

Memo

Date: Friday, January 19, 2024

Project: Truckee River Emergency Response Mapping

To: TRFMA

From: HDR Engineering

Subject: Truckee River Emergency Response Mapping

Introduction

This memo is intended to describe the hydrologic and hydraulic analyses performed to develop the Truckee River static flood frequency maps developed as part of the Truckee River Emergency Response Mapping task.

Maps were developed representing flooding along the Truckee River during the following flood events:

- 10% annual chance (10-year)
- 5% annual chance (20-year)
- 2% annual chance (50-year)
- 1.33% annual chance (75-year)
- 1% annual chance (100-year)
- 0.85% annual chance (117-year or 1997 flood-of-record)
- 0.67% annual chance (150-year)
- 0.5% annual chance (200-year)
- 0.2% annual chance (500-year)

Hydrology

Target flow rates at the US Geologic Survey (USGS) stream gages at Reno and Vista for the various flood events simulated are based upon peak flow rates listed in the US Army Corps of Engineers (USACE) Truckee Meadows GRR Hydrology Report (USACE, 2012). The target flow rates are shown in Tables 1 and 2.

Table 1. USACE Hydrology Flow Rates at City of Reno Gage

%AEP	10% (10 yr)	5% (20 yr)	2% (50 yr)	1.33% (75 yr)*	1% (100 yr)	0.85% (117 yr)**	0.67% (150 yr)***	0.5% (200 yr)	0.2% (500 yr)
Flow (cfs)	7,500	9,150	13,700	17,300	20,700	23,000	26,900	35,800	63,500

* Value based on USACE model inputs, no peak flow for 75-year event given in USACE Hydrology Appendix

** Peak flow taken from listed 1997 peak Q in USACE GRR Hydrology Appendix

*** Indicates peak flow value interpolated from USACE GRR Hydrology Appendix Chart 8

%AEP	10% (10 yr)	5% (20 yr)	2% (50 yr)	1.33% (75 yr)*	1% (100 yr)	0.85% (117 yr)**	0.67% (150 yr)***	0.5% (200 yr)	0.2% (500 yr)
Flow (cfs)	8,200	10,000	14,500	17,300	20,200	20,700	23,900	29,300	52,000

* Value based on USACE model inputs, no peak flow for 75-year event given in USACE Hydrology Appendix

** Peak flow taken from listed 1997 peak Q in USACE GRR Hydrology Appendix

*** Indicates peak flow value interpolated from USACE GRR Hydrology Appendix Chart 10

As indicated in the footnotes in Tables 1 and 2, the flow rates for some of the simulated events are not provided in the summary tables within the USACE hydrology report. While no flow rate for the 75-year event is provided in the USACE report, an HEC-RAS hydraulic model of the Truckee River Truckee Meadows reach developed by the USACE Hydrologic Engineering Center (HEC) includes model plans for the 75-year event. The Truckee River inflow hydrograph from this model shows a peak flow of 17,300 cfs.

The 1997 flood event is stated in the USACE hydrology report to have an estimated peak flow of 23,000 cfs at the Reno gage and 20,700 cfs at the Vista gage.

Flow rates for the 150-year flood event were estimated by interpolation from the flood frequency curves at the Reno and Vista gages presented in the USACE hydrology report. Inflow hydrographs for the 150-year event use the 200-year USACE hydrograph patterns, with the magnitudes reduced by a scaling factor based on the ratio between the 150-year and 200-year peak flow rates. The Truckee River hydrograph was reduced based on a ratio of peak flows at the Reno gage, while the inflow hydrographs for the tributary streams (Boynton Slough, North Truckee Drain, and Steamboat Creek) were based upon the ratio of peak flows at the Vista gage. The scaling factors used are shown in Table 3.

