Bear Creek Diversion: Lessons Learned

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Introduction

Bear Creek Diversion is located in Northwest Wyoming on Bear Creek approximately 10 miles Northeast of Dubois, WY (Fig. 1). Bear Creek is part of the East Fork Wind River drainage, which supports one of the largest genetically pure populations of Yellowstone Cutthroat Trout (*Oncorhynchus clarkii bouvieri*) in WY. Other native species that reside in Bear Creek and the larger East Fork drainage include Mountain Sucker (*Catostomus platyrhynchus*), Mountain Whitefish (*Prosopium williamsoni*), and Longnose Dace (*Rhinichthys cataractae*). Bear Creek provides important spawning and juvenile rearing habitat and the lower part of the drainage lies within WY Game and Fish (WGFD) managed lands before entering the East Fork Wind River. Lower Bear Creek has four irrigation diversions operated by WGFD that irrigate several hundred acres of meadows providing crucial winter forage for several big game species. Water management is key to balancing needs of wildlife and the fishery in Bear Creek, and in typical years irrigation water starts turning off when 20 cfs is measured below all four diversions. The largest of those four diversions is Bear Creek Diversion that provides water to roughly 250 acres. In 2009, work began to improve the diversion for fish passage, eliminate entrainment, and to reduce annual maintenance (Figure 2). Installation of those plans were completed in 2011 that included two grouted rock ramps, an over-shot rotary drum screen, sediment sluice, trash rack, and fish return pipe (Figure 3). Many lessons have been learned at this site that has provided valuable insight to fish passage and fish screening work across WY.

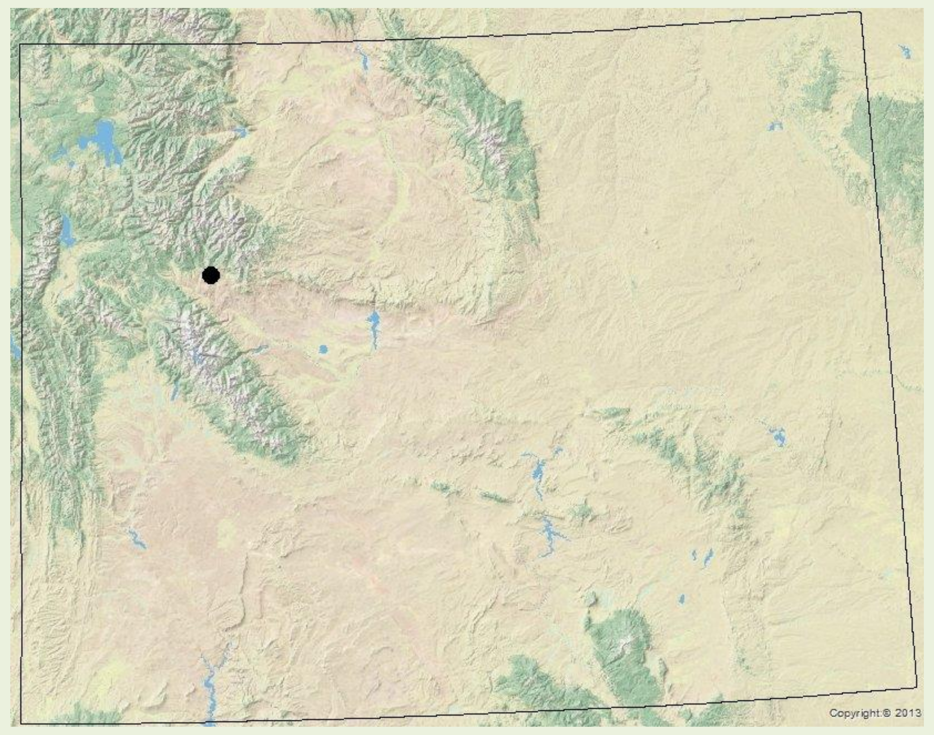


Figure 1. Project location in NW Wyoming.

Figure 2. 2010 conditions of Bear Creek Diversion; 1 large push-up dam tied into the headgate while another smaller push-up dam spanned the channel downstream. Notice the leaning headwall and sediment aggradation at headgate. The diversion required annual maintenance to divert water.

