Blue River Watershed Group
P.O. Box 1626
Frisco, CO 80443
September 10, 2014

Chris Sturm
Stream Restoration Coordinator
Colorado Water Conservation Board
1313 Sherman St. Rm 721
Denver CO 80203

Dear Chris:

Attached is the final report from the Blue River Watershed Group for the Tenmile Creek restoration project (grant CMS # 59794, contract #C150523).

Sincerely,

James W Shaw

Executive Summary

This is the final report from the Blue River Watershed Group (BRWG) for the Tenmile Creek restoration project (CMS number 59794). The project included stream and floodplain restoration, soil amendment, wetlands creation and revegetation in a heavily impacted reach of Tenmile Creek near the Copper Mountain ski area. This area had been impacted by historic mining, timber harvest, ski area development, and railroad and highway construction. Field construction occurred in the fall of 2013. Revegetation work was conducted in the summer of 2014. The project resulted in approximately 1,600 linear feet of restored stream channel and the creation of 5 new meander bends, 5 new riffle-pool-glide sequences, and 5 new oxbow wetland features. A total of 3.15 acres of riparian, wetland and floodplain habitat was restored. This project enhanced floodplain connectivity, fish habitat quality, scenery, and wetlands function by re-creating the stream morphology and floodplain characteristics that existed on the site before mining and development. This project was featured in two separate news articles published by the Summit Daily News out of Frisco, CO in 2013. Additional articles associated with the revegetation were published in 2014. Additional funding for this project came from the National Forest Foundation and Climax Molybdenum. In-kind support came from Copper Mountain Resort and the US Forest Service. BRWG contracted Ecological Resource Consultants (ERC) to complete final design and construction management for the project. BRWG was not able to secure enough funding to complete the project as originally envisioned. BRWG responded to this challenge by breaking the project into two phases. Phase 1 was completed in 2013. Although Phase 1 could be considered a successful standalone project, BRWG intends to seek additional funding to complete Phase 2 in 2015. The beginning of Phase 2 involves a stretch of stream that could affect Highway 91 and needs to be stabilized.

Project Goals, Objectives and Results

Objective One: Recreate desirable stream and floodplain characteristics by defining a new stream channel with morphology resembling reference conditions for a stream in a broad sub-alpine valley.
Results: This objective was met for Phase 1 of the project. Phase 2 has not been completed.

The construction plans for this project portray a sinuous stream channel with bends, pools, riffles, banks and gravel bars resembling the features that existed on the site before historic mining and development changed the channel morphology in the years between 1890 and 1938. Construction work on Phase 1 of the project was completed according to the construction drawings in 2013. A total of approximately 1,600 feet of stream channel were restored. This corresponds to 1.25 acres of stream channel and bank restoration. Five meander bends were added to the stream channel. Five riffle-pool-glide complexes were constructed. The new channel that was created has a width and depth resembling reference conditions for the geomorphological setting. A single-thread channel was created to replace a braided channel that formed in response to large sediment increases associated with mining impacts. The products of this work is a stable, singe-thread stream channel that provides improved fish habitat and that functions to transport the water and sediment delivered from upstream. This also improves habitat for other aquatic species, improves floodplain connectivity and improves scenery. The

two pictures below show the new channel which generally looks and behaves as designed (Figures 1 and 2).

Figure 1: Example of the new channel at Tenmile Creek

Figure 2: Another example of the new channel at Tenmile Creek showing excellent channel shape

Objective Two: Allow periodic flooding sufficient to support vigorous wetland and riparian habitat.
Results: This objective was met for Phase 1 of the project. Phase 2 has not been completed.

The new stream channel that was constructed in 2013 is sized such that it will overtop its banks periodically during high flows. A total of 3.15 acres of riparian, wetland and floodplain habitat was restored. The new stream channel was constructed with a low-permeability liner to provide for a perched water table to ensure consistent flows in drier months. The old channel was used as a location to create riparian wetlands resembling meander bends that have been cut off by stream channel migration—features that once were prevalent on the site. Created wetlands will be maintained by a combination of overbank flooding and subsurface flows. "Sub-irrigation" drainage features, as portrayed on construction drawings, were built to carry water from the new channel through highly permeable substrates to created wetlands. This is to ensure saturation will be sufficient to maintain wetland vegetation during the summer season. The products of this work will be a floodplain that is periodically inundated during high flows, enhanced surface water – groundwater exchange, and riparian wetlands that are maintained by natural processes.

