Rehabilitation of Grimes Creek, a Stream Impacted in the Past by Bucket-lined Dredge Gold Mining, Boise River Drainage, July 2008 to August 2011.

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For streams in forested regions of the Pacific Northwest, large woody debris is probably the most important factor governing stream habitat diversity. Wood in a stream decreases water velocity, promotes pool development, traps spawning gravels, and creates off-channel habitat. The restoration project that this report addresses is located on Grimes Creek, a stream in Southwest Idaho. In Grimes Creek, essentially all large woody debris was removed from the channel during historic bucket-lined dredge mining. The dredge rechanneled and buried the floodplain under heaps of mine tailings. The result is reduced channel complexity, narrow or nonexistent floodplain, and reduced overstory riparian vegetation. There is no opportunity for wood recruitment in a system nearly devoid of riparian trees. The result was the formation of homogeneous stream reaches dominated by shallow riffles and glides and stable gravel, cobble substrate that probably has remained in that condition for most of 60 years.

Grimes Creek is similar to other bucket-lined dredged areas. Streams are left in perpetuity as a simplified channel with limited or no instream structure, high water temperatures, shallow depths, few pools, a narrow constricted floodplain with a limited wetland and riparian area, and some unstable streambanks overloading the channel with some fine but mostly coarse sediment.

Trout Unlimited, along with a private landowner and volunteer help, started a long-term program in 2008 to rehabilitate sections of Grimes Creek on the Baumhoff's property that were severely impacted by bucket-lined dredge gold mining over 60 years ago. The TU project, completed in 2013, consisted of three restoration strategies;

1. Remove dredge tailings to create wider floodplains
2. Replant native deciduous vegetation to improve shade over the long-term
3. Install instream structures to increase habitat complexity and pool habitat, deepen the channel, and provide cover and complexity for fish.

This report represents the effects of installing numerous instream boulder structures and large woody debris in two sections of Grimes Creek totaling 2,479 feet. These sections were inventoried prior to treatment to determine existing baseline conditions and after to determine if the installation of instream structures benefited fish habitat mainly by increasing pool habitat, increasing complexity, and overall deepening the channel. More specifically, the study included a detailed analysis of these stream characteristics:

- Habitat types
- Bankfull and wetted widths- width/depth ratios

- Substrate composition and percent surface fines,
- Streambank condition, riparian structure and disturbance, canopy cover
- Large woody debris frequency
- Pool frequencies and depths
- Off-channel habitat, and fish cover characteristics

Although this study concentrated on instream aquatic habitat condition changes, probably the most important habitat issue in Grimes Creek for salmonids is excessive summer water temperatures. Because of high water temperatures, the project also included widening the floodplain to accommodate a wider, more developed riparian area by planting of native willows, alder, and black cottonwoods meant to eventually increase stream shading. Many other riparian plant species were planted to benefit birds and other wildlife as well. As stated, in this study, our goal was to determine if the addition of structures could change and improve instream habitat conditions for salmonids.

The general study area was Grimes Creek, the major tributary of Mores Creek that flows into Lucky Peak Reservoir near the city of Boise, Idaho. The first 15 miles of Grimes Creek flows through a relatively narrow flood plain until the town of Centerville, where the stream and floodplain was severely dredged and placer gold mined for the next nine miles.

There are numerous species of fish found in Grimes Creek. Bull trout is the only federally-listed fish that could possibly be found in the study area. Westslope cutthroat trout, although probably not native to Grimes Creek, is the only sensitive species that potentially could inhabit the project area. The only other salmonids found in the project area are native Interior Columbia River redband trout, and non-native brook trout and kokanee salmon. Other native fish found in Grimes Creek in the study reach are shorthead and mottled sculpin, mountain whitefish, Northern pike minnow, redside shiner, longnose and leopard dace, and mountain and largescale sucker. Fishery management by Idaho Fish and Game currently is focused on natural production of wild trout, which means it's important to improve natural habitat conditions for redband trout, westslope cutthroat, and possibly bull trout and kokanee salmon.

The project stream section had an extremely altered floodplain from past gold dredge mining. The riparian community along the project stream section was a willow dominated understory with a limited black cottonwood overstory. The channel ranged from 0 to 2% in stream gradient, had some sinuosity, relatively wide width/depth ratios in riffles and glides and mostly stable streambanks (Photograph 1).

Photograph 1. A typical riffle unit of Grimes Creek in the study area.

In the summer and fall of 2008 and 2010, 14 full spanning boulder structures (in diagonal, upstream, and downstream V's) were constructed in the study stream channel. Of the 14 full-spanning boulder structures, 13 were upstream facing "V"'s designed to divert flows away from banks and create pools in the center of the channel. In association with the full-spanning structures, numerous boulder clusters and individual large boulders were placed to provide additional scour and fish cover (boulder edge and turbulence). Also, one pool had 7 large woody debris pieces and one pool had three rootwads placed on the outside of eroding banks. Floodplain was created by pulling back the tailings piles and a variety of native vegetation was planted including black cottonwoods and alders to shade the creek.

