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## CHAPTER 4

# DECISION ANALYSIS

As discussed in Chapter 2, there are few single projects that can provide complete flood protection during a 100-year flood event. However, a multiple benefit solution for the watershed would require that several projects be initiated and coordinated with each other to provide the lower Pajaro River with the maximum range of benefits. Therefore, the individual projects that were evaluated in Chapter 3 were grouped into “packages” that would provide complete flood protection. To coordinate with the Corps efforts, the alternatives identified in Phase 2 were coupled with either of the two Corps projects to provide a minimum of 100-year flood protection.

After review of the packages, the Staff Working Group identified the following packages as the favored alternative packages:

- Corps Alternative 3 (65-yr) Project and New Small San Benito Dam
- Corps Alternative 3 (65-yr) Project and Open Earthen Bypass Channel
- Corps Alternative 1 (30-yr) Project and New San Benito Dam
- Corps Alternative 1 (30-yr) Project, New Pacheco Dam, and New Small San Benito Dam.

Since the Soap Lake Floodplain Preservation project was necessary to maintain the 100-year flow design value, this project was included with each of the packages.

This chapter includes a summary of the process used to develop the 100-year flood protection packages and selection process to identify several packages that could be considered viable options to provide downstream flood protection.

### 4.1 Development of 100-Year Flood Protection Packages

The 100-year flood protection packages were developed from combinations of the Corps projects and the alternative projects evaluated in Chapter 3. Since the two Corps projects did not provide complete 100-year flood protection, additional flood protection projects were considered necessary to supplement the Corps projects. Figure 4-1 is a graph of the modeled flood flow discharges at Chittenden at general plan buildout. The graph includes flood protection benefits for the Corps Alternative 1 with 30-year flood protection and Corps Alternative 3 with 65-year flood protection for the Lower Pajaro River. The 100-year flood event discharge and the existing level of flood protection are also shown. If the Corps Alternative 3 (65-year protection) project is constructed to provide flood protection, an additional 4,100 cfs of flow must be conveyed downstream or detained upstream by other facilities to provide 100-year protection. If the Corps Alternative 1 (30-year protection) project is constructed to provide flood protection, an additional 12,400 cfs must be conveyed downstream or detained upstream by other facilities to provide the same level of protection.

An incremental flood protection project was added to either of the Corps projects to provide protection against floods ranging from 43,500 cfs (98 percent of the 100-year flood flow) to 48,800 cfs (110 percent of the 100-year flood flow). The range of protection allowed is due to the preliminary nature of this phase of the study and potential routing effects that cannot be assessed at this preliminary stage.

