

Appendix A

**Example Displays of Project Engineering and Economic Performance Results
from Risk Analysis**

Table A-1a: Expected Value and Probabilistic Values of EAD and EAD Reduced

Plan	Expected Annual Damage (\$'000)		Damage Reduced (\$'000)		EAD Reduced that is Exceeded with Specified Probability (\$'000)		
	Without Plan	With Plan	Mean	Standard Deviation	0.75	0.50	0.25
20 foot levee	575	220	355	57	316	353	393
25 foot levee	575	75	500	77	451	503	555
30 foot levee	575	5	570	98	502	573	626
channel	575	200	375	65	328	370	415
detention basin	575	250	325	93	263	325	388
relocation	575	220	355	61	313	353	396

Table A-1b: Expected Value and Probabilistic Values of Costs

Plan	Annual Cost (\$'000)		Cost that is Exceeded with Specified Probability (\$'000)		
	Mean	Standard Deviation	0.75	0.50	0.25
20 foot levee	300	40	273	300	327
25 foot levee	400	45	370	400	430
30 foot levee	550	60	510	550	590
channel	300	30	280	300	320
detention basin	275	10	268	275	282
relocation	250	20	237	250	263

Table A-2: Expected Value and Probabilistic Values of Net Benefits

Plan	Expected Annual Benefit and Cost (\$'000)		Net Benefits (\$'000)		Prob. Net Benefit is > 0	Net Benefit that is Exceeded with Specified Probability (\$'000)		
	Benefits	Cost	Mean	Std. Dev.		0.75	0.50	0.25
20 foot levee	355	300	55	68	0.80	8	54	99
25 foot levee	500	400	100	88	0.88	45	104	164
30 foot levee	570	550	20	116	0.55	-62	14	91
channel	375	300	75	74	0.83	19	72	120
detention basin	325	275	50	96	0.70	-17	50	113
relocation	355	250	105	63	0.97	62	100	145

Table A-3: Expected Value and Probabilistic Values of Benefit/Cost Ratios

Plan	Expected Benefit/Cost Ratio		Probability B/C > 1	B/C Ratio Value that is Exceeded with Specified Probability		
	Mean	Standard Deviation		0.75	0.50	0.25
20 foot levee	1.21	0.26	0.80	1.03	1.19	1.35
25 foot levee	1.28	0.24	0.88	1.11	1.26	1.43
30 foot levee	1.05	0.22	0.55	0.89	1.03	1.17
channel	1.26	0.27	0.83	1.06	1.24	1.41
detention basin	1.19	0.35	0.70	0.94	1.18	1.42
relocation	1.44	0.27	0.97	1.25	1.40	1.60

Table A-4: Performance Described by AEP and Long-term Risk

Plan	Annual Exceedance Probability	Long-term Risk (Probability of Exceedance Over Indicated Time Period)		
		10 Years	30 Years	50 Years
Without	0.250	0.94	1.00	1.00
20 foot levee	0.020	0.18	0.45	0.64
25 foot levee	0.010	0.10	0.26	0.39
30 foot levee	0.001	0.01	0.03	0.05
channel	0.015	0.14	0.36	0.53
detention basin	0.030	0.26	0.60	0.78
relocation	0.020	0.18	0.45	0.64

Alternative Display

Table A-4: Performance Described by AEP and Long-term Risk

Plan	Annual Exceedance Probability (AEP)	Long-Term Risk (Chances of Exceedance Over Indicated Time Period)		
		10 Years	30 Years	50 Years
Without	0.250	1 in 1.1	1 in 1.0	1 in 1.0
20 foot levee	0.020	1 in 5.5	1 in 2.2	1 in 1.6
25 foot levee	0.010	1 in 10.5	1 in 3.8	1 in 2.5
30 foot levee	0.001	1 in 100	1 in 33.8	1 in 20.5
channel	0.015	1 in 7.1	1 in 2.7	1 in 1.9
detention basin	0.030	1 in 3.8	1 in 1.7	1 in 1.3
relocation	0.020	1 in 5.5	1 in 2.2	1 in 1.6

