

Risk and Uncertainty Analysis of 30 Percent Design Capital Cost Estimate for the Sites Reservoir Project

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IRWD is participating in the planning and environmental review of the Sites Reservoir Project with the intent of securing a reliable annual supply for its Groundwater Bank in Kern County. The IRWD Groundwater Bank provides IRWD with water supply reliability during emergencies, major droughts, and supply interruptions. Provided below is an overview of a risk and uncertainty analysis of the 30% design capital cost estimates for the Sites Project that was conducted by IRWD. The cost of the project will affect the price and terms of payments for IRWD and other participants in the project. An understanding of the cost risks and uncertainties may assist in making decisions regarding continued participation in the project. Following is an overview of the risk and uncertainty analysis conducted by IRWD.

Project Capital Cost Estimate:

In June 2025, the Sites Authority released a 30% design capital cost estimate for the Sites Project that was developed by engineers at AECOM and Jacobs in the amount of \$7.5 billion (in 2024 dollars). The total cost before contingencies was estimated at \$6.0 billion. Metropolitan Water District of Southern California performed a peer review of the cost estimate during its development.

Need for Risk and Uncertainty Analysis:

IRWD participated in value planning efforts that led to the release of the peer-reviewed 30% design capital cost estimate. During this process, IRWD along with other participating agencies advocated for conducting a risk and uncertainty analysis of the capital cost estimate. To lay the groundwork for such an analysis, engineers at AECOM and Jacobs developed ranges of probabilities and risk costs for 92 potential contingency design changes and compensatory mitigation requirements that might be necessary as detailed geotechnical exploration occurs, the project progresses to 100% design, and as biological surveys are completed. This information is provided as Exhibit “A”. The engineers also provided ranges of uncertainty for contingencies in non-contract costs, construction costs, and real estate purchases. To leverage IRWD’s experience in risk and uncertainty analyses, the Sites Authority provided IRWD with this information in support of building a Monte Carlo simulation-based Sites Reservoir cost risk and uncertainty model (Cost Risk Model).

Risk and Uncertainty Modeling:

IRWD used “@Risk”, a Microsoft Excel add-on tool, to develop the Cost Risk Model. The model replaces the single-point contingency cost estimates from the 30% design with probability distributions that incorporate AECOM and Jacobs expert opinions on risk costs and probabilities. The Sites Authority and AECOM reviewed the model and provided suggestions for

improvements that IRWD incorporated. The mathematical equations used in the model are provided in Exhibit “B”.

A presentation prepared by IRWD that presents the Sites Authority’s June 2025 cost estimate, IRWD’s approach to the risk and uncertainty modeling, the design and compensatory mitigation factors modeled, and risk and uncertainty analysis results from Monte Carlo iterations of the Cost Risk Model is included as Exhibit “C”.

Summary of Risk Model Results:

The capital cost of the Sites Project will affect the price and terms of payments for participation in the Sites Reservoir Project. The risk and uncertainty analysis results from the Cost Risk Model indicate that there is a 90% probability that, in 2024 dollars, the total capital cost of the project will be less than or equal to \$7.5 billion and a 95% probability that it would be less than or equal to \$7.6 billion.

If construction starts in 2027, there is a 3% probability that the capital cost would be less than or equal to \$7.6 billion and a 95% probability of being less than or equal to \$8.6 billion. These costs assume that the project would be constructed in one year and do not consider cost escalations over the proposed construction period. Cost escalations over the construction period and associated uncertainties are being considered in the project cash flow analysis being prepared by the Sites Reservoir Authority.

List of Exhibits:

Exhibit “A” – Reservoir Design, Conveyance Design, and Compensatory Mitigation Items Modeled in Risk Analysis

Exhibit “B” – Sites Reservoir Project Cost Risk and Uncertainty Modeling Equations

Exhibit “C” – Draft PowerPoint Presentation on Sites Reservoir Project Capital Cost Risk and Uncertainty Analysis

Exhibit "A"
Reservoir Design, Conveyance Design, and Compensatory Mitigation Items Modeled in Risk Analysis

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Golden Gate Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 5'.	\$ 31,872,019	31%	56%	31%	56%	31%	31%	31%	38%
Golden Gate Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 10'.	\$ 31,872,019	13%	13%	13%	13%	13%	13%	13%	13%
Golden Gate Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 15'.	\$ 31,872,017	3%	3%	3%	3%	3%	3%	3%	3%
Golden Gate Dam Foundation Excavation	No landslides are assumed in the dam foundation based on geomorphology. Risk: A significant landslide 20% of the excavation volume 300,000 cy) .	\$ 20,235,492	31%	13%	31%	3%	13%	3%	13%	15%
Golden Gate Dam Grout Curtain	The estimate assumes mandatory primary, secondaries, 50% tertiary , 50% allowance for higher order holes or 130k LF and 650 Holes Risk: Assume increases to 100% tertiary, which results in 180k LF and 990 Holes	\$ 11,685,558	13%	31%	31%	13%	13%	13%		19%
Golden Gate Dam Consolidation grouting	Golden Gate does not include consolidation grout. Risk Assumes 4 rows of consolidation grout holes (2 upstream and 2 downstream) Assume 20 foot spacing and 30 foot depth along the valley length of 2,400 feet.	\$ 4,090,242	31%	31%	13%	13%	3%	13%		17%
Golden Gate Dam Core Borrow	Materials inside the reservoir are likely to be dispersive. Core materials may be borrowed for the TRR outside the reservoir area which increases the haul distance from 2 miles to 8 miles. Additional Haul Distance for 1,060k CY	\$ 16,472,219	56%	56%	86%	31%	31%	56%	56%	53%
Golden Gate Dam Core widths increase	The core slopes are currently 0.25:1 (H:V). Risk: Further design may increase core width to 0.5:1 (H:V). GG = 1,060k to 2,120k CY of Core	\$ 38,049,139	31%	31%	31%	31%		13%	31%	28%

