

Redwood Creek Restoration at Muir Beach

Carolyn Shoulders
National Park Service



Climate Smart Actions for Natural Resource Managers

November 29, 2012



Expanded Tidal Lagoon, 2011

- Lead Agency: National Park Service, Golden Gate National Recreation Area
- Partners: Marin County; Golden Gate National Parks Conservancy; San Francisco Zen Center
- Funders:
 - California Dept. of Fish and Game
 - State Coastal Conservancy
 - U.S. Fish and Wildlife Service
 - State Wildlife Conservation Board
 - National Park Service
- Consultants: Phil Williams and Associates, Northern Hydrology and Engineering, Stillwater Sciences, Jones and Stokes, PRBO, Moffitt and Nichol, John Northmore Roberts, and many others

Project Overview

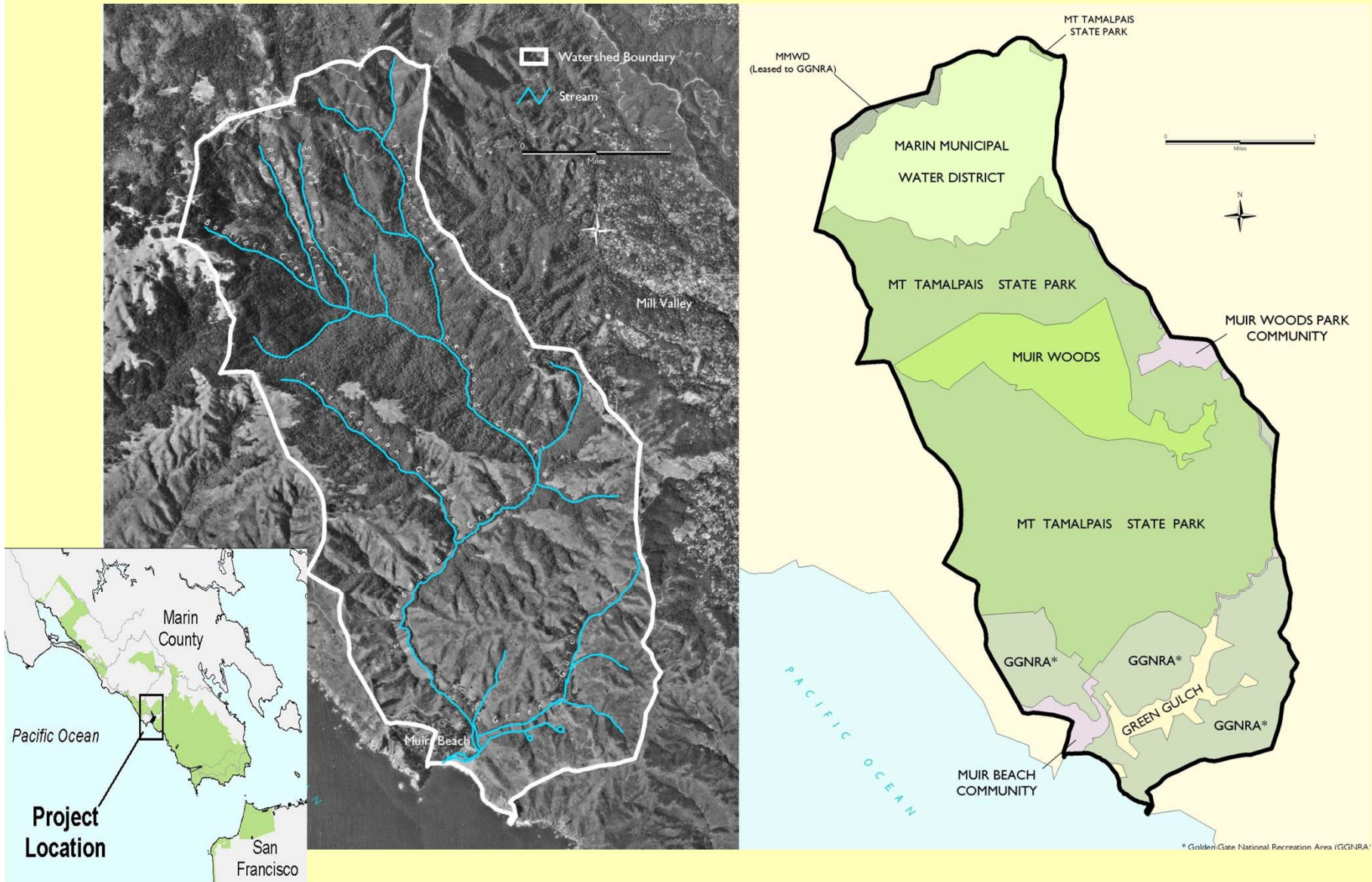
Pre-Project, 1999



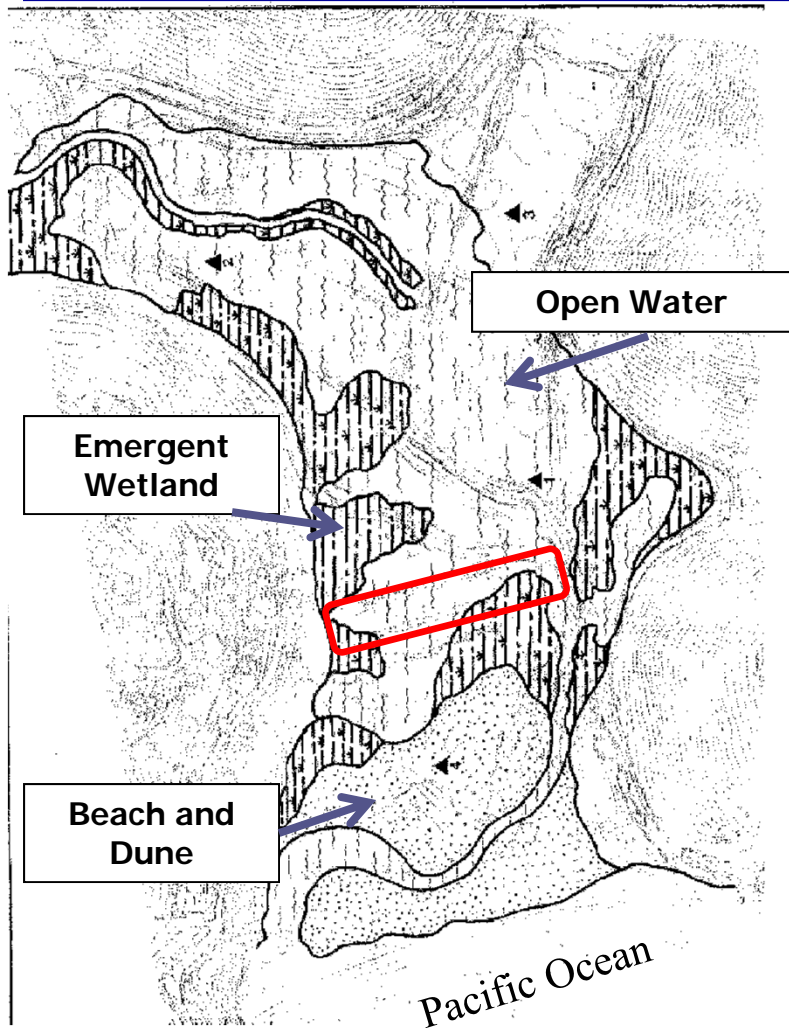
Partially Completed, 2011



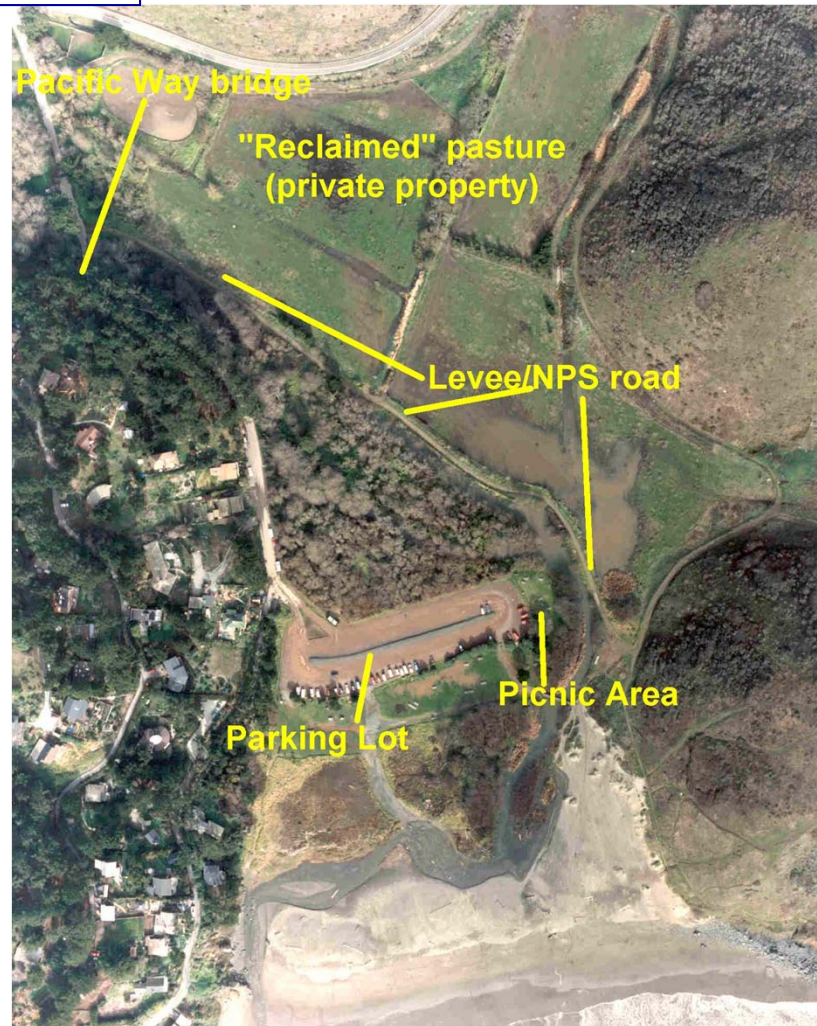
The Redwood Creek Watershed



1853 vs. 1994



1853 US Coast Survey Map Over Today's Landscape



1994 - Big Lagoon Area Filled

Project Need: Flooding on Pacific Way



Road impassable during routine winter events

24-ft-long bridge too narrow to convey flows

