



Introduction

Public Service Company of Colorado (PSCO), an Xcel Energy company, owns and operates under a license issued by the Federal Energy Regulatory Commission (FERC) the Cabin Creek Pumped Storage Hydroelectric Project (FERC No. 2351). As part of the relicensing studies, HDR conducted a functional assessment of all ecologically significant riparian and wetland areas to determine the condition of site wetland functions and characteristics. The Project is located within the Arapaho National Forest and occupies a total of 268 acres of National Forest lands. The site is located on South Clear Creek and its tributary, Cabin Creek, in Clear Creek County, Colorado, USA.

Study Methodology

Three wetland sites were assessed for functionality in July 2010 and July 2011. Only Site 4 is represented here. The main study goals were to: (a) document the distribution and condition of wetlands within the FERC Project Boundary; (b) assess the functional condition of ecologically significant wetlands using FACWet; (c) describe general characteristics of hydrological and biological composition of habitats and (d) review historical photographs in order to identify any potential locations for wetland restoration or enhancement.

What is FACWet?

The Functional Assessment of Colorado Wetlands Method (FACWet) involves four areas of investigation: 1) buffer and landscape context; 2) Hydrology; 3) Morphological, structural and chemical components of abiotic and biotic habitat; and 4) Functional Capacity Indices (FCI) of seven wetland functions that are weighted by individual scores in varying combinations (Johnson et al. 2010).

Wetland Site 4 Characteristics

Site 4 is structurally complex and represents one of the largest wetlands within the Project Boundary. Site 4 is a 2.39-acre riverine wetland that surrounds the area in which Cabin Creek and South Clear Creek join alongside the eastern side of the substation (Figure 1). HGM classification is riverine. This wetland has two NWI Cowardin classifications: Palustrine, scrub-shrub broad-leaved deciduous, permanently flooded and Palustrine emergent saturated. Water sources include surface flow, groundwater, and precipitation. The main hydrological input to the wetland is South Clear Creek, which flows in from the south. Remnant beaver dams were present throughout the area, creating saturation and sinuosity of South Clear Creek; although sinuous water moves downslope through the wetland then through a culvert into the Lower Reservoir. Overall, the wetland gradient is 2 to 4 percent. When floods occur, the flood water is channeled through the fence and flows between the boulders, which increase the water velocity resulting in minor scouring of the gravel access road that leads to the gage house. This scouring leads to sedimentation into South Clear Creek during flood events. An area of bank erosion was observed adjacent to South Clear Creek near the gage house and evidence of sediment from the road used to access the gage house in this area was observed.