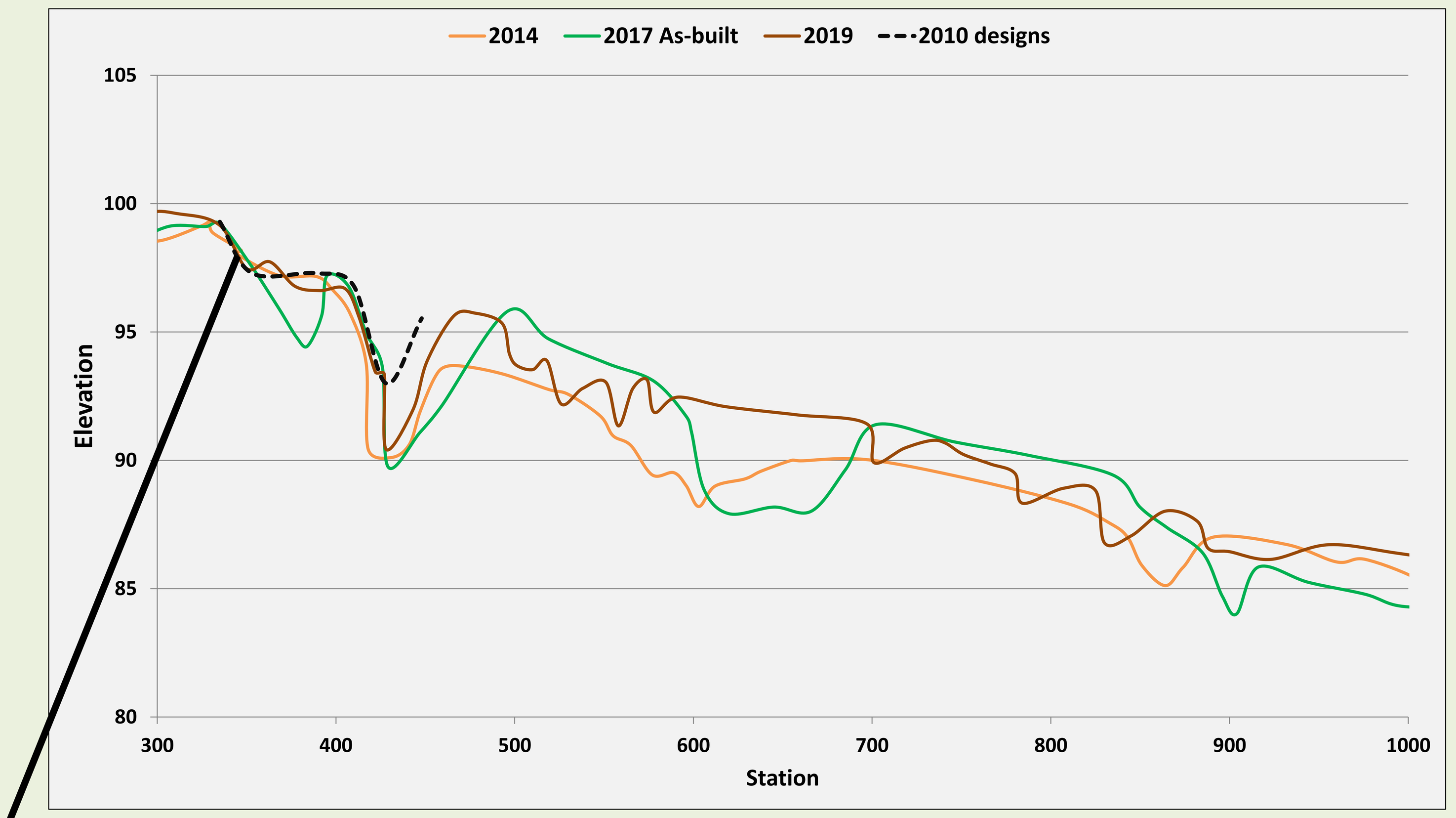