Bridge not placed where water naturally flows during large events

Sediment transport obstructed by bridge



Redwood Creek Alignment, April 2003 Big Lagoon, Muir Beach



Legend

- Redwood Creek
- Environmental Data Solutions X-section markers, April 2003

The creek alignment was mapped in the field using a GPS unit and external antenna.

50 0 50 100 Meters



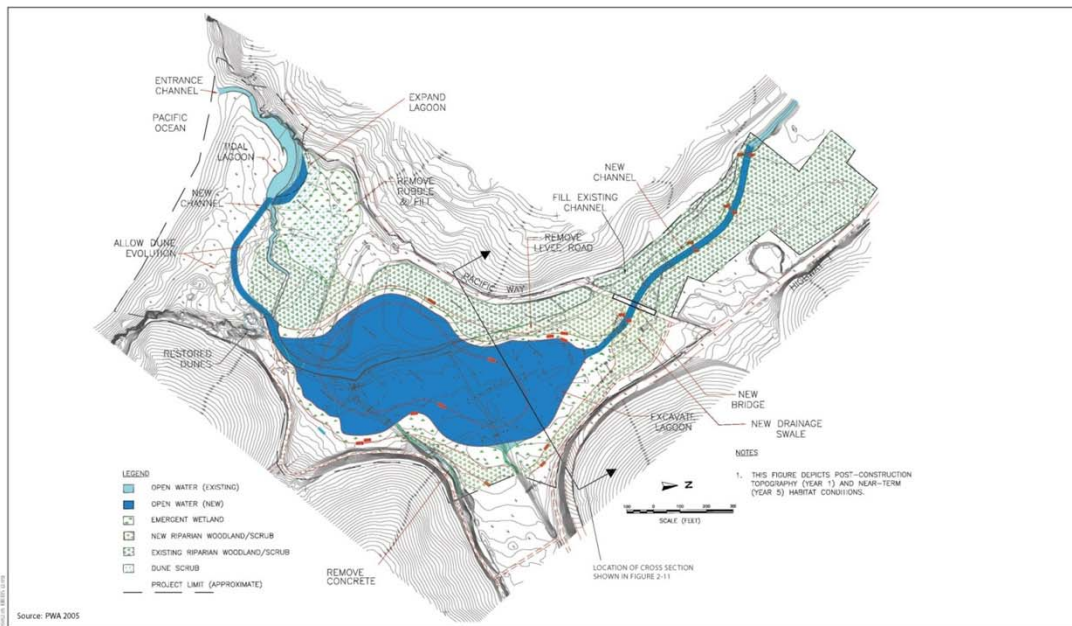
- Creek is confined by levee and parking lot
- Rapid sediment accumulation
- Flooding due to reduced channel capacity
- Water table has increased as channel bed aggraded
- Habitat quality for salmonids reduced

