



Step-Pool Creation to Restore Fish Passage and Riparian Health

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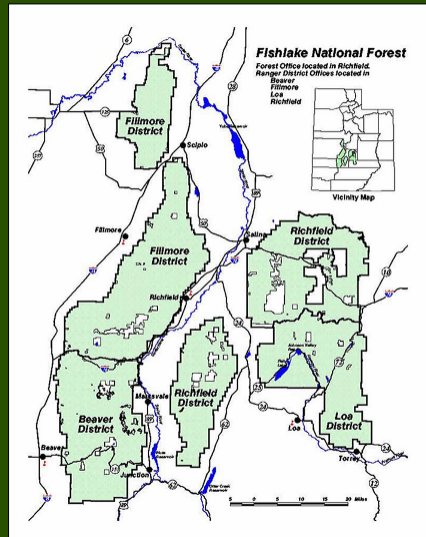
Steve Miller, Water Resources Engineer

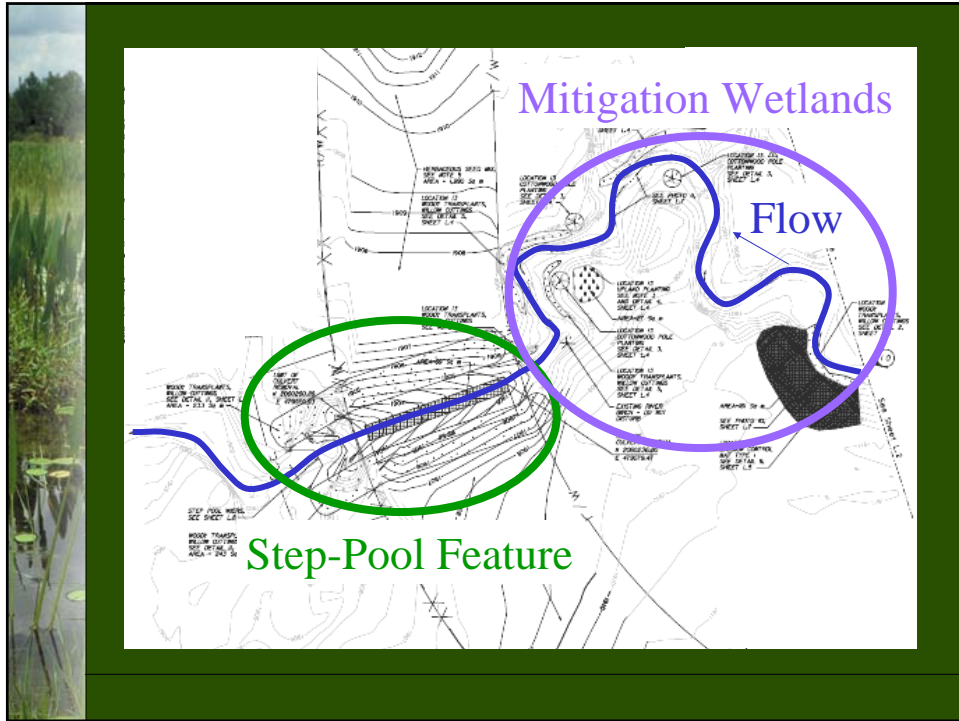
Gloria Beattie, Water Resources Engineer



Project Background

- Reconstructing Utah Forest Highway 39 through Fishlake National Forest
- Led by FHWA in cooperation with Sevier County and the U.S. Forest Service





Step-Pool Reach

- Channel instability caused by inadequate hydraulic capacity of existing culvert



Design Details - Step-Pool Reach

- Matches existing channel geometry
 - Invert elevation drop (2.4 meters)
 - Channel length (38.6 meters)
 - Slope (0.063)
- Meets fish passage criteria
 - 0.3 meters
- Morphometric features
 - $1 \leq \{(H/L) \text{ average} / S\} \leq 2$
 - *Abrahams et al., 1995*



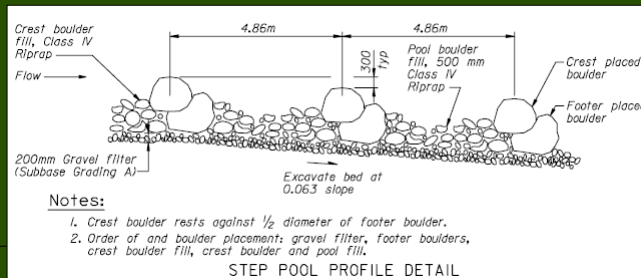
Design Details - Step-Pool Reach

- Existing bankfull channel geometry
 - Bottom width (2.7 meters)
 - Top width (4.6 meters)
 - Depth (1.1 meters)
- Step-pool channel geometry
 - Bottom width (3 meters)
 - Channel and overbank side slopes (3:1)
 - Depth (1.0 meter over crests, 1.25 meter over pools)