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Golden Gate Dam Embankment Upstream and Downstream Slopes	The embankment downstream slopes are currently 2:1 and have the potential to increase to 2.5:1 (H:V). The embankment upstream slopes are 2.25:1 and have the potential to increase to 3:1 (H:V). Risk: GG Total Embankment increases from 7.7M to 10M CY	\$ 102,004,009	31%	13%	31%	13%		31%	13%	22%
Golden Gate Rock Borrow Stripping and Overburden Removal	Currently assume 8 feet of overburden. Risk: This may grow to 16 feet	\$ 22,297,091	31%	31%	3%	31%	13%	13%	31%	22%
Golden Gate Rock Borrow	After removal of the overburden the estimate assumes 10% unsuitable material. Risk: This may grow to 20%	\$ 20,926,738	31%	31%	13%	31%	13%	13%	31%	23%
Golden Gate Rock Borrow	After removal of the overburden the estimate assumes 10% unsuitable material. Risk: This may grow to 30%	\$ 13,951,156	13%	13%	3%	13%	3%	3%	13%	9%
Golden Gate Filter and Drain Zones	Currently the Filter and Drain Widths are 12 feet and 8' feet respectively. Risk: Further design may require increased filter and drains width of 15 Feet and 10 Feet which would increase Filters and Drains by 25%	\$ 24,517,011	3%	13%	3%	13%		3%	13%	8%
Golden Gate Transition Zones	The estimate assumes 153k cy of Zone 4A and 350k cy of zone 4B are produced on site. Risk: Unable to make transitions for Golden Gate and Sites Dams on site. Need to import.	\$ 92,530,057	3%	3%	13%	13%		13%	13%	10%
Golden Gate and Sites Dam Transition Zones	The current width of transition zones is 10' feet. Risk of widths to increase 25%	\$ 10,868,234	3%	13%	3%	13%		13%	13%	10%
Sites Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 5'.	\$ 11,776,550	13%	31%	31%	31%	13%	13%	31%	23%
Sites Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 10'.	\$ 11,776,553	13%	13%	3%	13%	3%	3%	13%	9%

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Sites Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 15'.	\$ 11,776,551	3%	3%	3%	3%	3%	3%	3%	3%
Sites Dam Foundation Excavation	A landslide is assumed in the dam foundation based on geomorphology. A deep landslide may occur. Risk: A unidentified significant landslide 20% of the excavation volume 100,000 cy) .	\$ 6,976,084	31%	13%	31%	13%	13%	3%	56%	23%
Sites Dam Grout Curtain	The estimate assumes mandatory primary, secondaries, 50% tertiary , 50% allowance for higher order holes 65k LF and 240 Holes Risk: Assume increases to 100% tertiary, which results in 80k LF and 345 Holes	\$ 4,485,425	13%	31%	13%	13%	13%	13%		16%
Sites Dam Consolidation grouting	Sites does not include consolidation grout. Risk Assumes 4 rows of consolidation grout holes (2 upstream and 2 downstream) Assume 20 foot spacing and 30 foot depth along the valley length of 1,020 feet.	\$ 2,019,414	31%	31%	13%	13%	3%	13%		17%
Sites Core Borrow	Materials inside the reservoir are likely to be dispersive. Core materials may be borrowed for the TRR outside the reservoir area which increases the haul distance from 2 miles to 8 miles. Additional Haul Sites 280k CY	\$ 6,114,987	56%	56%	86%	31%	31%	56%	56%	53%
Sites Dam Core widths increase	The core slopes are currently 0.25:1 (H:V). Risk: Further design may increase core width to 0.5:1 (H:V). Sites = 280k to 560k CY of Core	\$ 8,166,711	31%	31%	31%	31%		13%	31%	28%
Sites Dam Embankment Upstream and Downstream Slopes	The embankment downstream slopes are currently 2:1 and have the potential to increase to 2.5:1 (H:V). The embankment upstream slopes are 2.25:1 and have the potential to increase to 3:1 (H:V). Risk: - The Sites embankment increases from 2.65M to 3.5M CY	\$ 51,473,385	31%	13%	31%	13%		31%	13%	22%
Sites Rock Borrow Stripping and Overburden Removal	Currently assume 8 feet of overburden. Risk: This may grow to 16 feet	\$ 8,211,606	13%	13%	3%	13%	3%	3%	31%	11%

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Sites Rock Borrow Quality	After removal of the overburden the estimate assumes 10% unsuitable material. Risk: This may grow to 25%	\$ 5,175,729	31%	31%	13%	13%	13%	13%	31%	21%
Sites Rock Borrow Quality	After removal of the overburden the estimate assumes 10% unsuitable material. Risk: This may grow to 35%	\$ 5,175,728	13%	13%	3%	3%	3%	3%	13%	7%
Sites Dam Filter and Drain Zones	Currently the Filter and Drain Widths are 12 feet and 8' feet respectively. Risk: Further design may require increased filter and drains width of 15 Feet and 10 Feet which would increase Filters and Drains by 25%	\$ 7,851,268	3%	13%	3%	13%		3%	13%	8%
Sites Dam Transition Zones	The estimate assumes 47k cy of Zone 4A and 114k cy of zone 4B are produced on site. Risk: Unable to make transitions for Golden Gate and Sites Dams on site. Need to import.	\$ 27,834,481	3%	3%	13%	13%		13%	13%	10%
Sites Dam Transition Zones	The current width of transition zones is 10' feet. Risk of widths to increase 25%	\$ 6,008,684	3%	13%	3%	13%		13%	13%	10%
Saddle Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 5'.	\$ 30,396,339	31%	56%	56%					47%
Saddle Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 10'.	\$ 30,396,338	13%	13%	31%					19%
Saddle Dam Foundation Excavation	Estimate assumes 15' excavation depth based on limited information. Risk: The excavation may increase 15'.	\$ 30,396,332	3%	3%	13%					6%
Saddle Dam Foundation Excavation	No landslides are assumed in the dam foundation based on geomorphology. Risk: A significant landslide 20% of the excavation volume.	\$ 19,700,830	3%	13%	13%					10%

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Saddle Dam Grout Curtain	The estimate assumes mandatory primary, secondaries, 50% tertiary , 50% allowance for higher order holes or 260k LF and 2740 Holes Risk: Assume increases to 100% tertiary, which results in 355k LF and 3900 Holes	\$ 34,126,480	31%	13%	31%					25%
Rim Grout	The estimate includes 51,300 LF of rim grout. Risk: Rim grout increases by 100% to 102.5k lf	\$ 8,583,274	56%	56%	31%					47%
Saddle Dam Core Borrow	Materials inside the reservoir are likely to be dispersive. Core materials may be borrowed for the TRR outside the reservoir area which increases the haul distance from 2 miles to 8 miles. Additional Haul Distance for 690k CY	\$ 25,520,958	13%	56%	31%					33%
Saddle Dam Core widths increase	The core slopes are currently 0.25:1 (H:V). Risk: Further design may increase core width to 0.5:1 (H:V). Saddles = 690k to 1,380k CY of Core	\$ 37,719,862	3%	13%	13%					10%
Spillway	The spillway is a small structure. The desing is based on 3,900 CY of concrete. Future studies may increase this volume. Risk the spillway increases by 100%.	\$ 14,329,083	31%	31%	31%					31%
Saddle Random Borrow	Estimate assumes little waste. The random borrow areas may have rocks, poor soils, or other unsuitable materials. Risk 15% Waste	\$ 7,712,784	13%	31%	31%					25%
Saddle Random Borrow	Estimate assumes little waste. The random borrow areas may have rocks, poor soils, or other unsuitable materials. Risk 30% Waste	\$ 56,560,392	3%	13%	31%					15%
Saddle Filter and Drain Zones	Currently the Filter and Drain Widths are 6 feet and 6' feet respectively. Risk: Further design may require increased filter and drains width to increase by 25%	\$ 27,064,793	13%	31%	31%					25%
Saddle and Sites Dam Transition Zones	The current width of transition zones is 6' feet. Risk of widths to increase by 25%	\$ 11,241,156	13%	31%	31%					25%