Project Goals



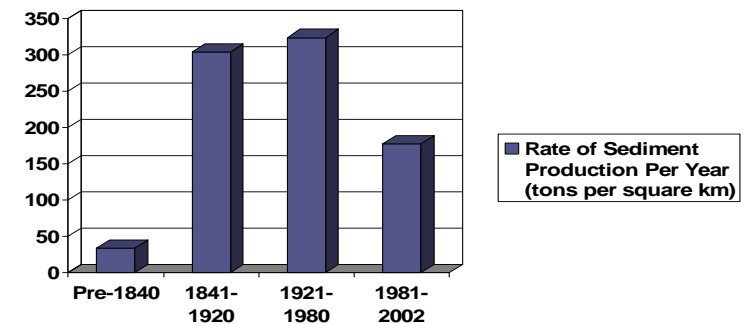
- Restore a functional, self-sustaining ecosystem, including wetland, aquatic and riparian components
- Develop a restoration design that functions in the context of the watershed (sediment transport, stream recovery)
- Provide habitat to support sustainable populations of coho, steelhead and the California red-legged frog
- Reduce flooding in the community
- Provide visitor access that is access compatible with ecosystem function
- Incorporate cultural values, provide public education and stewardship opportunities

Rejected Project Alternative



Jones & Stokes

Figure 2-9
Alternative 4 - Large Lagoon Restoration
Year 0

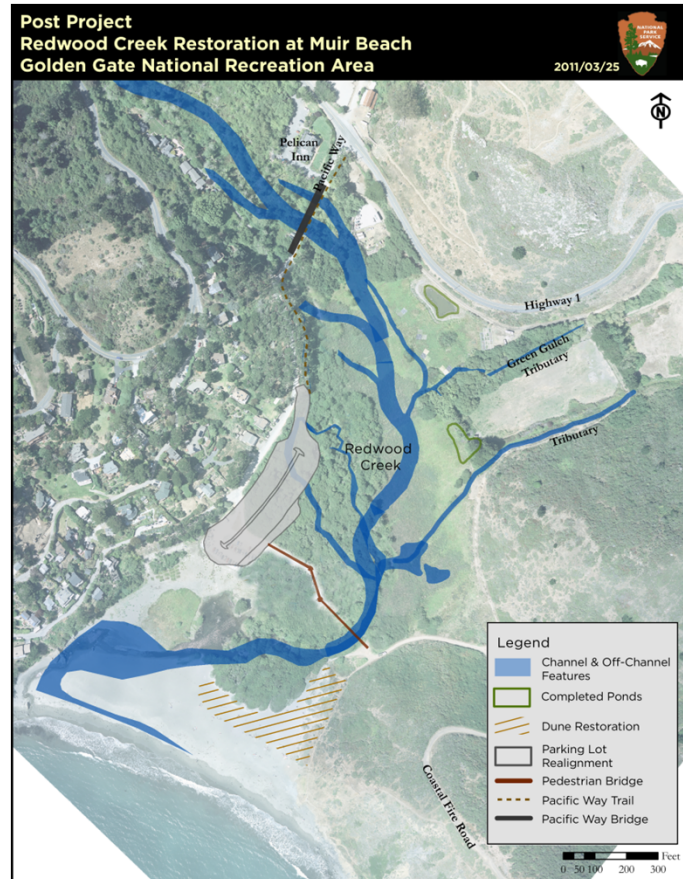


Elevated sediment production in current condition would fill a restored lagoon

Pre-Project Condition



Project Actions



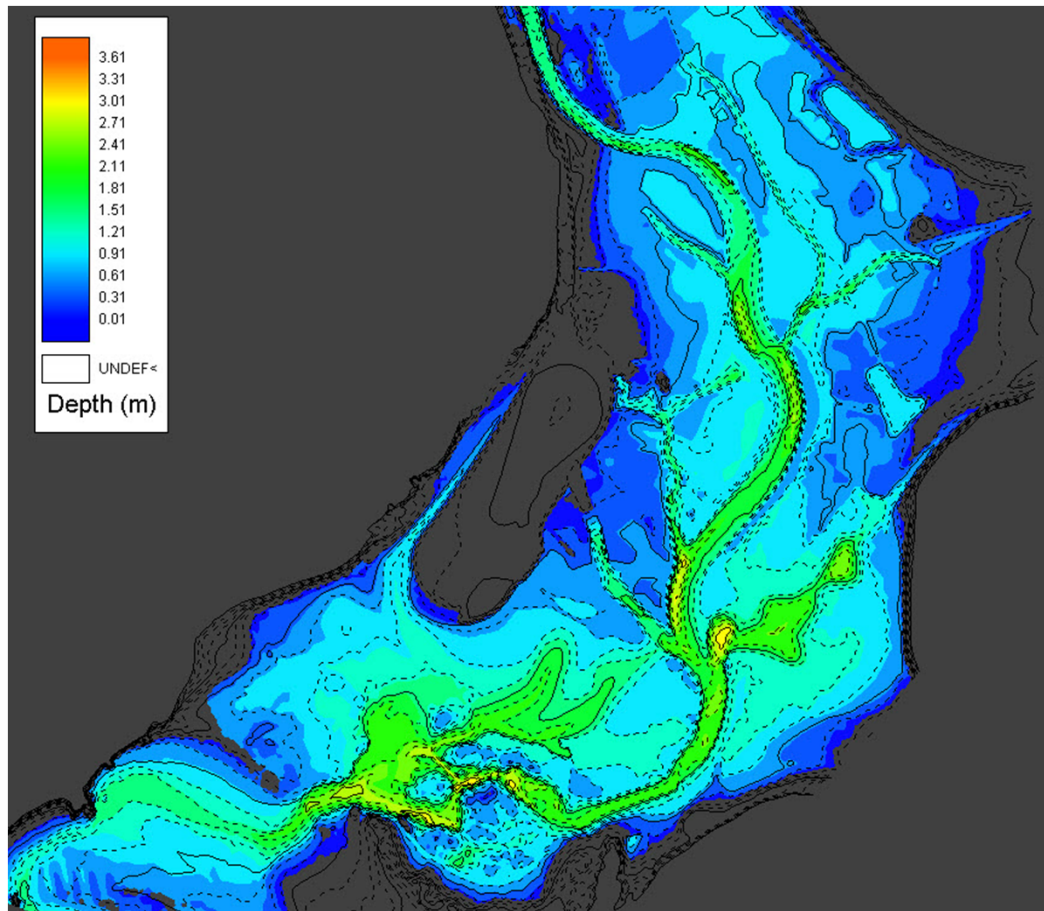
Realign 2,000 LF of Channel to Natural Location

