

**Scott River Fish Passage Project / Scott River Diversion Improvement Program**  
**US Fish and Wildlife Service**  
**Agreement # 113332J010**  
**Project # 2002-FISHPASS-01**  
(Siskiyou RCD Ref. # 41 II)  
**Final Report**  
December 18, 2004  
Gary Black, Project Coordinator

**ABSTRACT:**

The Scott River is a major tributary to the Klamath River. The Scott River and many of its tributaries support runs of three species of anadromous salmonids: Chinook, coho, and steelhead trout. The intent of the Scott River Fish Passage Project (FWS project agreement title) / Scott River Diversion Improvement Program (RCD proposal title) was to improve access and passage for migrating coho and steelhead trout in the important tributaries of the Scott River. This project shall be referred to as the Scott River Diversion Improvement Program throughout the remainder of this report.

The largest fish passage issue in the mid and lower tributary reaches are the structures constructed for agricultural diversions. These structures range from dams constructed from gravel using equipment to hand stacked boulder dams sealed with plastic. During the mid to later part of the summer and often extending into the fall, some of the diversion structures can be barriers to fish passage whether they are juvenile or adults. The intent of the Scott River Diversion Improvement Program was to improve four diversion structures in Patterson Creek (a tributary to the Scott River) so fish passage was available during most flow scenarios. This was achieved by installing boulder weirs to act as a grade control and by installing a headgate at each diversion head to control adjustment of flows. A NOAA/CDFG approved fish screen was installed at all four sites (fish screens were not funded through this contract, but were planned in conjunction with the installation of the weirs). The weirs have been installed for two to three winters and appear to be functioning well for fish passage and diversion purposes. During December of 2004, adult coho have been observed above all weirs and the structures meet juvenile fish passage standards when there is more than 0.2-0.3 cubic feet per second (cfs) going over the weir.

## **BACKGROUND AND PROJECT INTENT:**

Patterson Creek is an important tributary of the Scott River. It is a snowmelt fed tributary with elevations over 7,000 feet. The stream quickly descends down the mountains to the foothills and valley floor where the gradient becomes favorable to anadromous fish. Variation in flow volumes is dramatic as flows in Patterson Creek vary from 150 cfs during spring snow melt to less than 1cfs in the later summer and fall. Patterson Creek disconnects in two reaches during the summer and year round flows only occur in two locations totaling two miles within anadromous use. Even though flows are small in the summer, temperatures in Patterson Creek remain cool throughout the summer, providing summer refugia for cold-water dependent species where year round flows occur. Patterson Creek is used by coho salmon as well as steelhead. Steelhead use the system every year, while coho use Patterson two out of three brood years.

There are five active diversions located on Patterson Creek. In order to divert water as flows decrease the common practice has been to construct gravel dams using bed load. The construction of such dams prevents fish passage in some cases, and annually disturbs the bed load. The Siskiyou RCD and property owners have been looking for alternative diversion structures to gravel/cobble diversion dams. The intent of this project was to demonstrate the feasibility of using boulder vortex weirs as a diversion structure, as well as, an instream enhancement structure. Some weirs have been installed in low gradient reaches (0.4%) where others have been installed in steeper gradient reaches (1.2+ %). In all cases, the weirs act as a gradient control for stream channel elevation stability. A stable channel elevation located just above the weir provides the opportunity to install a permanent head gate structure (then a fish screen can be installed below). Without a gradient control, permanent head gate structures are not possible (and newly installed fish screens are at risk of damage in high flows), as the diversion head locations must adjust to the changing elevation of the stream channels, which can vary several feet.

