Successful Floodplain Reconnection
Design, Implementation, Monitoring and Adaptive Management
Upper Truckee River, Lake Tahoe, California

Michael Rudd, PE, Charley Miller PE, Virginia Mahacek, Chad Krofta PE, and Julie Etra
Outline

- Lake Tahoe Overview
- Watershed Disturbance and Management History
- Upper Truckee River Case Studies
  - Lower West Side Project
  - Middle Reach Project
    - Objectives, Design, Implementation
    - Monitoring
    - Adaptive Management Activities
- Conclusions
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1800</td>
<td>Pre-European Contact: Washoe peoples collect plants and take advantage of fisheries</td>
</tr>
<tr>
<td>1820</td>
<td>Fremont sights Lake Tahoe</td>
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<tr>
<td>1840</td>
<td>Silver discovered in Nevada</td>
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<td>1860</td>
<td>Dam at Truckee River outlet</td>
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<td>1880</td>
<td>Lumber mills close</td>
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<tr>
<td>1900</td>
<td>Highest recorded lake level (6,231.26)</td>
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<td>1900</td>
<td>Lake Tahoe Protection Association</td>
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<tr>
<td>1920</td>
<td>Dust Bowl Drought (1929 to 1936)</td>
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<td>1920</td>
<td>Auto route encircles the lake</td>
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<tr>
<td>1940</td>
<td>Tahoe Research Group begins studies</td>
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<td>1940</td>
<td>Tahoe Keys development begins</td>
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<tr>
<td>1960</td>
<td>Winter Olympics held at Squaw Valley</td>
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<td>1960</td>
<td>Export of sewage effluent begins</td>
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<tr>
<td>1980</td>
<td>TRPA created</td>
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<td>1980</td>
<td>LTIMP instituted</td>
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<tr>
<td>1980</td>
<td>Lowest recorded lake level (6,220.26)</td>
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<tr>
<td>2000</td>
<td>Highest recorded instantaneous flow in the Upper Truckee River (155.2 m$^3$s$^{-1}$)</td>
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Comstock Era Deforestation

Modern Development

~40 Years of Protection and Restoration Efforts

Pre-European Contact: Washoe peoples collect plants and take advantage of fisheries

Fremont sights Lake Tahoe

Figure 3. Historical Summary of Lake Tahoe. Compiled from Hey, Rowe et al. (2002).
Upper Truckee River Restoration Projects

Lower West Side

Middle Reach Project
Upper Truckee Marsh and Urban Landscape, including ‘Tahoe Keys’
Upper Truckee Marsh 1940 (~50 years after Comstock Logging)
Dredge spoil disposal during construction of the Tahoe Keys in 1969.
Fill placement early 1970s, stopped by State of CA lawsuit
Key Objectives

- Restore floodplain geomorphic processes and naturally-functioning wetland system
- Contribute to water quality protection of lake and river
- Maintain public access opportunities and be compatible with adjacent land uses
- Protect sensitive, threatened, or endangered species
- Be functional and implementable given uncertain future of river channel and marsh project(s)
Design Elements

- Hydrology and Hydraulics
- Sediment and Buried Soils
- Vegetation Communities
  – Analogs in adjacent marsh
Implementation Highlights

- **Reconnected >12-Acres**
  - Removed up to 6 feet of fill
  - Reserved fill for future channel restoration
  - 1,500 willow stakes
  - 12,505 upland plants
  - 98,000 wetland plugs

- **Excavation and Off-Haul**
  - 82,400 CY of fill
  - 300 truck trips/day (6 trucks/10 min)
  - 6,300 truck trips
  - Fill used to restore 5-acre upland quarry site
Reactivated Wetlands / Floodplain nine years later, in 2011.
Monitoring

- **5-year Post Construction Monitoring**
  - Vegetation success
    - Percent cover, photo points, point intercept
  - Water Quality
    - Groundwater and surface water
    - TSS, Turbidity, TN, TP and Conductivity
    - Sediment traps; weighed, TN and TP
  - Wildlife
    - Bird species diversity and number
    - Area Search method
Adaptive Management

- **Vegetation**
  - No additional planting was needed

- **Erosion**
  - Small erosion repairs in 2004
  - Hand crews, jute netting and coir logs
  - Minimal costs
  - Permits were still active

12 years after LWS began functioning, the ‘rest’ of river and marsh restoration has yet to be approved.
Middle Reach Project
Upper Truckee River, 1940 (~50 years after Comstock Logging)
River relocated for airport construction in 1958.
‘Static’ rip-rapped trapezoidal channel for ~50 years (2007)
Key Objectives

- Improve natural geomorphic function
- Increase overbank flow frequency and area
- Deposit sediment into the floodplain more frequently
- Avoid impacts to buried infrastructure and adjacent airport
Design Elements

- Channel Analysis and Modeling
  - HECRAS 6 miles of stream
  - BSTEM to analyze options
  - Bed load modeled and measured
  - Effective discharge calculated under differing sediment load conditions
  - Sensitivity analysis on channel geometry
  - Design to overbank at 450 cfs
Implementation Highlights

- Reconstructed 2300 feet of Channel
- Installed 3 LWD habitat structures
- Removed 2 fish migration barriers
- Reconnected 18 acres of floodplain

Project Phasing
  - Water quality protection
Channel reconstruction and floodplain reconnection, 2008
Activated new channel and backfilled straight reach
Post Construction Nov. 2011
Monitoring

- Multiple Purpose
  - Performance
  - Effectiveness

- Multiple Parties, Multiple Approaches
  - UTRWAG
    - Qualitative observations and opinions
  - Third Party Contractor
    - Detailed Scope,
    - > 5-year Plan
    - Quantitative
Overbanking at 590 cfs

Too BIG?

Just Right?

Overbanking at 590 cfs
Adaptive Management

- Permit Restrictions
  - Planning permit still open
  - Water Board construction permit had expired
  - No “in-channel” work, only “hand work”

- Erosion Repairs
  - Launchable stone behind bank failure
  - Cobble Toe with willow staking
  - City Maintenance Crews completed the work
Conclusions

- Thinking BIG is vulnerable to changes in players, priorities, funding and supporting science
- Moving forward on functionally independent elements generates confidence
- Monitoring remains difficult to fund and use for decision-making, even after decades of collaboration
Project Owners/Sponsors
California Tahoe Conservancy
City of South Lake Tahoe
U.S. Bureau of Reclamation