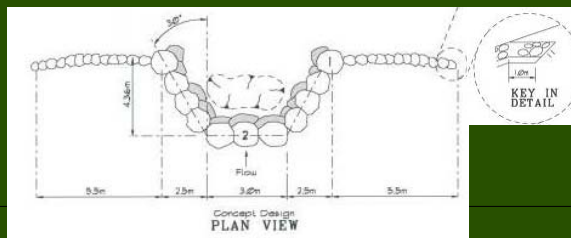
Design Details - Step-Pool Reach

- Final proposed configuration:
 - 9 crests / 8 pools over the 40-meter reach
 - Pool spacing of 4.9 meters
 - 0.3-meter elevation drop from pool-crest to pool-crest



Design Details - Step-Pool Reach

- Final proposed configuration:
 - Boulder structures extend to the bankfull (1.5-year return interval discharge) stage elevation
 - Extend rock sill or key up to 2-feet above the 100-year discharge





Design Details - Step-Pool Reach

- Rock riprap and live willow cuttings
- Riprap sized to accommodate 100-year and 500-year flood events
 - Step-pool crests and footer rocks consist of 1-meter boulders
- Live willow stakes and deciduous tree plantings for long-term stability



Mitigation Wetlands



- Required to compensate for road realignments and several crossings of Gooseberry Creek
- Mitigation site is degraded reach upstream from culvert
 - Livestock grazing
 - Downstream undersized culvert



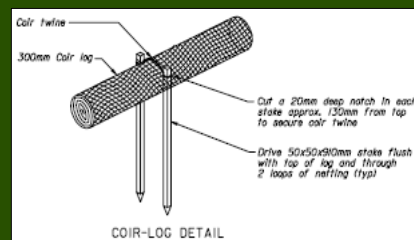
Design Details - Mitigation Wetlands

- Channel Characteristics
 - E5 Rosgen stream type
 - Bank Failure



Design Details - Mitigation Wetlands

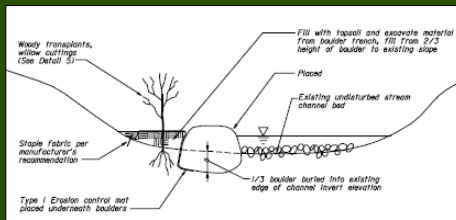
- Bank Protection
 - ~198 meters of shoreline protected using local willow cuttings
 - ~17 meters of shoreline protected using willow fascines or coir logs





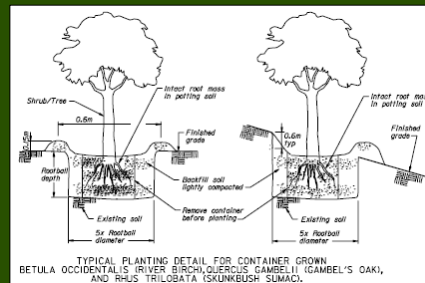
Design Details - Mitigation Wetlands

- Bank Protection
 - ~11.6 meters of shoreline protected using boulders



Design Details - Mitigation Wetlands

- Woody Species Plantings
 - 13 cottonwoods
 - 3 river birch
 - ~175 square meters of riparian area planted using willow cuttings





Design Details - Mitigation Wetlands

- Riparian Herbaceous Vegetation
 - Planting of ~242 square meters
- Upland Restoration
 - Restoration of ~226 square meters of degraded oak communities
- Site Fencing



Design Details - Mitigation Wetlands

- Performance Criteria
 - Riparian and upland vegetation monitoring
 - *Percent canopy cover, survival, no invasive weed species*
- Monitoring Methods
 - Baseline (before construction)
 - Yearly monitoring
 - Final measurements (Year 5)



Design Summary

- Site improvements
 - Step-pool feature
 - Slope stabilization
 - Revegetation of riparian and upland areas
- Relies on bioengineering wherever possible, and only uses rock revetments where necessary



Construction and Implementation

- Construction of roadway began in October 2004
- Two-year schedule for entire roadway project

Questions?

