

Appendix E: LACFCD Dam Hydrology and Cost Estimates

Page

Tables

Table E-1. Big Tujunga Dam Structural Concept Results.....	E-3
Table E-2. Cogswell Dam Structural Concept Results	E-4
Table E-3. Devil's Gate Dam Structural Concept Results	E-5
Table E-4. Eaton Wash Dam Structural Concept Results	E-6
Table E-5. Morris Dam Structural Concept Results.....	E-7
Table E-6. Pacoima Dam Structural Concept Results.....	E-8
Table E-7. Puddingstone Diversion Dam Structural Concept Results.....	E-9
Table E-8. San Dimas Dam Structural Concept Results	E-10
Table E-9. San Gabriel Dam Structural Concept Results.....	E-11
Table E-10. LACFCD Dams Non-Structural Concept Results – High 1 Scenario	E-12
Table E-11. LACFCD Dams Non-Structural Concept Results – Low 1 Scenario.....	E-13
Table E-12. LACFCD Dams Non-Structural Concept Results – Low 2 Scenario.....	E-14
Table E-13. LACFCD Dams Summary of Estimated Costs of Structural Concepts.....	E-15

Figures

Figure E-1. Cost Estimate for Big Tujunga Dam Structural Concept.....	E-17
Figure E-2. Cost Estimate for Cogswell Dam Structural Concept	E-21
Figure E-3. Cost Estimate for Devils Gate Dam Structural Concept	E-25
Figure E-4. Cost Estimate for Eaton Wash Dam Structural Concept	E-29
Figure E-5. Cost Estimate for Morris Dam Structural Concept.....	E-33
Figure E-6. Cost Estimate for Pacoima Dam Structural Concept.....	E-37
Figure E-7. Cost Estimate for Puddingstone Diversion Dam Structural Concept.....	E-41
Figure E-8. Cost Estimate for San Dimas Dam Structural Concept	E-45
Figure E-9. Cost Estimate for San Gabriel Dam Structural Concept.....	E-49

Supplemental Section

E-1 STORAGE SOLUTIONS – LACFCD SANTA ANITA DAM	E-53
E-1.1 STRUCTURAL CONCEPT.....	E-53
E-1.2 RESULTS	E-53
E-1.3 CAPITAL AND OPERATIONAL COSTS	E-53
E-1.4 OTHER PROJECT CHARACTERISTICS AND BENEFITS	E-53
Table E-14. Santa Anita Dam Structural Concept Results	E-54
Figure E-10. Cost Estimate for Santa Anita Dam Structural Concept	E-55

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

This page intentionally left blank.

Table E-1. Big Tujunga Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	20,016	NA	12,845	NA	7,079	NA	64.2%	NA	NA	NA	0.58	NA
High 1	53,683	53,695	19,299	40,753	34,289	12,846	35.9%	75.9%	-28.2%	11.7%	1.85	3.61
Medium 2	31,069	31,074	14,699	26,485	16,277	4,496	47.3%	85.2%	-16.9%	21.1%	1.24	1.48
Low 1	14,439	14,441	8,910	12,509	5,425	1,827	61.7%	86.6%	-2.5%	22.5%	0.50	0.45
Low 2	25,103	25,106	14,160	22,480	10,841	2,523	56.4%	89.5%	-7.8%	25.4%	1.15	1.06

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Table E-2. Cogswell Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	25,524	NA	19,282	NA	6,208	NA	75.5%	NA	NA	NA	0.44	NA
High 1	53,339	53,353	27,397	51,680	25,898	1,624	51.4%	96.9%	-24.2%	21.3%	1.82	0.36
Medium 2	34,701	34,708	22,187	33,949	12,477	721	63.9%	97.8%	-11.6%	22.3%	1.06	0.18
Low 1	19,034	19,039	14,593	18,630	4,404	370	76.7%	97.9%	1.1%	22.3%	0.43	0.10
Low 2	29,393	29,398	21,199	29,000	8,158	359	72.1%	98.6%	-3.4%	23.1%	0.90	0.11

Table E-3. Devil’s Gate Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	14,295	NA	9,570	NA	4,725	NA	66.9%	NA	NA	NA	1.56	NA
High 1	32,202	32,204	12,925	32,204	19,277	0	40.1%	100.0%	-26.8%	33.1%	2.94	0.00
Medium 2	20,098	20,099	10,324	20,071	9,774	28	51.4%	99.9%	-15.6%	32.9%	2.04	0.02
Low 1	10,649	10,649	6,879	10,649	3,770	0	64.6%	100.0%	-2.3%	33.1%	0.93	0.00
Low 2	16,229	16,230	10,103	16,230	6,127	0	62.2%	100.0%	-4.7%	33.1%	1.85	0.00

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Table E-4. Eaton Wash Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	4,249	NA	3,681	NA	568	NA	86.6%	NA	NA	NA	1.52	NA
High 1	9,165	9,166	6,426	9,105	2,739	61	70.1%	99.3%	-16.5%	12.7%	5.46	0.10
Medium 2	6,071	6,072	4,780	6,057	1,291	15	78.7%	99.8%	-7.9%	13.1%	3.14	0.04
Low 1	3,366	3,367	2,867	3,351	500	15	85.2%	99.5%	-1.5%	12.9%	NA	0.02
Low 2	5,080	5,081	4,226	5,064	854	16	83.2%	99.7%	-3.4%	13.0%	2.20	0.06

