Project components

From Alternative 5 of the Merced Wild and Scenic River Final Comprehensive Management Plan and EIS, February 2014, p. 8-199):

"Retain all historic bridges, including Sugar Pine Bridge, for the near-term. Additional study will be conducted by a third party to determine the hydrologic impacts of the historic bridges. Develop criteria for [Sugar Pine] bridge removal (prior to study) that establishes quantitative conditions related to altered flow velocity (speed and direction) attributed to the bridge, both upstream and downstream. Quantify and compare the cost associated with constructing, maintaining, and monitoring mitigation installations over a 20-year period with the cost of bridge removal."

Project components

From the Request for Proposals (NPS, Announcement #P15AS00005, 11/18/2014):

1. "…to collaboratively develop restoration and impact mitigation measures for the Merced River in east Yosemite Valley, Yosemite National Park".

2. "Within this restoration area…complete a detailed study of hydraulic and geomorphic impacts of the Sugar Pine Bridge and mitigations thereto…to investigate the extent to which non-removal options/mitigations can reduce the geomorphic and hydrologic impacts of Sugar Pine Bridge, and to develop a long-term cost-benefit of these options relative to bridge removal."

Scope of the research project

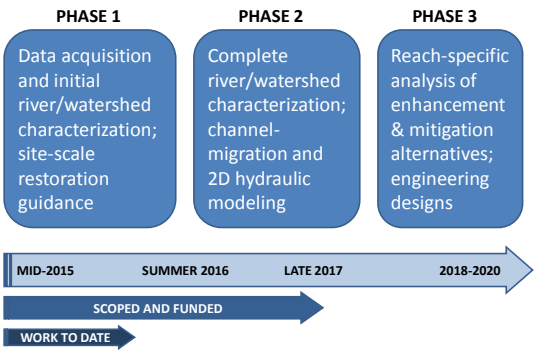
3 phases:

Phase 1: Summary of existing data and reports, field data-collection protocols, status report on work-in-progress, guidance on site-scale riparian restoration projects, stakeholder meeting

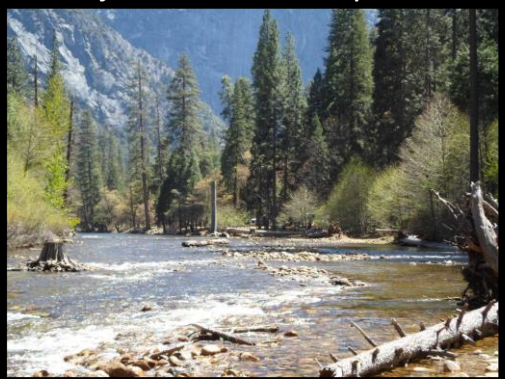
Phase 2: Complete geomorphic and riparian mapping, channel migration modeling, watershed sediment budget, implement updates to 2D modeling (if warranted), stakeholder meeting

Phase 3: In-stream conceptual project designs and alternatives in the Sugar Pine Bridge reach to arrest channel widening, narrow channel, restore riparian zone vegetation, restore in-channel complexity; define criteria for success/failure of management plan; cost-benefit analysis of alternatives; 50% project design of preferred alternatives.