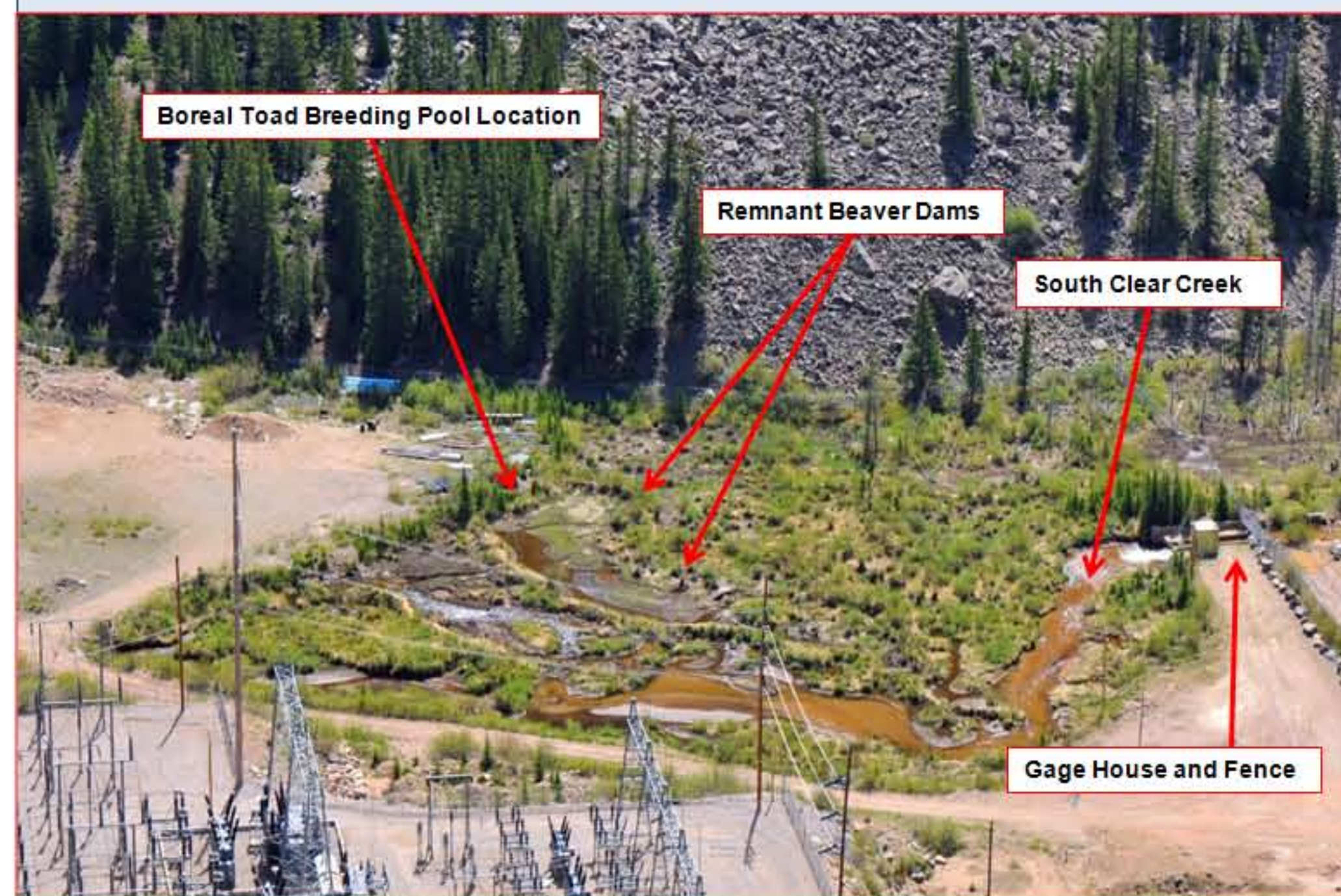


Figure 1. Overlook of Wetland Site 4 and the Boreal Toad Breeding Pool.

Functionality of Alpine Wetland Habitats Using the Functional Assessment of Colorado Wetlands Method (FACWet) at a Pumped Storage Hydroelectric Facility in the Rocky Mountains of Colorado

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Results

Site 4 had high plant species richness in comparison to other sites studied within the FERC Boundary. The tree canopy consisted of Engelmann spruce (*Picea engelmannii*) and Colorado blue spruce (*Picea pungens*) on the edges of the wetland area, particularly in the southeastern border of the wetland. The shrub layer was dominated by diamondleaf willow (*Salix planifolia*) with bog birch (*Betula glandulosa*) subdominant. Table 1 reflects dominant and subdominant plant species identifiable at the time of the survey. No non-native vegetation was observed within the Site 4 wetland boundary.

Scores for functional capacity were calculated and are summarized in Tables 2 and 3. The results indicate that Site 4 has the ability to carry out each function relatively equally. Each functional capacity index (FCI) is around 80 percent, and the total composite FCI score for Site 4 was 83 percent, or a "B." Based on this grade, Site 4 is a highly functioning wetland (Johnson et al. 2010) and the functions performed by the wetland are fundamentally sound.

Site 4 Wildlife and Potential Habitat Enhancements

Mammals seen during site investigation in this area include American yellow-bellied marmot (*Marmota flaviventris*), least chipmunk (*Eutamias minimus*), and deer (*Odocoileus sp.*). These species were all observed on the perimeter of Site 4 or within the AA itself. Yellow-bellied marmots were mostly seen in the large boulders along the substation edge, on the west side of Site 4. Brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) were observed just upstream of the confluence of South Clear Creek and Cabin Creek.

During FACWet assessment of Site 4 in July 2010, more than 1,000 boreal toad (*Anaxyrus* [formerly *Bufo*] *boreas boreas*) larvae were observed in a depression that was approximately 2 m wide x 10 m long, with a maximum approximate depth of 3.8 cm (Figure 1).

Changes to Site 4 were documented in 2011. High spring runoff caused down-cutting erosion and loss of woody debris at the outlet of the site damaged vulnerable, remnant beaver dams (Figures 1, 2 and 4).

In 2011, boreal toad eggs did not survive to hatching because of an unusual flood event that swept away the eggs and damaged the remnant dam at the outlet, a porous breach which had provided a suitable hydraulic control for water level. Damage to the outlet created a hole in the remnant beaver dam, lowered the hydraulic control point, and reduced the maximum area and depth of the impoundment to the extent that the habitat is likely prone to early drying (Figure 3 and 4). Despite less suitable conditions, the site may still attract breeding boreal toads, which like other pond-breeding amphibians tend to exhibit high fidelity to breeding sites.