Table E-5. Morris Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	113,078	NA	44,980	NA	68,045	NA	39.8%	NA	NA	NA	0.64	NA
High 1	242,483	242,576	53,120	156,526	189,341	86,017	21.9%	64.5%	-17.9%	24.7%	0.96	1.49
Medium 2	156,519	156,567	46,560	118,413	109,910	38,094	29.7%	75.6%	-10.0%	35.9%	0.76	0.83
Low 1	85,657	85,688	42,070	72,169	43,516	13,435	49.1%	84.2%	9.3%	44.4%	0.46	0.32
Low 2	130,601	130,631	46,067	109,524	84,465	21,026	35.3%	83.8%	-4.5%	44.1%	0.76	0.56

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Table E-6. Pacoima Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	7,144	NA	6,219	NA	899	NA	87.0%	NA	NA	NA	0.32	NA
High 1	18,509	18,509	14,354	18,009	4,123	468	77.6%	97.3%	-9.5%	10.3%	1.70	0.49
Medium 2	10,854	10,854	9,419	10,678	1,404	145	86.8%	98.4%	-0.3%	11.3%	0.57	0.08
Low 1	5,034	5,034	4,387	4,977	613	23	87.1%	98.9%	0.1%	11.8%	0.20	0.01
Low 2	8,611	8,611	7,927	8,546	651	31	92.1%	99.3%	5.0%	12.2%	0.44	0.02

Table E-7. Puddingstone Diversion Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	6,802	NA	6,452	NA	349	NA	94.9%	NA	NA	NA	0.88	NA
High 1	14,081	14,082	12,106	14,053	1,975	29	86.0%	99.8%	-8.9%	4.9%	3.54	0.02
Medium 2	8,905	8,906	8,010	8,898	895	7	90.0%	99.9%	-4.9%	5.1%	1.77	0.01
Low 1	4,694	4,694	4,323	4,686	371	8	92.1%	99.8%	-2.8%	5.0%	0.62	0.01
Low 2	7,317	7,317	6,783	7,298	533	19	92.7%	99.7%	-2.2%	4.9%	0.94	0.02

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Table E-8. San Dimas Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	5,451	NA	4,474	NA	957	NA	82.1%	NA	NA	NA	0.72	NA
High 1	10,884	10,884	6,798	10,771	4,066	93	62.5%	99.0%	-19.6%	16.9%	2.00	0.15
Medium 2	6,937	6,937	4,823	6,864	2,094	53	69.5%	99.0%	-12.6%	16.9%	1.45	0.08
Low 1	3,645	3,645	2,883	3,592	740	31	79.1%	98.5%	-3.0%	16.4%	0.49	0.05
Low 2	5,636	5,636	4,471	5,564	1,144	50	79.3%	98.7%	-2.8%	16.7%	0.94	0.08

Table E-9. San Gabriel Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	110,658	NA	90,825	NA	19,825	NA	82.1%	NA	NA	NA	0.52	NA
High 1	235,551	235,608	140,764	224,166	94,785	11,438	59.8%	95.1%	-22.3%	13.1%	1.89	0.88
Medium 2	152,736	152,760	108,576	147,980	44,151	4,770	71.1%	96.9%	-11.0%	14.8%	1.18	0.25
Low 1	84,125	84,139	68,813	82,523	15,302	1,603	81.8%	98.1%	-0.3%	16.0%	0.42	0.13
Low 2	127,561	127,575	102,910	125,292	24,640	2,270	80.7%	98.2%	-1.4%	16.1%	0.88	0.15

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Table E-10. LACFCD Dams Non-Structural Concept Results – High 1 Scenario

Dam Name	Mean Annual Volume Captured (ac-ft)			Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio			Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Event	
	Historical	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Historical	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
4 Devil's Gate	9,570	12,925	11,677	19,277	19,898	66.9%	40.1%	36.3%	-26.8%	-30.7%	2.94	4.14
5 Eaton Wash	3,681	6,426	3,183	2,739	5,284	86.6%	70.1%	34.7%	-16.5%	-51.9%	5.46	25.15
13 Santa Anita	3,312	6,775	6,412	1,862	2,176	92.9%	78.4%	74.2%	-14.5%	-18.7%	2.38	3.52
Totals	16,564	26,126	21,272	23,877	27,357	74.9%	52.2%	42.5%	-22.7%	-32.4%	NA	NA

Table E-11. LACFCD Dams Non-Structural Concept Results – Low 1 Scenario

Dam Name	Mean Annual Volume Captured (ac-ft)			Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio			Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Event	
	Historical	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Historical	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
4 Devil's Gate	9,570	6,879	6,131	3,770	4,090	66.9%	64.6%	57.6%	-2.3%	-9.4%	0.93	1.45
5 Eaton Wash	3,681	2,867	1,271	500	1,508	86.6%	85.2%	37.7%	-1.5%	-48.9%	1.12	9.52
13 Santa Anita	3,312	2,382	2,291	282	323	92.9%	89.2%	85.8%	-3.6%	-7.0%	0.49	0.63
Totals	16,564	12,127	9,693	4,552	5,922	74.9%	72.7%	58.1%	-2.2%	-16.8%	NA	NA