Project timeline

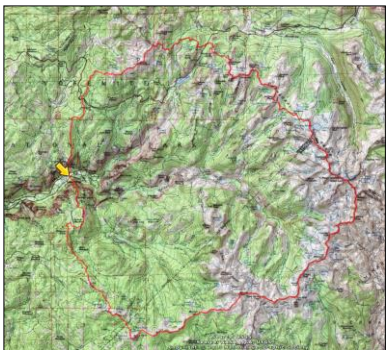


Project area and study reach

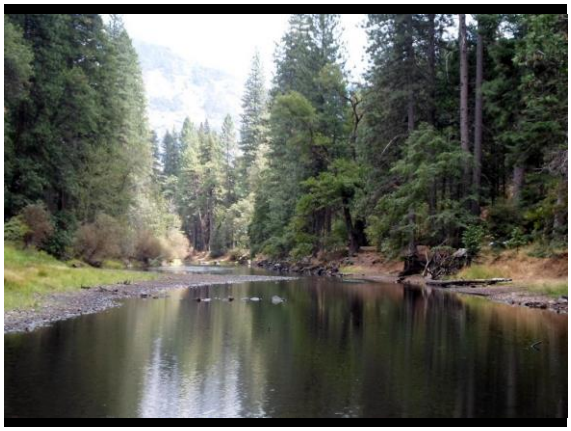


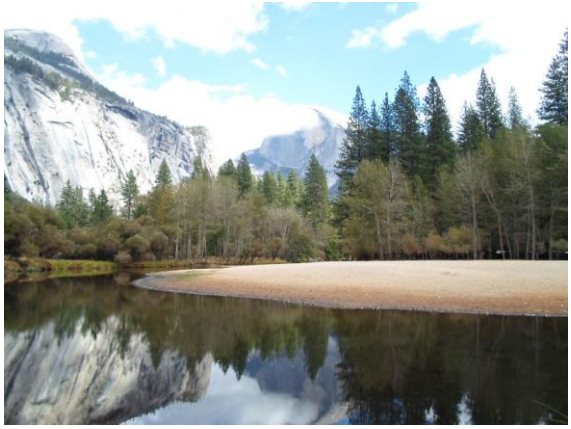
1. The project area

Technically, the entire watershed draining to the Merced River through Yosemite Valley.