Rotate Parking Lot to Open Floodplain

New 250-LF Vehicular Bridge over Creek and Floodplain

450-LF Pedestrian Bridge over Floodplain – Long spans to allow channel migration

Floodplain Restoration: Benefits



Modelled Water Depth in 100-year event

Hydraulic constraints removed

Connected floodplain

Conveyance of flood flows

Room for channel migration

Natural sediment deposition
and transport

Reduced flood elevations

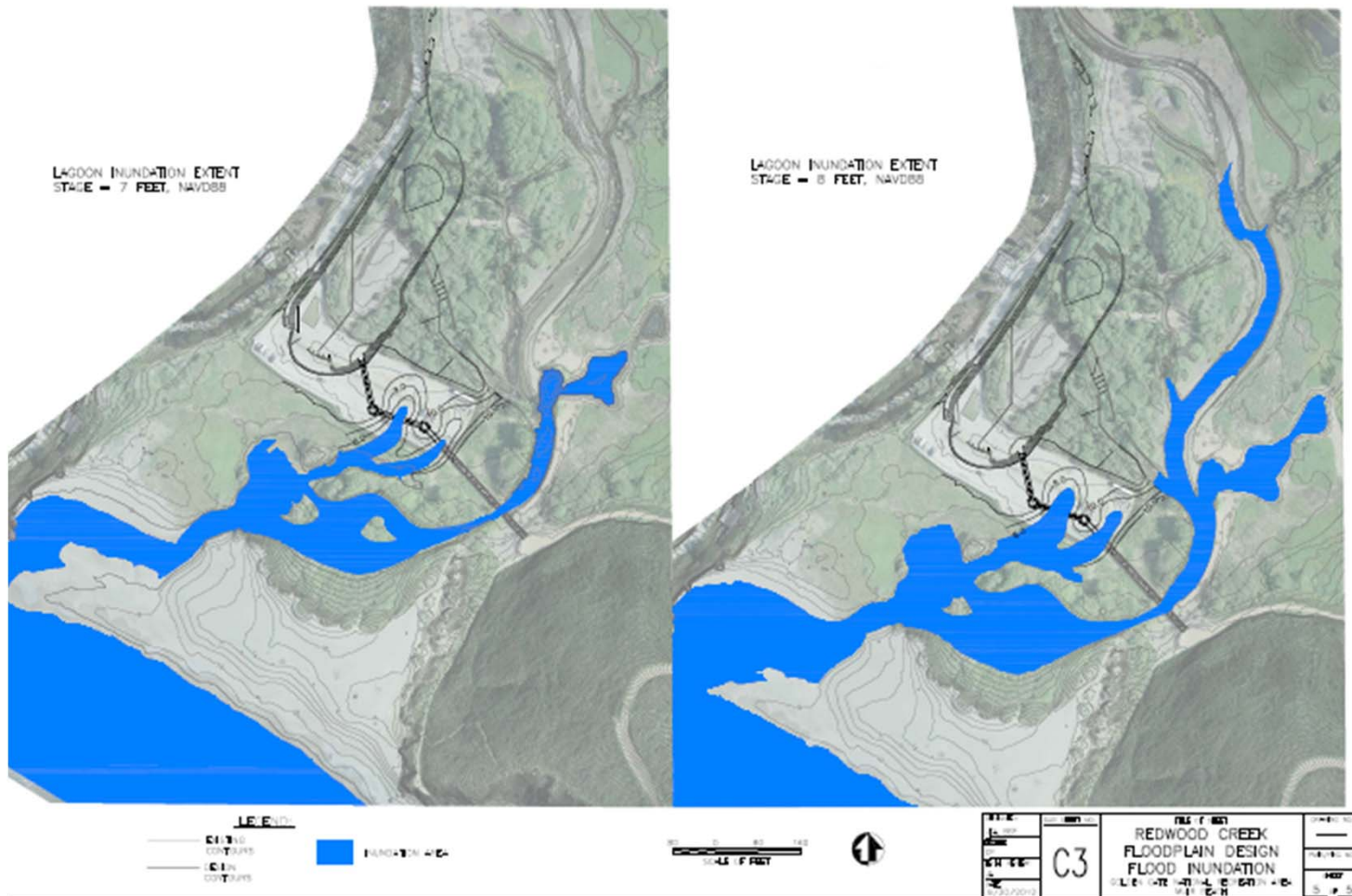
Winter habitat for coho

Leeway for storm surge

Landward migration of beach

Better accommodates
increased storm intensity

Floodplain Restoration Design Where Parking Lot is Removed



Swales with
emergent
vegetation

Often
inundated

Provide
backwater
habitat for
coho

Leeway for
storm surge

Leeway for
Beach retreat

Climate Change Analyses

Analyzed as part of feasibility analyses and for EIS/EIR by Phil Williams and Associates (PWA)

IPCC projections for sea level rise changed during planning