Three water users on four diversions agreed to install vortex boulder weirs to replace gravel dams that prevent fish passage in Patterson Creek (the fifth diversion allows fish passage at this point). Previously, the water users had to move gravel (bed load) material to develop their diversion dams in order to divert water. Later in the summer, all of the participating water users developed diversion dams that blocked the channel and fish passage, thus preventing migration of fish until the diversion dams were either removed or washed out with fall rains. Previously, the four participating diversions broke three miles of Patterson Creek into four stream segments that prevented migration in and out of each stream segment from mid-June through December. The diversion dams prevented juvenile fish from moving upstream in search of year round water or dispersing to better habitat because of reduced flow. When fall rains came late, they also prevented adult fish from accessing spawning grounds in Patterson Creek until flows increased to the point of overtopping and washing out the diversions.

## **PROJECT DESCRIPTION:**

The diversions targeted for improvement were located in spawning and rearing reaches of Patterson Creek. Prior to the project, the diversion structures and practices created migration barriers beginning in late May or June. In order to reduce impacts to the channel and provide for year-round fish passage, we reconfigured the diversion methods and locations. In several cases, we moved the diversion take-out point up-stream in order to gain elevation so the diversion(s) would have sufficient fall. Therefore, a gravel dam preventing fish passage was no longer required in order to build head to divert water.

The Scott River Diversion Improvement Project had two objectives that focused on developing a fish friendly diversion system in the Patterson Creek:

- 1.) Develop fish friendly diversion takeout structures in five locations to reduce instream impacts, provide over summering cover, and fish passage.
- 2.) Install a headgate structure (and fish screen with by-pass) to protect fish from the diversion, measure and regulate the diversion and protect the diversion from adverse impacts of high flows. The fish screens were designed and constructed (meeting NOAA/CDFG specifications) by the Siskiyou RCD using Wildlife Conservation Board (WCB) funds.

## **CONSTRUCTION STANDARDS**

**Installation of Boulder Vortex Weirs:** The boulder vortex weirs extend across the active channel and are be keyed into the banks on either side of the stream. The weirs were constructed per the CDFG Stream Improvement Handbook, 1998. The weirs serve two purposes: 1.) Improve instream habitat and 2.) Eliminate the negative effects caused by the previous diversion system. The weirs are arched upstream in order to focus flow towards the center of the stream to create a pool and reduce erosion of the stream bank immediately below the weir. Elevations of the boulders within the weir change over the length of the structure in relation to the channel bottom. Elevations of the weir are highest near the banks with the lowest elevation at the point of desired thalweg and low flow location. Desired positioning of the low flow notch usually favors the side of the channel where the diversion take-out is located.

Construction of the weirs occurred in the fall of 2002 during low flows when the water was cool to protect the fish from stress. The weirs were constructed out of large boulders, which were placed deep in the bed load (3/4 of the boulder was trenched in the bed load). The large boulders were 3 to 6 feet in diameter. The weirs were composed of one row of boulders placed across the channel on a base of smaller (1 to 3 foot diameter) quarry rock. The quarry rock extends below the weir to absorb some of the plunging energy created by the weir. The quarry rock placed below the weir extends approximately 6 to 8 feet below the weir. A small spacing between boulders allows bed load movement to pass through the weir and fish passage over the weir during a wide variety of flow conditions. Placement and

angle of each weir varied based on the meander pattern, the location of diversion (head gate), and gradient of the stream. Diversion points were often moved up stream in order to gain sufficient elevation for weir placement. Weirs were often located at the base of runs or at a meander cross over.

The weirs will also provide much needed cover in the stream and pool habitat for rearing steelhead and coho juveniles. As previously mentioned Patterson Creek is an important spawning and rearing area for steelhead and coho salmon. Adult coho salmon were seen holding in the pools created by the weirs in several locations in the winter of 2004 and spawning in the tail outs of three of the pools generated by the weirs. Juvenile fish were also noted using the habitat created by the weir over the 2003 and 2004 summer.

**Installation of Culvert and Headgate:** The diversion take-out is placed just above the weir where channel elevation is stable. The head gate structures were placed at the diversion take-out on the edge of the stream bank. Headgates varied from a simple head gate style placed on the end of a culvert to concrete vaults with a built-in Waterman headgates. Three diversions received waterman style headgates that affixed directly to the diversion culvert.