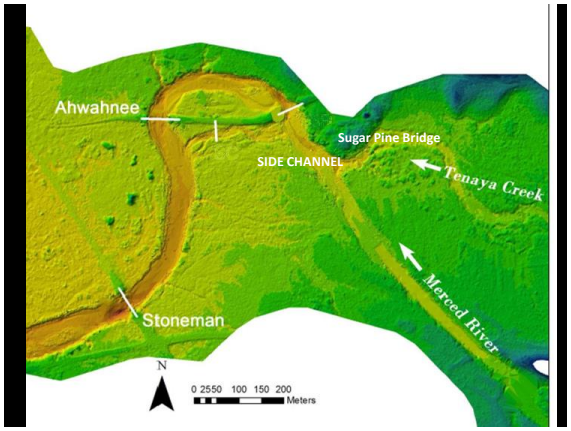


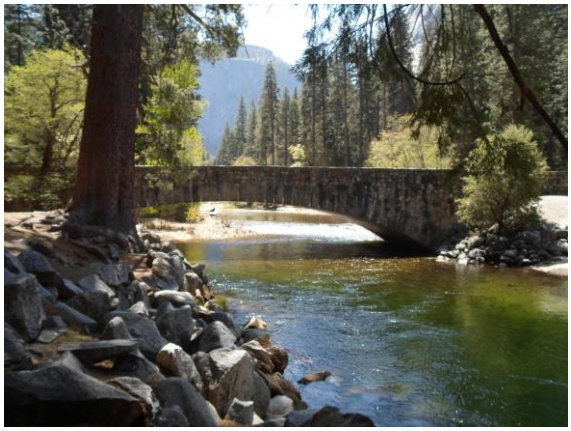
1. The project area





2. The study reach

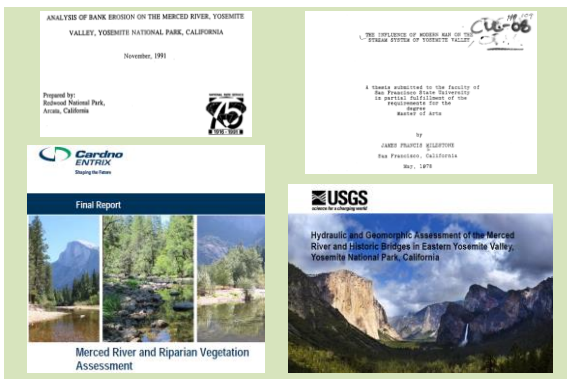




Research team

- **Derek Booth, PhD, PE, PG**: Professor, UCSB – Overall project coordinator for the UCSB team; analyzing watershed-scale processes, reach geology and geomorphology, integration of site-specific evaluations and treatments into broader watershed context.
- **Thomas Dunne, PhD**: Professor, UCSB – Formulating meaningful research questions to guide the investigation and ensure that the quality of the team's work meets the highest scientific standards.
- **Eric Larson, PhD**: Research Scientist, UC Davis – Analyzing river channel bank erosion and river meander migration for the purpose of river channel management and riparian vegetation potential.
- **Katie Ross-Smith, PhD**: Cardno Inc.– River and riparian zone management and engineering; lead for site-specific and reach-scale treatments, design.
- **Juliana Birkhoff, PhD:** California State University Sacramento, Center for Collaborative Policy (CCP) – Stakeholder engagement and collaboration.
- **Peter Moyle, PhD**: Professor, UC Davis – Consultation on instream ecological processes and conditions during Phase 3, if/as needed.

Prior studies



Milestone, 1978 (MS thesis, SF State University)

Reconstruction of: historical changes to the river channel, 1870's through 1960's: base level lowering at the El Capitan moraine (downstream of the project area), dike and riprap placements, bridge constructions, removal of logs and stumps from the channel. Notes channel widening relative to bridge openings.

→ Provides insight into the timing and magnitude of human activities, allowing a better interpretation of modern riverine features and unraveling of their expression of "current" vs. "legacy" conditions.

Madej, 1991 (National Park Service report, & subsequent 1994 peer-reviewed article)

Documentation of riparian and bank conditions; analysis of sediment delivery and flood hydrology; identification of likely causative factors of channel widening, including loss of riparian vegetation, loss of in-channel large woody material, flow constriction from bridges, and artificial bank armoring.

→Highlights the primary stressors on the Merced River through Yosemite Valley; provides a detailed snapshot of conditions 25 years ago; frames many of the management alternatives still being discussed today.

Cardno, 2012 (consulting report to NPS)

Systematic compilation of near-current channel and riparian conditions in GIS framework, allowing efficient comparison with past/future studies. Focus on large woody material in the channel and riparian zone, and on the vegetation communities adjacent to the river.

→Provides an extensive database of well-collected, well-archived data on past and recent (2011) riverine and riparian conditions that provide an existing framework for updates and additional analyses. Highlights previously acknowledged impacts to the Merced River.

Minear and Wright, 2013 (USGS Open-File Report 2013–1016)

Development of 2-dimensional hydraulic model for the project area and study reach, calibrated on extent of historical floods but lacking real-time velocity measurements. Provides key hydraulic parameters (flow depth, velocity, shear stress) necessary for design of future in-channel or bank-stabilization projects.

→Provides a critical tool for engineering design; requires additional calibration before judged fully reliable (such measurements are planned under the current research project), but existing model is a major step towards achieving this goal.

Work to date

Completed

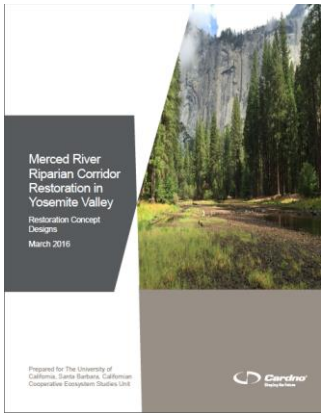
- Compile and summarize all relevant, existing data
- Prepare field data-collection plan based and develop field protocols for data collection by overall team and others.
- Identify short-term (2015-2016) riparian project opportunities, including locations and types/options (*Merced River Riparian Corridor Restoration in Yosemite Valley Restoration Concept Designs*, March 2016).
- Provide guidance to NPS on gage installation and for setting control points for water surface elevation observations and velocity measurements for future validation of hydraulic model.