THE EFFECTS FROM RESTORATION ACTIONS

Major changes in habitat conditions in the study section of Grimes Creek occurred in only one year after an average year of spring runoff flows. Before treatment, the study section of Grimes Creek was dominated by high and low gradient riffles, comprising 75% of the channel length (Photograph 1). The remaining habitat types were 14% pools and 11% glide habitats. After treatment, pool habitat were the dominant habitat type, amounting to 51% of the habitat, while riffles and glides made up 41% and 8%, respectively, of the study section length (Photographs 2-5). Treatment increased surface area and water volume by 7,023 ft^2 and 13,305 ft^3, respectively. This major shift in wetted surface area and water volume after treatment can somewhat be explained by the addition of the full-spanning boulder structures and their capability of backing and deepening water upstream due to the low gradient channel.

Pools/mile increased from 15 to 41 after treatment. Another value of installing boulders structures was increasing instream habitat complexity. Prior to treatment, there were 26 separate habitat units and only scour pools. After treatment, there were 34 separate habitat units, with full-spanning boulder structures creating dammed, scour, backwater pool, and plunge pools. The pool/riffle ratio changed from1/3 to 2/1. There were other major changes in habitat conditions. Boulder structures, tree boles, and root wads substantially increased cover conditions for trout. These structures provided over 2,000 lineal feet of edge cover and over 580 ft^2 of turbulence downstream from full-spanning structures. Structures also increased the amount of deep pool areas.

	BEFORE	AFTER
Pools per Mile	15	41
Separate Habitat Units	26	34
Pool/Riffle Ratio	1/3	2/1
Cover Created by wood and boulders	0	2,000 lineal feet and 580 ft^2 turbulent cover

Photograph 2. Initial construction of a downstream facing “V” designed to direct water down a side channel on the right bank.

Photograph 3. The same downstream facing “V” in Photograph 2 after one year of spring high flows, showing a long upstream dam pool.

Photograph 4. A typical upstream facing “V” structure right after installation

Photograph 5. A upstream facing “V” structure after one year of spring high flows.

Photograph 6. An upstream facing “V” structure showing a kokanee spawning just upstream from the structure.

The restructured sections of Grimes Creek showed substantial changes in instream habitat conditions when compared to pre-treatment conditions and the control stream section. Prior to treatment, habitat for salmonids in Grimes Creek was limited and generally in poor condition due to shallow depths, limited pool habitat, lack of instream cover, narrow floodplain, and some unstable streambanks overloading the channel with some fine but mostly coarse sediment. After treatment, pool habitat increased substantially in length, depth, surface area, and volume, whereas riffle and glide habitat after treatment showed a reverse shift decreasing in both treated sections. The main objective of this project was to improve habitat conditions in the stream reach heavily impacted by past dredge mining is possibly to provide good habitat conditions for future migrating bull trout to reach the forested, cooler upstream reaches of Grimes Creek to spawn and rear. The results of this project, thou small in stature, will hopefully show it is possible to substantially improve habitat conditions in stream reaches heavily impacted by dredge mining by use of large boulders, large woody debris, and root wads. Although not an objective of this project, structures are now used by spawning kokanee salmon. Electrofishing was performed in the project area on July 01, 2013. Three times more fish were found in the treated sections of the stream than in untreated sections immediately adjacent.

Based on our assessment of habitat indicators in the study reach prior to treatment, many were functioning at an unacceptable risk, including large woody debris, pool frequency, instream cover, and width/depth ratios in riffles. After treatment, a few of these habitat variables improved substantially, including pool frequency and instream cover. The only downstream facing "V" designed to improve an existing side channel, substantially increased flows, surface area, and water volume in the side channel (Photographs 2 and 3). Upstream facing "V" structures protected streambanks from eroding and created plunge pools in the center channel and dam pools upstream (Photographs 4, 5, and 6). Photograph 6 shows a kokanee salmon spawning on newly deposited gravel just upstream from a upstream facing boulder structure.

As mentioned before, one major problem in Grimes Creek is excessive summer water temperatures, due mainly to lack of riparian shade and probably the high amount of coarse sediment providing a heat sink. Although not systematically measured, the project probably had minimal effect of water temperatures; however the substantial increase in the amount of deeper water in dammed and plunge pools might provide cooler bottom water and possibly provide more refuge from water temperatures in the summer that exceed 70ºF. Vegetation will take some years to grow to provide adequate shading to impact stream temperatures. A surrogate measure for shade is plant mortality rates until enough growth can provide a measurable indicator of percent shade achieved.

After treatment, of the 14 full-spanning boulder structures that were subjected to high spring flows, only two had boulders move, mainly because the contractor ran out of large boulders and had to install smaller two foot diameter boulders. These smaller boulders moved about two feet downstream and sank into the substrate, reducing the height of the full spanning structure. The results of this evaluation are evidence that streams impacted from bucket-lined dredge gold mining, lacking structural components to reestablish and maintain complex instream habitat, can be rehabilitated to provide favorable habitat conditions for salmonids.