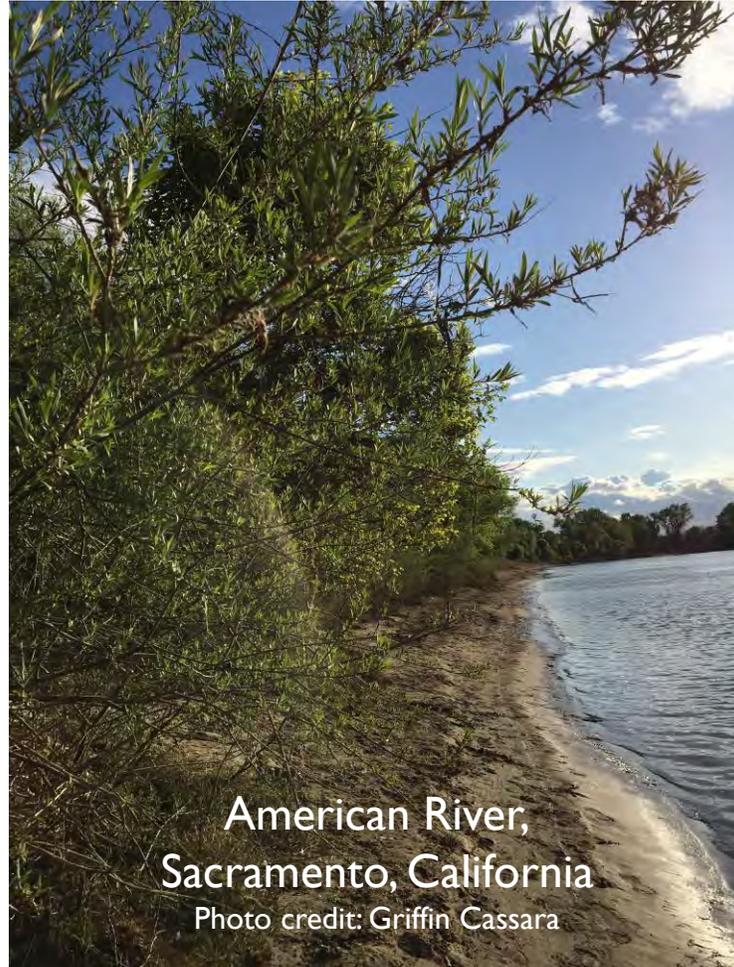
Sources: Gregory et al. 1991, Junk et al. 1989