The length of the culvert at the head of the diversion varied depending on conditions. Our intent was to bury the culvert through areas where high flows could enter the diversion ditch and potentially divert the channel or fill in the diversion. Diameter of the culvert (ranged from 18" to 30") was based on adjudicated volume, condition of current use, and grade of diversion ditch.

While all the headgates and culverts were installed by the RCD, three of the headgates (concrete vaults) were provided by the California Department of Water Resources through a contract with the CDFG. Excess funds proposed for headgate purchase were transferred to installation costs for higher quality concrete vault headgates, and for quarry rock for the rock apron placed below the weir. Additional matching funds and in kind services came from diversion users who helped in the construction of the weirs either providing some physical assistance or equipment donation.

Bank armoring was installed above and below the weirs, around the headgate and over the culvert to protect it from being eroded during high flows. Armoring will protect the head gate and stream bank from high flows and energy released from the plunge of the weirs. Armoring was also placed on the stream banks located just downstream of the weirs to protect the banks from the erosive power of the plunging water. Quarry rock was also placed in the trenches used to key the weir into the banks. Diameter of bank armoring ranged from 6 inches to 4 feet in diameter at the toe to provide additional cover and complexity.

**SITE DESCRIPTIONS:**

**#1) Upper Ditch:** Physical description of site location: On Patterson Creek 1 ½ mile above Hwy 3 Bridge over French Creek.

**Legal description:** T42N R9W Sec.7

**Length of weir:** 45 feet of boulders through active channel.

**Length of weir keyed in on south bank:** 10 feet

**Length of weir keyed in on north bank:** 15 feet

**Achieved channel elevational increase at weir:** 4/10 feet ratio at low flow (apex)

**Length of bank armoring:** South Bank: None

North Bank: 20 feet above weir, 20 feet below

**Length of culvert installed:** 30 feet long by 30-inch diameter. Culvert was buried off of the north bank.

**Materials Volumes for site:**

Number of individual Large Boulders: 22 Large Boulders

Cubic yards of Trench Rock: 110 cu/yds

Cubic Yards of Quarry Rock: 60 cu/yds

**#2.) Lower Young Ditch:** Physical description of site location: On Patterson Creek 0.6 miles above Hwy 3 Bridge.

**Legal description:** T42N R9W Sec. 7

**Length of weir:** 44 feet of boulders through active channel.

**Length of weir keyed in on south bank:** 30 feet

**Length of weir keyed in on north bank:** 60 feet

**Achieved elevational gain at weir:** 5/10-foot ratio (at apex)

**Length of bank armoring:** South Bank: 40' below

North Bank: 25' below

**Length of culvert installed:** 40 feet long by 30-inch diameter culvert buried off of south bank. 4/10 foot of fall over 40 feet of culvert.