Conclusion

To restore suitable boreal toad breeding and rearing conditions, PSCO and HDR are repairing the remnant beaver dam that shelters the breeding pool from damaging flows and aquatic predators. Currently, a stop-gap repair will consist of patching the hole in the remnant beaver dam and reinforcing the immediately adjacent structure (Figure 5). The dam patch will be comprised of suitably sized woody debris collected from the trash rack, sandbags and stockpiled soil from within the Project Boundary. PSCO will also evaluate the overflow spill outlet, and will design the repaired dam to hold water in the pool, optimizing the size/depth of the pool for breeding. Without repair of the remnant beaver dam, it is likely that Site 4 will be lost as boreal toad breeding habitat, the remnant beaver dam will continue to deteriorate, and other functional values of the wetland will degrade. Although no measure can guarantee successful boreal toad breeding and rearing, PSCO anticipates that this stop-gap measure will be sufficient to permit boreal toad breeding in 2012 and maintain the population until a more robust enhancement is implemented.

Table 1. Plant Species Dominance by Layer at Site 4 During Assessment on July 26, 2010.

Canopy Layer	Dominant Species Present		Subdominant Species Present	
	Common Name	Scientific Name	Common Name	Scientific Name
Tree			•Engelmann spruce	• <i>Picea engelmannii</i>
Shrub	•Diamondleaf willow	• <i>Salix planifolia</i>	•Bog birch	• <i>Betula glandulosa</i>
Forb	•Bentgrass •Sedge •Boreal alopecurus •Timber oatgrass •Fowl mannagrass	• <i>Agrostis idahoensis</i> • <i>Carex utriculata</i> • <i>Alopecurus alpinus</i> • <i>Danthonia intermedia</i> • <i>Glyceria striata</i>	•Onestem fleabane •Mountain gentian •Largeleaf avens •Heartleaf bittercress •Willowherb •Scorpion weed •Broadleaf knotweed •Heartleaf amica	• <i>Erigeron simplex</i> • <i>Pneumonanthe (Gentiana) parryi</i> • <i>Geum macrophyllum</i> • <i>Cardamine cordifolia</i> • <i>Epilobium ciliatum</i> • <i>Phacelia alba</i> • <i>Polygonum minimum</i> • <i>Arnica cordifolia</i>
Emergent	•Alpine yellowcress •Boreal alopecurus	• <i>Rorippa curvipes</i> var. <i>alpina</i> • <i>Alopecurus alpinus</i>	•Western sedge •Black alpine sedge •Spike trisetum	• <i>Carex occidentalis</i> • <i>Carex nigricans</i> • <i>Trisetum spicatum</i>

Table 2. FACWet Scores of Variables Assessed for Site 4.

Variable	Variable Name	Stressors Present	Rationale	Score
1	Habitat Connectivity - Neighboring Wetland and Riparian Habitat Loss	Wetland habitat type change as a result of Project existence	From assessment of historical photograph (1953), there were multiple wetland habitats where the Lower Reservoir now sits. Wetland habitats south of the AA are still intact with regards to historical wetland habitat type. Approximately 25% of wetlands in the 500 m Habitat Connectivity Envelope (HCE) have changed (75% wetlands remain unimpacted).	0.7
2	Habitat Connectivity - Migration/Dispersal Barriers	Tertiary Roadways Fence Parshall flume	Connectivity is limited downstream due to the presence of gravel fill in the maintenance yard. Adjacent wetland and riparian habitat areas are small. Fence lines the entire east side of the AA.	0.7
3	Buffer Capacity	Transportation Corridor Dams / Impoundments Artificial Waterbody	Score based on size of land use change, but remaining habitat unaffected by Project operations for this wetland. The biological capacity of the buffer area is in place.	0.7
4	Water Source	Diversions Culverts or Constrictions	Stressors present, but stressors cause much sinuosity in the AA, so floodplain is still present. Stream gage at inlet creating a bottleneck in floodplain of off Site water source as it flows into AA.	0.8
5	Water Distribution	Culverts Artificial Banks / Shoreline	Score based on the presence of the Project road. The majority of the wetland water distribution is unaffected. Remnant beaver dams within the assessment area affect the pool size and have a minor effect on stream sinuosity within the wetland.	0.8
6	Water Outflow	Culverts Artificial stream banks	The outflow magnitude and timing are unaltered. However, some stressors are still present.	0.8
7	Geomorphology	Fill (maintenance yard and substation slope)	Although some ponding has occurred as a result of the Project, sinuosity is high in the wetland floodplain in the AA.	0.8
8	Water and Soil Chemical Environment	Nearby construction site (not in AA), lack of shading (open scrub shrub/emergent wetland)	Water quality data collected on South Clear Creek upstream and downstream of this site and summarized in the Pre-Application Document indicate that with the exception of iron, the concentrations of nutrients, metals, and trace elements were very low or below detection limits. Water quality sampling in 2010 confirms this.	0.9
9	Vegetation Structure and Complexity	No stressors present in assessment area	Percent cover was based upon a visual classification. Classes: 0-5, 5-10, 10-25, 25-50, 50-75, and 75-100.	1