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
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Tunnel Excavation Ground Stability	The 30% design assumes a 50/50 initial ground supports mix. If ground is not as stable there will be decrease in excavation rate, additional stabilization measures (steel sets, grouting etc). Risk: Increase in poor ground from 50 to 75 percent, i.e. 75/25.	\$ 83,121,719	13%	13%	13%	13%	13%	31%	13%	16%
Tunnel Excavation Ground Water	Very little data available for the tunnel. Assumed some perched water in the rim and exploration holes and dewatering. If water inflows are greater and it is required to grout ahead of the tunnel and/or dewatering increased to stabilize the excavation then the excavation rate will slow and additional efforts will be required. Risk: Water inflows are greater than expected. Impacts additional 20 percent of tunnel requiring more dewatering, grouting ahead and slowed rate of excavation.	\$ 46,916,032	56%	31%	56%	31%	13%	13%	31%	33%
Tunnel Excavation Fault Crossing	Very little data available for the tunnel. Assumed no faults cross the tunnel. There are faults in the area and are currently mapped on either side. Risk: A fault is identified crossing the tunnel and there is a need to design for fault rupture potential. This is a special design to provide the ability to accommodate fault offset but maintain full function of the I/O works.	\$ 35,664,222	13%	13%	13%	13%	13%	31%		16%
Foundation Excavation	The I/O structure is on a cut slope in the Boxer formation which is predominantly mudstone. There is very little geotechnical data to confirm the depth of suitable foundation rock. Risk: The depth of suitable foundation rock is 5 feet lower requiring reconfiguration of the I/O structure and additional excavation. Assume 10' Increases to 20'	\$ 16,189,310	31%	31%	31%	31%	31%	31%	31%	31%

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Portal Excavation	The I/O inlet portal and structure is on a cut slope in the Boxer formation which is predominantly mudstone. There is very little geotechnical data. There are no visible signs of a landslide, but there are no borings to confirm. Risk: There is a landslide in the portal rock requiring reconfiguration of the I/O structure and additional excavation. Assumed the excavation increases by 25% or 66k CY	\$ 21,468,745	56%	31%	31%	31%	31%	13%	31%	32%
I/O Configuration	The I/O has been evolved from a tower to a sloping intake. Other configurations have been discussed including a shaft with adits and a socketed tower. Risk: Regulatory agencies require a different configuration.	\$ 50,000,000	31%	56%	31%	56%	31%	56%	31%	41%
Tunnel Steel Field Fabrication	The I/O Tunnel is 18.5' in diameter. A vendor has confrimed the pipe can be shipped however a detailed logistics study has not been performed. Risk - The pipe must be fabricated on site resulting in a unit price increase.	\$ 79,320,000	13%	31%	13%	31%	13%	31%	13%	21%
New Road Added	Risk: As the design progresses an additional permanent road may be added. This could be a road from the I/O to the Golden Gate Dam along the high water and connecting to the Sites Lodoga, or it could be additional length of roads to avoid areas with impacts to community. Cost Assumption - 2.0 Miles in mountainous terrain similar to the SLR Detour	\$ 60,990,094	56%	56%	31%	31%		31%	56%	43%
Structural Section	Risk: Structural Sections, Agg Base and Asphalt increase by 25%	\$ 23,127,052	13%	13%	13%	13%		31%	13%	16%
Excavation - Rock Excavation	Rock excavation is included in the estimate as 60% of the total excavation. Risk: Rock excavation may increase to 80%.	\$ 12,947,638	31%	31%	13%	31%		13%	31%	25%
Retaining Walls	Risk: Retaining walls increase from 225k sf to 550k sf or wall types change.	\$ 38,007,732	56%	31%	31%	31%		31%	56%	39%
Bridge Foundations	Bridge foundation volume and pile increases based on geotechnical conditions. All increase by 25%	\$ 12,350,727	86%	31%	31%	13%		31%	3%	32%

Reservoir Design Contingency Items										
Scope	Risk Description	Risk Cost	Score Card Values Probability %							
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Bridge Height	The SLR bridge is at elevation increases 10 Feet . See qty calcs	\$ 24,873,136	86%	31%	31%	13%		31%	3%	32%
Bridge Type	Bridge type is revised from an Spliced Girder Bridge to Cantilever Bridge resulting in a significant cost increase. Assume 100% increase to all costs above the columns.	\$ 47,972,189	31%	3%	13%	13%		31%		18%
	Allowances were included in the design for animal crossings. With futher studies and design these could change. Risk - Animal Crossings increase by 100%.	\$ 7,112,517	31%	56%	31%	56%		56%	31%	43%
	Allowances are included in the estimate for the drainage features along the roads. Risk - Futher studies increase quantitiy and size of the drainage features by 50%.	\$ 3,557,195	31%	56%	31%	56%		56%	31%	43%
	68, 69, D road improvements are full depth reclimation and the roads stay at the same elevation. Risk - Road elevation need to be increased to reduce flooding risk. Risk - The cost of the road improvements increase by 100%.	\$ 14,048,118	31%	56%	31%	56%		56%	31%	43%

Hydraulic Design Contingency Items												
Scope	Risk Description	Risk Cost	Score Card Values Probability %									
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Average
Funks, TRR and Environmental Pipelines - CLSM Processing	Estimate assumes native trench material will be acceptable for production of CLSM onsite. Risk assumes CLSM materials must be obtained offsite.	\$ 16,210,000	50%	75%	50%	50%	75%	50%	40%	50%		55%
Dunnigan Pipeline - CLSM Processing	Estimate assumes native trench material will be acceptable for production of CLSM onsite. Risk assumes CLSM materials must be obtained offsite.	\$ 8,945,000	50%	75%	50%	50%	75%	25%	50%	50%		53%
TRR PGPs - Discharge Structure depth	Future design and/or modeling efforts (i.e., CFD modeling) results in design change to TRR Discharge Structure, increasing depth by 5 feet.	\$ 3,002,625	50%	50%	75%	50%		75%	50%			58%
Funks PGPs - Discharge Structure depth	Future DSOD coordination, future design and/or modeling efforts (i.e., CFD modeling) results in design change to Funks Discharge Structure, increasing depth by 15 feet and width by 25 feet	\$ 6,335,311	75%	50%	75%	75%		75%	50%			67%
Dunnigan Pipeline: Discharge Structure - Discharge Structure depth	Future design and/or modeling efforts (i.e., CFD modeling, geotech data) results in design change to Dunnigan Pipeline Discharge Structure increasing depth by 15-ft.	\$ 3,880,000	50%	75%	50%	25%		50%	60%			52%
TRR Pipeline: Tunnels under Funks Reservoir - Tunnel	Further geotechnical investigations results in design change (i.e., tunnel needs to be 20-ft lower) to tunnel and shafts.	\$ 2,803,700	50%	75%	75%			75%	75%	80%		72%

