

Technical Memorandum

Update to Frequency of Storage at the Chain of Lakes

Subject: Update to Frequency of Storage at the Chain of Lakes

Prepared For: Dexter Yee, Ed Cummings, Jim O-Toole

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Reviewed by: Randy Raines

Date: March 9, 2006

Reference:

1 Purpose

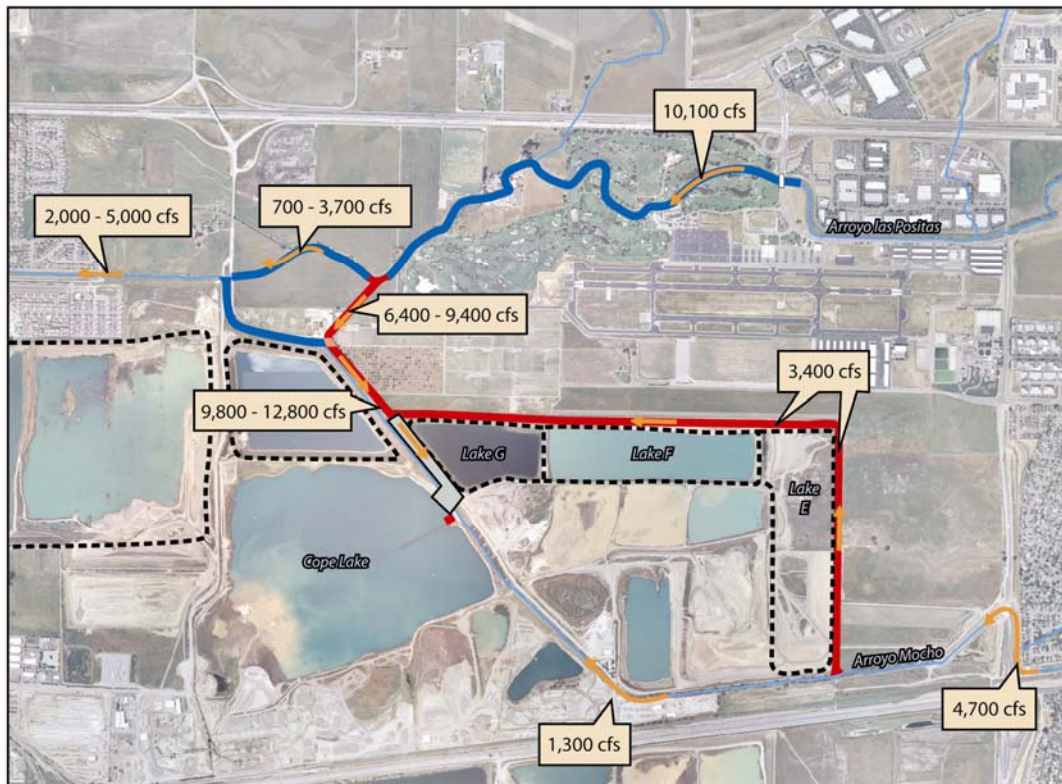
The purpose of this Technical Memorandum (TM) is to update the attached Draft TM dated September 2004 (last modified December 2005), submitted as part of the Administrative Draft Stream Management Master Plan (ADSMMP). The previous Draft TM is attached to this appendix.

2 Updates

The previous schematic of proposed stormwater diversion flows during a 100-year event (Figure 3) is updated as shown below. Updates in flows are based on refinements to Chain of Lakes project components resulting from further conceptual design.

As previously discussed in the Draft Frequency of Storage TM, it is anticipated that 3,400 cubic feet per second (cfs) of the 4,700 cfs peak flow in Arroyo Mocho will be diverted into the Arroyo Mocho Bypass Channel during a storage event. The peak flow on Arroyo las Positas is estimated to be 10,100 cfs, and an expected 6,400 to 9,400 cfs would be diverted to storage. These diversions during the future 100-year storm event will leave 700 to 3,700 cfs in Arroyo las Positas and 1,300 cfs in Arroyo Mocho. The expected flow in Arroyo Mocho (downstream of the confluence with Arroyo las Positas) when storage is triggered ranges from 2,000 to 5,000 cfs. The revised Figure 3 is shown below.