Source: <http://slco.org/watershed/streams-101/the-riparian-zone/>

# RIPARIAN WETLANDS: CALIFORNIA'S CENTRAL VALLEY



**San Joaquin River**  
**Madera, California**  
Photo credit: Emily Mecke



**American River,**  
**Sacramento, California**  
Photo credit: Griffin Cassara

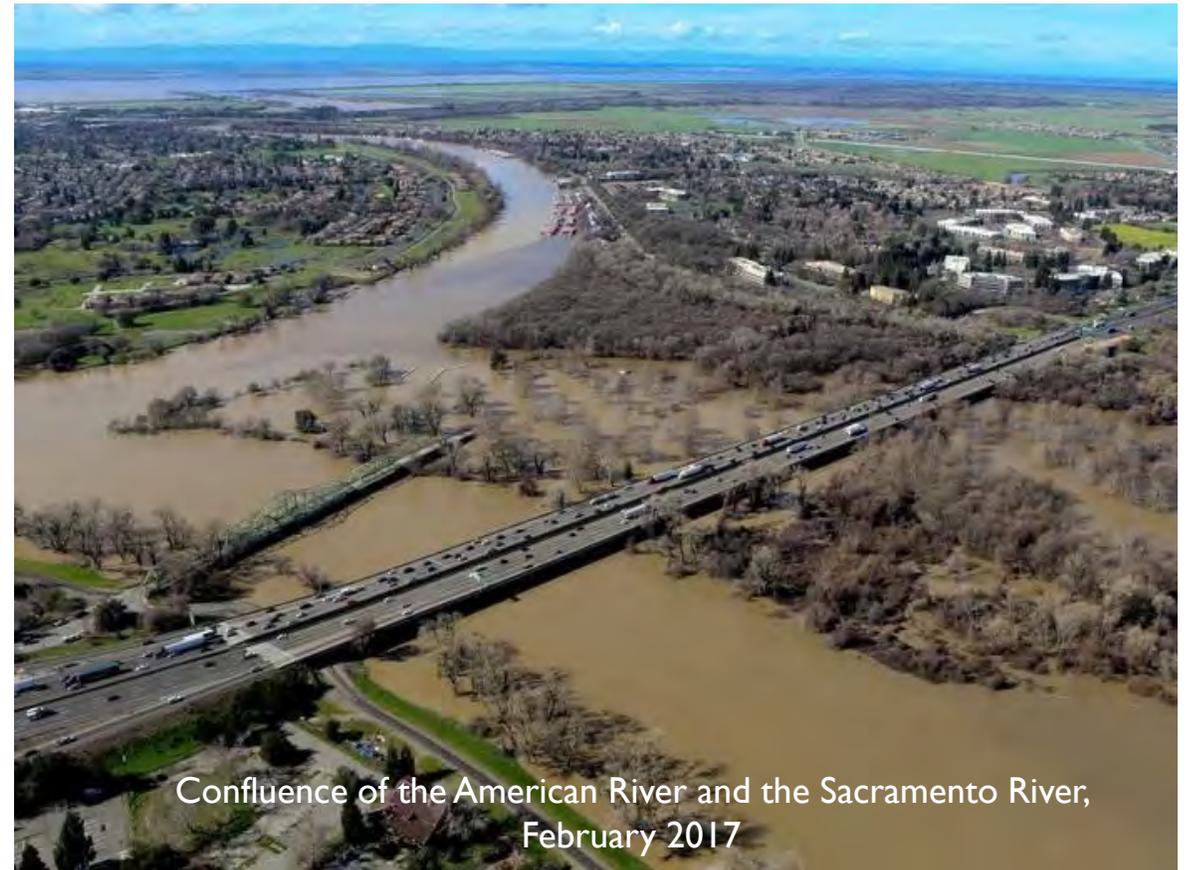


**Creek in Lincoln, California**  
Photo credit: Daniel Wong

# RIPARIAN WETLAND ECOSYSTEM SERVICES

- Flood storage and protection
- Water quality improvement
- Biodiversity
- Wildlife corridors
- Groundwater recharge
- Recreation
- Cultural resources
- Aesthetic resources

Source: Duffy and Kahara 2011



Confluence of the American River and the Sacramento River,  
February 2017

Source: <http://www.sacbee.com/news/local/article133007389.html>

# REGULATORY BACKGROUND

- Federal and State regulations that protect aquatic resources, including riparian wetlands
  - Federal Clean Water Act Section 404
  - Federal Clean Water Act Section 401, State Porter-Cologne Act
  - Section 1600 of the California Fish and Game Code



**US Army Corps  
of Engineers**®



CALIFORNIA  
**Water Boards**  
STATE WATER RESOURCES CONTROL BOARD  
REGIONAL WATER QUALITY CONTROL BOARDS



# USACE 2008 MITIGATION RULE

- “No Net Loss” of aquatic resources
- Requires compensatory mitigation for impacts to aquatic resources
  - Restoration
  - Enhancement
  - Establishment (creation)
  - Preservation