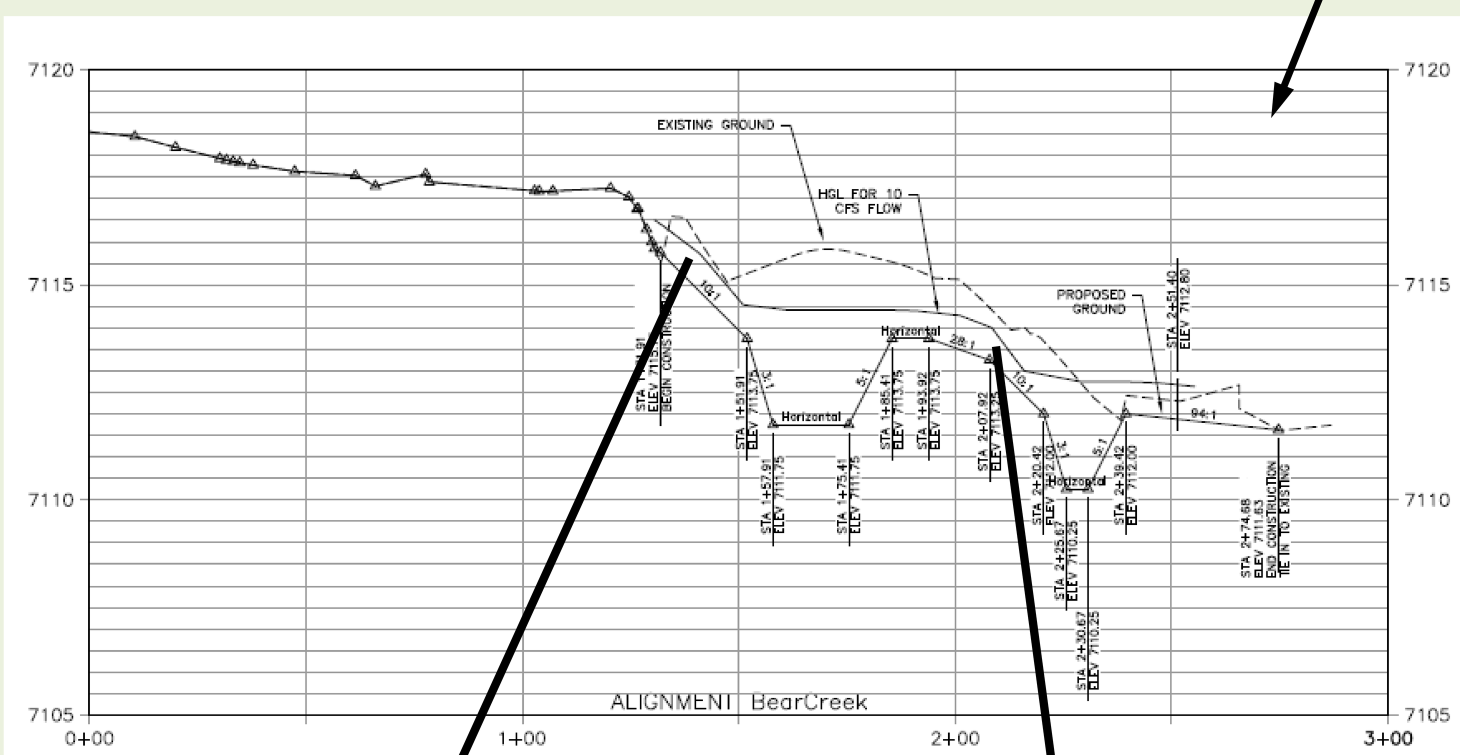