Reno	0.75
Vista	0.82

Hydraulics

The HEC-RAS fully two-dimensional (2D) HEC-RAS model of the Truckee River and tributaries within the Truckee Meadows that was recently developed to update the Federal Emergency Management Authority (FEMA) floodplain mapping in the area was used to create the emergency response flood maps that accompany this memo. Because the FEMA mapping of flooding along tributary streams (Boynton Slough, North Truckee Drain, and Steamboat Creek) is based upon large storms on those streams, the mapping presented in the emergency response maps may vary slightly from the FEMA floodplain maps in areas away from the main Truckee River.

Inflow hydrographs for the Truckee River and the major tributaries within the Truckee Meadows were based on hydraulic model inputs used in previous USACE one-dimensional HEC-RAS modeling of the Truckee River. As mentioned above, no 150-year model plan or hydrographs was located. The flow inputs for this event are based upon the USACE 200-year hydrographs with a scaling factor being applied to reduce the entire hydrographs.

Model plans were created and executed for each simulated event. The resulting peak flow rates were extracted at the Reno gage and downstream of the Vista gage and compared to the target peak flow rates. These results are shown in Tables 4 and 5. It is necessary to extract peak flow rates below the Vista gage due to the relocation of the North Truckee Drain outlet to a point below the gage location.

Table 4. Model Results at City of Reno Gage									
%AEP	10% (10 yr)	5% (20 yr)	2% (50 yr)	1.33% (75 yr)	1% (100 yr)	0.85% (117 yr)	0.67% (150 yr)	0.5% (200 yr)	0.2% (500 yr)
Target Flow (cfs)	7,500	9,150	13,700	17,300	20,700	23,000	26,900	35,800	63,500
Results Flow (cfs)	7,592	9,133	13,715	17,278	20,624	23,107	27,197	35,730	63,197
% Difference	1%	0%	0%	0%	0%	0%	1%	0%	0%

Table 5. Model Results at Vista Gage									
%AEP	10% (10 yr)	5% (20 yr)	2% (50 yr)	1.33% (75 yr)	1% (100 yr)	0.85% (117 yr)	0.67% (150 yr)	0.5% (200 yr)	0.2% (500 yr)
Target Flow (cfs)	8,200	10,000	14,500	17,300	20,200	20,700	23,900	29,300	52,000
Results Flow (cfs)	8,194	10,242	14,534	17,238	20,248	23,113	24,621	30,466	52,153
% Difference	0%	2%	0%	0%	0%	12%	3%	4%	0%

In general, the model result peak flow rates match well to the target flow rates, with the exception of the 117-yr (1997) event. For the 1997 flood event, the peak flow at the Vista gage is 12% higher than the USACE estimate.

The inflow hydrographs for the 117-yr event are based upon a US Army Corps of Engineers' 1D HEC-RAS model developed for previous iterations of the Truckee River Flood Control Project. That previous model geometry represented the conditions of the floodplain during the 1997 (117-yr) event. It is assumed that the physical changes to the Truckee River system that have taken place since that flood event, along with the transition to a fully 2D hydraulic model, have resulted in a model geometry that responds differently and does not attenuate the peak flow at Vista in the same manner as the older 1D model.

It is assumed that even 12%-14% discrepancies in peak flow rates will have minimal influence on the extents of flooding for an advisory level set of static maps.

Emergency Response Maps

Following completion of the HEC-RAS model runs, inundation boundaries were developed in HEC-RAS Mapper. No revisions to remove internal holes or external islands from the inundation boundaries were made.

The ArcGIS Pro mapping software suite was used with the inundation boundary shapefiles to develop maps of inundation extent along the Truckee River main stem channel along the entire model reach, from White Fir St. upstream of downstream to just above Lockwood. These maps are attached to this memo in electronic format.

It should be noted that these models and maps are advisory in nature. They have not been reviewed or approved by FEMA. The results are approximate and should not be used for any design, planning, or development activities. The actual behaviors of the Truckee River floodplain during future flooding events can vary from those simulated in this model due to unforeseen phenomenon such as channel and levee erosion, or other floodplain changes that typically occur during extreme events.