Hydraulic Design Contingency Items												
Scope	Risk Description	Risk Cost	Score Card Values Probability %									
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Average
TRR Pipeline: Tunnels under PG&E corridor at TRR PGP - Tunnel	Further geotechnical investigations results in design change (i.e., tunnel needs to be 20-ft lower) to tunnel and shafts.	\$ 2,803,700	50%	50%	75%			75%	40%	75%		61%
Dunnigan Pipeline: Tunnels @ I-5, HWY 99 and RR. - Tunnel	Further geotechnical investigations results in design change (i.e., tunnels need to be 20-ft lower) to tunnel and shafts.	\$ 5,496,360	50%	50%	75%			75%	60%	80%		65%
Funks and TRR Pipelines - Trench Width	Further geotechnical investigations results in design change to TRR/Funks pipeline trench width. Assume 1500 LF of trench changes from Standard Detail 3123-110A to 3123-110B.	\$ 7,171,500	75%	90%	75%	75%	75%	75%	50%			74%
TRR Pipelines - Trench Width	Further geotechnical investigations results in design change to pipeline trench width. Assume 3000 LF of trench changes from Standard Detail 3123-110C to 3123-110D.	\$ 13,149,000	25%	75%	90%	75%	75%	75%	50%			66%
Environmental Pipeline - Trench Width	Further geotechnical investigations results in design change to pipeline trench width. Assume 1200 LF of trench width changes from Pipe OD + 18" to Pipe OD x 3.	\$ 168,000	50%	50%		75%	75%	75%	50%			63%
Dunnigan Pipeline - Trench Width	Further geotechnical investigations results in design change to pipeline trench width. Assume 9500 LF of trench width changes from Pipe OD + 18" to Pipe OD x 3.	\$ 2,109,000	50%	75%	90%	75%	75%	75%	50%			70%

Hydraulic Design Contingency Items												
Scope	Risk Description	Risk Cost	Score Card Values Probability %									
			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Average
Dunnigan Pipeline - Implementing Alt 2 Design	Extending Dunnigan Pipeline from the CBD to the Sacramento River (ALT2). Additional 29,500lf of 12' Dia Pipeline. Discharge Structure at the Sacramento River	\$ 129,500,000	50%					50%				
WAPA - Crossing WAPA Power Lines with Sites Power Lines	Coordination with WAPA alters where TRR Pipelines and 230 kv Transmission lines cross WAPA and 500 kv TANC Power Lines. Go 3,000-LF north of 30% design layout.	\$ 5,681,820	90%	75%	75%			75%			50%	73%
PG&E Point of Interconnection (POI) - Location of POI	POI to PG&E lines needs to extend from TRR area to near PG&E power plant (4 miles north) resulting in 4 miles of additional power lines for Sites.	\$ 40,000,000	90%	50%	75%			50%			50%	63%
Funks PGP - Pump bay size	Future design and/or modeling efforts (i.e. buoyancy/flotation calculations) results in design change to PGP bays, increasing top slab thickness 1.5 feet (27%).	\$ 2,011,192	50%	50%	75%			50%	50%			55%
TRR PGP - Pump bay size	Future design and/or modeling efforts (i.e. buoyancy/flotation calculations) results in design change to PGP bays, increasing top slab thickness 1.5 feet (27%).	\$ 1,645,693	50%	50%	75%			50%	50%			55%
13.8KV Distribution Power Lines - Electrical Lines	Environmental constraints requires all 13.8 KV overhead distribution power lines to be underground. Current estimate is OH.	\$ 9,697,500	90%	50%	75%			75%	50%		50%	65%

Hydraulic Design Contingency Items												
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			Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Average
Funks PGP - Water Supply	Required to install 600-gpm groundwater well and 18,000-LF of 8-inch-diameter piping for fire tank water, instead of pulling water directly from Funks Reservoir.	\$ 14,500,000	50%	90%	90%			90%				80%
TRR PGP - Water Supply	Required to install 600-gpm groundwater well and 11,000-LF of 8-inch-diameter piping for fire tank water, instead of pulling water directly from TRR.	\$ 8,900,000	50%	90%	90%			90%				80%
Funks and TRR Pipelines - Funks/TRR Connection Manifold	Further design and onsite fabrication of manifold increase cost of construction	\$ 1,000,000	75%	50%	75%	75%	75%	75%				71%

Mitigation Contingency Items						
Scope	Risk Description	Risk Cost	Score Card Values Probability %			
			Expert 1	Expert 2	Expert 3	Average
Wetland Banks Split	Estimate assumes 404/401/1602 Splits of Commercial, Permittee Responsible, and Conservation Easement of 5%, 95%, and 0% respectively. Risk: Spilt Changes to 10%, 90%, and 0%.	\$ 23,051,300	31%	31%	31%	31%
Wetland Banks Split	Estimate assumes 404/401/1602 Splits of Commercial, Permittee Responsible, and Conservation Easement of 5%, 95%, and 0% respectively. Risk: Spilt Changes to 15%, 85%, and 0%.	\$ 23,051,300	13%	13%	13%	13%
Wildlife Banks Split	Estimate assumes Wildlife Splits of Commercial, Permittee Responsible, and Conservation Easement of 5%, 60%, and 35% respectively. Risk: Spilt Changes to 10%, 60%, and 30%.	\$ 16,572,941	31%	31%	31%	31%
Wildlife Banks Split	Estimate assumes Wildlife Splits of Commercial, Permittee Responsible, and Conservation Easement of 5%, 60%, and 35% respectively. Risk: Spilt Changes to 15%, 60%, and 25%.	\$ 16,572,941	13%	13%	13%	13%
Cost of Banks	Estimate unit rates are based on current averages of available data. Project specific mitigation unit rates could increase once developed. Risk: Cost of Land Banks increases by 10% over expected inflation	\$ 68,922,353	13%	13%	31%	19%
Cost of Banks	Estimate unit rates are based on current averages of available data. Project specific mitigation unit rates could increase once developed. Risk: Cost of Land Banks increases by 20% over expected inflation	\$ 68,922,353	3%	13%	13%	10%
Mitigation Acreage	Estimate is based on the best information available however, once accessible additional studies are required to verify the amount of impacted species/habitats. Risk: Impacted Area Increases by 10%	\$ 68,942,094	31%	31%	31%	31%

