

Case Study 4. Forest Road 732 Jersey Barrier Fords

Location

Northern Arizona. Prescott National Forest. Verde Ranger District. Cienega Creek. Forest Road 732, Squaw Peak Road.

Crossing Description

These crossings are unvented fords on an ephemeral channel that transports up to boulder-sized rock during floods. Jersey barriers and large riprap support the downstream edge of the road. The jersey barriers also function to trap sediment and prevent channel downcutting occurring due to land use in the area.

Setting

Tonto Transition Section (313-C). Rock types are lava flows, plugs, dikes, and relatively flat sedimentary deposits. Vegetation in this area is pinyon, juniper, and chaparral.



Figure A16. Jersey barrier ford, FR 732.

Why Were These Structures Selected?

Channels in this area flood 4 to 5 times each year during summer thunderstorms and are dry the rest of the time, making unvented fords feasible structures. Jersey barriers act as a retaining structure, providing support for the road. They also work to control channel downcutting. These structures are simple, easy, and inexpensive to construct with road maintenance equipment, and they have low maintenance requirements.

Appendix A—Case Study **4**

Crossing Site History

Originally, this road accessed mines and ranches in the Cienega Creek area, and the alignment followed the wash, so that flood flows tended to divert down the road. After a major flood event in 1993, the road was relocated away from the channel, and crossings were realigned to eliminate the diversion potential. Crossings were also stabilized with jersey barriers to keep water in the channel and to control channel downcutting. Previous crossing structures on this road were culverts, which were overtopped and began washing out in 1993.

Road Management Objectives

This road is part of the Great Western Trail system, an off-road system stretching from the Mexico to the Canada border. It is maintained for high-clearance vehicles (maintenance level 2), and receives moderate mostly recreational use. Approximately 5 to 20 vehicles use the road per day, with the higher number occurring during hunting season. Traffic is interrupted about 3 to 4 days per year, 2 hours at a time by flooding.

Stream Environment

Hydrology: Annual precipitation is about 16 to 20 inches, falling as winter snow and rain during summer thunderstorms. Cienega Creek is a tributary to Ash Creek in the Agua Fria River watershed. There is naturally low ground cover and high runoff.

Channel Description: The channel is poorly defined immediately above and below the structure, although most of the channel is confined. Channel slope is around 2 to 3 percent and substrate is large cobbles and small boulders with gravel infill.

Aquatic Organisms: Providing passage for aquatic species is not an issue at this location.

Water Quality: Channels are downcutting in this area because the natural vegetative cover was modified by overgrazing, which increased surface runoff and erosion during rainstorms. The 1993/94 flood restoration project aimed to stabilize the channels with jersey barriers. There is a naturally high sediment load due to the large amount of granite in the watershed.

Structure Details

Structure: Jersey barriers (usually seen on freeway medians) act as a retaining structure supporting the roadway. Barriers are set to mimic channel width and shape (figure 18a) and the ends of the structure (at channel edges/road approaches) should extend above the elevation of the largest expected flood. Figure 18b shows how they can be connected.

The fords are backfilled with native rock material and large riprap is usually placed downstream to prevent scour (figure A17). Experience has shown that the downstream edge of the jersey barriers should be protected from scour by gabions or an engineered riprap fill (figure A18c) unless the channel is highly resistant to erosion.



Figure A17. Looking upstream across another jersey barrier ford on FR 732. Sloped road approaches prevent diversion and large rock is placed downstream to prevent scour.

Bank stabilization and approaches: Road approaches slope down into the crossing to prevent diversion down the road.

Cost: Cost was minimal due to the use of off-the-shelf technology and small equipment. The barriers had been used in a previous Arizona Department of Transportation project, and were inexpensive to buy from a contractor.

Safety: This type of crossing is appropriate on the 732 road, which is designed for high clearance vehicles and meant to be driven at low speed. The crossings are not signed.

4



Appendix A—32

**Flood and Maintenance
History**

No significant flood events have occurred since these structures were installed in 1993, and no maintenance has been done. Some of the structures are now showing the need for repair. For example, in figure A19 the jersey barriers were not extended high enough to control high flows, and water has gone around the ends of the barriers. Part of the reason for this could also be that sediment has been deposited and revegetated upstream of the crossings.



Figure A19. High flows have outflanked one of the ford structures.

**Summary and
Recommendations**

This structure type is a good choice at this site because of the hard, rocky substrate, flashy ephemeral flow regime, and the risk of culvert plugging by boulders moving during floods. The fords are working both as channel rehabilitation and crossing structures.

Some of the information for this case study came from field notes from an August 1999 visit to the Prescott National Forest by the Riparian Roads team from the San Dimas Technology and Development Center. Notes were written by Lisa Lewis, Jim Doyle, and Mary Lee Dereske. Other information was supplied by Doug MacPhee, retired Prescott National Forest team leader for Range, Soils, Water and Ecology, and Tim Mabery, Prescott National Forest range technician.

Appendix A—Case Study **4**

Similar Structures in Other Locations

See also Mendenhall, Rod (1983). The use of jersey barriers as ford walls. USDA Forest Service Engineering Program, Engineering Field Notes v15 (January – March):3-7.

The Prescott National Forest has used the same design on crossings in the Copper Canyon drainage (FR 136). Concentrated runoff from Interstate 17 drains directly into the canyon, and was accelerating channel downcutting. In 1991, Jersey barrier fords were installed in a series at several stream crossings that had been unarmored natural fords. The fords have worked well to retain sediment and foster the growth of riparian vegetation (figure A20). They are working both as stream crossing structures and as riparian improvements.



Figure A20. Jersey barrier ford on FR 136 has helped control channel downcutting and restore the riparian area in Copper Canyon. Photo is looking upstream at the ford.

The Tonto National Forest, just south of the Prescott, also uses jersey barrier fords, sometimes adding gabion basket energy dissipators to control downstream scour (figure A21). Jersey barrier fords generally create a downstream drop, and require scour protection to avoid being undermined. When they fail, it is often because of downstream degradation or outflanking when floodwaters rise above the protected approaches. Upstream aggradation can exacerbate problems with outflanking, and care is required to create enough sag and armor the approaches high enough to avoid it.



Figure A21. This jersey barrier-gabion ford on the 7-Springs Road on the Tonto replaced a bridge washed out in a flood.