Figure 3 Updated Schematic of Proposed Diversion Flows during a 100-Year Event



DRAFT Technical Memorandum



Frequency of Storage at the Chain of Lakes

Subject: Frequency of Storage at the Chain of Lakes

Prepared For: Ed Cummings, Dexter Yee, Jim O'Toole

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Reviewed by: Randy Raines

Date: September 22, 2004 (last modified December 9, 2005)

Reference:

The purpose of this TM is to determine the frequency of diversion and storage of flows from Arroyo Mocho and Arroyo las Positas. The purpose of using detention storage is to minimize predicted flooding in Arroyo de la Laguna (ADLL) downstream of the Chain of Lakes area. Design discharges for the future 100-year flood event and existing conveyance capacities through these channels are shown in Table 1 below.

Table 1 Design discharges for 100-year flood and existing conveyance capacities

Channel	Zone 7 Reach	100-year Design Discharge ¹	Existing Channel Capacity	SMMP Recommendation ³
Arroyo las Positas	H-1	10,100	1,800 ²	Widen Arroyo las Positas through the golf course to convey 100-year design flows (10,100 cfs)
Arroyo Mocho	G-50	4,700	900 ²	Increase conveyance capacity to 1,300 cfs by implementing vegetation management along 15,000 feet of channel (from Station 200+00 to Station 350+00)
Arroyo de la Laguna	B-50	25,500	18,730 ³	Attenuate 100-year design discharges by detaining peak flows at Chain of Lakes

¹ Schaaf & Wheeler, June 2000

² West Yost Associates, March 2002

³ RMC Water and Environment Inc., March 2004

The feasibility of providing detention storage at the Chain of Lakes during a 100-year flood has been investigated in two main studies conducted for Zone 7 by Schaaf & Wheeler (S&W, March 1998) and West Yost & Associates (WYA, November 2001). A table summarizing the range of diversion rates and storage volumes investigated under both studies is presented in Table 2. Table 2 includes the following information:

Storage (AF) This is the volume of storage assumed to be available at the Chain of Lakes. Storage alternatives were developed with a combination of lakes including Cope Lake, Lakes G, H, I, K, or SMP 38.

Total Flow (cfs) This is the combined peak flows of Arroyo las Positas and Arroyo

	Mocho immediately upstream of the diversion structures.
Stored Flow (cfs)	Diverted peak flows from Arroyo las Positas and Arroyo Mocho.
Bypassed Flow (cfs)	The combined flow to be maintained in Arroyo las Positas and Arroyo Mocho. This flow would bypass the diversion structure and continue through both creeks.
Peak Return Flow (cfs)	This flow represents the maximum return flow from storage. Hydrographs for the return flows were only available in the Schaaf & Wheeler report. In this study, it was assumed that discharges from storage would begin one hour after diversion into storage. The lag time between peak return flows and peak stored inflows was assumed to be four hours.
Peak Combined Flow (Reach G-40) (cfs)	This is the combined flow reaching Arroyo Mocho immediately downstream of its confluence with Arroyo las Positas (i.e. Arroyo Mocho at Reach G-40). The Peak Combined Outflow is equal to the sum of the Bypassed Inflow and the Peak Outflow from Storage.
Peak Flow in Arroyo Mocho (Reach G-20) (cfs)	This is the peak flow in Arroyo Mocho at the confluence with Chabot Canal (Reach G-20).
Peak Flow in ADLL @ Bernal Avenue (Reach B-50)	This is the peak flow in ADLL at the Bernal Avenue Bridge crossing.

Table 2 Diversion rates & storage volumes investigated under previous studies

	Inflow				Resulting Peak Discharge/Outflow (cfs)			
	Storage (AF)	Total Flow (cfs)	Stored Flow (cfs)	Bypassed Flow (cfs)	Peak Return Flow (cfs)	Peak Combined Flow (Reach G-40) (cfs)	Peak Flow in Arroyo Mocho (Reach G-20) (cfs)	Peak Flow in ADLL @ Bernal Avenue (Reach B-50) (cfs)
S&W	3,487	12,395	9,395	3,000	3,257	6,257	NA	19,577
WYA #1	4,420	14,170	11,170	3,000	2,660	5,660	8,850	19,810
WYA #2	5,560	14,170	12,670	1,500	3,360	4,860	7,520	18,480