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Table E-12. LACFCD Dams Non-Structural Concept Results – Low 2 Scenario

Dam Name	Mean Annual Volume Captured (ac-ft)			Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio			Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Event	
	Historical	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Historical	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
4 Devil's Gate	9,570	10,103	9,658	6,127	6,353	66.9%	62.2%	59.5%	-4.7%	-7.4%	1.85	2.24
5 Eaton Wash	3,681	4,226	2,030	854	2,432	86.6%	83.2%	40.0%	-3.4%	-46.7%	2.20	14.96
13 Santa Anita	3,312	3,919	3,800	382	472	92.9%	91.0%	88.3%	-1.8%	-4.6%	0.69	1.15
Totals	16,564	18,248	15,487	7,362	9,257	74.9%	71.2%	60.5%	-3.7%	-14.4%	NA	NA

Table E-13. LACFCD Dams Summary of Estimated Costs of Structural Concepts

Dam Name	Estimated Total Annual Cost	Change of Mean Annual Volume Captured (ac-ft)				Estimated Annual Cost per Ac-Ft of Additional Volume Captured			
		High 1	Medium 2	Low 1	Low 2	High 1	Medium 2	Low 1	Low 2
Big Tajunga	\$1,099,474	21,454	11,786	3,599	8,320	\$51	\$93	\$305	\$132
Cogswell	\$1,145,670	24,283	11,762	4,036	7,801	\$47	\$97	\$284	\$147
Devil's Gate	\$4,634,504	19,279	9,747	3,770	6,127	\$240	\$475	\$1,229	\$756
Eaton Wash	\$1,351,402	2,679	1,277	485	838	\$504	\$1,059	\$2,788	\$1,613
Morris	\$3,798,384	103,406	71,853	30,099	63,457	\$37	\$53	\$126	\$60
Pacoima	\$3,029,836	3,655	1,259	591	619	\$829	\$2,407	\$5,130	\$4,892
Puddingstone Diversion	\$466,349	1,947	888	363	515	\$239	\$525	\$1,286	\$906
San Dimas	\$1,366,958	3,973	2,041	709	1,094	\$344	\$6703	\$1,929	\$1,250
San Gabriel	\$10,550,903	83,402	39,404	13,710	22,382	\$127	\$268	\$770	\$471
Totals	\$27,443,480	264,079	150,015	57,362	111,153	\$104	\$183	\$478	\$247

This page intentionally left blank.

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
14 Foot Tall Pneumatically Actuated Gate	122	LF	\$ 12,600	\$ 1,537,200	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
SUBTOTAL				\$ 1,537,200	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 1,537,200	\$ 122,976	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 122,976	
INSTALLATION COSTS					
14 Foot Tall Raised Spillway	122	LF	\$ 15,120	\$ 1,844,640	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
SUBTOTAL				\$ 1,844,640	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 3,504,816	\$ 350,482	Percentage of estimated construction costs

Figure E-1. Cost Estimate for Big Tujunga Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	30%	%	\$ 3,855,298	\$ 1,156,589	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	15%	%	\$ 3,855,298	\$ 578,295	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 3,855,298	\$ 192,765	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 7,517,830	\$ 826,961	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 3,855,298	\$ 192,765	Percentage of estimated construction costs (including General Conditions)
Permitting	30%	%	\$ 3,855,298	\$ 1,156,589	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 3,855,298	\$ 385,530	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 4,489,494	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 8,344,792	\$ 2,503,437	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 10,848,229	

Figure E-1. Cost Estimate for Big Tujunga Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 10,848,229	\$ 452,124	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1+i)^n))
SUBTOTAL				\$ 452,124	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	11,786	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	1.5	EA			
Number of Hours per Year	8.3	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 6	Annual Power Cost (\$) = [(kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 332	
Annual Operation & Maintenance Cost	5%	%	\$ 3,855,298	\$ 486,334	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 3,855,298		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 160,678	
SUBTOTAL				\$ 647,350	

Figure E-1. Cost Estimate for Big Tujunga Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 10,848,229	
		ANNUAL CAPITAL COST				\$ 452,124	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 647,350	
		TOTAL ANNUAL COST				\$ 1,099,474	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	11,786	Ac-Ft		\$ 93	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-1. Cost Estimate for Big Tujunga Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
13 Foot Tall Pneumatically Actuated Gate	145	LF	\$ 11,050.00	\$ 1,602,250	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
SUBTOTAL				\$ 1,602,250	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 1,602,250	\$ 128,180	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 128,180	
INSTALLATION COSTS					
13 Foot Tall Raised Spillway	145	LF	\$ 13,260	\$ 1,922,700	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
SUBTOTAL				\$ 1,922,700	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 3,653,130	\$ 365,313	Percentage of estimated construction costs