# USACE 2015 Mitigation and Monitoring Guidelines

## Performance Standard Categories

Physical Structure

Hydrology

Flora

Fauna

Water Quality

## Riparian Wetland Ecosystem Services

Flood Storage and  
Protection

Improving Water  
Quality

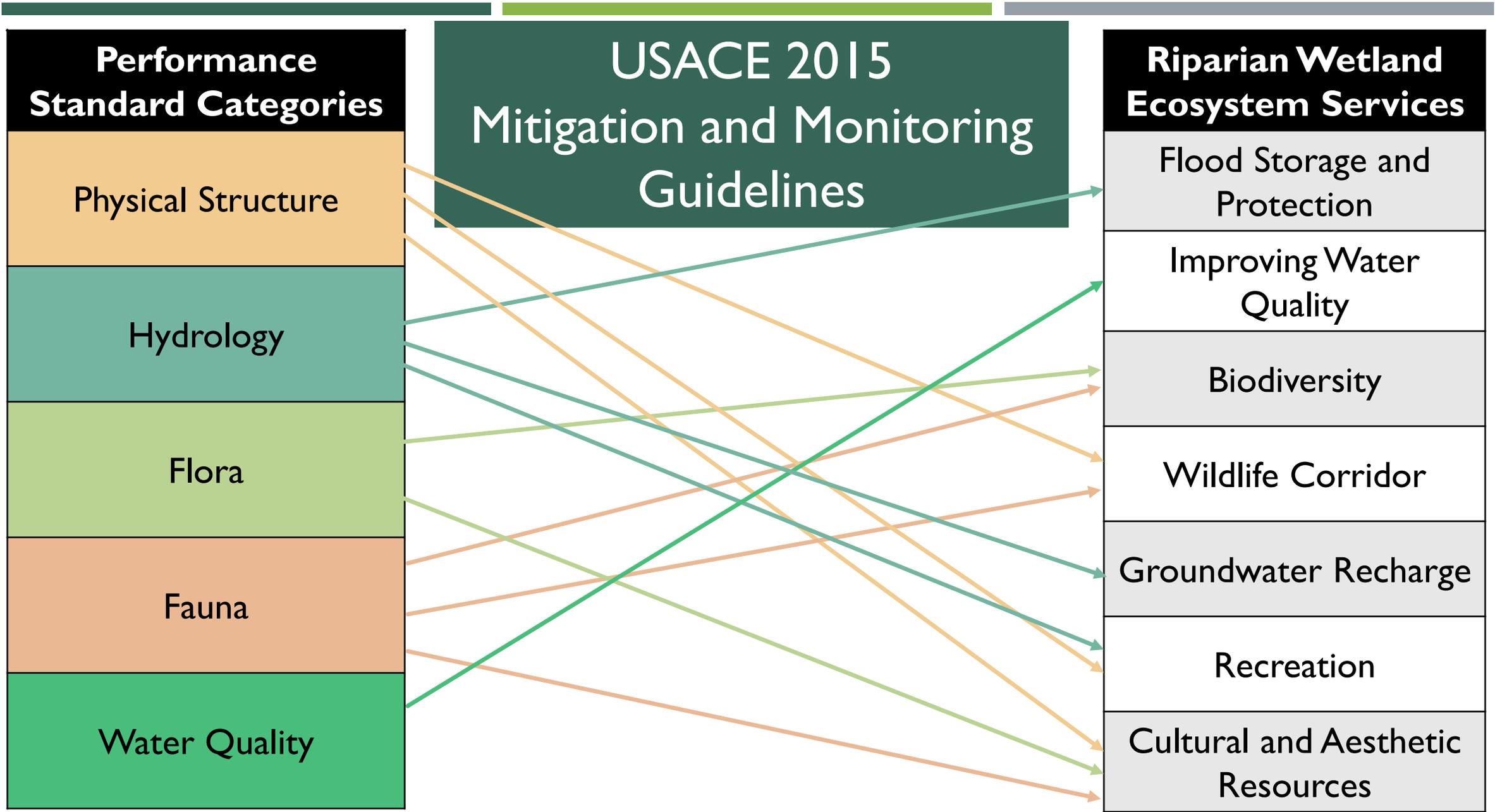
Biodiversity

Wildlife Corridor

Groundwater Recharge

Recreation

Cultural and Aesthetic  
Resources



# ASSESSMENT METHODS

Method	Date	Author	Type
WET	1987	USACE Wetland Research Program	Functional
HGM	1995	USACE Wetland Research Program	Functional
CRAM	2013 (updated)	California Wetland Monitoring Workgroup	Condition



# EVALUATION OF ASSESSMENT METHODS

Functions evaluated

Performance standard category

Process/variables/indicators

Equipment needed?