Figure 5. Longitudinal profile data of the Bear Creek Diversion reach. The Black dashed line corresponds to the 2010 design elevations. 2014 data were collected after the meander cutoff downstream and 2017 data is of as-built conditions of the constructed riffles. 2019 data represents current conditions.



Upper grouted vane looking towards headgate. Teal pipe is the sluicepipe

Lower grouted vane after pouring the concrete cut-off wall upstream

Figure 3. Engineer's plans for the grouted rock vanes that were built in 2010. Arrows correspond with the location of the vanes in the drawings and what they looked like during construction.

Channel Morphology Changes

In 2014, high spring runoff cutoff a meander downstream (Fig. 4) of the diversion causing water surface levels to drop nearly 2 ft on the lower rock vane at base flows from 2012 post-construction conditions (Fig. 5). This impacted fish passage as several large YSC were seen having difficulty navigating past the lower rock vane. Survey data were collected in 2014 for use in designs to stabilize the channel and return the water surface level to 2012 conditions. In 2017, two constructed riffles (Fig. 6) were built to raise the channel bed and water surface levels to improve fish passage and reduce the risk of further damage of the lower rock vane (Fig. 7). Repairs made in 2017 have adjusted slightly but appear to have stabilized the channel and maintain connectivity past this diversion.

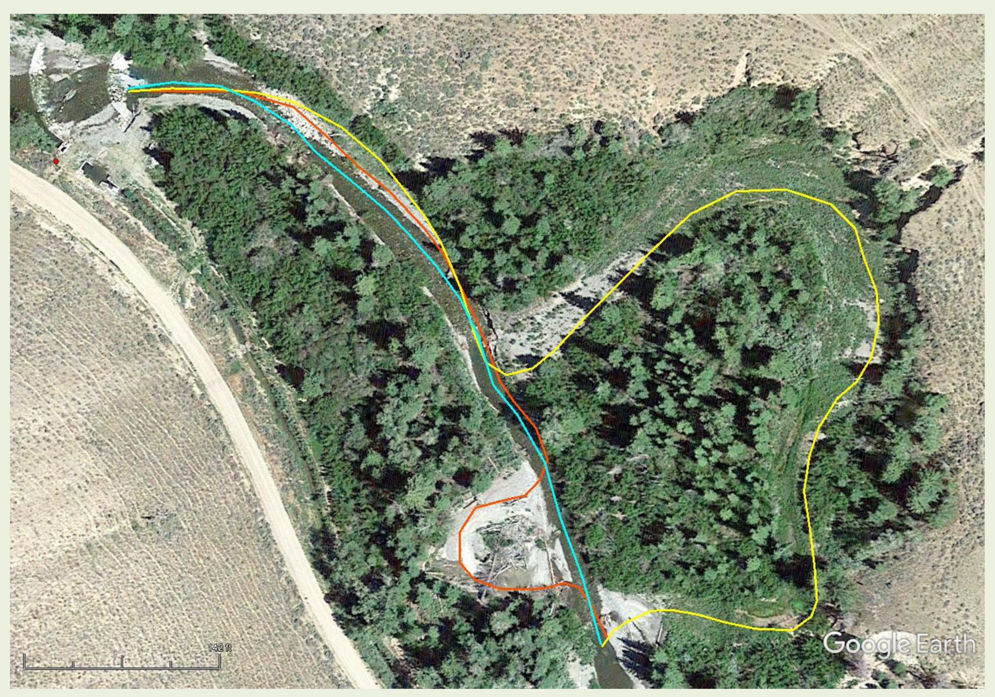


Figure 4. 2014 aerial photo: Yellow = 1994 channel (1565'), Orange = 2009 channel (908'), and Blue = 2014 channel (761'). Meander cutoffs since 1994 reduced the channel distance by 51%. The diversion stopped this headcut from moving upstream.

Entrainment & Screening

In 2007 & 2008, entrainment sampling occurred weekly in Bear Creek Ditch throughout the irrigation season, primarily June and July. A total of 160 fish were documented with (40) 25% of them being Yellowstone Cutthroat Trout (YSC). We also found a radio tagged YSC stuck in irrigation pipe fed by this ditch in spring 2009. Population estimates of YSC in this section of Bear Creek in 2007 were about 500/mile and 90 > 6 in. Most of our entrained YSC were > 6 in., so there was potentially 20-25% of the population of YSC > 6 in. lost each year in lower Bear Creek. Thus, a fish screen was incorporated into the new diversion structure to eliminate entrainment. The initial screen was an overshot, internal paddlewheel drum, 22 in. diameter by 60 in. wide (Fig. 8) rated to screen about 8 cfs, which was slightly less than double the appropriated water right of 9 cfs. Flow measurements after installation found the screen was submerged at flows lower than 8cfs, so a 30 in. diameter overshot drum was installed. Still, occasionally diverted flows were near the screen top, so we replaced the overshot drum screen with a fully open 36 in. diameter drum powered by external paddle wheel vs. internal paddlewheel to increase surface area for screening since ½ the screen is covered with overshot drum screens.