An evaluation of the channel behavior and performance has been possible after the 2014 runoff season. An analysis of stream flow observations from 2014 and historical flows recorded by the USGS at the gauging site for Tenmile Creek at Frisco indicate that the project site experienced a flood in 2014 with a magnitude that can be expected approximately once every 10 to 15 years. The magnitude of this event, which was much higher than the average annual flood, tested the channel design; the results were mixed. The design approach included a natural channel design that relies in part upon riparian vegetation as an important component of channel stability. Ideally, the riparian vegetation would have had at least one year of growth before experiencing a flood of the magnitude seen in 2014. In 2014 most of the new vegetation had not been planted and this affected the stability. In general we saw a stream channel that functioned well however, the channel experienced adjusted in both width and depth. There were two areas where the bank stability was insufficient to prevent bank erosion (Figure 3). One of those is in need of some repair (identified as BS8-A in Figure 3) and that is expected to occur in 2014. The other (identified as BS6-A in Figure 3) is being reevaluated and may be left alone. One result of the channel adjustments was that Tenmile Creek overtopped its bank and flowed into OX-4 during spring runoff carrying away much of the amended topsoil that was applied for the purpose of creating an off-channel wetland in that location. That flow helped protect the next downstream bank and it may be desirable for to maintain an overflow channel here, however created wetlands are still desired in this location. Riparian plantings conducted this year after runoff peak have been largely successful and consequently bank stability will be improved in 2015 compared to 2014.

Several pictures follow showing areas where pool filling occurred during the 2014 high flow (Figures 4 and 5), areas where channel function and bank stability were very good (Figures 6 and 7), areas where bank erosion occurred (Figures 8 and 9), an oxbow that worked well (Figure 10) and the oxbow where topsoil was lost after the bank failure (Figure 11).

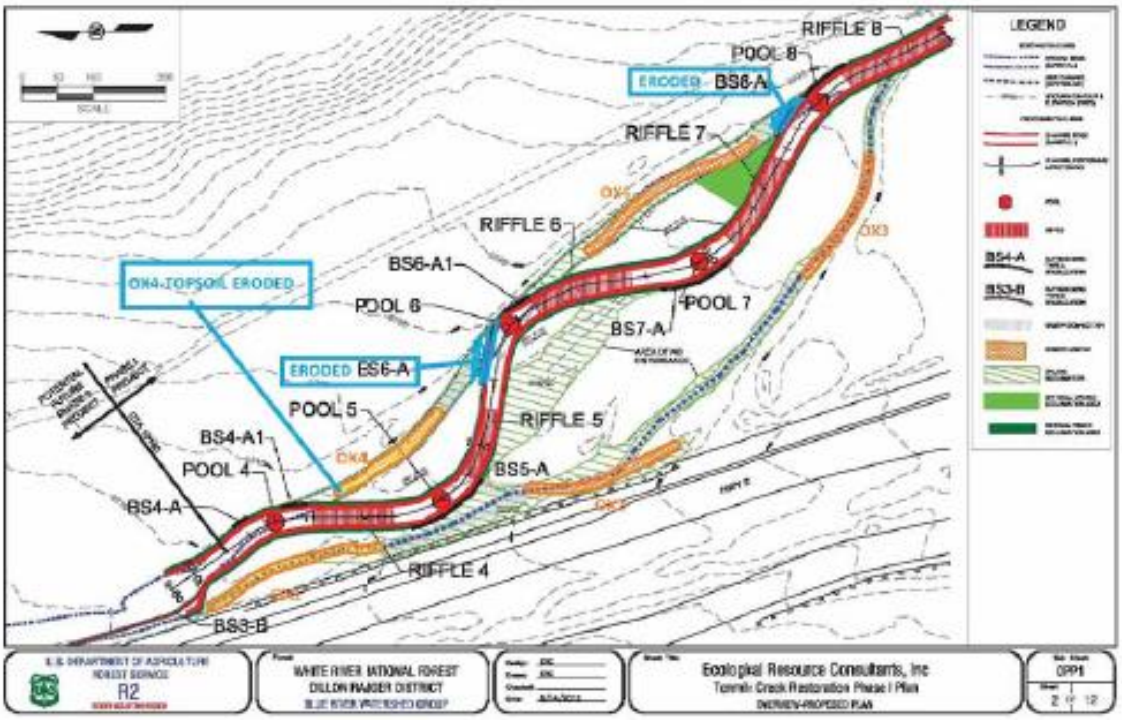

Figure 3: Overview of the construction plans, with notes identifying areas of bank erosion

