FINAL HYDRAULIC REPORT
TARRYALL CREEK BRIDGE
TARRYALL CREEK ROAD
CO PFH 81-1(2)
PIKE NATIONAL FOREST
PARK COUNTY
COLORADO

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I. PROJECT DESCRIPTION AND LOCATION

A. PROJECT DESCRIPTION

The Tarryall Creek Bridge is located in the Colorado Rocky Mountains, approximately 13.0 miles (from Station 1228+75 to 1262+66) Option Z (Bridge), serves as a collector highway between U. S. Highway 285 at Jefferson (also designated as Park County Road 77).

According to an initial reconnaissance and scoping report prepared by the Federal Highway Administration, Central Federal Lands Highway Division, in August, 1993 and subsequent site visits during the fall of 2000 and spring of 2001, the bridge is too narrow.

This project represents a collaborative effort between the CFLHD and U.S. Forest Service to implement and monitor methods for rehabilitation and reconstruction of Tarryall Creek Road.

The existing bridge over Tarryall Creek is two span steel girders with cast in place Deck Bridge with vertical abutments and wingwalls. The bridge is 22.0 feet wide with a 48 feet long bridge. The roadway in the vicinity of the bridge is being realigned to improve the geometry and motorist safety and thus will require the installation of a new bridge.

The proposed bridge will be a 92 feet, single span, pre-stressed, precast girder bridge.

B. LOCATION

The proposed bridge replacement and roadway rehabilitation project is located on Forest Highway 81 (Tarryall Creek Road) in the Park County, Colorado.

II. HYDROLOGY

The drainage area of this project was delineated based on topography provided by the following USGS quadrangle maps; for Farnum Peak, Eagle Rock, Topaz, Observatory Rock, Mount Logan, Jefferson, Boreas Pass, Como, Milligan Lakes, and Elkhorn, Colorado.

The Watershed Modeling System (WMS version 8.0) was used to compute discharges using United States Geological Survey (USGS) maps for Colorado. The specific regression equations used for this project to estimate peak discharges are those for the Colorado Mountain Region. Variables used in the equations are total drainage basin area, mean basin elevation, and longitude of basin at the outlet location. The Federal Lands Highway Project Development and Design Manual recommend using regression equations for determining peak flows for basins greater than 0.46 mi^2 in size. Peak discharges for the 50-year design storm were determined for this bridge.

The equations used are listed below:

$Q^2 = 74.3A^{.693}\ SB^{0.894}$
$Q^5 = 81.5A^{.698}\ SB^{0.719}$
$Q^{10} = 86.1A^{.635}\ SB0^{0.635}$
$Q^{25} = 91.5A^{.699}\ SB^{0.550}$
$Q^{50} = 94.9A^{.497}\ SB^{0.497}$
$Q^{100} = 98.5A^{.698}\ SB^{0.452}$
$Q^{500} = 106A^{.696}\ SB^{0.364}$

Where:
A = drainage area in square miles, is the total area that contributes runoff upstream of the location of the stream site of interest.

SB= Mean Basin Slope, in feet per foot.

Table 1: Peak Discharges Summary for Tarryall Creek Bridge

Location	Area (mi^2)	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)	Q500 (cfs)
Tarryall Bridge	327.21	605	1031	1362	1813	2165	2543	3431

Because of increasing recreational traffic as well as local traffic due to private development along the FH 81 corridor, roadway improvements are necessary to safely and efficiently accommodate current and future traffic demands. Planned roadway

improvements include roadway realignment, widening, paving, and replacement or addition of numerous drainage structures along the project site.

If the bridge is to be replaced, detail hydrologic and hydraulic bridge calculations will be needed to ensure that the bridge can pass the design discharge event without overtopping, and that the bridge has a sufficient foundation design to resist the design scour event.

II. BRIDGE HYDRAULICS

The US Army Corp of Engineers (USACE) River Analysis System (HEC-RAS), version 3.13 was used to evaluate the bridge hydraulics for both the existing and proposed bridge configurations. A base HEC-RAS Analysis was prepared for Tarryall Creek Bridge extending 500 feet downstream of the existing bridge and 500 feet upstream of the bridge. Cross sections were taken from field measurements. Manning's "n" values were estimated from field experience and field inspection as 0.035 for the main channel, and also 0.051 for the flood plain overbank areas. The hydraulic model includes analyses for the 2-year, 50-year, 100-year, and 500-year peak discharges.

The proposed Tarryall Creek Bridge crossing is designed to carry the 50-year flood event without overtopping the roadway. The major stream bridge crossing has also been designed for the 100-year flood event for scour protection purpose, and has been analyzed for the 500-year (super flood) scour condition

Table 2: Hydraulic Summary for the Tarryall Creek Bridge

Frequency	Discharges (cfs)	WSEL (ft)	V (ft/s)	Flow Depth (ft)	Proposed Freeboard (ft)
2-year	605	8827.69	5.40	3.19	6.96
50-year	2165	8830.26	8.60	5.76	4.39
100-year	2543	8830.77	8.96	6.26	3.88
500-year	3431	8832.01	8.74	7.55	2.64

The bridge low chord elevation is 8834.65.

III. SCOUR ANALYSIS

The FHWA publication Hydraulic Engineering Circular 18, Fourth Edition, May 2001, was used to determine scour depths.

The reach of the Tarryall Creek encompassing the site is stable. There is no apparent degradation or aggradations in the vertical plane. The channel is essentially straight for about 150 feet upstream of the proposed bridge. The creek has a meandering pattern upstream of the straight section and downstream of the proposed bridge. There is little likelihood that the channel will shift horizontally during the service life

of the bridge. For these reasons, the design does not incorporate any long term bed elevation change. The channel is well defined.

Abutment Slope Protection

Under normal circumstances (where there is significant return flow from the floodplain) a bridge with vertical abutments would be more susceptible to abutment scour than a bridge with spill through abutments. However; in this case since most of the flow is confined to the channel there would be no apparent advance of bridge with spill through abutments over a bridge with vertical abutment. It is important to remember that regardless of which abutment type is selected that a transition WILL NOT Disturb to upstream and downstream bank on both sides of the stream.
Abutment protection at the proposed bridge is not needed. Since the abutments are buried and do not constrict the channel. Therefore; no abutment protection would be anticipated.
Water surface profiles through the project reach for 100-year discharge is 8830.30 ft. and the elevation the abutment is 8832.50 ft.
Please do not disturb the existing structure check dam.
The proposed bridge abutment consist of foundation consist of steel H-Piles driven to elevations of 8823.50 ft. at abutment 1, and 8823.50 ft. at abutment 2.

IV. RECOMMENDATIONS

The bridge waterway design is in compliance with the provisions of 23 CFR 650 Subpart A, Bridges, Structures, and Hydraulics. The 50-year and 100-year recurrence interval discharge water surfaces are given in Table 2 and freeboards for these two discharges are 4.39 feet and 3.88 feet respectively.