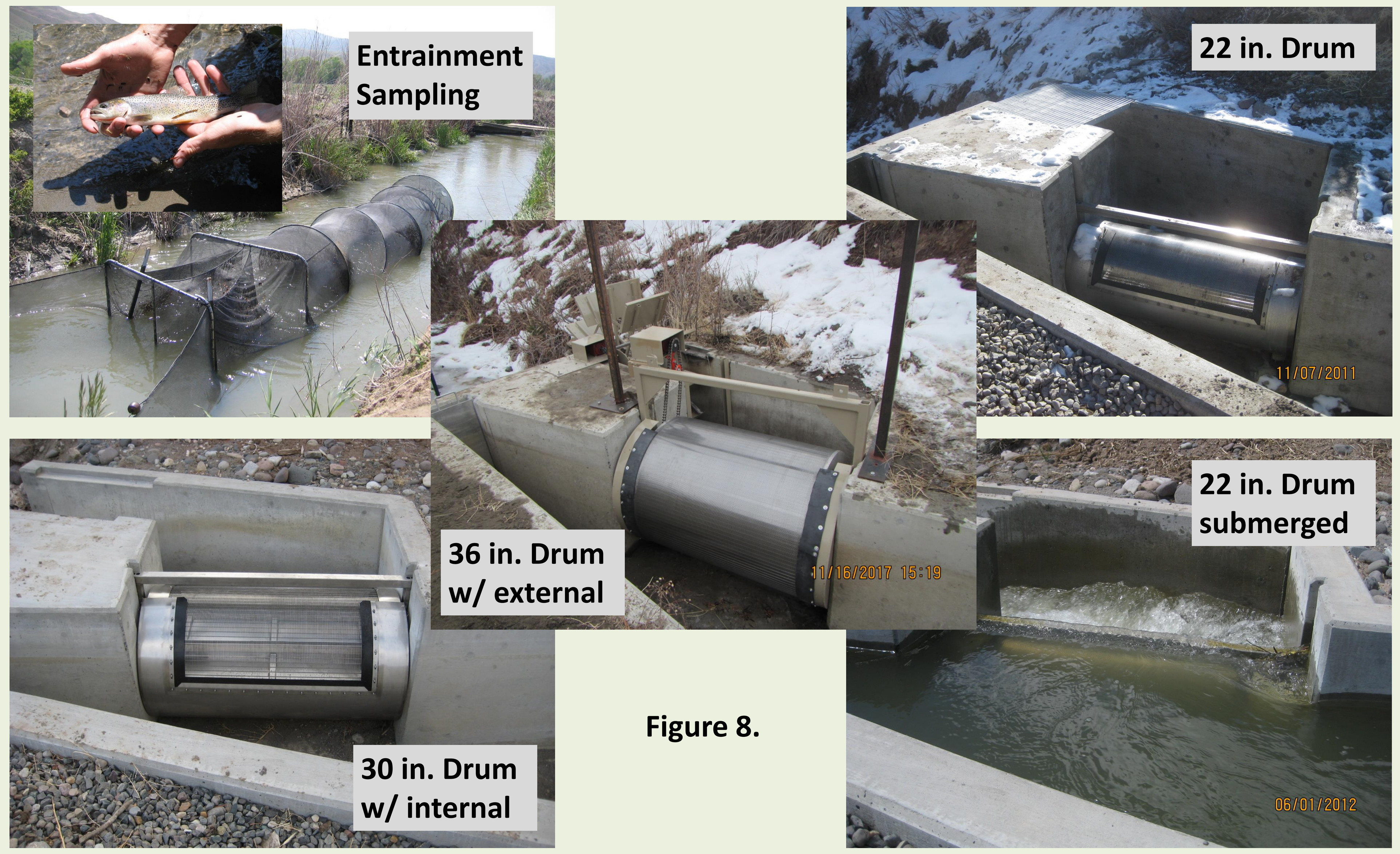


Figure 8.

Figure 6. Before (left) and after (right) 2017 constructed riffle installation looking upstream.

Figure 7. Water surface conditions below lower rock vane in 2012, 2015, and after channel reconstruction in 2017.

Lessons Learned

1. View aerial photos and survey a longer stream reach to understand potential channel changes working towards your project area.
2. Understand sediment supply and transport of the system and how it may impact designs and their long-term stability.
3. Size drum fish screens to allow sufficient freeboard and allow maximum diversion flexibility to handle changes in flow regimes.
4. Collect sufficient channel data of as-built conditions that is repeatable to document changes and assess when repairs are needed.
5. If possible, avoid 90 degree or greater bends in fish return and sediment sluicing pipes in high sediment/debris streams.
6. Have data to support installation of fish screens to justify expenses of long-term maintenance.