St. Vrain Creek Breaches Restoration Alternatives Discussion

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Colorado EWP Program Vision

- To implement watershed recovery projects that reduce risk to life and property, enhance riparian ecosystems, and generate long-term stream system resilience through a collaborative, watershed-based approach that incorporates the needs of diverse stakeholders.
Stream Functions Pyramid

1. HYDROLOGY » FUNCTION: Transport of water from the watershed to the channel » PARAMETERS: Channel-Forming Discharge, Precipitation/Runoff Relationship, Flood Frequency, Flow Duration

2. HYDRAULIC » FUNCTION: Transport of water in the channel, on the floodplain, and through sediments » PARAMETERS: Floodplain Connectivity, Flow Dynamics, Groundwater/Surface Water Exchange

3. GEOMORPHOLOGY » FUNCTION: Transport of wood and sediment to create diverse bed forms and dynamic equilibrium » PARAMETERS: Sediment Transport Competency, Sediment Transport Capacity, Large Woody Debris Transport and Storage, Channel Evolution, Bank Migration/Lateral Stability, Riparian Vegetation, Bed Form Diversity, Bed Material Characterization

4. PHYSICOCHEMICAL » FUNCTION: Temperature and oxygen regulation; processing of organic matter and nutrients » PARAMETERS: Water Quality, Nutrients, Organic Carbon

5. BIOLOGY » FUNCTION: Biodiversity and the life histories of aquatic and riparian life » PARAMETERS: Microbial Communities, Macrophyte Communities, Benthic Macroinvertebrate Communities, Fish Communities, Landscape Connectivity

Geology

Climate
Restoration – Typical Cross Section

ZONE 3 (C) UPPER RIPARIAN

- Cottonwood - Willow - Deciduous Shrub
- (ULF) - FACU - FAC

ZONE 2 (B) LOWER RIPARIAN

- Willow - Sedge - Rush
- (FACU - CBL - CBL)

ZONE 1 (A) WETLAND

- Sedge - Rush
- (CBL)

- Tasselhead
- small-winged sedges
- cattail rush
- low water
- horsetails
- bullrush
- bluejoint reedmace
- bulrush
- sedges
- water horsetail
- needle rush
- sedges
- rush
- bulrush
- reeds
- horsetails

LEWIS CLASSIFICATION

- ZONE #
- Forest/Forest-Sedge (FRS)
- Zone 3b
- Forest/Forest-Sedge (FRS)
- Zone 3a

- Sedge-Rush / Palustrine Emergent (PRM)
- Zone 2
- Palustrine Emergent (PRM)
- Zone 1
- Zone 0

NOTES:
1. ALL ZONES ARE TO BE SEEDED WITH ONE BROAD-SPECTRUM SEED MIX CONTAINING THE SPECIES SHOWN ON THE SEED SCHEDULES.
2. REFER TO PLANTING AND SEEDING SCHEDULES FOR SPECIES SIZE/FORM AND QUANTITY.
3. UPLAND SPECIES MAY BE FOUND AND LOCATED IN WETLAND AREAS, AND CONVERSELY WETLAND SPECIES IN UPLAND AREAS, DEPENDING ON FIELD CONDITIONS ESTABLISHED DURING GRADING OPERATIONS. PLANT ZONATION SHOWN IS A GENERAL GUIDELINE, TRANSITION OR EXTENSION OF SPECIES BETWEEN ZONES MAY VARY DEPENDING ON ACTUAL FIELD CONDITIONS, SLOPE, HYDROLOGY, MICROHABITAT, SOIL TEXTURE, AND MOISTURE CONDITIONS. THE ECOLOGIST SUPERVISING PLANTING OPERATIONS MUST MAKE DISCRETIONARY CALLS ON PLANT LOCATIONS CONSIDERING THAT OVERFLOW SWALES INCLUDE ZONE (A) WETLAND PLANT MATERIALS THAT MAY EXTEND UP INTO ZONE (B), ZONE (C) PLANT MATERIALS MAY EXTEND DOWN INTO ZONE (A), ZONE (C) PLANTS MAY EXTEND INTO ZONE (B).
Restoration – Biotechnical Bank Stabilization
**Restoration Details – Cross Vanes**