Table A-5: Annual Exceedance Probability Uncertainty

Plan	Annual Exceedance Probability (AEP)		AEP of Plan that is Exceeded with Specified Probability		
	Mean	Std. Dev.	0.75	0.50	0.25
Without	0.250	0.140	0.155	0.249	0.344
20 foot levee	0.020	0.016	0.008	0.017	0.029
25 foot levee	0.010	0.008	0.004	0.008	0.013
30 foot levee	0.001	0.003	0.000	0.001	0.002
channel	0.015	0.010	0.008	0.013	0.020
detention basin	0.030	0.021	0.015	0.025	0.040
relocation	0.020	0.015	0.010	0.019	0.030

Table A-6: Risk Comparison

Plan	Annual Exceedance Probability
Without	0.250
20 foot levee	0.020
25 foot levee	0.010
30 foot levee	0.001
channel	0.015
detention basin	0.030
relocation	0.020
Comparable Property	
Fire Damage	0.001
Wind Damage	0.005
Earthquake	0.001

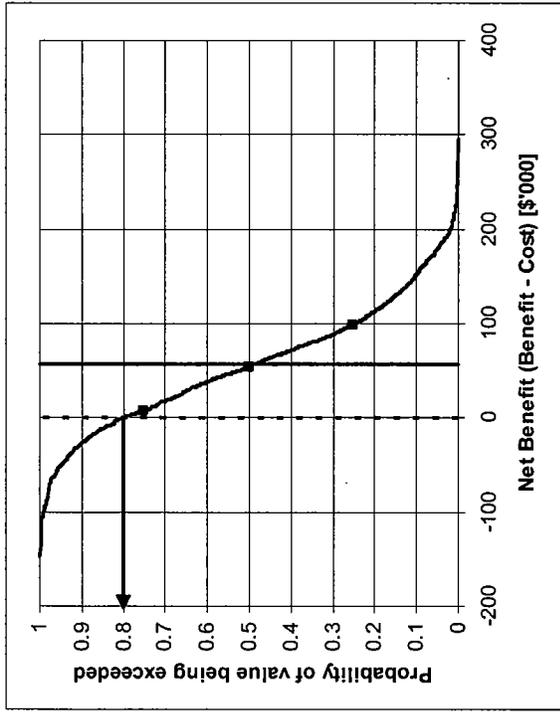


Figure A-1. Cumulative Distribution Function of Net Benefit for 20' Levee

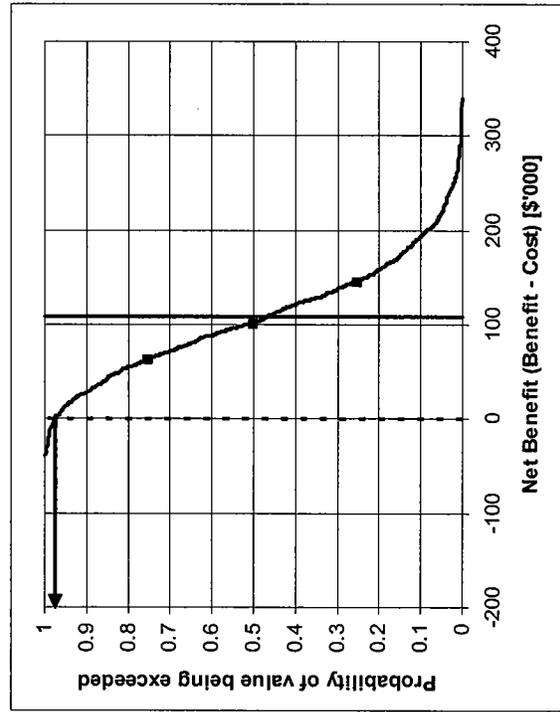


Figure A-2. Cumulative Distribution Function of Net Benefit for Relocation