Table 3. Functional Capacity Indices (FCI) and Scores for Site 4

FCI Name	Total Functional Points	FCI
1 Support of Characteristic Wildlife Habitat	4.1	0.82
2 Support of Characteristic Fish/Aquatic Habitat	7.3	0.81
3 Flood Attenuation	7.3	0.81
4 Short and Long Term Storage	4.8	0.8
5 Nutrient/Toxicant Removal	3.3	0.83
6 Sediment Retention/Shoreline Stabilization	4.3	0.86
7 Production Export/Food Chain Support	6	0.85
Composite FCI Score		0.83



Figure 2. Boreal Toad Breeding Area



Figure 3. Aerial View of Site 4 Conceptual Enhancements



Figure 4. Outflow Hole in a Remnant Beaver Dam Potentially Created by a Surge Flow Event

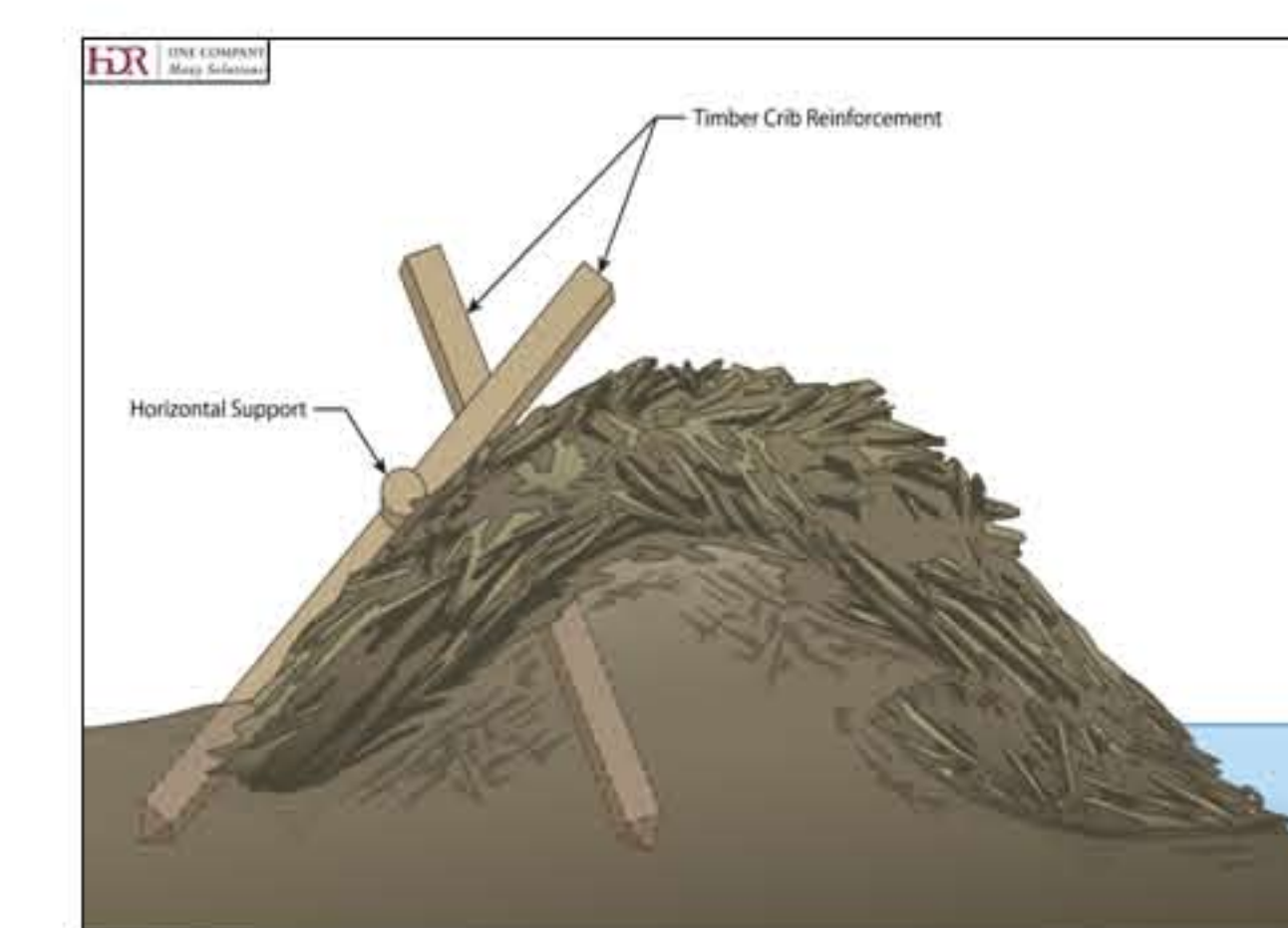


Figure 5. Site 4 Wetland Remnant Beaver Dam Conceptual Stabilization.