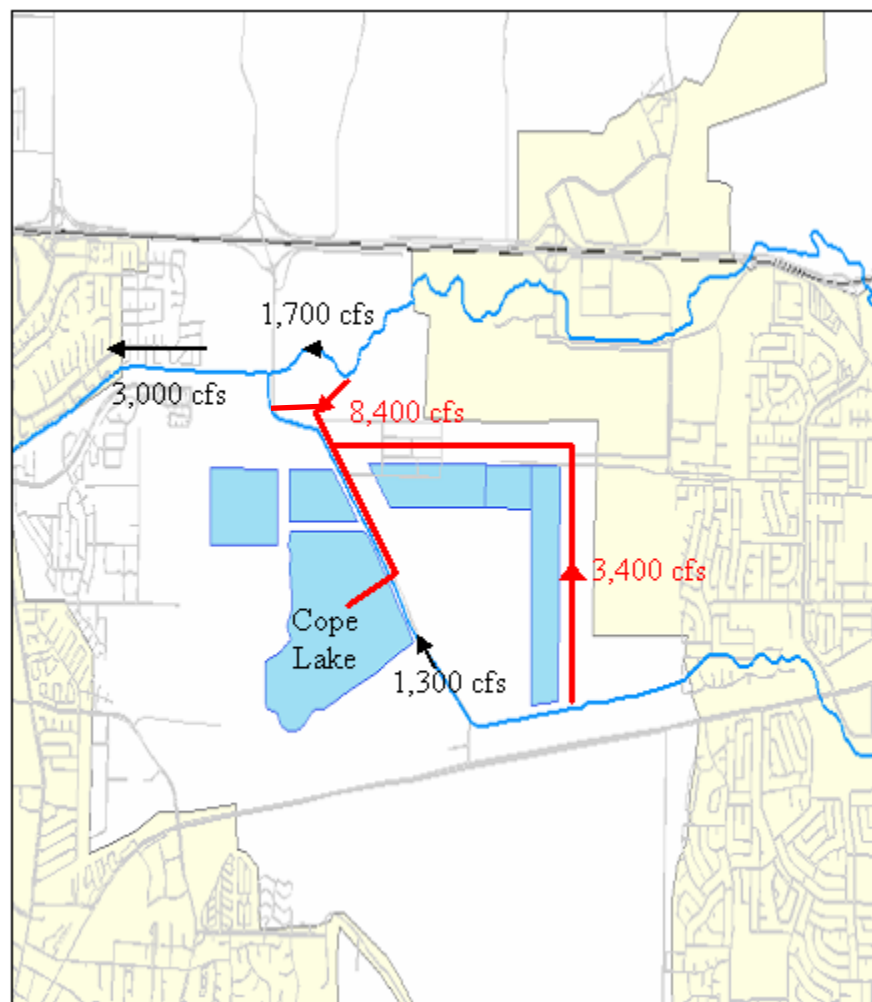
The frequency of diversion into storage will be based on the peak combined flow in Arroyo Mocho (Reach G-40) and resulting peak flows in ADLL at Bernal Avenue (Reach B-50). As presented in Table 2, in order to maintain the peak flow in ADLL below its current capacity of 18,730 cfs, the peak combined flow at Reach G-40 should not exceed approximately 5,000 cfs. The trigger for diversion of flows into storage will therefore be a flow of approximately 5,000 cfs in Arroyo Mocho (Reach G-40). As shown in the attached flood frequency curve for Reach G-40 (Figure 1), a flow of 5,000 cfs through this reach is expected to occur once every 6 to 7 years. Thus storage will be used on the average of once every 6 to 7 years. Once diversion is triggered, the bypassed flows from Arroyo Mocho and Arroyo las Positas will be decreased to 3,000 cfs. A summary of these flows is shown in Table 3 below¹.

¹ Flows are approximate and have not been modeled.

Table 3 Summary of diversion rates & detention storage needed at COL

Storage (AF)	Inflow			Resulting Peak Discharge/Outflow (cfs)			
	Total Flow (cfs)	Stored Flow (cfs)	Bypassed Flow (cfs)	Peak Return Flow (cfs)	Peak Combined Flow (Reach G-40) (cfs)	Peak Flow (Reach G-20) (cfs)	Peak Flow in ADLL @ Bernal Avenue (Reach B-50) (cfs)
5,200	14,800	11,800	3,000	2,000	5,000	NA	≤ 18,700

As seen in Table 3, approximately 5,200 AF of storage will be required to meet the 18,730 cfs capacity at ADLL during a 100-year flood². A schematic of the approximate stored flows and bypassed flows is shown in Figure 3.

Figure 3 Schematic of proposed diversion flows during a 100-year flood

The frequency of diversion of flows from Arroyo Mocho will depend on the channel capacity after recommended improvements, as outlined in the SMMP and shown in Table 1 (i.e. 1,300 cfs), are implemented. As shown in the attached flood frequency curve for Reach G-50 (Figure 2), a flow of 1,300 cfs through this reach is expected to occur once every 5 years. These flows will be diverted through the

² Additional storage will be required to meet contingency requirements.

bypass channel but will not be stored until the flows in Reach G-40 reach the 5,000 cfs trigger point for storage.