Prepared models assuming 0.7 feet rise in 50 years, but also analyzed conditions with a rise of 2 feet and worst case scenario of 1 meter in 100 years

- Hydraulic models assumed an extreme high tide to model effects on upstream flood elevations



Climate Change Analyses (continued)

Benefits of reconnecting the floodplain apply to sea level rise - model showed that increased flood levels from sea level rise and inland tidal influence are localized in the restoration zone, not in developed areas

Projected beach retreat of 80 to 100 feet, accommodated by project actions

Project actions would lower groundwater elevations by about 1 foot due to improved conveyance in channel, but sea level rise would increase groundwater levels. With this, riparian habitat may convert back to wetland

New Riparian Habitat May Convert Back to Wetland



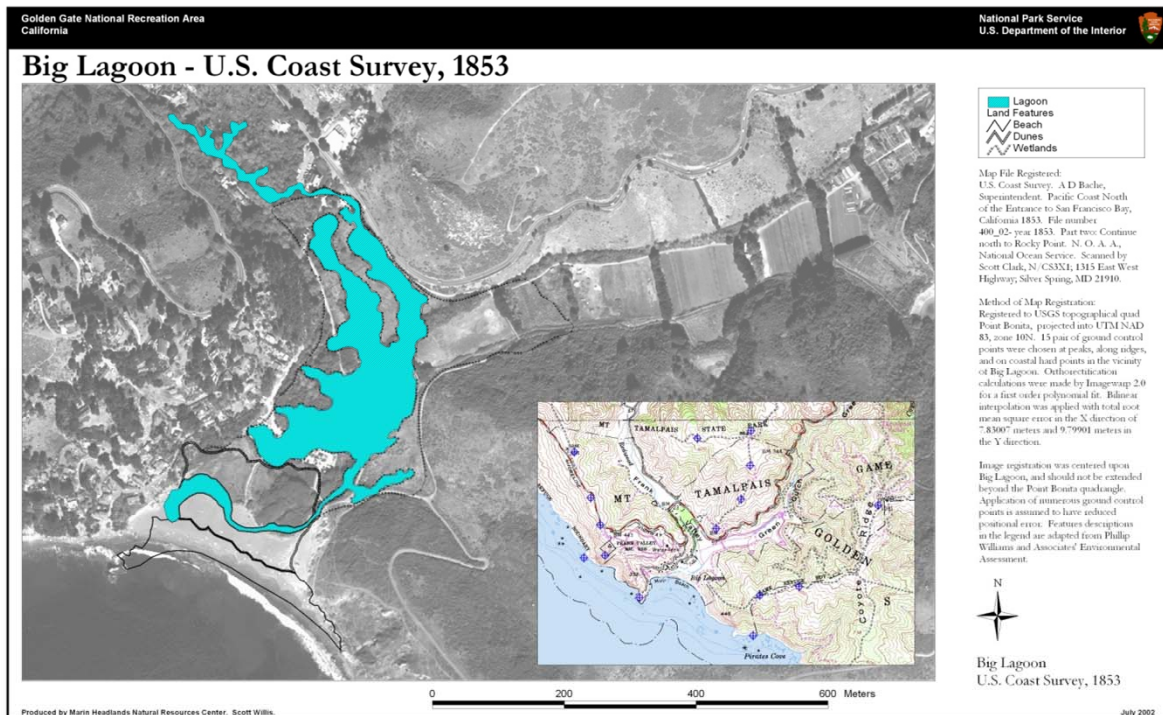
Plant Pallette for Revegetation includes use of native clonal grasses and diverse species to allow for adaptation