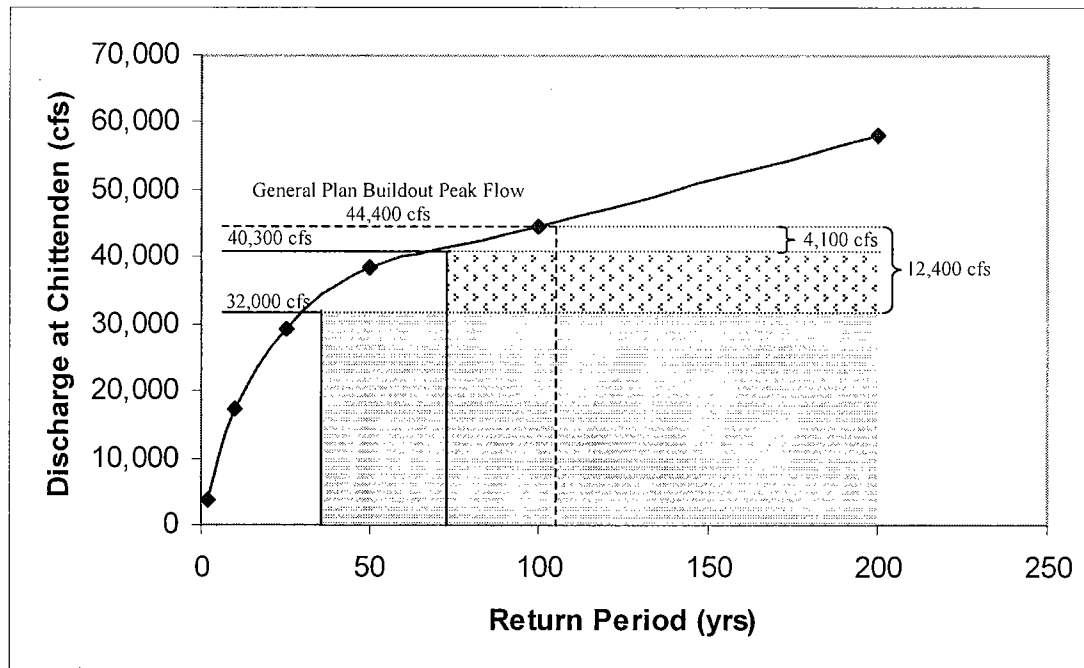


Figure 4-1: 100-year flood protection deficit of the Corps Alternatives 1 and 3.

One of the Corps alternatives and any combination of additional projects necessary to provide 100-year flood protection were considered a 100-year flood protection package. Certain guidelines were followed in developing each 100-year flood protection packages. These included:

- Each package must use either the Corps Alternative 1 (30-year protection) or 3 (65-year protection) projects as a baseline project. This guideline provides coordination with the Corps projects.
- Combinations of projects with total flood protection by detention or conveyance between 98% and 110% (43,500 cfs and 48,800 cfs) of the 100-year protection flow rate (44,400 cfs) are considered possibilities. This guideline maintains project packages of roughly similar flood protection for comparison purposes.
- Single projects, when combined with the Corps 65- or 30-year project, are considered possibilities regardless of the level of protection so long as it is at least 98%. This guideline creates packages that may exceed the 100-year flood protection level, but ensures consideration of nearly every alternative.
- Two projects identified in Chapter 3, Soap Lake Floodplain Preservation and Floodwalls, were not included in the development of 100-year flood protection packaging. The Soap Lake Floodplain Preservation project was not included since it is considered necessary to maintain the design flows used in the development of alternatives. The floodwall alternative was essentially equivalent to economically infeasible Corps Alternative 4.
- Efforts were made to develop packages with every combination of projects possible.

Sixty distinct packages were developed based on the above guidelines. The listing of packages, as well as their flood protection benefit and expected cost, is included on Table 4-1. In order to reduce the number of packages to be compared, each package was evaluated based on four criteria. If a package met a single elimination criterion, it was not considered further. The four elimination criteria are:

- 1) Package cost is greater than \$500 million.

- 2) 100-year flood protection is not available upstream of Salsipuedes Creek.
- 3) Extensive relocation of infrastructure, facilities, and residences is required.
- 4) Reservoirs are located nearby and upstream of population centers.

The comparison of each package against the four elimination criteria is also shown on Table 4-1 at the end of this chapter.

## **4.2 Recommended Packages for Comparison**

Seven packages remained after application of the elimination criteria. These packages were considered viable options to provide complete flood protection during the 100-year flood event and are listed on Table 4-2 at the end of this chapter. An eighth package was added since it provided a significant amount of flood protection with a package cost of only slightly more than \$500 million. One other reference package was included in Table 4-2 to demonstrate the size and cost of an effective conveyance project that provides all of the necessary flood protection during a 100-year event without the use of one of the Corps projects.

To provide a comparison of flood protection packages and their costs at a similar level of flood protection, projects in three of the packages were made smaller to provide overall flood level protection closer to 100 percent. In package 12, the size of the San Benito Dam was reduced to provide protection only up to the 100-year flood event. In packages 3 and 24, the size of the lined flood protection channel was reduced to provide capacity for only the amount of flow that could not be conveyed through each of the Corps Lower Pajaro River Flood Protection Projects. One other package was developed to provide an earthen open bypass channel for Corps Alternative 1 (30-year protection) for comparison with Package 2. The nine packages are listed at the end of this chapter in Table 4-3. A brief description of each of the projects, their sizes, and costs that were used for the final packaging is listed in Table 4-4, also at the end of this chapter.

