

Case Study 1 Red Clover Rock Ford

Location

Northeastern California. Plumas National Forest. An unnamed tributary to Red Clover Creek in McReynolds Valley, 5 miles north of Lake Davis, CA. Forest Road 25N05, Station 82+10 (Red Clover Timber Sale).

Crossing Description

This ford was constructed in 2001 as a simple rock-armored ford across an unnamed ephemeral draw on a road constructed to access a timber sale. The ford is a simple, elongated rolling dip with a riprap-reinforced subgrade with aggregate surfacing and a riprap-armored outlet (figures A1A and A1B). The road is 12 feet wide and the armored portion of the ford is 30 feet long. The entire roadway surface through the dip is approximately 120 feet long. The structure is relatively new, and to date it has only been through moderate runoff events. This design is the “standard” simple, rock ford.



A



B

Figures A1a and A1b. Red Clover rock dip. Figure A1a. Flow is from left to right across the dip. Figure A1b. View is upstream.

Setting

Eastern Sierra Nevada. The area has broad valleys between granitic and volcanic mountains. This east-side forest area has a light cover of pine and sagebrush at an elevation of 5,410 feet.

Appendix A—Case Study **1**

Why Was This Structure Selected?

This structure was chosen because of its minimal cost and because the crossing site is an ephemeral draw that flows only during the early spring, typically before any road use. Traffic volume and type are such that rare interruptions are acceptable. A culvert was considered but not selected due to its higher cost. Maintenance costs are anticipated to be low. This structure was designed and constructed by the Plumas National Forest.

Crossing Site History

This road previously had an unreinforced dip that would either wash out or become soft and rut in the springtime.

Road Management Objective

It is maintained for logging or pickup trucks (USDA Forest Service maintenance level 2), with some sections that are native- and some gravel-surfaced. Annual average daily traffic is 10 vehicles or less, mostly during the summer months. During a timber sale, road use is a mix of logging traffic and USDA Forest Service administrative traffic, with occasional other public use.

This road provides access from lower Red Clover Valley through McReynolds Valley to Squaw Queen Valley and the east side of the forest. The through route is closed during the winter. During the summer, traffic interruptions might occur up to two times per year during intense thunderstorms. These floods can last approximately 4 to 8 hours.

Stream Environment

Hydrology: Average annual precipitation—predominately snow—is approximately 30 inches. The stream is ephemeral, draining approximately 140 acres. The 100-year flow for this very small, flashy watershed is estimated at 75 to 115 cubic feet per second.

Channel Description: The channel is only slightly entrenched with banks that are relatively flat and stable except for local scour at some bends (figure A2). Bank vegetation is coniferous trees, shrubs, and grasses. The channel varies from 4 to 10 feet wide near the site and channel slope is about 3 percent. The substrate is a poorly graded mixture of clayey sands, some gravels, and occasional volcanic rocks.



Figure A2. Measuring bankfull channel dimensions on the ephemeral channel upstream of dip.

Aquatic Organisms: None known.

Water Quality: Sediment delivery and movement in this watershed is a moderate concern since the larger watershed produces significant amounts of sediment. The armored dip is being used to prevent the production of sediment as vehicles drive across this drainage.

Structure Details

Structure: The Plumas National Forest designed this structure as part of the Red Clover Timber Sale road package. The timber purchaser accomplished the road construction. The project took approximately 2 days to construct and required a total of 50 cubic yards of rock. The design involves a simple 1-foot thick reinforced bed of Class II riprap, covered with a 0.4-foot-thick layer of Class II crushed aggregate. A layer of geotextile separates the native soil and Class II riprap (figure A3).

Bank and bed stabilization, and approaches: The outlet to the crossing is armored with several cubic yards of Class VI riprap to prevent downslope scour and serve as an energy dissipator where flow returns to the natural stream channel.

Cost: Cost was estimated at \$2,000 in 2001.

Safety: The structure is at grade with the natural stream channel so it presents no more safety hazard than any other part of the road. Crossing of the drainage during high flows is very unlikely because of the low road use.

Appendix A—Case Study **1**

Flood and Maintenance History

The crossing has not yet experienced a large runoff event. The road is bladed once every other year or during periods of intensive use, such as a timber sale. The crossing will require maintenance after high flows, which are expected to remove the aggregate surfacing (choke) material.

Summary and Recommendations

The Red Clover simple rock ford is an example of a very cost-effective drainage crossing structure for locations with ephemeral channel flows and low road use. Maintenance will be needed across the structure after high flows to replace the aggregate surfacing. The at-grade structure and downstream riprap should prevent scour and sediment loss from the site.

Charlie Carter, design team leader on the Plumas National Forest (retired), designed the structure and provided information for this case study.