Mitigation Contingency Items						
Scope	Risk Description	Risk Cost	Score Card Values Probability %			
			Expert 1	Expert 2	Expert 3	Average
Mitigation Acreage	Estimate is based on the best information available however, once accessible additional studies are required to verify the amount of impacted species/habitats. Risk: Impacted Area Increases by 20%	\$ 68,942,094	3%	13%	13%	10%
Mitigation Ratio	Mitigation ratios required by state and federal agencies could increase as areas are surveyed and impact assumptions verified. Risk: Impact ratios increase by 10%	\$102,429,250	3%	13%	13%	10%
Mitigation Ratio	Mitigation ratios required by state and federal agencies could increase as areas are surveyed and impact assumptions verified. Risk: Impact ratios increase by 20%	\$102,429,250	3%	13%	3%	6%
Other Mitigation - non-survey based	Items not Reviewed - Cost Includes - Other Landcover, Cultural Resources, Paleontology, Air Quality, and Greenhouse Gasses.	\$ 58,524,000	3%	13%	13%	10%

Exhibit “B”

**Sites Reservoir Project Cost Risk and Uncertainty
Modeling Equations**

CALCULATING CAPITAL COST WITH DESIGN CONTINGENCIES¹

Capital Cost With Design Contingencies

$$= 30\% \text{ Design Cost} + \text{Non Contract Costs} + \text{Real Estate Costs} + \text{Compensatory Mitigation Costs} \\ + \text{Design Contingency}$$

Where:

Design Contingency

$$= \sum_{i=1}^n \text{RiskCost}_i * \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum}_i, \text{average}_i, \text{maximum}_i)) \\ + \sum_{j=1}^x \text{RiskDiscrete}(\{\text{RiskCost1}_j, \text{RiskCost2}_j, \text{RiskCost3}_j, 0\}, \{P1_j, P2_j, P3_j, 1 - (P1_j + P2_j + P3_j)\})$$

n = number of design items with one potential design modification with a risk cost and probability of 1 or 0

x = number of design items with up to three potential design modifications with risk cost and probability pairs as follows:

$\{\text{RiskCost1}_j, P1_j = \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum1}_j, \text{average1}_j, \text{maximum1}_j))\}$

$\{\text{RiskCost2}_j, P2_j = \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum2}_j, \text{average2}_j, \text{maximum3}_j))\}$

$\{\text{RiskCost3}_j, P3_j = \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum3}_j, \text{average3}_j, \text{maximum3}_j))\}$

minimum = minimum of experts' opinions of probability of needing design modification

average = average of experts' opinions of probability of needing design modification

maximum = maximum of experts' opinions of probability of needing design modification

¹ For more information regarding @Risk functions used in the modeling equations, go to the following:

https://help-risk.lumivero.com/v8_11/en/@RISK/Function/Distribution-Functions.htm

CALCULATING TOTAL CAPITAL COST ALL CONTINGENCIES²

Total Capital Cost with Contingencies

$$\begin{aligned} &= \text{Capital Cost With Design Contingencies} + \{\text{Non Contract Costs} * \text{RiskUniform}(0,0.15)\} \\ &+ \{(30\% \text{ Design Costs} + \text{Design Contingency}) * \text{RiskUniform}(0,0.104)\} \\ &+ \{\text{Real Estate Costs} * \text{RiskUniform}(0,0.20)\} + \text{Compensatory Mitigation Contingency} \end{aligned}$$

Where:

Compensatory Mitigation Contingency

$$\begin{aligned} &= \sum_{k=1}^y \text{MitigationRiskCost}_k * \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum}_k, \text{average}_k, \text{maximum}_k)) \\ &+ \sum_{m=1}^z \text{RiskDiscrete}(\{\text{MitigationRiskCost1}_m, \text{MitigationRiskCost2}_m, \text{MitigationRiskCost3}_m, 0\}, \{P1, P2, P3, 1 \\ &- (P1 + P2 + P3)\}) \end{aligned}$$

y = number of compensatory mitigation items with one potential design modification with a risk cost and probability of 1 or 0.

z = number of compensatory mitigation items with risks of up to three design modifications w/cost and probability pairs as follows:

$$\{\text{MitigationRiskCost1}_m, P1_m = \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum1}_m, \text{average1}_m, \text{maximum1}_m))\}$$

$$\{\text{MitigationRiskCost2}_m, P2_m = \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum2}_m, \text{average2}_m, \text{maximum3}_m))\}$$

$$\{\text{MitigationRiskCost3}_m, P3_m = \text{RiskBinomial}(1, \text{RiskTriang}(\text{minimum3}_m, \text{average3}_m, \text{maximum3}_m))\}$$

minimum = minimum of experts' opinions of probability of needing design modification

average = average of experts' opinions of probability of needing design modification

maximum = maximum of experts' opinions of probability of needing design modification