Figure E-2. Cost Estimate for Cogswell Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	30%	%	\$ 4,018,443	\$ 1,205,533	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	15%	%	\$ 4,018,443	\$ 602,766	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 4,018,443	\$ 200,922	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 7,835,964	\$ 861,956	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 4,018,443	\$ 200,922	Percentage of estimated construction costs (including General Conditions)
Permitting	30%	%	\$ 4,018,443	\$ 1,205,533	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 4,018,443	\$ 401,844	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 4,679,477	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 8,697,920	\$ 2,609,376	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 11,307,296	

Figure E-2. Cost Estimate for Cogswell Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 11,307,296	\$ 471,257	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1 + i)^n))
SUBTOTAL				\$ 471,257	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	11,762	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.2	EA			
Number of Hours per Year	0.5	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 0	Annual Power Cost (\$) = [(\$ kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 20	
Annual Operation & Maintenance Cost	5%	%	\$ 4,018,443	\$ 506,915	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 4,018,443		
Annual Replacement Cost	0.0417			\$ 167,478	Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
SUBTOTAL				\$ 674,413	

Figure E-2. Cost Estimate for Cogswell Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 11,307,296	
		ANNUAL CAPITAL COST				\$ 471,257	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 674,413	
		TOTAL ANNUAL COST				\$ 1,145,670	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	11,762	Ac-Ft		\$ 97	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-2. Cost Estimate for Cogswell Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
5 Foot Tall Pneumatically Actuated Gate	171	LF	\$ 2,250.00	\$ 384,750	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
(W' X H') 12.75' X 4' Slide Gate	8	EA	\$ 562,100.00	\$ 4,496,800	
(W X H') 14' X 4' Slide Gate	3	EA	\$ 606,350.00	\$ 1,819,050	
SUBTOTAL				\$ 6,700,600	Slide Gate Cost Estimates derived from USBR historical bids from the Expect Database Search at the Technical Service Center (TSC) in Denver. Rectangular and square gates are measured width by height (W' X H').
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 6,700,600	\$ 536,048	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 536,048	
INSTALLATION COSTS					
5 Foot Tall Raised Spillway	171	LF	\$ 2,700	\$ 461,700	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
12.75' X 4' Slide Gate	8	EA	\$ 674,520	\$ 5,396,160	
14' X 4' Slide Gate	3	EA	\$ 727,620	\$ 2,182,860	
SUBTOTAL				\$ 8,040,720	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 15,277,368	\$ 1,527,737	Percentage of estimated construction costs

Figure E-3. Cost Estimate for Devils Gate Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	1	LS		\$ 4,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	1	LS		\$ 2,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 16,805,105	\$ 840,255	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 30,166,126	\$ 3,318,274	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 16,805,105	\$ 840,255	Percentage of estimated construction costs (including General Conditions)
Permitting	1	LS		\$ 4,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 16,805,105	\$ 1,680,510	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 16,679,295	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 33,484,400	\$ 10,045,320	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 43,529,719	
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 43,529,719	\$ 1,814,199	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1 - i)^n))
SUBTOTAL				\$ 1,814,199	

Figure E-3. Cost Estimate for Devils Gate Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 43,529,719	\$ 1,814,199	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1+i)^n))
SUBTOTAL				\$ 1,814,199	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	9,747	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.0	EA			
Number of Hours per Year	0.0	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ -	Annual Power Cost (\$) = [(\$ kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ -	
Annual Operation & Maintenance Cost	5%	%	\$ 16,805,105	\$ 2,119,914	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 16,805,105		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 700,391	
SUBTOTAL				\$ 2,820,305	

Figure E-3. Cost Estimate for Devils Gate Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 43,529,719	
		ANNUAL CAPITAL COST				\$ 1,814,199	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 2,820,305	
		TOTAL ANNUAL COST				\$ 4,634,504	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	9,747	Ac-Ft		\$ 475	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-3. Cost Estimate for Devils Gate Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
10 Foot Tall Pneumatically Actuated Gate	270	LF	\$ 7,000	\$ 1,890,000	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
SUBTOTAL				\$ 1,890,000	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 1,890,000	\$ 151,200	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 151,200	
INSTALLATION COSTS					
10 Foot Tall Raised Spillway	270	LF	\$ 8,400	\$ 2,268,000	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
SUBTOTAL				\$ 2,268,000	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 4,309,200	\$ 430,920	Percentage of estimated construction costs

Figure E-4. Cost Estimate for Eaton Wash Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	30%	%	\$ 4,740,120	\$ 1,422,036	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	15%	%	\$ 4,740,120	\$ 711,018	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 4,740,120	\$ 237,006	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 9,243,234	\$ 1,016,756	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 4,740,120	\$ 237,006	Percentage of estimated construction costs (including General Conditions)
Permitting	30%	%	\$ 4,740,120	\$ 1,422,036	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 4,740,120	\$ 474,012	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 5,519,870	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 10,259,990	\$ 3,077,997	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 13,337,987	