Figure 4: An example of an area where a pool was constructed but had filled in after erosion and deposition occurred during the 2014 flood

Figure 5: Another example of an area where a pool was constructed but had filled in after erosion and deposition occurred during the 2014 flood

Figure 6: An example of an area where channel function and bank stability were very good

Figure 7: Another example of an area where channel function and bank stability were very good

Figure 8: An example of an area where bank erosion occurred

Figure 9: Another example of an area where bank erosion occurred

Figure 10: An example of successful revegetaion in a created oxbow

Figure 11: An example of flooding and topsoil loss in what was intended to be a created wetland characterized by saturated soils rather than running water

Objective Three: Establish a vegetation community typical of a broad subalpine valley.
Results: This objective was met for Phase 1 of the project. Phase 2 has not been completed.

Soil amendment products were applied in disturbed areas as portrayed on construction drawings in order to ensure successful revegetation. Soil amendments included a mixture of compost, imported topsoil, and ZeoPro applied in depths ranging from 3" to 6." This was necessary because topsoil had been completely lost prior to restoration. Desired native grasses were planted on site according to the revegetation plan and the construction drawings. Existing willows and spruce trees on site were transplanted into and around created wetlands. The products of this work are enhanced soil quality and productivity, increased cation exchange and buffering capacity in the soil, improved capacity for nutrient cycling and attenuation/uptake of metals and salts, and the establishment of a desirable plant community. As vegetation grows it will lead to increased ability to trap sediments from flood waters, the development of a vegetative buffer to trap sediments from road runoff, and improved scenery and recreational opportunities.

In June 2014 the Friends of the Dillon Ranger District held a willow planting day when approximately 2,000 willows that had been harvested by the Forest Service were planted on site, particularly in the oxbow area. These willows appear to have a tremendous survival rate due in part to the wet summer. In addition, 500 containerized native shrubs grown by the Forest Service and 300 more purchased by ERC were planted by ERC subcontractors along the stream banks and in the oxbows. Success rates are very good. A number of the pictures above show the successful revegetation efforts. The shrubs were watered by hand by the Forest Service and by the BRWG in June. As the summer progressed there was sufficient rainfall to sustain the new shrubs.

Below are two pictures of riparian vegetation (Figures 12 and 13) and two pictures of floodplain restoration that show the success of this first summer's effort (Figures 14 and 15). There are some weed issues which the BRWG will try to address before the snow flies.

Figure 12: An example of riparian plantings

Figure 13: Another example of riparian plantings

Figure 14: An example of successful floodplain revegetation

Figure 15: Another example of successful floodplain revegetation

This report is being submitted with a separate attachment showing eight figures depicting some before, during and after sequences from the construction for specific features. They were all taken in 2013 before the revegetation activities at the site. They provide a good look at the construction. These pictures show the work that went into preparing the site for revegetation and help explain why the 2014 effort was so successful as well as why the floodplain area restoration was so successful.

Tangible Outcomes

The following table describes the tangible outcomes of this project.

Number	Unit & Description
3.15	Acres (total) of Floodplain, riparian, and wetland habitat restored
1,600	Linear feet of stream channel restored
5	New meander bends created
5	Riffle-pool-glide features created within the stream channel (partial success)
5	Oxbow wetland features created (one failure in spring runoff at OX-4)
3	News articles published in the local newspaper describing the project

Community Outreach

The Blue River Watershed Group reached out to the local newspaper which in turn published two news articles featuring the Tenmile Creek restoration project. News articles were published in the Summit Daily News shortly after construction began on the project on Saturday, August 31st and again on Friday October 18th 2013 after the completion of construction activities. Both articles were published in print editions. The October article is available online at the following URL: http://www.summitdaily.com/news/8562414-113/project-creek-restoration-mile There was another article about the revegetation activities in 2014 around the FDRD willow planting day.