Expertise needed?

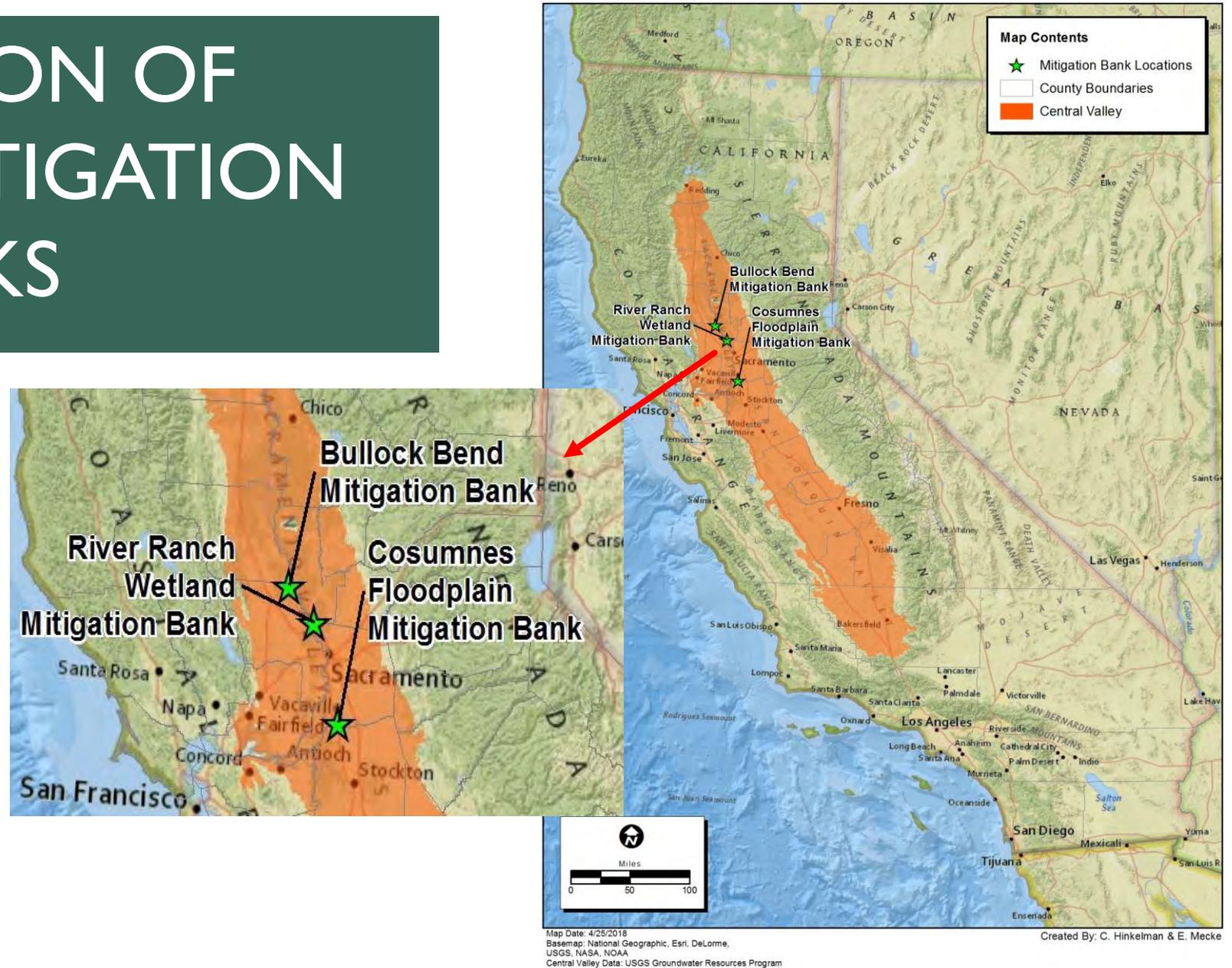
Level of effort (high, medium, low)

Likely to change or develop over time?