Figure E-4. Cost Estimate for Eaton Wash Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 13,337,987	\$ 555,891	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1 + i)^n))
SUBTOTAL				\$ 555,891	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	1,277	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.0	EA			
Number of Hours per Year	0.1	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 0	Annual Power Cost (\$) = [(\$ kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 4	
Annual Operation & Maintenance Cost	5%	%	\$ 4,740,120	\$ 597,952	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 4,740,120		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 197,555	
SUBTOTAL				\$ 795,511	

Figure E-4. Cost Estimate for Eaton Wash Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 13,337,987	
		ANNUAL CAPITAL COST				\$ 555,891	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 795,511	
		TOTAL ANNUAL COST				\$ 1,351,402	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	1,277	Ac-Ft		\$ 1,058	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-4. Cost Estimate for Eaton Wash Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
23 Foot Tall Pneumatically Actuated Gate	171	LF	\$ 31,050	\$ 5,309,550	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
SUBTOTAL				\$ 5,309,550	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 5,309,550	\$ 424,764	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 424,764	
INSTALLATION COSTS					
23 Foot Tall Raised Spillway	171	LF	\$ 37,260	\$ 6,371,460	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
SUBTOTAL				\$ 6,371,460	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 12,105,774	\$ 1,210,577	Percentage of estimated construction costs

Figure E-5. Cost Estimate for Morris Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	30%	%	\$ 13,316,351	\$ 3,994,905	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	15%	%	\$ 13,316,351	\$ 1,997,453	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 13,316,351	\$ 665,818	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 25,966,885	\$ 2,856,357	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 13,316,351	\$ 665,818	Percentage of estimated construction costs (including General Conditions)
Permitting	30%	%	\$ 13,316,351	\$ 3,994,905	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 13,316,351	\$ 1,331,635	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 15,506,891	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 28,823,243	\$ 8,646,973	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 37,470,215	

Figure E-5. Cost Estimate for Morris Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 37,470,215	\$ 1,561,656	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1 + i)^n))
SUBTOTAL				\$ 1,561,656	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	71,853	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.8	EA			
Number of Hours per Year	47.3	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 31	Annual Power Cost (\$) = [(\$ kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 1,890	
Annual Operation & Maintenance Cost	5%	%	\$ 13,316,351	\$ 1,679,818	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 13,316,351		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 554,989	
SUBTOTAL				\$ 2,236,728	

Figure E-5. Cost Estimate for Morris Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 37,470,215	
		ANNUAL CAPITAL COST				\$ 1,561,656	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 2,236,728	
		TOTAL ANNUAL COST				\$ 3,798,384	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	71,853	Ac-Ft		\$ 53	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-5. Cost Estimate for Morris Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
(W' X H') 14' X 14' Slide Gate	2	EA	\$ 2,118,680	\$ 4,237,360	Slide Gate Cost Estimates derived from USBR historical bids from the Expect Database Search at the Technical Service Center (TSC) in Denver. Rectangular and square gates are measured width by height (W' X H').
SUBTOTAL				\$ 4,237,360	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 4,237,360	\$ 338,989	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 338,989	
INSTALLATION COSTS					
14' X 14' Slide Gate	2	EA	\$ 2,542,416	\$ 5,084,832	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
SUBTOTAL				\$ 5,084,832	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 9,661,181	\$ 966,118	Percentage of estimated construction costs

Figure E-6. Cost Estimate for Pacoima Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	30%	%	\$ 10,627,299	\$ 3,188,190	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	15%	%	\$ 10,627,299	\$ 1,594,095	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 10,627,299	\$ 531,365	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 20,723,233	\$ 2,279,556	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 10,627,299	\$ 531,365	Percentage of estimated construction costs (including General Conditions)
Permitting	30%	%	\$ 10,627,299	\$ 3,188,190	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 10,627,299	\$ 1,062,730	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 12,375,490	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 23,002,788	\$ 6,900,837	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 29,903,625	

Figure E-6. Cost Estimate for Pacoima Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 29,903,625	\$ 1,246,301	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1+i)^n))
SUBTOTAL				\$ 1,246,301	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	1,259	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.1	EA			
Number of Hours per Year	0.4	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 0	Annual Power Cost (\$) = [(\$ kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 16	
Annual Operation & Maintenance Cost	5%	%	\$ 10,627,299	\$ 1,340,602	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 10,627,299		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 442,917	
SUBTOTAL				\$ 1,783,535	

Figure E-6. Cost Estimate for Pacoima Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 29,903,625	
		ANNUAL CAPITAL COST				\$ 1,246,301	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 1,783,535	
		TOTAL ANNUAL COST				\$ 3,029,836	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	1,259	Ac-Ft		\$ 2,407	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-6. Cost Estimate for Pacoima Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
6 Foot Tall Pneumatically Actuated Gate	175	LF	\$ 3,000	\$ 525,000	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
SUBTOTAL				\$ 525,000	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 525,000	\$ 42,000	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 42,000	
INSTALLATION COSTS					
6 Foot Tall Raised Spillway	175	LF	\$ 3,600	\$ 630,000	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
SUBTOTAL				\$ 630,000	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 1,197,000	\$ 119,700	Percentage of estimated construction costs