**CROSS VANE PURPOSE:**

- **GRADE CONTROL**
- **CENTRALIZING FLOW**
- **ENERGY DISSIPATION**
- **ENCOURAGE POOL AND RIFFLE FORMATION**

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**ROCK CROSS VANE - PLAN VIEW**

1. FOOTER BOULDERS
2. SCOUR HOLE DEVELOPMENT AREA
3. APROXIMATE TOP OF LEFT BANK
4. APROXIMATE TOP OF RIGHT BANK
5. RIVER FLOW
6. 6-8 IN. SPACING BETWEEN CENTER HEADER BOULDERS
7. CENTER HEADER BOULDERS
8. FOOTER BOULDERS
9. APPROXIMATE CHANNEL BOTTOM

**ROCK CROSS VANE - SECTION VIEW Y-Y**

1. Y-LEFT OF BANK
2. Y-RIGHT OF BANK
3. 5-8 IN. SPACING BETWEEN CENTER HEADER BOULDERS
4. HEADER BOULDERS
5. FOOTER BOULDERS
6. APPROXIMATE CANAL BOTTOM
7. SWITCH TO PROPOSED BOTTOM WIDTH
8. APPROXIMATE TOP OF LEFT BANK
9. APPROXIMATE TOP OF RIGHT BANK

**ROCK CROSS VANE - SECTION VIEW Z-Z**

1. CHANNEL BOTTOM
2. RIVER FLOW
3. 10% D
4. FOOTER BOULDERS

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**GENERAL NOTES**

Preliminary drawings to show concept only. Not for construction.

**NOTES**

1. Rock cross vane boulders shall be selected and arranged to allow for visual inspection of boulder placement and positioning to ensure proper channel alignment and proper flow characteristics.
2. All boulders shall be placed in a manner to ensure proper alignment and positioning to allow for proper flow characteristics.
3. Center header boulders shall be arranged to allow for proper flow characteristics and proper alignment.
4. Rock vanes and rock cross vanes shall be arranged to allow for proper alignment and proper flow characteristics.
5. Rock cross vane boulders shall be placed in a manner to allow for proper flow characteristics.
6. Rock cross vane boulders shall be placed in a manner to allow for proper flow characteristics.
**Restoration Details - Vanes**

**ROCK VANE PURPOSE:**
- BANK PROTECTION
- FORMATION OF THALWEG
- REDIRECT NEAR BANK VELOCITIES
- SEDIMENT STORAGE

1. Blend boulders into bank protection on left and right bank
2. Approximate channel bottom
3. 1/3 channel width

**GENERAL NOTES**

PRELIMINARY DRAWINGS TO SHOW CONCEPT ONLY. NOT FOR CONSTRUCTION

1. Rock vane boulders shall be neatly uniformly placed from center of channel to bank full and trimmed back to this trim line at time of construction.
2. All boulders shall be neatly trimmed.
3. Rock Vane and Rock Cross-Vanes shall be placed into the left and right arm.
4. Rock Layer Cross Vane shall be rippled on 10 feet downstream and 15 feet upstream.
5. A WEIR IN FRONT OF CHANNEL BANKS ARE INCLINED TO 3:1. BANKS SHALL BE TRIMMED FOR ROCK TO ROCK INSTALLATION.
ROOT WAD PURPOSE:

- BANK PROTECTION
- HABITAT IMPROVEMENT
- LIMITED STORAGE OF SEDIMENT
BREACH 1 – No Action plus Stream Restoration

RETAIN BERM WITH BIOENGINEERED MODIFICATIONS
- USE BIOENGINEERED EROSION PROTECTION, VANES AND ROOT WADS FOR BANK STABILIZATION, SEDIMENT STORAGE, HABITAT COMPLEXITY
BREACH 1 – Limited Setback Berm

