



The Trusted Integrator for Sustainable Solutions

PLANNING CONSIDERATIONS FOR DAM REMOVALS



Environmental
Solutions



Sustainable
Solutions



Property
Redevelopment



Energy
Solutions



Design/Build
Construction

August 2011

DAM REMOVALS

ELVIDIO V. DINIZ, P.E., D. WRE
Senior Client Service Manager,
Hydrology and Drainage Specialist

WESTON Solutions, Inc.



**SAPILLO CREEK BELOW LAKE ROBERTS
DAM, GILA, NM**



**JEMEZ DAM, SANTA
ANA PUEBLO, NM**



**PONDEROSA DAM,
PONDEROSA, NM**

OUTLINE

- Introduction
- Dam Construction Impacts
- River Corridor Response
- Reservoir Sediment Accumulation
- Reservoir Water Quality
- Existing Geomorphology
- Existing Habitats
- Expected Geomorphology
- Expected Habitats
- Stream Water Quality
- Developing The Plan



KINNEY DAM, ALBUQUERQUE, NM

🌐 Introduction

- Only option to restore natural stream conditions
- Careful and detailed planning is required
- Three approaches to removal:
 - Complete
 - Partial
 - Staged
- Operating rules and management



"Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land. "

-Luna Leopold

🌐 Dam Construction Impacts

- Large Dams
 - Control all but extreme floods
 - Stratification of reservoir
 - Cold water release
 - Sediment sorting & organics deposition
 - Hungry water releases



Katse Dam

④ Dam Construction Impacts

■ Small Dams

- Capture only minor floods
- Large sediment deposition only
- Well mixed storage by bigger flows
- Sediment movement around and out of reservoir
- Minor floodplain effects



Beaver Dam

🌀 Dam Construction Impacts

- Stream Equilibrium
 - Pre-removal
 - Post-removal
- Size of dam –vs- stream flow
- Purpose of dam –vs- flow regime
- Different ecological effects between large & small dams



Lake Delhi Dam break

🌐 River Corridor Response

■ Physical

- Depth and Width
- Coarse material moves by dispersal. No sediment pulse.
- Fine material movement – pulse wavelength increases and amplitude decreases downstream
- Debris transport and accumulation across cross-section
- Cut bank and terrace formation



Isleta Dam on Rio Grande,
Albuquerque, NM

Ⓢ River Corridor Response

■ Hydrologic

- Timing of removal vs. high flow periods
- Natural river flow regime
- 2 or 3-D velocity and sediment distribution across channel modeling
- Temporal flow variations – flow duration, peak frequency, flow mass curves
- In-stream flow requirements – pre- and post dam removal

■ Environmental

- Differential rates of deposition and scour over space and time
- Sediment transport variability with flows
- Heterogeneous water quality
- Bio-diversity & population density increase
- Debris island habitat formation
- Relationship between wash, suspended, and bed loads
- Flow volume + ground water recharge + floodplain soil wetting determine species diversity

🌐 Reservoir Sediment Accumulation

- Delta formation
 - Main stream and tributaries
 - New channel evolution

Sediment sorting

- Coarse vs. fine
- Sources of post-dam removal sediment



Hondo Arroyo Dam built in 1900's is silted to the top, Santa Fe, NM

Reservoir Water Quality

- Nutrient processing
 - Related to fine sediment disposition
 - DO availability
 - Sediment re-suspension
- Temperature variations
 - Reservoir velocity current circulation
 - Stratification
 - Bank vegetation



Farmington Lake, NM - water storage and quality

Existing Geomorphology

■ Reservoir

- Water Storage cycles
- Velocity currents
- Bank erosion
- Island formation
- Delta stabilization

■ Stream

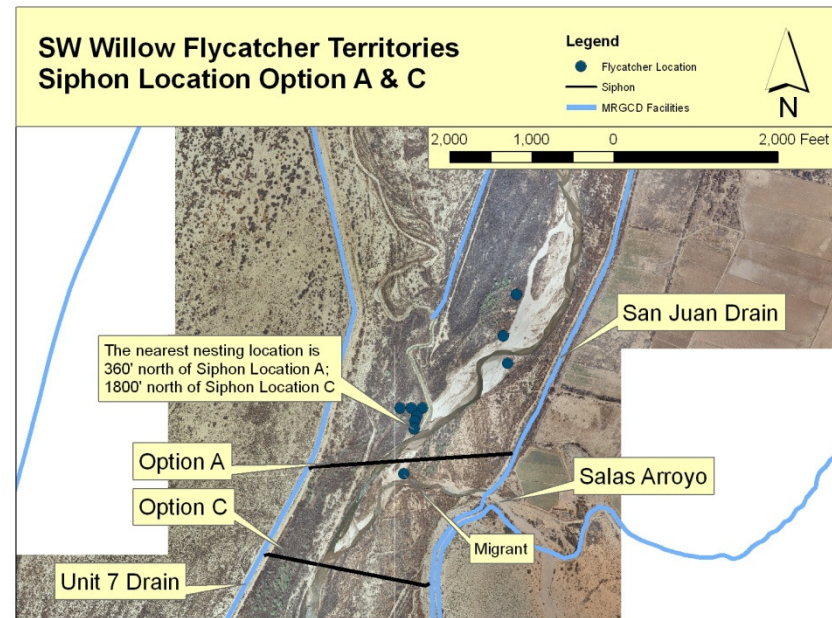
- Water release cycles
- Bar formation
- Pools and riffles
- Meanders



Galisteo Creek, New Mexico

Existing Habitats

- Soils
- Vegetation
- Ecozones
- Biota



"Riparian areas are those plant communities adjacent to and affected by surface or ground water of perennial or ephemeral water bodies such as rivers, streams, lakes, ponds, playas, or drainage ways. These areas have distinctly different vegetation than adjacent areas or have species similar to surrounding areas that exhibit a more vigorous or robust growth form."

Expected Geomorphology

- Sediment characterization
- Toxic or poor quality sediment, depth and extent
- Sediment disturbance/initiating movement
- Sediment transport
- Dispersal and deposition
- Stream response
- Long term monitoring
- River aggradation
- Flood plain impacts



Grand Canyon, AZ

Expected Habitats

- Soils and nutrients
- Suspended sediment concentrations and turbidity
- Vegetation transforms
- Ecozones/terraces
- Biota, opportunistic and succession
- Water quality protection
- Short term control of dust and erosion



Quality habitats support an entire biological community

Stream Water Quality

- Expected Changes
 - temperature
 - nutrients
 - dissolved oxygen
 - other contaminants



Many benefits of good water quality; FISH!

Developing The Plan

- Baseline inventory
- Stakeholder involvement
- Restoration designs
- Permitting and licensing issues
- Plan formulation
- Evolution of outcomes
- Benefits vs. risks
- Plan development
- Implementation





The Trusted Integrator for Sustainable Solutions

Do something that the world would care about for decades after you have passed on.

Lorrin L. Lee

🌐 *Thank you!*

- DAM REMOVAL DESIGN
- STORMWATER MANAGEMENT
- RIVER RESTORATION
- HYDROLOGY AND HYDRAULICS

WESTON Services



Environmental
Solutions



Sustainable
Solutions



Property
Redevelopment



Energy
Solutions



Design/Build
Construction