Figure E-7. Cost Estimate for Puddingstone Diversion Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	1	LS		\$ 1,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	1	LS		\$ 500,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 1,316,700	\$ 65,835	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 4,080,040	\$ 448,804	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 1,316,700	\$ 65,835	Percentage of estimated construction costs (including General Conditions)
Permitting	1	LS		\$ 1,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 1,316,700	\$ 131,670	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 3,212,144	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 4,528,844	\$ 1,358,653	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 5,887,498	

Figure E-7. Cost Estimate for Puddingstone Diversion Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 5,887,498	\$ 245,375	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1+i)^n))
SUBTOTAL				\$ 245,375	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	888	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.0	EA			
Number of Hours per Year	0.0	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ -	Annual Power Cost (\$) = [(\$ kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ -	
Annual Operation & Maintenance Cost	5%	%	\$ 1,316,700	\$ 166,098	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 1,316,700		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 54,876	
SUBTOTAL				\$ 220,974	

Figure E-7. Cost Estimate for Puddingstone Diversion Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 5,887,498	
		ANNUAL CAPITAL COST				\$ 245,375	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 220,974	
		TOTAL ANNUAL COST				\$ 466,349	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	888	Ac-Ft		\$ 525	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-7. Cost Estimate for Puddingstone Diversion Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
11 Foot Tall Pneumatically Actuated Gate	135	LF	\$ 8,250	\$ 1,113,750	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
19 Foot Tall Pneumatically Actuated Gate	35	LF	\$ 22,800	\$ 798,000	
SUBTOTAL				\$ 1,911,750	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 1,911,750	\$ 152,940	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 152,940	
INSTALLATION COSTS					
11 Foot Tall Raised Spillway	135	LF	\$ 9,900	\$ 1,336,500	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
19 Foot Tall Raised Spillway	35	LF	\$ 27,360	\$ 957,600	
SUBTOTAL				\$ 2,294,100	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 4,358,790	\$ 435,879	Percentage of estimated construction costs

Figure E-8. Cost Estimate for San Dimas Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	30%	%	\$ 4,794,669	\$ 1,438,401	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	15%	%	\$ 4,794,669	\$ 719,200	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 4,794,669	\$ 239,733	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 9,349,605	\$ 1,028,457	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 4,794,669	\$ 239,733	Percentage of estimated construction costs (including General Conditions)
Permitting	30%	%	\$ 4,794,669	\$ 1,438,401	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 4,794,669	\$ 479,467	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 5,583,392	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 10,378,061	\$ 3,113,418	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 13,491,479	

Figure E-8. Cost Estimate for San Dimas Dam Structural Concept
 (Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 13,491,479	\$ 562,288	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1+i)^n))
SUBTOTAL				\$ 562,288	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	2,041	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.1	EA			
Number of Hours per Year	0.2	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 0	Annual Power Cost (\$) = [(kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 8	
Annual Operation & Maintenance Cost	5%	%	\$ 4,794,669	\$ 604,833	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 4,794,669		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 199,829	
SUBTOTAL				\$ 804,670	

Figure E-8. Cost Estimate for San Dimas Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 13,491,479	
		ANNUAL CAPITAL COST				\$ 562,288	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 804,670	
		TOTAL ANNUAL COST				\$ 1,366,958	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	2,041	Ac-Ft		\$ 670	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-8. Cost Estimate for San Dimas Dam Structural Concept
 (Sheet 4 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
25 Foot Tall Pneumatically Actuated Gate	456	LF	\$ 36,250	\$ 16,530,000	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
SUBTOTAL				\$ 16,530,000	
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 16,530,000	\$ 1,322,400	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 1,322,400	
INSTALLATION COSTS					
25 Foot Tall Raised Spillway	456	LF	\$ 43,500	\$ 19,836,000	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
SUBTOTAL				\$ 19,836,000	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 37,688,400	\$ 3,768,840	Percentage of estimated construction costs

Figure E-9. Cost Estimate for San Gabriel Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	1	LS		\$ 4,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	1	LS		\$ 2,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 41,457,240	\$ 2,072,862	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 59,748,688	\$ 6,572,356	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 41,457,240	\$ 2,072,862	Percentage of estimated construction costs (including General Conditions)
Permitting	1	LS		\$ 4,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 41,457,240	\$ 4,145,724	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 24,863,804	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 66,321,044	\$ 19,896,313	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 86,217,357	

Figure E-9. Cost Estimate for San Gabriel Dam Structural Concept
(Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 86,217,357	\$ 3,593,303	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1 + i)^n))
SUBTOTAL				\$ 3,593,303	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	39,404	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.3	EA			
Number of Hours per Year	1.7	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 1	Annual Power Cost (\$) = [(kW-hr)(0.7457 kW/hp)(hp)(t)] / 0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 68	
Annual Operation & Maintenance Cost	5%	%	\$ 41,457,240	\$ 5,229,707	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 41,457,240		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 1,727,824	
SUBTOTAL				\$ 6,957,600	