- BIOENGINEERING METHODS (LWD, ROOT WADS, TOP SLOPE BOULDERS, AND/OR REVEGETATION)

- APPROX. FLAT (~30:1 SLOPE)

- GRADUAL SLOPE INTO FLOODPLAIN (~10 to 30:1)

- 10-yr Channel

- 2-yr Channel

- VANES

- ROOT WADS OR OTHER BIOENGINEERING METHODS

- REMOVE BERM, REPLACE WITH VERY GRADUAL SLOPE TO 10-YR CHANNEL HEIGHT, THEN GRADUAL SLOPE INTO FLOODPLAIN

- USE BIONENGINEERED EROSION PROTECTION, VANES AND ROOT WADS FOR BANK STABILIZATION, SEDIMENT STORAGE, HABITAT COMPLEXITY
BREACH 1 – Full Floodplain Access

REMOVE BERM, ALLOW FLOODPLAIN ACCESS
BUILD BERM AT FLOODPLAIN SETBACK
- USE BIOENGINEERING METHODS FOR BANK EROSION PROTECTION (LWD, ROOT WADS, TOE SLOPE BOULDERS AND/OR REVEGETATION)
BREACH 2 – Maintain Berm plus Stream Restoration
BREACH 2 – Overflow Berm plus Stream Restoration

- Cross vanes for grade control and erosion protection
- Rebuild with armored low point for overflow
- Bioengineered erosion protection
- Fill & reinforce erosion scars
- Shoreline repairs
- Conveyance improvements
- Bioengineered toe slope protection (root wads, etc.)
BREACHES 5,6,8,9 – No Action

LEAVE OPEN AS-IS

CREEK FLOW THROUGH POST-FLOOD CHANNEL WITHIN HEPP #1 RESERVOIR

ADDITIONAL ARMORING - USE BIOENGINEERED EROSION PROTECTION TO STABILIZE

LEAVE OPEN AS-IS
BREACHES 5,6,8,9 – Stream Reroute

- LEAVE OPEN AS-IS
- redirect creek flow within HEPP #1 reservoir
- remove
- additional armoring - use bioengineered erosion protection to stabilize
BREACHES 5,6,8,9 – Overflow Berm

BERM WITH ARMORED LOW POINT FOR OVERFLOW (USE BIOENGINEERED OVERTOPPING PROTECTION)

RE-DIRECT CREEK FLOW THROUGH PRE-FLOOD CHANNEL
- RE-ESTABLISH SINUOSITY
- PLACE VANES THROUGHOUT ON OUTSIDE BENDS (ENCourage MEandering, PROVIDe BANK STABILIZATION, AND SEDIMENT STORAGE)
- STREAM HABITAT RESTORATION

LEAVE OPEN FOR OUTFLOW AND BACKWATER
- USE BIOENGINEERED EROSION PROTECTION

RE-MOve OR KEEP
BREACHES 5,6,8,9 – Limited Backflow

BERM WITH ARMORED LOW POINT FOR OVERFLOW (USE BIOENGINEERED OVERTOPPING PROTECTION)

REDIRECT CREEK FLOW THROUGH PRE-FLOOD CHANNEL
- RE-ESTABLISH SINUOSITY
- PLACE VANES THROUGHOUT ON OUTSIDE BENDS (ENCourage MEandering, PROVIDe BANK STABILIZATION AND SEDIMENT STORAGE)
- STREAM HABITAT RESTORATION

OVERFLOWS THROUGH HEPP #1 RESERVOIR

HEPP #1 RESERVOIR RESTORED OVER TIME

BERM WITH ARMORED LOW POINT FOR OVERFLOW (USE BIOENGINEERED OVERTOPPING PROTECTION)
BREACHES 7a/7b – No Action
BREACHES 7a/7b – Overflow Berm

- Re-grade
  - Use bioengineered erosion protection

- Re-build with armored low point for overflow
BREACHES 7a/7b – Setback Berm

- Setback Berm with armored low point for overflow
- Re-grade
  - Use bioengineered erosion protection
Thank you!

For more information, visit the project website

or contact

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