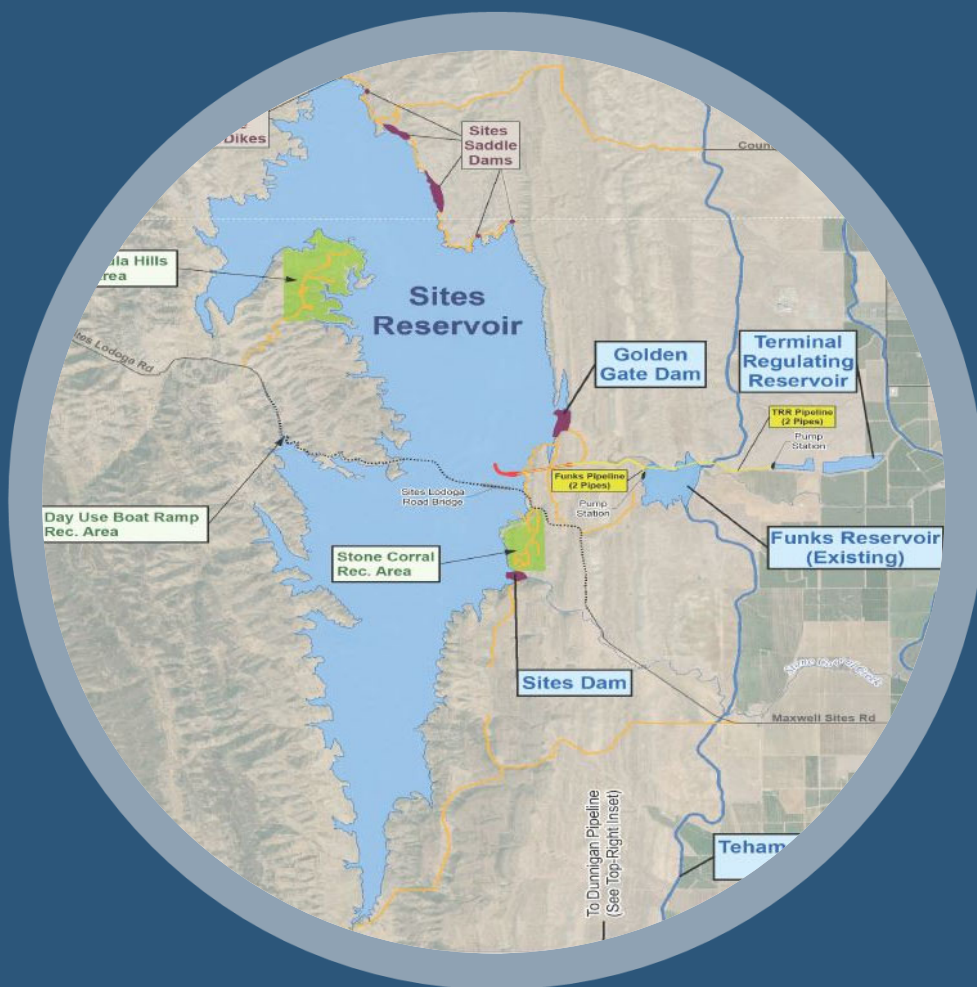
² Experts' non-contract cost contingencies range from 0 to 15%. Construction contingencies range from 0 to 10.4%. Real estate contingencies range from 0 to 20%.



Irvine Ranch
Water District

SITES RESERVOIR PROJECT CAPITAL COST RISK AND UNCERTAINTY ANALYSIS

January 2026



PRESENTATION OVERVIEW

1. Sites Authority's June 2025 Capital Cost estimate
2. Overview and approach to IRWD's risk and uncertainty analysis
3. Engineering design and compensatory mitigation factors evaluated
4. Risk analysis model results



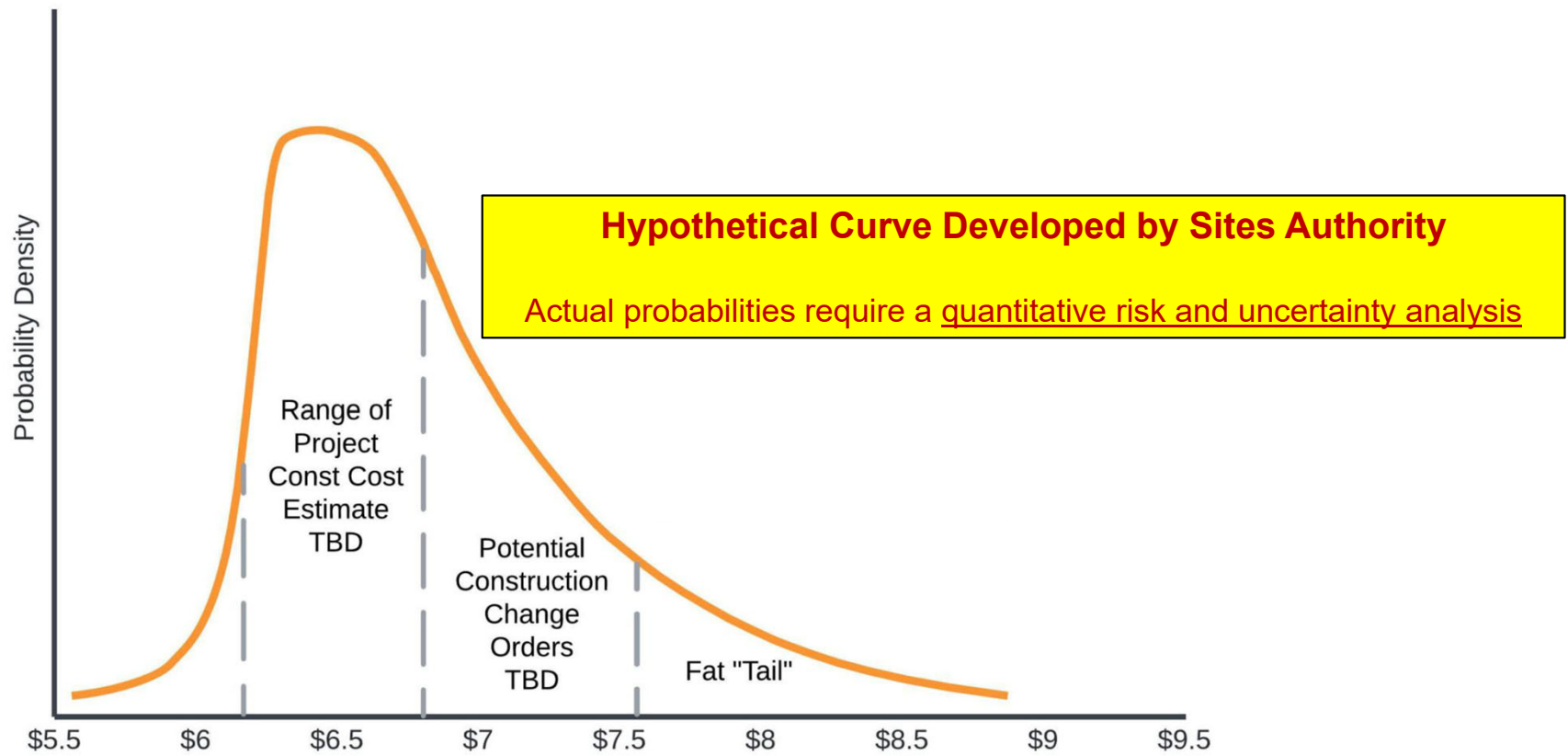
Sites Reservoir Location

SITES PROJECT 30% DESIGN COST ESTIMATE (JUNE 2025)

(Costs developed by Engineers at AECOM and Jacobs)

Item	Cost in \$2024 (Millions)
Reservoir (2-Main Dams, 9-Saddle Dams, Inlet/Outlet, Roads and Bridges)	\$2,435
Conveyance (Pipelines, pumpstations, power, canal improvements, etc.)	\$1,444
Non-Contract Costs	\$1,244
Real Estate	\$123
Compensatory Mitigation	\$789
Capital Costs of Project Before Contingencies	6,035
Design Contingency	\$659
Construction Contingency	\$471
Non-Contract Cost Contingency	\$187
Real Estate Contingency	\$25
Compensatory Mitigation Contingency	\$86
Total Contingencies (24%)	\$1,428
Total Project Cost	\$7,463

WHAT ABOUT RISKS AND UNCERTAINTIES?