Future Flows at Arroyo Mocho (Location G-40)
Schaaf & Wheeler (June 2000)

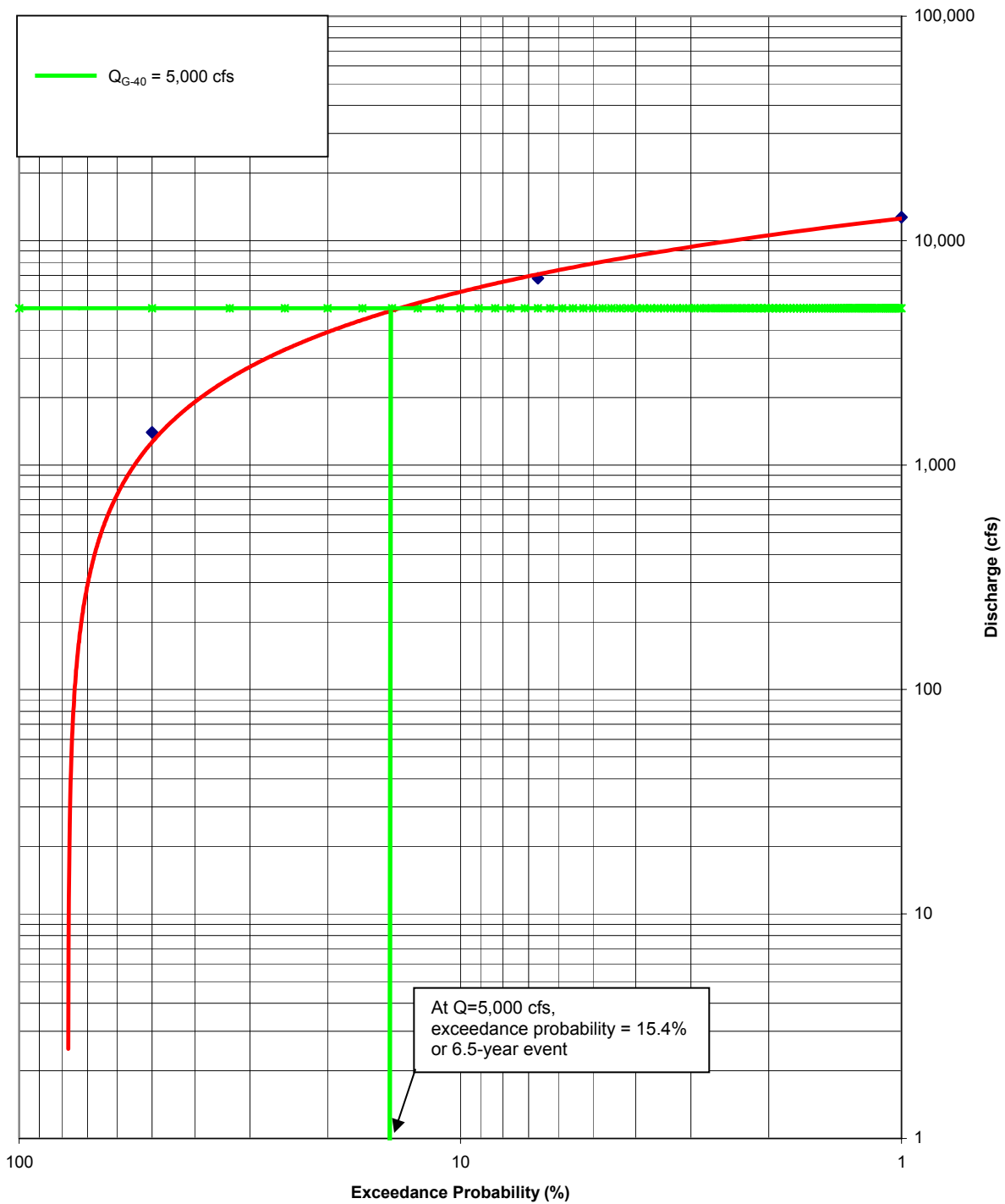


Figure 1 Flood frequency curve for Arroyo Mocho (Reach G-40) (Schaaf & Wheeler, June 2000)

Future Flows at Cope Lake on Arroyo Mocho (Location G-50)
(Schaaf & Wheeler, June 2000)