Figure E-9. Cost Estimate for San Gabriel Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 86,217,357	
		ANNUAL CAPITAL COST				\$ 3,593,303	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 6,957,600	
		TOTAL ANNUAL COST				\$ 10,550,903	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	39,404	Ac-Ft		\$ 268	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-9. Cost Estimate for San Gabriel Dam Structural Concept
 (Sheet 4 of 4)

E-1 Storage Solutions – LACFCD Santa Anita Dam

E-1.1 Structural Concept

As discussed in Section 2.4.3.1 of the report (Task 5 Infrastructure & Operations Concepts Report of the Los Angeles Basin Stormwater Conservation Study), Santa Anita Dam was recently modified to allow uncontrolled releases when reservoir elevation is above the seismically safe water elevation. A structural concept was developed for Santa Anita Dam that does not account for seismic constraints. Buttrussing the dam would be necessary to address those seismic issues and allow the structural concept to be implemented. Therefore, the structural concept for Santa Anita Dam is excluded from subsequent discussions in the report of the nine other LACFCD dams for which structural concepts were developed.

The structural concept for Santa Anita Dam was developed using the same approach used for the nine other LACFCD dams described in Section 2.4.3.1 of the report; and the same modeling approach was used, as well. The structural concept includes pneumatic gate at a covered channel spillway and a slide gate on the outlet of a semi-circular weir outlet, to allow stormwater to be captured at elevations above the spillway crest.

E-1.2 Results

A summary of the results for Santa Anita Dam for each of the four scenarios analyzed in Task 5 is presented in Table E-14 below. The Task 5 results for the key metrics are presented Santa Anita Dam alongside the corresponding Task 4 results for ease of comparison. Selected results are also provided for the Historical period for comparison.

E-1.3 Capital and Operational Costs

A cost estimate was developed for the structural concept for Santa Anita Dam by identifying major characteristics of the spillway facilities, including spillway types, dimensions and operational controls.

E-1.4 Other Project Characteristics and Benefits

Like the structural concepts for the other LACFCD dams, the structural concept for Santa Anita Dam is climate resilient. If (or when) buttrussing the dam is implemented to remedy the seismic issues, the structural concept could be implemented to increase the capture and storage of stormwater. Like the structural concepts for the other LACFCD dams, this concept also offers an opportunity for increased flood risk management. These concepts may also provide a water quality benefit. However, the combined cost of buttrussing Santa Anita Dam and implementation of the structural concept would be extraordinarily high in comparison with the costs of the structural concepts for other LACFCD dams, particularly in light of the relatively small volume of additional stormwater capture at this dam (431 AFY for the Mid 2 scenario).

Los Angeles Basin Study
 Task 5. Infrastructure and Operations Concepts Appendices

Table E-14. Santa Anita Dam Structural Concept Results

Scenario	Mean Annual Inflow (ac-ft)		Mean Annual Volume Captured (ac-ft)		Mean Annual Spillway Discharge Volume (ac-ft)		Capture Ratio		Capture Ratio Change from Historical		Mean Annual Frequency of Spillway Events	
	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)	Task 4	Task 5 (Structural Concept)
Historical	3,566	NA	3,312	NA	250	NA	92.9%	NA	NA	NA	0.40	NA
High 1	8,641	8,641	6,775	7,897	1,862	740	78.4%	91.4%	-14.5%	-1.5%	2.38	1.45
Medium 2	5,238	5,238	4,589	5,020	644	213	87.6%	95.8%	-5.3%	3.0%	1.15	0.52
Low 1	2,669	2,669	2,382	2,528	282	136	89.2%	94.7%	-3.6%	1.8%	0.49	0.29
Low 2	4,306	4,306	3,919	4,164	382	137	91.0%	96.7%	-1.8%	3.8%	0.69	0.31

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
RAISED SPILLWAY COSTS (GATES)					
9 Foot Tall Pneumatically Actuated Gate (W' X H') 8' X 8' Slide Gate	27	LF	\$ 5,850	\$ 157,950	Pneumatic Gate Cost Estimates derived from market research (Obermeyer Hydro). Costs include clamping and anchoring, materials & equipment, shipping charges, and installation supervision.
	1	EA	\$ 691,820	\$ 691,820	
SUBTOTAL				\$ 849,770	Slide Gate Cost Estimates derived from USBR historical bids from the Expect Database Search at the Technical Service Center (TSC) in Denver. Rectangular and square gates are measured width by height (W' X H').
PROGRAMMABLE LOGIC CONTROLLER COSTS					
PLC Controller (% of Gate Cost)	8%	%	\$ 849,770	\$ 67,982	Programmable Logic Controller (PLC) cost derived from Hydrotech and Obermeyer Hydro. PLC Cost are estimated at 8% of Rubber Dam or Pneumatically Actuated Gate (or Slide Gate) Costs.
SUBTOTAL				\$ 67,982	
INSTALLATION COSTS					
9 Foot Tall Raised Spillway 8' X 8' Slide Gate	27	LF	\$ 7,020	\$ 189,540	Labor, equipment and installation costs for construction/installation of raised spillway gates derived from market research (Hydrotech and Obermeyer Hydro) and estimated at 60% of gate cost with multiplier of 2.0 to adjust for difficulty of site access and constricted spaces.
	1	EA	\$ 830,184	\$ 830,184	
SUBTOTAL				\$ 1,019,724	
GENERAL CONDITIONS					
SUBTOTAL	10%	%	\$ 1,937,476	\$ 193,748	Percentage of estimated construction costs

