MWH

BUILDING A BETTER WORLD

MEMORANDUM

TO:	Bureau of Reclamation U.S. Department of the Interior	DATE:	August 24, 2012
FROM:	MWH	REFERENCE:	AVC EIS
SUBJECT:	Arkansas Valley Conduit Flood Hydrology and Floodplains Assessment		

Introduction

The flood hydrology and floodplains resource area considers the effects of water movement from one location to another on the magnitude and recurrence interval of peak streamflow and the inundation of land along surface water bodies (including streams and reservoirs) during flooding conditions. The Federal Emergency Management Agency (FEMA) maps 100-year floodplains and sets regulations for construction within these areas or alterations of the 100-year floodplains. Typically, regional, county, or local building departments enforce FEMA regulations and complete reviews of proposed construction within floodplains or alteration of floodplains. This memo reviews the potential effects to flood hydrology and floodplains, including riparian zones, due to the AVC project.

Methods and Analysis

The study area for flood hydrology and floodplains analysis encompasses the same water bodies (streams and reservoirs) as the surface water hydrology study area. A qualitative analysis was conducted to determine whether AVC operation would have effects on flood hydrology and floodplains along the Arkansas River. Several published studies were reviewed for flood hydrology and floodplain information in the analysis area. The bulk of the information used for the analysis was information collected and disclosed by the Southern Delivery System (SDS) Environmental Impact Statement (EIS) (Reclamation 2008). Additional hydrologic information was collected from an initial hydrologic analysis prepared by MWH for the AVC at the outset of the AVC EIS (MWH 2010). No additional data was collected as part of this evaluation.

Based upon the magnitude of results in the SDS EIS for SDS alternatives, the effects of AVC on streamflow and reservoir contents in the Arkansas River Basin upstream of Pueblo Reservoir and in the Colorado River Basin would be minimal, and would not affect flood hydrology and floodplains. Therefore, only the Arkansas River Basin between Pueblo Reservoir and John Martin Reservoir was analyzed in this memorandum.

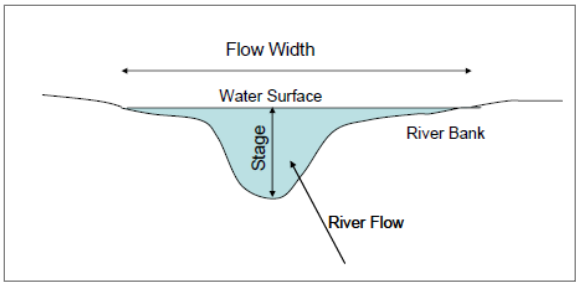

Figure 1. Floodplain Effects Parameters Diagram

Flood-related indicators analyzed include the peak flows recurring at 2-year (Q_2), 10-year (Q_{10}), and 100-year (Q_{100})

intervals as well as floodplain stage and width at the 100-year peak flow. Floodplain width would be equal to the "Flow Width" shown in Figure 1 for flow conditions at the 100-year peak flow value.

Criteria for Determining Significance of Effects

Table 1 lists significance criteria used to describe the intensity of floodplain and flood hydrology effects. These criteria were applied to average and maximum peak streamflow values. All floodplain and flood hydrology effects would be long-term.

Table 1. Floodplains and Flood Hydrology Effect Intensity Descriptions

Impact Intensity	Intensity Description
Negligible	The effects to flood hydrology and floodplains would be less than the accuracy of calculations and would not be detectable. Stage increases would be less than 0.2 feet (2.5 inches) for the 100-year flood flow at USGS gages. Riparian areas would not be affected.
Minor	The effects to flood hydrology and floodplains would be greater than the accuracy of calculations, but would likely not be detectable. Stage increases would be 0.2 to 0.5 feet (2.5 to 6 inches) for the 100-year flood flow at USGS gages. Riparian areas would not be affected.
Moderate	The effects to flood hydrology and floodplains would be detectable and greater than the accuracy of calculations, but would not result in inundation of additional existing structures. Stage increases would be 0.5 to 1.0 feet (6 to 12 inches) for the 100-year flood flow at USGS gages. Localized areas of riparian vegetation could be affected.
Major	The effects to flood hydrology and floodplains would be detectable and greater than the accuracy of calculations; or, would result in inundation of additional structures. Stage increases would be greater than 1.0 feet (12 inches) for the 100-year flood flow at USGS gages, or an increase in floodplain depth or width would inundate existing structures not currently inundated. Regional areas of riparian vegetation could be affected.

Results

The preliminary hydrologic analysis showed that for most months, streamflow would decrease between the AVC alternatives and existing conditions in the Arkansas River below Pueblo Reservoir. The maximum estimated average monthly decrease in streamflow immediately below Pueblo Reservoir (Above Pueblo gage) was approximately 61 cfs, while the maximum estimated average monthly increase in streamflow would be approximately 9 cfs[1]. These values were used to determine a range of potential change in flood flow along the Arkansas River downstream of the Pueblo Reservoir. The corresponding change in flow depth was estimated based upon stage discharge relationships determined from USGS stream gage data. The results are presented in Table 2 for the 2, 10, and 100-year peak flows.