Partners Involved

The Blue River Watershed Group (BRWG) partnered with Copper Mountain Resort and the US Forest Service to accomplish the Tenmile Creek restoration project. BRWG provided contract oversight and financial management for the project, and board members provided expert review of design products and construction plans. The US Forest Service provided survey and design work, technical guidance and project management. Copper Mountain provided boulders for in-stream habitat improvements, the staging area for the construction project, and logistical support during construction. Financial support came from the National Forest Foundation, Colorado Water Conservation Board, and Climax Molybdenum. Ecological Resource Consultants was hired for final design, construction drawings and construction oversight. Tezak Heavy Equipment was hired for construction services. Friends of the Dillon Ranger District did a massive willow transplant day at the site in 2014.

Challenges Encountered

The single biggest challenge encountered during the course of the Tenmile Creek restoration project was that BRWG was not able to raise sufficient funds to complete the project as originally envisioned. In response to the budget shortfall, BRWG refined the strategy for completing the project; the project was broken into two phases. Phase 1 was completed in 2013, except for shrub plantings that occurred in the spring of 2014. Phase 1 accomplishments include the restoration of 1,600 feet of stream channel ending where the stream reaches its closest point to Highway 91, as well as the rehabilitation of 3.15 acres of associated stream banks, wetlands and floodplains. Originally, the target length of the stream restoration project was approximately 3,200 feet. Floodplain grading, soil amendment and re-vegetation were to occur on an area covering approximately 7 acres. Phase 2, to be completed in 2015 if funding becomes available, focuses on restoring an additional 1,200 feet of stream channel as well as 3 acres additional stream bank, wetland and floodplain rehabilitation. Phase 2 includes an important area where the stream impinges in Highway 91. Although each phase could be considered a stand-alone restoration project—one immediately downstream from the other—Phase 2 is envisioned as the final stage in the completion of the overall project. Due to some refinement in the design for the downstream portion of the project (Phase 2) the total restoration area covered by Phase 1 and Phase 2 would be somewhat less than originally envisioned for the entire project.

Lessons Learned

One important lesson learned from this project relates to the contracting process. BRWG originally envisioned that the project would be accomplished using a design-bid-build process rather than a design-build process. BRWG solicited proposals for a consultant that would complete final design and prepare a bid package for the construction work. Ecological Resource Consultants (ERC) was selected from a pool of bidders for the final design work because of their superior proposal and their extensive experience with design and construction oversight on other similar stream restoration projects. The original plan was that ERC would conduct a bidding process for construction, BRWG would select the construction contractor and then ERC would oversee construction by the successful bidder. The rationale for the design-bid-build sequence was to build an extra level of protection and certainty for the BRWG that could not be accomplished through a design-build process. However, because the design-bid-build process required an extra step it required more time and more money to accomplish. Also, construction bidders seemed to react to the design-bid-build process by increasing their unit costs beyond what was expected for similar projects accomplished through a design-build process. When bids came in higher than expected it became clear that the design-bid-build process was costly. In order to save money for construction work BRWG modified plans and entered a design-build contract with ERC. This saved both time and money but presented a little more risk for BRWG. As it turned out, ERC with their extensive experience in stream restoration and close relationship with construction contractors was able to accomplish the project with unit costs well below that of the other bidders. In hindsight, the design-build process saves money and the project may have gotten off to a smoother start had BRWG pursued the design build process in the beginning.

As discussed above, there were some problems with erosion and pool filling associated with this year's high runoff. This provides insights into how the channel will perform in future floods. Although there were some failures, overall the project was a success and there is a lot to learn

from seeing the reaction of the channel to a flood. Discussions between ERC, BRWG, and the USFS are ongoing about how to improve channel performance, pool characteristics and bank stability. It is clear that there is room for improvement in the constructed channel, but the improvements would be minor compared to the large effort undertaken in 2013. It is anticipated that if Phase 2 of the project receives funding, lessons learned from the flood will be incorporated into final design for the Phase 2 channel. If Phase 2 is implemented there will be an opportunity to make some minor improvements to the Phase 1 channel at a reasonable cost when equipment will be on-site.

Financial Summery

Income

Climax Molybdenum	$80,000
National Forest Foundation	$20,906
CWCB	$350,000
Total:	$450,906

Expenditures

Phase one design	$45,421.25
Phase one construction (ERC)	$371,338.64
Phase one revegetation (ERC)	$30,540.13
BRWG management	$3605.98
Total:	$450,906

In-Kind Contributions

Copper Mountain Resort	$70,000
FDRD	$5000
BRWG	$7500
USFS	$20,000