Figure E-10. Cost Estimate for Santa Anita Dam Structural Concept
(Sheet 1 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
NON-CONTRACT COSTS					
Feasibility Studies, Surveys & Design Data	1	LS		\$ 1,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Designs & Specifications	1	LS		\$ 500,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$0.5M/\$2.0M)
Materials, Structural & Seismic Testing	5%	%	\$ 2,131,223	\$ 106,561	Percentage of estimated construction costs (including General Conditions)
Project Management	11%	%	\$ 5,057,468	\$ 556,321	Percentage of estimated construction costs & other non-contract costs
Legal	5%	%	\$ 2,131,223	\$ 106,561	Percentage of estimated construction costs (including General Conditions)
Permitting	1	LS		\$ 1,000,000	Percentage of estimated construction costs (including General Conditions) with min./max. LS cost (\$1.0M/\$4.0M)
Construction Management	10%	%	\$ 2,131,223	\$ 213,122	Percentage of estimated construction costs (including General Conditions)
SUBTOTAL				\$ 3,482,566	
CONTINGENCIES					
SUBTOTAL	30%	%	\$ 5,613,789	\$ 1,684,137	15% to 40% of estimated construction costs & non-contract costs
TOTAL CONSTRUCTION COST					
TOTAL				\$ 7,297,926	

Figure E-10. Cost Estimate for Santa Anita Dam Structural Concept
(Sheet 2 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
ANNUAL CAPITAL COST					
Project Life (n)	50	Yrs			
Federal Project Planning Rate (i)	3.375%	%			
Annual Cost	0.0417		\$ 7,297,926	\$ 304,158	Annual Cost (\$) = Total Cost (\$) * (i / (1 - (1+i)^n))
SUBTOTAL				\$ 304,158	
ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS					
Structural Concept Analysis Results:					
Mean Annual Volume Captured	431	Ac-Ft			Data specific to dam from Task 5 results for Medium 2 Future Climate Scenario
Number of Events per Year	0.5	EA			
Number of Hours per Year	0.9	Hrs			
Annual Power Cost:					
Electric Cost per kW-hr		kW-hr	\$ 0.15		
Pneumatic Gate Pump	5	HP		\$ 1	Annual Power Cost (\$) = [(\$ kW-hr)(0.7457 kW/hp)(hp)(t)]/0.84 for the combined horsepower for all motors, provided by vendors.
Slide Gate Motor	300	HP		\$ 36	
Annual Operation & Maintenance Cost	5%	%	\$ 2,131,223	\$ 268,847	Percentage of estimated construction costs (not including non-contract cost or contingencies)
Annual Replacement Cost (Pneumatically Actuated Gates):					
Useful Life	25	Yrs			Useful Life (25 years) provided by vendors.
Present Value of Replacement at 25 Years			\$ 2,131,223		Annual Cost multiplier applied to Present Value of materials, installation and general conditions costs of Pneumatically Actuated Gates, only.
Annual Replacement Cost	0.0417			\$ 88,824	
SUBTOTAL				\$ 357,708	

Figure E-10. Cost Estimate for Santa Anita Dam Structural Concept
(Sheet 3 of 4)

Los Angeles Basin Study
Task 5. Infrastructure and Operations Concepts Appendices

Identifier	Material or Rating	Description	Quantity	Units	Unit Cost \$/Unit	Estimated Cost	Notes
		SUMMARY					
		TOTAL CONSTRUCTION COST				\$ 7,297,926	
		ANNUAL CAPITAL COST				\$ 304,158	
		ANNUAL OPERATING, MAINTENANCE & REPLACEMENT COSTS				\$ 357,708	
		TOTAL ANNUAL COST				\$ 661,865	
		TOTAL ANNUAL COST per Ac-Ft (Medium 2 Scenario)	431	Ac-Ft		\$ 1,536	
NOTES:							
1 - This cost estimate is conceptual in nature and is appropriate for strategic planning, business development, project screening, alternative scheme analysis, confirmation of technical and/or economic feasibility, and preliminary approval to proceed. While these estimates are appropriate for the appraisal level analysis required for the purposes of this document, they are not appropriate for budget authorization, funding agreements, bid, or tender offers. Accuracy ranges are considered to be -15% to -30% on the low side and +20% to +50% on the high side.							
2 - All costs are presented in 2015 dollars.							
3 - Taxes & contractor OH&P are included in the unit prices.							
4 - Distributive Costs include but are not limited to additional planning efforts, investigations, analysis, regulatory compliance, acquisition, contract administration, construction management, inspection, etc.							
5 - The RSMean construction data was used to derive Feasibility, Design, Material Testing, Structural, and Seismic Testing percentages. The total materials and labor costs are used for the percent cost.							

Figure E-10. Cost Estimate for Santa Anita Dam Structural Concept
 (Sheet 4 of 4)