In Table 4-3, the listed final packages were compared using the previously identified criteria. This table allowed comparison of how additional benefits, such as additional water supply and land use maintenance, were gained by combining either of the Corps projects with projects developed in the Pajaro River Watershed Study. Flood protection packages with upstream storage generally provided additional water supply, water supply for multiple agencies, improved surface water quality, and recreational opportunities. Flood protection packages with downstream conveyance generally had less potential for damage in seismic events and less infrastructure interference.

The nine packages listed on Table 4-3 were presented to the interagency Staff Working Group. After review of the packages, the Staff Working Group identified the following packages as the favored alternative packages:

- Corps Alternative 3 (65-yr) Project and New Small San Benito Dam
- Corps Alternative 3 (65-yr) Project and Open Earthen Bypass Channel
- Corps Alternative 1 (30-yr) Project and New San Benito Dam
- Corps Alternative 1 (30-yr) Project, New Pacheco Dam, and New Small San Benito Dam.

Since the Soap Lake Floodplain Preservation project was necessary to maintain the 100-year flow design value, this project was included with each of the packages.

Each of these packages utilizes the downstream Corps project at some level of flood protection. The upstream dams will reduce the peak discharge, alter the timing of the peak, and provide benefits such as water supply, potential water quality improvements, and recreation opportunities. The open earthen bypass channel would remove the peak discharge from the main channel and transport it to the mouth of the river during flood events.

Concurrent to the selection of the four alternative packages for further analysis in Phase 3 of this study, the Corps was reassessing the 100-year peak flow expected at Chittenden. Based on additional flow monitoring during record floods in 1998, the Corps was planning to reduce the 100-year peak flow rates at Chittenden. This peak flow reduction will allow the Corps Alternative 3 to provide downstream flood protection in a 100-year flood event. This project has the least cost of the favored alternative packages and was considered to be most likely to be implemented. However, the Corps has not formally reduced the peak flood value, and has not made a final selection of the project and level of protection.

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Table 4-1: Comparison of 100-Year Flood Protection Packages with Four Decision Criteria.

Package No.	Package Projects	Package Flood Protection	Package Cost (Millions)	Decision Criteria			
				Package cost is greater than \$500M	100% Flood protection is not available upstream of Salsipuedes Creek	Extensive relocation of facilities and residences is required	Reservoirs are located nearby and upstream of population centers
1	Corps 65-Yr San Benito Detention Basin	105%	\$1,370	X		X	
2	Corps 65-Yr Earthen Open Channel	98%	\$255				
3	Corps 65-Yr Lined Flood Channel	148%	\$506	X			
4	Corps 65-Yr Underground Bypass	116%	\$866	X			
5	Corps 65-Yr Flood Tunnel	148%	\$2,392	X			
6	Corps 65-Yr Raise Existing Dams New College Lake Dam	99%	\$311		X		
7	Corps 65-Yr Raise Existing Dams New Pacheco Dam	98%	\$356				
8	Corps 65-Yr New College Lake Dam Raise Existing Dams	99%	\$311		X		X
9	Corps 65-Yr New College Lake Dam New Pacheco Dam	100%	\$316		X		
10	Corps 65-Yr New Soap Lake Dam	120%	\$257			X	
11	Corps 65-Yr New Tres Pinos Dam	110%	\$204			X	