Climate Change Analyses (continued)

Extreme Sea Level Rise

Could create conditions similar to historic “Big Lagoon”

Higher groundwater, beach berm, freshwater impounded behind beach berm at least seasonally



Climate Smart Adaptation Principles Applied to Project

Principle

- Focus on Future Conditions, Incorporate Extremes
- Use plausible scenarios w/modeled projections to address uncertainty
- Design Actions in Ecosystem Context
- Employ Adaptive and Flexible Approaches

Project Application

- Created fluvial system rather than big lagoon. Expanded tidal lagoon further inland.
- Modeled creek function, flow elevations, overbank events with and without sea level rise
- Links watershed for multiple species; allows habitat shifts
- ***Leeway for changes after implementation; allows long-term beach change

Climate Smart Adaptation Principles Applied to Project

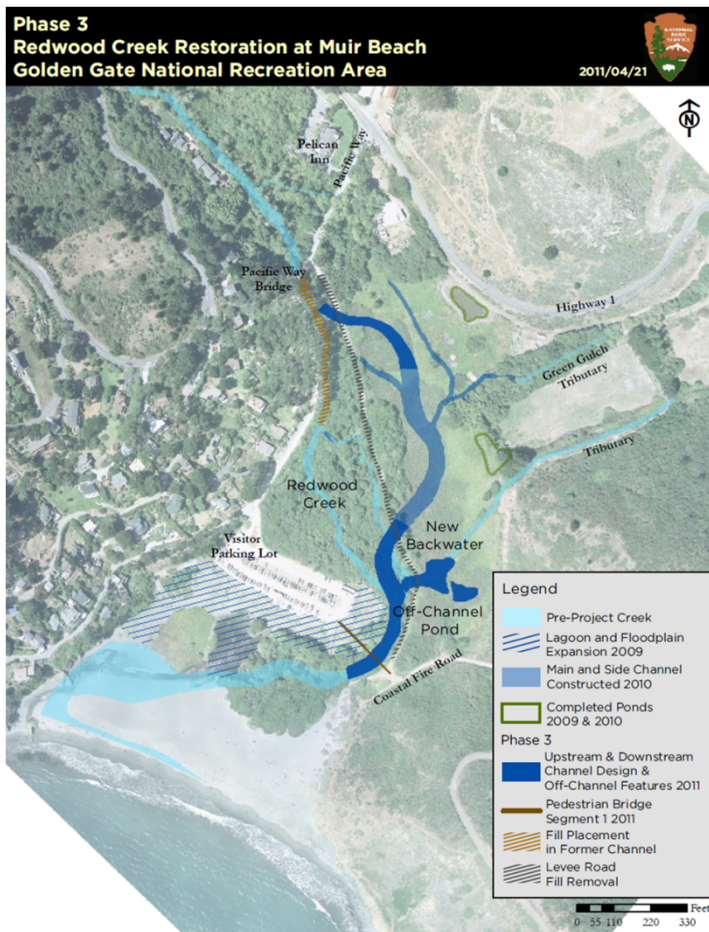
Principle

- Prioritize Actions based on best available science for multiple plausible scenarios
- Collaborate and Communicate Across Sectors

Project Application

- Accommodates large events; no action for possible draught
- For coho, used recent science on off-channel habitats – prioritized for near-term benefits in particular
- Extensive public workshops for planning – combined public, agencies, consultants; routine stewardship and educational events; successful design review process with academics and agencies