Work to date

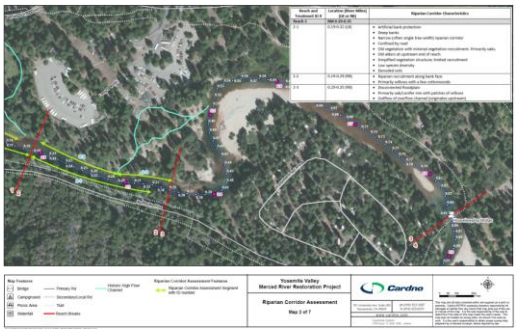
In Progress

- Riparian vegetation mapping
- Bank erosion mapping
- Compile and evaluate post-1989 trends in channel widths
- Collection and analysis of historic migration patterns, emphasizing what can be used to calibrate the UCD predictive model.
- Geologic/geomorphic mapping, an effort presently being led by the NPS and supported with field and other technical advice from the UCSB team. This collaboration is anticipated to continue through Phase II, with anticipated culmination in a published map at 1:12,000 scale in 2017.

Initial product of the Cooperative Agreement (March 2016):



Example of riparian corridor assessment information:

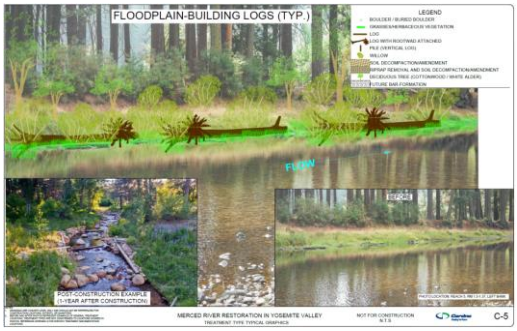


From *Merced River Riparian Corridor Restoration Concept Designs*, March 2016

Example map providing general guidance and location of treatment types and sites:

From *Merced River Riparian Corridor Restoration Concept Designs*, March 2016

Example of treatment type typical graphic:



From *Merced River Riparian Corridor Restoration Concept Designs*, March 2016

Example table of site-scale descriptions and guidance:

Reach and Treatment ID # (Map ID)	Location (River Miles) (LB or RB)	Existing Condition and Recommendations			Implementation Needs		
		Problems and Issues	Treatment Objective	Treatment Type	Analyses	Design	Field Oversight
Reach 2	RM 0.19-0.33						
2-1	0.19-0.33 (RB)	• Compacted/Dewatered Soils • Floodplain Fill	**Restore native vegetation** Remove non-native fill material, re-contour the topography, and reintroduce native vegetation to restored areas.	• Floodplain Fill Removal • Floodplain Grading and Soil Modification	• Visual Survey • Soils Analysis	• Materials List / Quantities	• Staking
2-2	0.28 (RB)	• Disconnected Floodplain / Entrenched Channel	**Reactivate overflow channel and protect return flows.**	• Bank Lowering with Overflow Channel Reactivation (Typical Graphic C-9) Required with Treatment 3-3.	• Hydraulic Modeling • Bank Stability Modeling	• Details • Specifications • Materials List/Quantities • Cost Estimate	• Staking • Construction Direction • Inspection
2-3	0.26-0.3 (LB)	• Stormwater Drainage Infrastructure	**Reduce erosion and improve water quality.** Direct/control runoff paths and slowing runoff flows from the road before they enter the river.	• Stormwater Pre-treatment	• Visual Survey to identify runoff flow paths • Hydrologic Calculations for Culvert Design/ Detention Volume	• Details • Specifications • Materials List/Quantities • Cost Estimate	• Construction Direction • Inspection
2-4	0.19-0.33 (LB)	• Artificial Bank Protection • Lateral Confinement • Minimal Vegetation • Bank Erosion • Simplified Vegetation Structure • Low Species Diversity • Denuded and/or Compacted Soils	**Stabilize streambank and protect road.** Retain existing riprap to protect road.	• Retain Artificial Bank Protection	-	-	-

From *Merced River Riparian Corridor Restoration Concept Designs*, March 2016