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12	Corps 65-Yr New San Benito Dam	120%	\$271				
13	Corps 65-Yr New Large Chittenden Dam	148%	\$292			X	X
14	Corps 65-Yr New Small Chittenden Dam New College Lake Dam	99%	\$247		X		X
15	Corps 65-Yr New Small Chittenden Dam Earthen Open Channel	100%	\$278				X
16	Corps 30-Yr San Benito Detention Basin Earthen Open Channel New College Lake Dam	99%	\$1,464	X	X		X
17	Corps 30-Yr San Benito Detention Basin Raise Existing Dams New College Lake Dam New Pacheco Dam	99%	\$1,565	X	X		X
18	Corps 30-Yr San Benito Detention Basin New College Lake Dam New Pacheco Dam New Small Chittenden Dam	98%	\$1,501	X	X	X	X
19	Corps 30-Yr San Benito Detention Basin New Tres Pinos Dam	106%	\$1,366	X		X	
20	Corps 30-Yr Earthen Open Channel Underground Bypass	104%	\$913	X			
21	Corps 30-Yr Earthen Open Channel Raise Existing Dams New College Lake Dam New Tres Pinos Dam	107%	\$385			X	X

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22	Corps 30-Yr Earthen Open Channel Raise Existing Dams New Pacheco Dam New Tres Pinos Dam	105%	\$430			X	
23	Corps 30-Yr Earthen Open Channel New Tres Pinos Dam	98%	\$251			X	
24	Corps 30-Yr Lined Flood Channel	130%	\$475				
25	Corps 30-Yr Underground Bypass Raise Existing Dams	100%	\$922	X			
26	Corps 30-Yr Underground Bypass New College Lake Dam	103%	\$882	X	X		X
27	Corps 30-Yr Underground Bypass New Pacheco Dam	101%	\$927	X			
28	Corps 30-Yr Underground Bypass New Small Chittenden Dam	100%	\$858	X			X
29	Corps 30-Yr Flood Tunnel	130%	\$2,361	X			
30	Corps 30-Yr Raise Existing Dams New San Benito Dam	104%	\$327				
31	Corps 30-Yr Raise Existing Dams New Soap Lake Dam	104%	\$313			X	
32	Corps 30-Yr Raise Existing Dams San Benito Detention Basin Earthen Open Channel New College Lake Dam	102%	\$1,551	X	X	X	X

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33	Corps 30-Yr Raise Existing Dams San Benito Detention Basin Earthen Open Channel New Pacheco Dam	100%	\$1,596	X		X	
34	Corps 30-Yr Raise Existing Dams San Benito Detention Basin Earthen Open Channel New Small Chittenden Dam	98%	\$1,527	X		X	X
35	Corps 30-Yr Raise Existing Dams Earthen Open Channel New Tres Pinos Dam	101%	\$338			X	
36	Corps 30-Yr Raise Existing Dams Earthen Open Channel Underground Bypass	107%	\$1,000	X			
37	Corps 30-Yr New College Lake Dam New Soap Lake Dam	107%	\$273			X	X
38	Corps 30-Yr New College Lake Dam New San Benito Dam	107%	\$287				X
39	Corps 30-Yr New College Lake Dam Earthen Open Channel San Benito Detention Basin Raise Existing Dams New Pacheco Dam	106%	\$1,643	X		X	X
40	Corps 30-Yr New College Lake Dam Earthen Open Channel San Benito Detention Basin New Small Chittenden Dam New Pacheco Dam	105%	\$1,579	X		X	X

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41	Corps 30-Yr New College Lake Dam Earthen Open Channel San Benito Detention Basin Raise Existing Dams New Small Chittenden Dam	104%	\$1,574	X		X	X
42	Corps 30-Yr New College Lake Dam Earthen Open Channel San Benito Detention Basin New Pacheco Dam	103%	\$1,556	X		X	X
43	Corps 30-Yr New College Lake Dam Earthen Open Channel San Benito Detention Basin New Small Chittenden Dam	101%	\$1,487	X		X	X
44	ff 30-Yr New Pacheco Dam New Soap Lake Dam	105%	\$318			X	
45	Corps 30-Yr New Pacheco Dam New San Benito Dam	105%	\$332				
46	Corps 30-Yr New Pacheco Dam San Benito Detention Basin New Small Chittenden Dam Earthen Open Channel	100%	\$1,532	X		X	X
47	Corps 30-Yr New Pacheco Dam Earthen Open Channel New Tres Pinos Dam	102%	\$343			X	
48	Corps 30-Yr New Pacheco Dam Raise Existing Dams New Tres Pinos Dam	99%	\$352			X	
49	Corps 30-Yr New Pacheco Dam New College Lake Dam New Tres Pinos Dam	101%	\$312		X	X	X