Performance Standard Category	WET		HGM		CRAM	
	Function Evaluated	Potential?	Function Evaluated	Potential?	Function (Metric) Evaluated	Potential?
Physical Structure	Recreation	No	Maintain spatial structure of habitat	Yes	Structural patch richness	Yes
	Uniqueness/heritage	No	Maintain interspersion and connectivity	Yes	Topographic complexity	Yes
	-	-	-	-	Aquatic area abundance	No
	-	-	-	-	Buffer	No
Hydrology	Groundwater recharge and discharge	No	Groundwater recharge and discharge	No	Water source	No
	Floodflow alteration	Yes	Flood protection/energy dissipation	Yes	Channel stability	Yes
	-	-	Surface water storage	No	Hydrologic connection	Yes
Flora	-	-	Maintain characteristics plant communities	Yes	Plant community	Yes
	-	-	Maintain characteristic detrital biomass	Yes	Horizontal interspersion	Yes
	-	-	-	-	Vertical biotic structure	Yes
Fauna	Aquatic diversity and abundance	Yes	Maintain distribution and abundance of invertebrates	Yes	-	-
	Wildlife diversity and abundance	Yes	Maintain distribution and abundance of vertebrates	Yes	-	-
Water Quality	Sediment stabilization	Yes	Retention of particles	Yes	-	-
	Sediment/toxicant retention	No	Removal of imported elements and compounds	No	-	-
	Nutrient removal/transformation	Yes	Nutrient cycling	Yes	-	-
	Product export	No	Organic carbon export	No	-	-

# EVALUATION OF RIPARIAN MITIGATION BANKS

- Cosumnes Floodplain Mitigation Bank
- Bullock Bend Mitigation Bank
- River Ranch Wetland Mitigation Bank



# EVALUATION OF RIPARIAN MITIGATION BANKS

Mitigation Bank	Reference Site(s) Used?	Assessment Method Used?	Consistent with USACE 2015 Mitigation and Monitoring Guidelines?
<b>Cosumnes Floodplain Mitigation Bank</b>	Yes	Yes	No Before guidelines were published
<b>Bullock Bend Mitigation Bank</b>	Yes	Yes Only to evaluate reference sites	Yes
<b>River Ranch Wetland Mitigation Bank</b>	Yes	No	No Before guidelines were published

# MANAGEMENT RECOMMENDATIONS

## Riparian Mitigation Banks in the Central Valley:

- Continue to use multiple reference sites
- Include performance standards for all five performance standard categories
- Use assessment methods to evaluate reference sites and provide a model for performance standards

# MANAGEMENT RECOMMENDATIONS

## General Recommendations:

- Reference standard (site) is **KEY** (Van den Bosch and Matthews 2017)
- Develop performance standards for all five performance standard categories
- Use different functions from each of the assessment methods
- Use functions that are likely to change and/or develop over time
- Use functions that are easily measured in a mitigation monitoring scenario (Collins 2018)
- Develop interim standards for monitoring to ensure restoration is on the right trajectory (Matthews and Endress 2008)

# MANAGEMENT RECOMMENDATIONS

## Permittee-Responsible Riparian Restoration Projects in the Central Valley:

Performance Standard Category	Assessment Method	Function
Physical structure	CRAM	Structural patch richness
Hydrology	HGM	Flood protection and energy dissipation
Flora	CRAM	Plant community
Fauna	WET	Wildlife abundance and diversity
Water quality	WET/HGM	Sediment stabilization/retention of particles



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