**Materials Volumes for site:**

Number of individual Large Boulders: 24 Large Boulders

Cubic yards of Trench Rock: 110 cu/yds

Cubic Yards of Quarry Rock: 90 cu/yds

**#3.) Crystal Dairy Ditch:** Physical description of site location: On Patterson Creek 1.10 miles below Hwy 3 Bridge.

**Legal description:** T42N R9W Sec. 7

**Length of weir:** 48 feet of boulders through active channel.

**Length of weir keyed in on South bank:** 20'

**Length of weir keyed in on North bank:** 20'

**Achieved elevational change of channel at weir:** 5/10 foot

**Length of bank armoring:** South Bank: 50

North Bank: 30

**Length of culvert installed:** 30 feet long by 30-inch diameter culvert was buried.

**Materials Volumes for site:**

Number of individual Large Boulders: 34 Large Boulders

Cubic yards of Trench Rock: 180 cu/yds

Cubic yards of quarry Rock: 160 cu/yds

**#4.) Pipe Ditch:** Physical description of site location: On Patterson Creek 2.10 miles below Hwy 3 Bridge.

**Legal description:** T42N R9W Sec. 7

**Length of weir:** 42 feet of boulders through active channel.

**Length of weir keyed in on South bank:** 15 feet

**Length of weir keyed in on North bank:** 15 feet

**Achieved elevational change of channel at weir:** 5/10-foot ratio

**Length of bank armoring:** South Bank: 20 feet

North Bank: 30 feet

**Length of culvert installed:** 40 feet long by 24-inch diameter culvert was buried off North bank.

**Materials Volumes for site:**

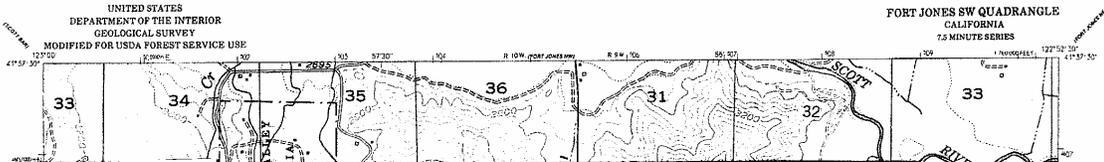
Number of individual Large Boulders: 24 Large Boulders

