Stream Reclamation

A good practice has gotten better

William P. Ruzzo, PE, LLC
Cherry Creek Basin Water Quality Authority
Cherry Creek Basin Water Quality Authority

- Quasi-municipal corporation and political subdivision of the state formed in 1988 (C.R.S. 25-8.5-101 et seq.)

- Mission: Protect beneficial uses by preserving, enhancing, and balancing water quality in Cherry Creek Reservoir and Cherry Creek Watershed.

<table>
<thead>
<tr>
<th>County</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Arapahoe, Douglas)</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Municipality</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Aurora, Castle Pines, Castle Rock, Centennial, Foxfield, Greenwood Village, Lone Tree, Parker)</td>
<td>8</td>
</tr>
</tbody>
</table>

| Special Districts (represents all water and wastewater service district providers) | 1 |
| Appointed by the Governor                                                      | 7 |
| Total members of Authority Board                                              | 18 |
Stream Reclamation

What is reclamation?

What are the benefits?

How do we know it works?
What is meant by Reclamation?

- means additional measures or *enhancements* to channel or stream stabilization...

- that typically includes *riparian and floodplain vegetation* enhancements...

- and a channel cross section that results in *more frequent connection and flooding of the overbank area*

- Must recognize effects of *urban hydrology*
Reclamation Sites in Cherry Creek Watershed

Presentation focus

Completed projects

Projects in progress
Figure 2. Representative Cross Section of Reclamation Concept
Cottonwood Creek...in need of Reclamation

- Incised channel
- Sediment pollutants
- Engineered channel?
Low energy approach allows simple bank protection
Next stage of bank protection (outside low-flow bends)
Final bank protection stage
Cottonwood Creek after Reclamation
Cottonwood Creek later
Typical Riffle-Pool Grade Control

9” d50 riffle pool (9”) drop
Stream Reclamation

What is reclamation?

What are the benefits?

How do we know it works?
What are the benefits of Reclamation?

- **Channel has low velocity, shear, and stream power:**
  1. Reduced erosion and sedimentation
  2. Reduced particulate pollutant transport

- **Riparian Vegetation further reduces velocities:**
  1. Promotes more sedimentation
  2. More pollutant filtration

- **Restoring the floodplain reduces velocities**
  1. More sedimentation
  2. More filtration
  3. Can also promote infiltration
Cherry Creek Reclamation

- 300 vrs < 10-square miles
- More growth constraints
- Higher energy approach
- More bank protection
Stream Reclamation

What is reclamation?
What are the benefits?

*How do we know it works?*
Action plan of choice
Monitoring Data
Technical Analysis

Stream reclamation dominates watershed actions plans for TMDL investigations
Action Plan of Choice
Example Findings

- “The quality of water in the stream corridor is normally a primary objective of restoration, either to improve it to a desired condition, or sustain it.” (FISRWG 2000).

- “This study has shown that stream restoration can be one of the most cost-effective methods of preventing phosphorus from entering lakes.” (Dove 2009)

- “…stream restoration projects that were hydrologically connected to their floodplains had increased rates of denitrification relative to restored streams that were not as well reconnected to their floodplains.” (Berg 2009)
Action plan of choice

Monitoring Data

Technical Analysis

Using a diversion channel we were able to reclaim Cherry Creek in mostly dry conditions
Cottonwood Creek
the new baseline

TP Comparison U/S to D/S Cottonwood Creek

Average Flow Weighted TP (ug/L)

Year


Before u/s wetlands

2002 u/s wetlands

Phase I 2004

Phase II 2008

2013 flood

Upstream

downstream
Large scale sculpted drop structure illustrates Cherry Creek higher energy requirements

Action plan of choice
Monitoring Data
Technical Analysis
Using Hydraulic Characteristics to Quantify Water Quality Benefits

- We analyzed Cottonwood Creek and compared it to another project in progress.

- Statistical Analysis of Channel Characteristics:
  - Velocity, Shear, & Power

- Probability analysis of Wetted Area
Probability Analysis of the Wetted Area

- Main channel connection to riparian area and floodplain is vital.
  - How often does the main channel leave its banks?
  - How much riparian and floodplain area can be inundated on an average annual basis?
Wetted Area Analysis

- Using HECRAS we calculated the wetted area for flood frequencies between the mean annual to the 1% chance.

- Plotted flooded area for Cottonwood Creek as a function of probability.
Does a straight line represent the best the project can achieve?

**Wetted Unit Area versus Flood Probability**

- Avg annual wetted unit area = 44.3 acres/mile
- Floodplain connection occurs uniformly throughout flood frequency
- Average annual wetted area appears to be an important parameter
1. The channel is generally confined through the 10-year event, then spreads out much more rapidly.
2. The Average Annual Wetted Unit Area is noticeable less than for Cottonwood Creek (44.3 vrs 31.9)
3. The wetted area for the 50- and 100-yr flood events is about three times that for Cottonwood Creek, but the average annual is less.
State and Federal Approvals and Permitting

Water Rights Implications
Permitting & Approvals

- Received Colorado Parks and Wildlife approval
- Received USACE approval from the Omaha District Office
- Received a Nationwide 27 404 Permit for Aquatic Habitat Restoration, Establishment, and Enhancement.
Water Rights Considerations

- Does evapo-transpiration from “created” riparian area require an augmentation plan?

- Reference reach analysis:
  - Showed that proposed riparian area not greater than natural riparian areas

- Channel Evolution Model:
  - Natural processes would eventually create similar riparian corridor areas.
What have we learned and what’s next?

One risk in this approach is the design needs to buy time between construction and adequate vegetation to minimize erosion.
Stream Reclamation – The Right Thing to Do.

- Water quality benefits of stream reclamation supported by:
  - Literature
  - Authority (and other?) data
  - Technical Analysis

- Cottonwood Creek has become Authority’s baseline for comparison
Stream Reclamation, Water Quality Benefit Evaluation - Interim Status Report

Prepared for the
CHERRY CREEK BASIN WATER QUALITY AUTHORITY
8390 East Crescent Parkway, Suite 500
Greenwood Village, Colorado 80111

Prepared by the
CCBWQA Technical Advisory Committee

June 16, 2011
Stream Reclamation

If we do a good job you can’t see it.