[1] The preliminary hydrology values were later compared with simulated hydrology from the Daily Model. The preliminary values were similar to those calculated by the Daily Model, thus the analysis was not recomputed use values from the Daily Model.

Table 2. Summary of Potential Changes in Flood Flows

USGS Stream Gage	Peak Flow (cfs) by Recurrence Interval [1]			Range of Effects					
				As % of Peak Flood Flow			As Estimated Change in Flow Depth (inches)		
	Q_2	Q_{10}	Q_{100}	Q_2	Q_{10}	Q_{100}	Q_2	Q_{10}	Q_{100}
Arkansas River Above Pueblo (07099400)	4,220	6,070	7,350	0.1% to -1.4%	0.1% to -1.0%	0.1% to -0.8%	0.03 to -0.5	0.04 to -0.41	0.04 to -0.35
Arkansas River near Avondale (07109500)	No Data	16,500	44,400	----	0.0% to -0.4%	0.0% to -0.1%	----	0.0 to -0.21	0.0 to -0.08
Arkansas River near Nepesta (07117000)	No Data	19,700	50,600	----	0.0% to -0.3%	0.0% to -0.1%	----	0.0 to -0.06	0.0 to -0.02

[1] Corps 2001. Recurrence interval is the average period in years between storm events equal to or larger than a given amount. It is the reciprocal of the probability of that storm event being equaled or exceeded in any year. For instance, a Q_{100} recurrence interval would have an average of 100 years between storms, and a 1 percent chance of occurrence in any given year.

Based on information presented in Table 2, peak flood flows in the Arkansas River downstream of Pueblo range from 6,070-19,700 cfs for 10-year recurrence intervals and 7,350-50,600 cfs for 100-year recurrence intervals, with the lowest flows being immediately downstream of Pueblo Dam and the highest flows further downstream. Although the Q_2 flow was not available for much of the river, it was available for the section of the Arkansas River immediately downstream of Pueblo Dam. The 2-year peak flow (Q_2) was analyzed because it generally determines the bankfull discharge, which is also referred to as the channel forming discharge.

The results show that there would be approximately a 0.1 percent increase to 1.4 percent decrease in Q_2 peak flow, and up to 1 percent decrease in the Q_{10} and Q_{100} peak flows, with the largest effects immediately downstream of Pueblo Dam. The corresponding estimated change in flow depth provide up to ½ inch decrease for the Q_2 flow, and slightly smaller decreases for Q_{10} and Q_{100} Flow. These amounts could be considered within the margin of error for determining flood hydrology and floodplains. Therefore, based on the initial hydrology, there would be negligible effects of the alternatives on flood hydrology. In addition, since anticipated changes in flood hydrology are negligible, there would be negligible effects on floodplain width or stage due to changes in peak flows.

The SDS EIS identified potential encroachment of riparian vegetation as a potential floodplain effect and identified the Arkansas River downstream of Fountain Creek as a depositional reach. Encroachment of riparian vegetation in the channel could occur due to general reductions in streamflow, and would result in a loss of channel capacity. In addition, potential increases in sediment deposition caused by lower streamflow and reduced sediment transport capacity could further reduce channel capacity. Loss of channel capacity would increase floodplain stage and width during flood events. Because the amount of riparian vegetation encroachment is difficult to quantify, the effects on floodplain stage and width were not determined. The SDS EIS indicated these effects would be minimal at generally the same magnitude of maximum monthly flow reductions as AVC. Therefore, the effects of AVC on riparian vegetation are also expected to be negligible.

Both Pueblo Reservoir and John Martin Reservoir are operated for Flood Control purposes. Changes in reservoir storage as a result of AVC operations would be confined to the conservation pools and would not affect the reservoirs' ability to store within dedicated flood control pools. Therefore, the AVC would not affect inundation or the ability of these reservoirs to serve their flood control purposes. No new dams or reservoirs are considered as part of any alternative for the AVC.

Conclusions

Based upon these findings, effects of AVC would be negligible on flood hydrology and flooding, and negligible on riparian vegetation. Therefore, no further environmental consequences analyses are required for Flood Hydrology and Floodplains as part of the AVC EIS.

References

Black & Veatch (B&V). Arkansas Valley Conduit Pre-NEPA State and Tribal Assistance Grant (STAG) Final Report. B&V Project Number 142542. August.

MWH. 2010. Memorandum: Arkansas Valley Conduit/Excess Capacity Master Contract Environmental Impact Statement: Initial Hydrologic Assessment. To Signe Snortland, Reclamation. October 20

United States Department of the Interior, Bureau of Reclamation (Reclamation). 2008. Southern Delivery System Final Environmental Impact Statement. Filing Number: FES 08-63. Great Plains Region, Eastern Colorado Area Office, Loveland. December.

United States Army Corps of Engineers (Corps). 2001. Arkansas River from Otero/Pueblo County Line to John Martin Reservoir, Channel Capacity and Riparian Habitat Planning Study. August.