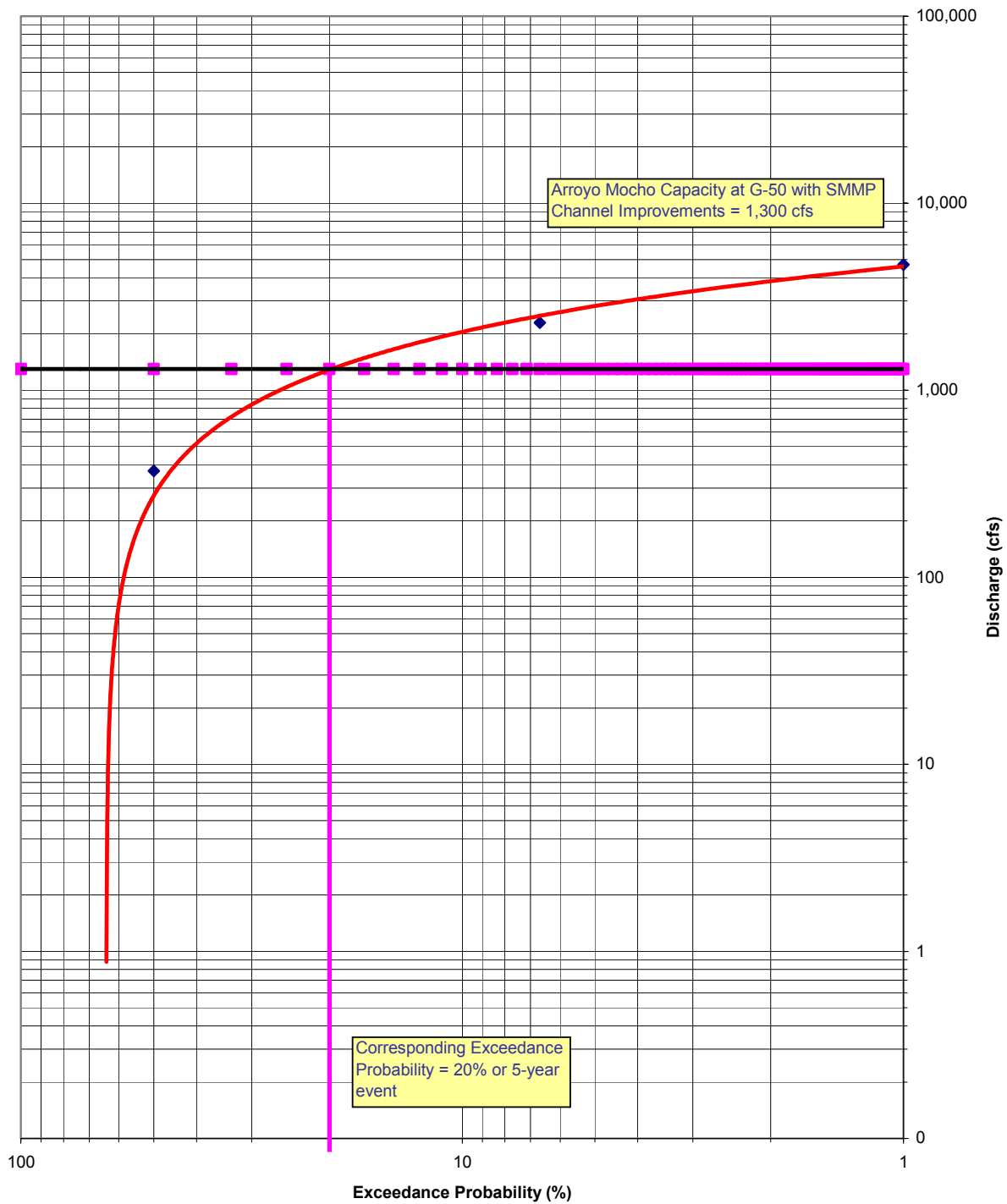


Figure 2 Flood frequency curve for Arroyo Mocho (Reach G-50) (Schaaf & Wheeler, June 2000)

References

RMC Water and Environment Inc. Zone 7 Stream Management Master Plan Phase 1 Interim Report. March 2004.

Schaaf & Wheeler. Feasibility Study Storage on Arroyo Mocho/Arroyo las Positas: Prepared for Zone 7 Water Agency. March, 1998.

Schaaf & Wheeler. Zone 7 Special Drainage Area 7-1 Program Update of Channel Improvement Costs: Prepared for Zone 7, Alameda County Flood Control and Water Conservation District. June, 2000.

West Yost & Associates. Technical Memorandum No. 5 Task E: Evaluation of Problem Areas & Identification of Solutions, Appendix C. November, 2001.

West Yost & Associates. Issue Paper No. 2 Flood Flows in Zone 7 Channels. March 2002.