Current Status: 3 of 5 Phases Complete



Pedestrian Bridge: Long Spans to Allow Channel Migration

PEDESTRIAN BRIDGE INSTALLATION
PHASE 3 2011



PEDESTRIAN BRIDGE INSTALLATION
PHASE 3 2011



Before



After, 2011



Before



After, 2011



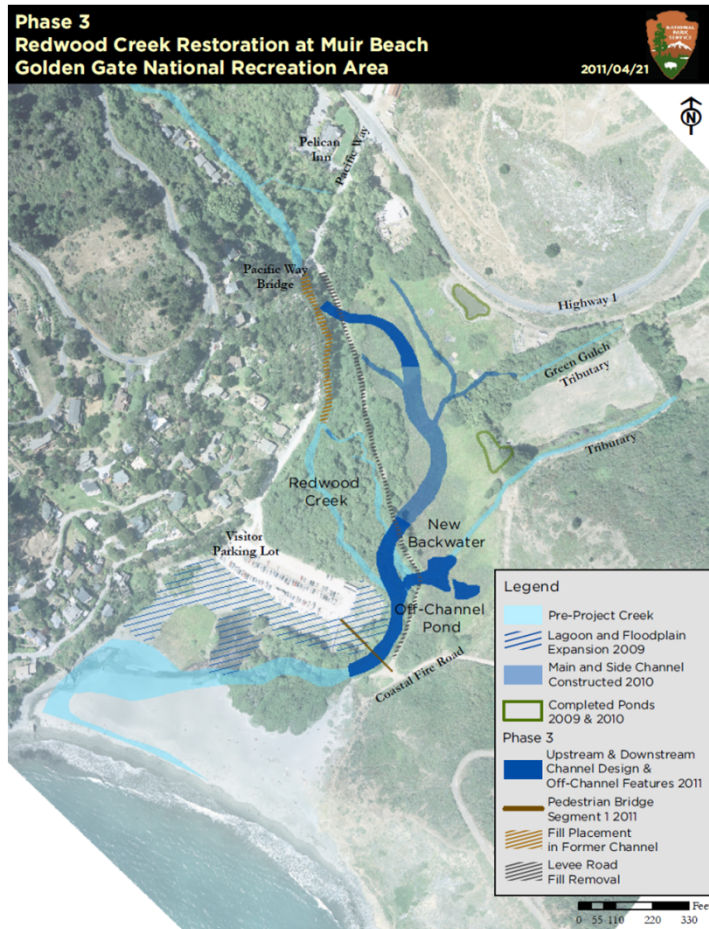
Before



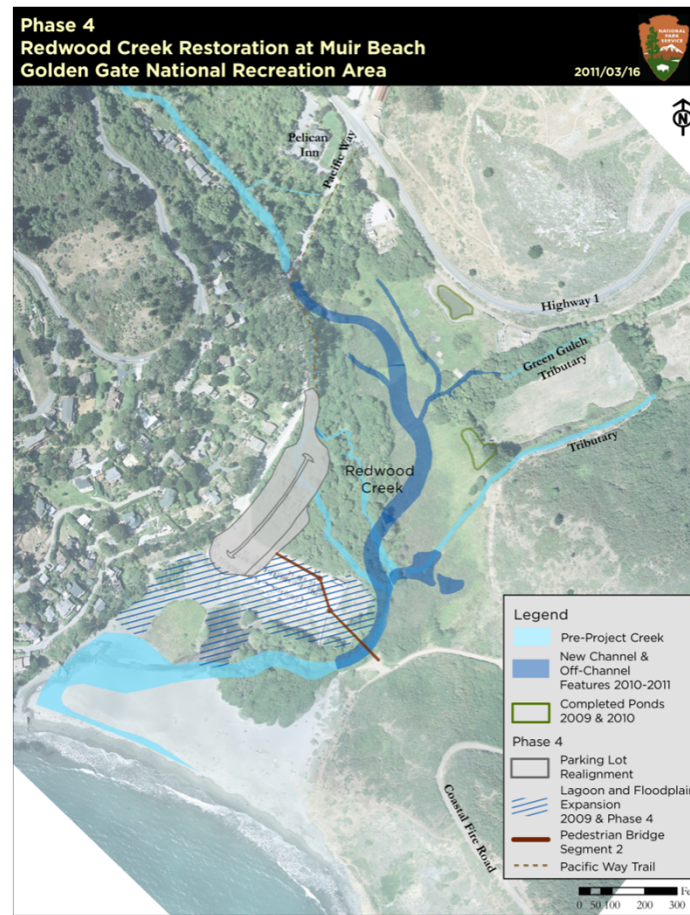
After, 2011



Phase 3, 2011



Phase 4, Target- 2013



Phase 4 Actions:

- New Parking Lot & Picnic Area
- Restored Floodplain where PL is removed
- 225-LF Pedestrian Bridge Addition
- New Beach Access Trail to allow dune restoration



Questions and Discussion

If relevant...