WHAT IS QUANTITATIVE RISK AND UNCERTAINTY ANALYSIS?

- Probabilistic method to numerically evaluate project risks on cost, time, and performance.
- Monte Carlo simulations with thousands of random samples from probability distributions.
- Since 1980, @Risk has been an add-on to Microsoft Excel, commonly used for:
 - Dam safety, construction, and engineering;
 - Aerospace and Defense;
 - Financial Services; and
 - Other applications.
- Used at IRWD for:
 - Dam Safety Risk Informed Decision Making;
 - Evaluating cost risks of Sites Reservoir Project;
 - Other applications.



BENEFITS OF QUANTITATIVE RISK ANALYSIS

- Proven method for evaluating risks and uncertainties affecting cost
- Variability using probabilities rather than single-point estimates
- Establishes likelihood of different outcomes
- Quantifies how much each risk item can affect cost
- Helps identify which risks are most critical based on impact and likelihood
- Informs funding decisions



APPROACH TO SITES RISK AND UNCERTAINTY ANALYSIS

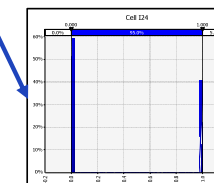
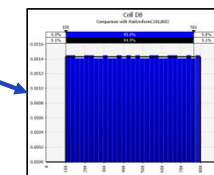
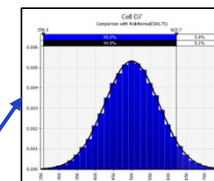
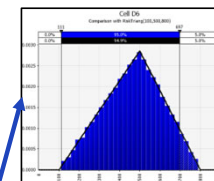
- Applied @Risk quantitative risk analysis software
- Used expert estimates of risk costs and probabilities for:
 - Reservoir and conveyance design changes
 - Compensatory mitigation increases
 - Uncertainties in contingencies
- Expert information provided by AECOM, Jacobs, and Sites Authority
- Cost Risk and Uncertainty Model developed and implemented by IRWD
- Results reviewed by AECOM and the Sites Authority



PROBABILITY DISTRIBUTIONS USED WITH @RISK

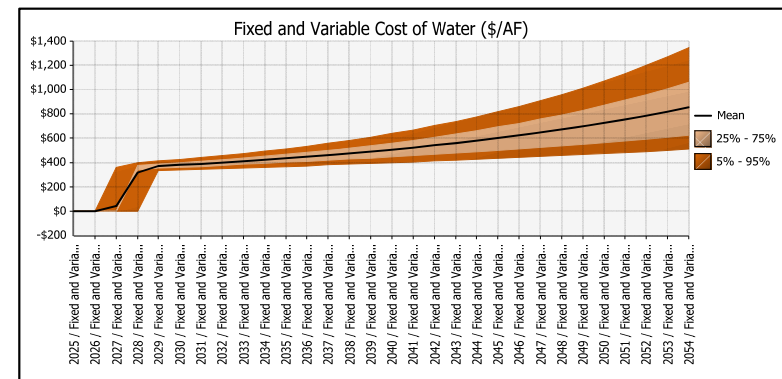
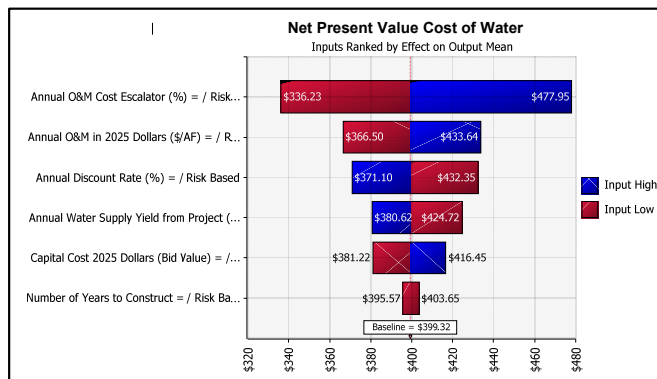
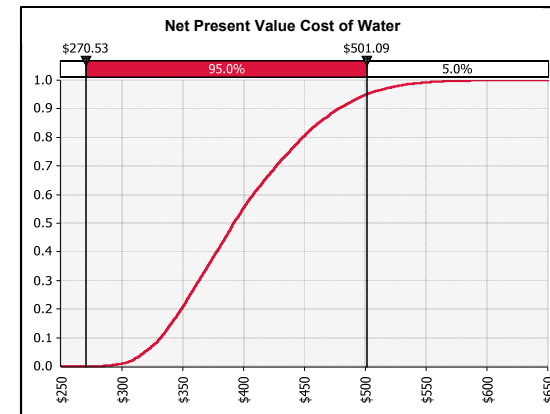
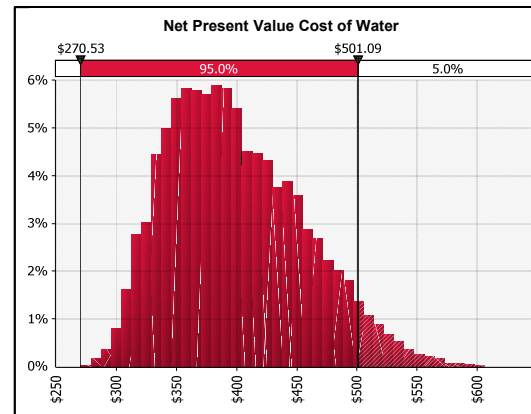
Distribution	Use Case	Key Parameters
Triangular ¹	When data is limited but <u>expert</u> estimates for minimum, most likely, and maximum are available	Minimum, Most Likely, Maximum
Normal	When data is symmetrically distributed around a mean	Mean, Standard Deviation
Uniform ¹	When <u>experts</u> determine that all outcomes within a range are equally likely	Minimum, Maximum
Discrete ¹	For specific outcomes with probabilities assigned by experts	Value-probability pairs

1/ Used in Sites capital cost risk and uncertainty analysis using risk cost and probability values provided by design experts at AECOM and Jacobs



SAMPLE @RISK MONTE CARLO SIMULATION CHARTS

- Relative probability density charts
- Cumulative probability charts
- Sensitivity charts
- Time series trend charts



DESIGN CONTINGENCY AND MITIGATION ITEMS MODELED

Design Contingency Items and Requirements	Number of Items Modeled
Golden Gate and Sites Dams	30
Saddle Dams	13
Reservoir roads and bridges	17
Hydraulic conveyance facilities	21
Compensatory mitigation	11
TOTAL	92