Cubic yards of Trench Rock: 80 cu/yds

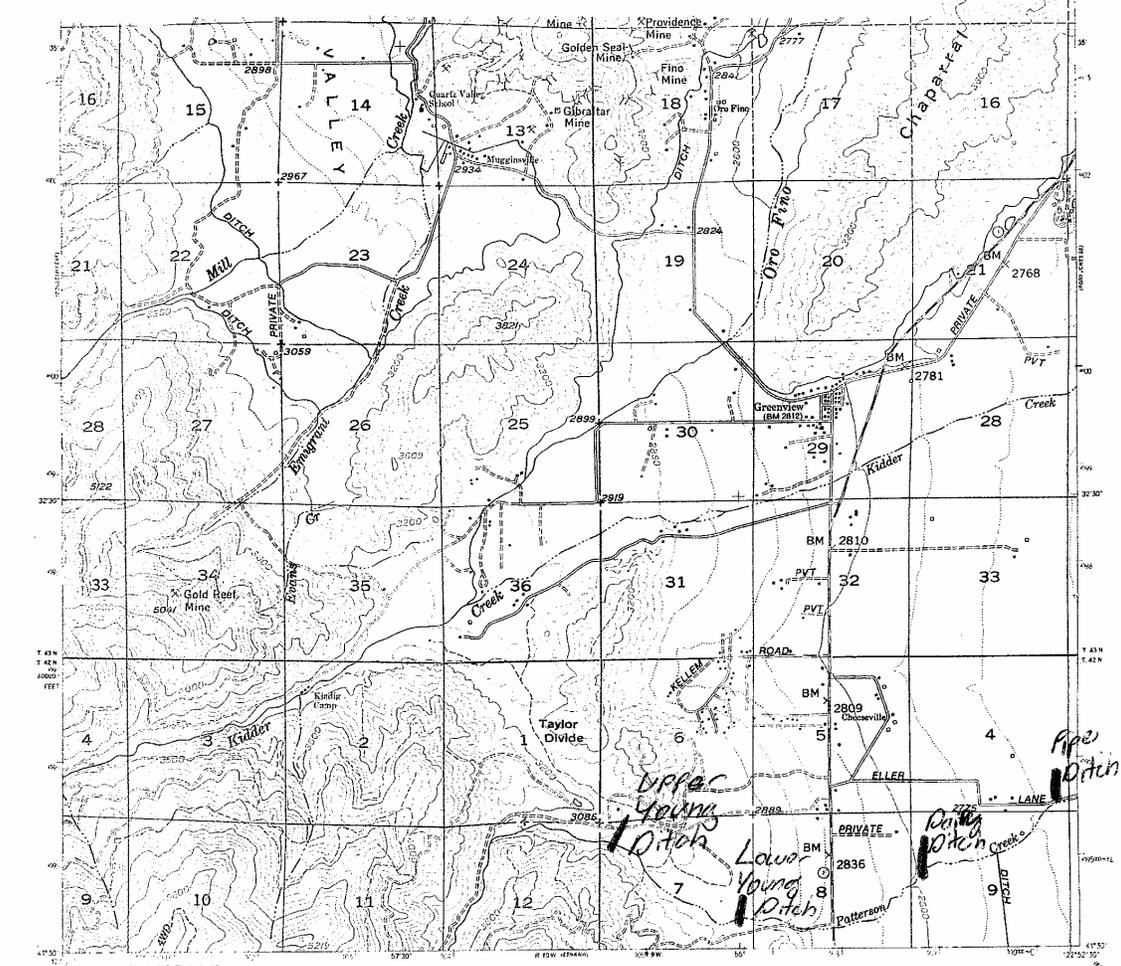
Cubic yards of quarry Rock: 60 cu/yds

**SUMMARY:** The Scope of the project was to provide fish friendly diversion take out systems on four diversions. We were able to construct weirs on 4 diversions in high priority locations in the Patterson Creek sub-basin. The project improved fish passage significantly during low flow periods and reduced the amount of instream activity required to divert flows. The diversion users are pleased with the structures, which will likely encourage proper maintenance of the diversion structure. During the low flow period of 2003 and 2004, juvenile fish were seen passing through the weirs and adult coho were noted holding within the weirs in the winter. While we are pleased with the construction and current operation of the weirs, we recognize they have not experienced flood stage events. We also do not know the volume of maintenance required over time.

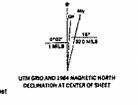
Over the past three years the Siskiyou RCD has installed weirs at 12 diversions in the Scott River watershed. We have altered our design to compensate for the streams reaction to the weirs. We have found that weirs in deep or soft bed load are the most difficult to design as they plunge over the weir and can cut the channel elevation below the weir. The change in elevation over the weir can make juvenile fish passage more difficult and often a second weir is required. We have found that providing fish passage with the wide variation of flows that occur in the Scott River is difficult, but we are confident boulder vortex weirs are the proper structures to address the fish passage issue through diversions in many cases. The Siskiyou RCD will work with the diversion users to monitor the structures and suggest maintenance techniques over time.



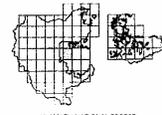
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Base map prepared by the U.S. Geological Survey  
 Center of USGS and USGS  
 Topography by photogrammetric methods from aerial  
 photographs taken 1951. Field sketch 1954  
 Potentiometric projection 1983 North American datum  
 10,000-foot grid based on California coordinate system,  
 2011  
 1000-meter Universal Transverse Mercator grid ticks,  
 zone 10, shown in blue  
 INTERIM EDITION  
 Modification to USGS base map prepared by the  
 Geomatrix Service Center from 1982 aerial photography  
 and 1983 correction guide furnished by the Pacific Southwest  
 Region



CONTOUR INTERVAL: 10 FEET METERS: DECIMETRE SCALE OF 1:62,500	
	National Forest Boundary
	Altered Land with the National Forest Boundary
	TOWNSHIP AND SECTION LINE CLASSIFICATION
	Surveyed, Location Reliable
	Surveyed, Location Approximate
	Primary Highway
	Secondary Highway
	Improved Light Duty
	Unimproved Dirt
	Trail
	Locked Gate
	U.S. Highway
	State Highway
	County Road
	Forest Highway
	Forest Road
	Forest Trail



FORT JONES SW, CALIF.  
 N4188-W1222E-7.5  
 REVISED 1983