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50	Corps 30-Yr New Pacheco Dam New Small Chittenden Dam New Tres Pinos Dam	98%	\$288			X	X
51	Corps 30-Yr New Soap Lake Dam	101%	\$226			X	
52	Corps 30-Yr New Tres Pinos Dam Earthen Open Channel New College Lake Dam	104%	\$298			X	X
53	Corps 30-Yr New Tres Pinos Dam Earthen Open Channel New Small Chittenden Dam	101%	\$274			X	X
54	Corps 30-Yr New Tres Pinos Dam Raise Existing Dams New College Lake Dam	100%	\$307		X	X	X
55	Corps 30-Yr New Tres Pinos Dam New College Lake Dam New Small Chittenden Dam	100%	\$243		X	X	X
56	Corps 30-Yr New San Benito Dam	101%	\$240				
57	Corps 30-Yr New Large Chittenden Dam	130%	\$261			X	
58	Corps 30-Yr New Small Chittenden Dam New San Benito Dam	103%	\$263				X
59	Corps 30-Yr New Small Chittenden Dam New Soap Lake Dam	103%	\$249			X	X
60	Corps 30-Yr New Small Chittenden Dam New Tres Pinos Dam San Benito Detention Basin	108%	\$1,389	X		X	X

Table 4-2: Project Packages Remaining after Application of Elimination Criteria.

Package No.	Package Projects	Package Flood Protection	Package Cost (Millions)
56	Corps Alternative 1 (30-Yr) New San Benito Dam	101%	\$240
2	Corps Alternative 3 (65-Yr) Earthen Open Channel	98%	\$260
12	Corps Alternative 3 (65-Yr) New San Benito Dam	120%	\$270
30	Corps Alternative 1 (30-Yr) Raise Existing Dams New San Benito Dam	104%	\$330
45	Corps Alternative 1 (30-Yr) New Pacheco Dam New San Benito Dam	105%	\$330
7	Corps Alternative 3 (65-Yr) Raise Existing Dams New Pacheco Dam	98%	\$360
24	Corps Alternative 1 (30-Yr) Lined Flood Channel	130%	\$480
3	Corps Alternative 3 (65-Yr) Lined Flood Channel	148%	\$506
Ref	Large Lined Flood Channel	100%	\$570

Table 4-3: Final Flood Protection Packages.

		Comparison Criteria									
	Package Projects	Package Flood Protection (%)	Package Cost (Millions)	Provides Additional Water Supply	Water Supply for Multiple Agencies	Improved Surface Water Quality	Recreation Opportunities	Maintains Land Use	Limited Potential for Flood Damage in Seismic Event	Least Infrastructure Interference	Dam Permitting Not Required
A	Corps 65-Yr Small San Benito Dam	100%	\$200-240	X		X	X			X	
B	Corps 65-Yr Very Small Lined Flood Channel	100%	\$210-250						X		X
C	Corps 30-Yr New San Benito Dam	101%	\$220-260	X		X	X			X	
D	Corps 65-Yr Earthen Open Channel	98%	\$230-290					X	X		X
E	Corps 30-Yr Small Lined Flood Channel	100%	\$270-330						X		X
F	Corps 30-Yr Raise Existing Dams New San Benito Dam	104%	\$300-360	X	X	X	X			X	
G	Corps 30-Yr New Pacheco Dam New San Benito Dam	105%	\$300-360	X	X	X	X				
H	Corps 65-Yr Raise Existing Dams New Pacheco Dam	98%	\$320-400	X	X	X	X				
I	Corps 30-Yr Large Open Channel	100%	\$420-520					X	X		X