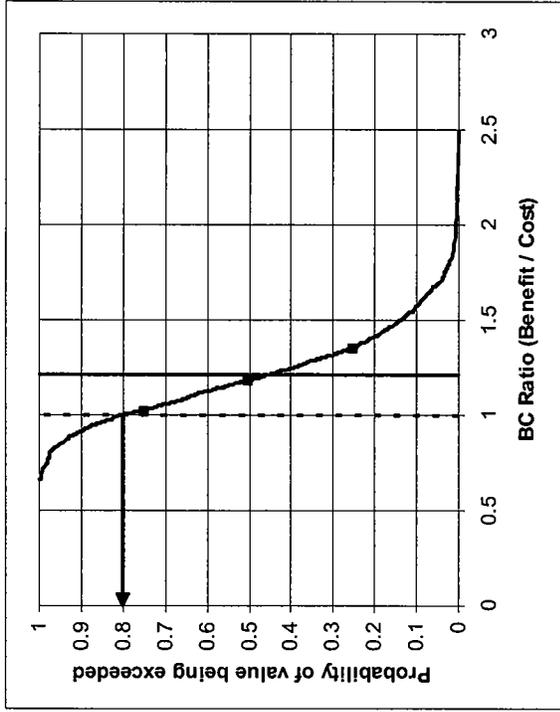


Figure A-3. Cumulative Distribution Function of BC Ratio for 20' Levee

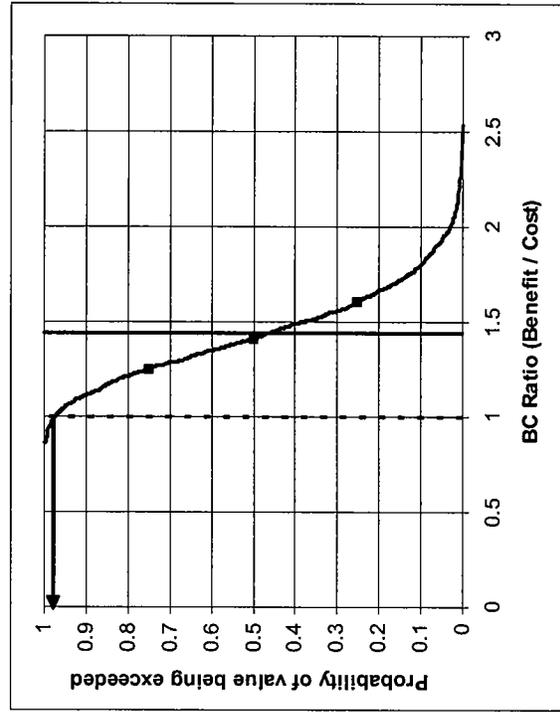


Figure A-4. Cumulative Distribution Function of BC Ratio for Relocation

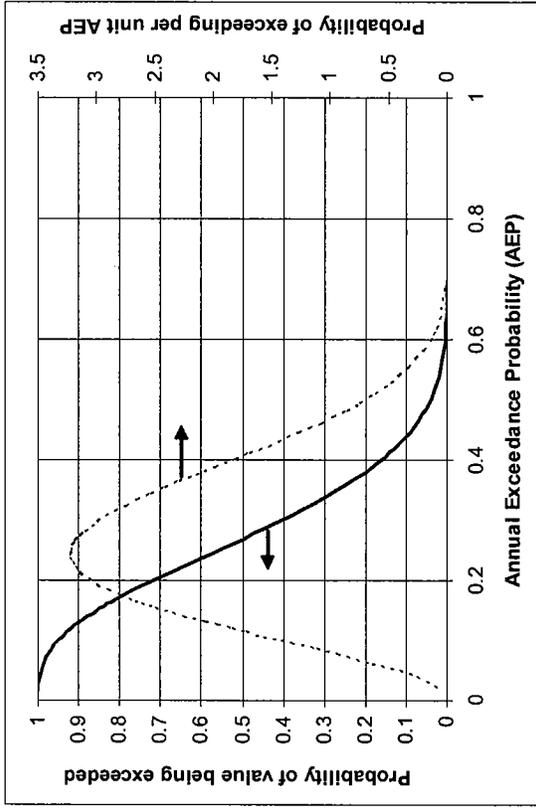


Figure A-5. Distribution Functions of AEP for Without Project

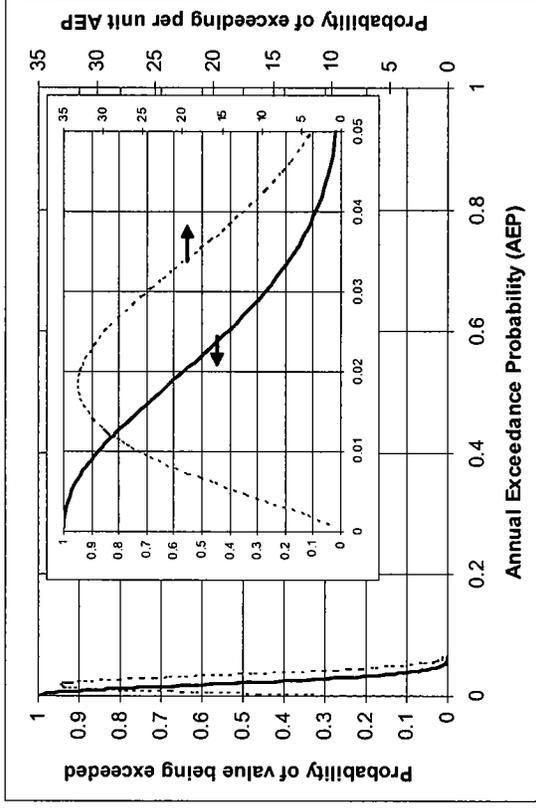


Figure A-7. Distribution Functions of AEP for Relocation

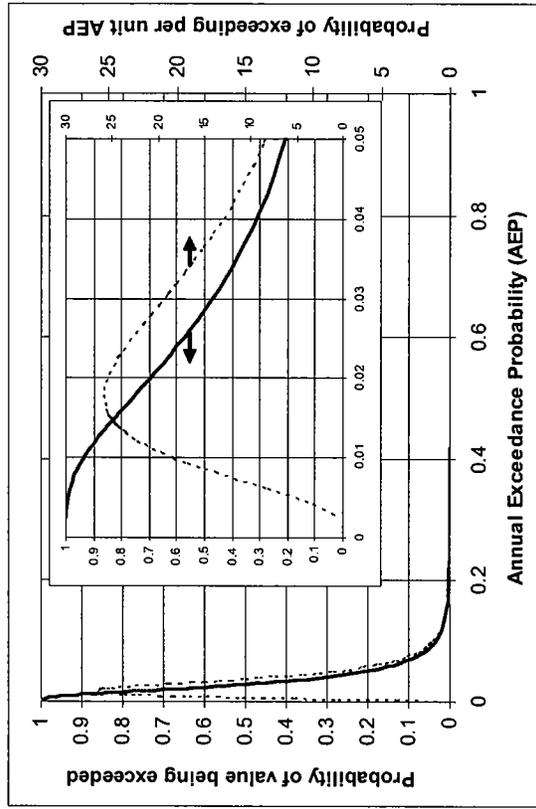


Figure A-6. Distribution Functions of AEP for 20' Levee

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Should the levees protecting My City south of the Your River be threatened, residents could attempt to move to nearby higher ground. The depth of flooding in the protected neighborhoods in this area would generally not exceed that at the river's edge although a few areas would experience flooding of more than 10 feet. New Town, on the other hand, is ringed by levees so that residents trying to leave the area would have to find their way across the main highway system to areas of higher ground. Moreover, because New Town is in a depression, a third of the area would flood to depths over 10 feet. Some areas would flood to as much as 35 feet. Because of the lengthy duration of flooding and the lack of natural drainage from this area, flood water would likely remain in New Town for 2 weeks or more. With the proposed levee, New Town is subject to a 1 in 100 chance of being flooded in any year but a 1 in 2.5 chance in 50 years. Therefore, the probability of a catastrophic event within the lifetime of most residents is nearly the same as flipping a fair coin and getting heads.

SOURCE: Adapted from: National Research Council. 1995. Flood Risk Management and the American River Basin: An Evaluation. Washington, DC: National Academy Press.

Figure A-8. Example Scenario