OTHER RISK AND UNCERTAINTY ITEMS MODELED

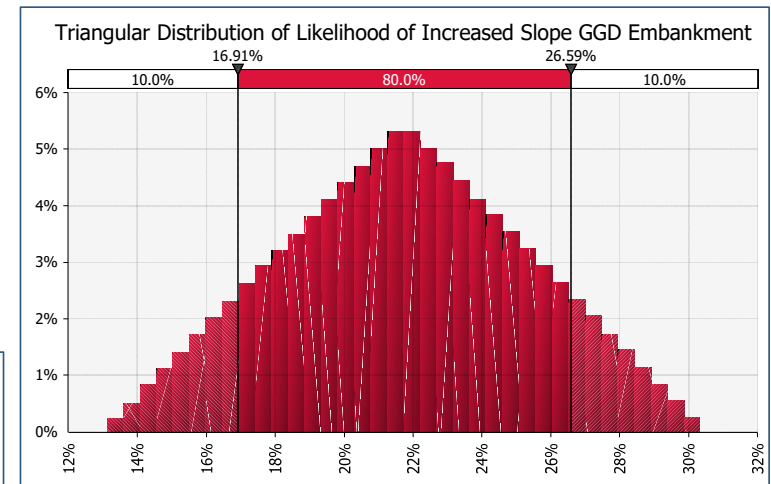
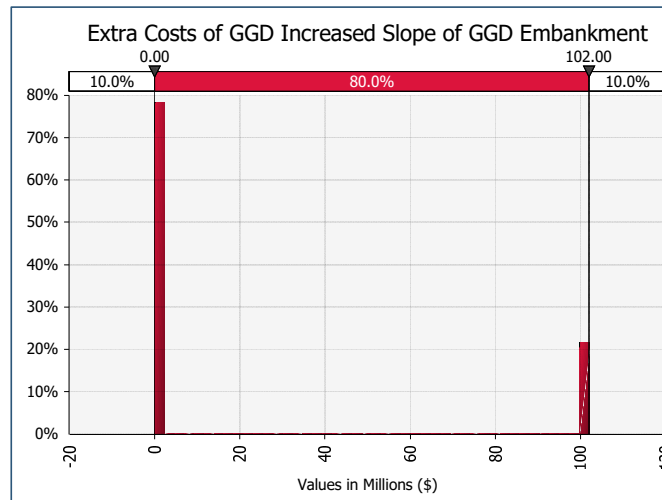
- Non-contract cost contingencies
- Construction cost contingencies
- Real estate cost contingencies
- Annual cost escalators



EXAMPLE: MODELING GOLDEN GATE DAM SLOPE RISKS

- Build triangular distribution based on expert opinions of needing to increase slope.
- For each iteration, identify the cost of increased excavation and placement based on random sample (p) from triangular distribution:
- Likelihood (p) of \$102 M in extra excavation costs
- Likelihood ($1-p$) of \$0 in extra excavation costs
- 30,000 Monte Carlo iterations performed.

Expert Opinions of Probability of Needing to Increase Slope						
Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Average
31%	13%	31%	13%	31%	13%	22%



MODEL RESULTS: TOTAL SITES CAPITAL COSTS

(Values in 2024 Dollars)

Statistics (\$ Billion):

Minimum = \$6.4

Maximum = \$8.2

Most Likely = \$7.2

Mean = \$7.2

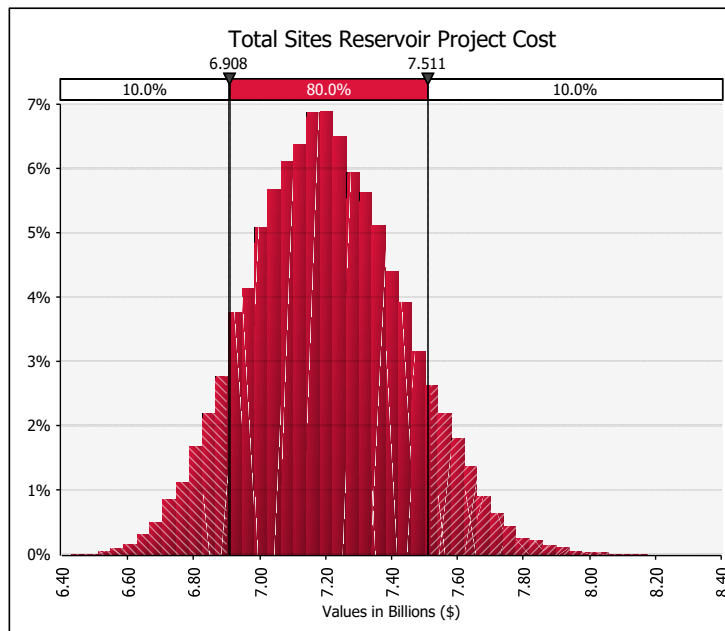
5 Percentile <= \$6.8

10 Percentile <= \$6.9

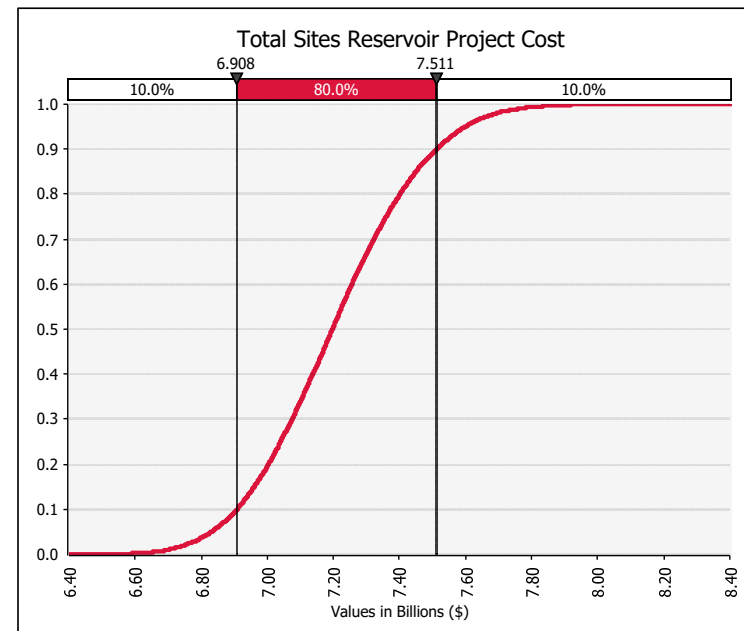
50 Percentile <= \$7.2

90 Percentile <= \$7.5

95 Percentile <= \$7.6



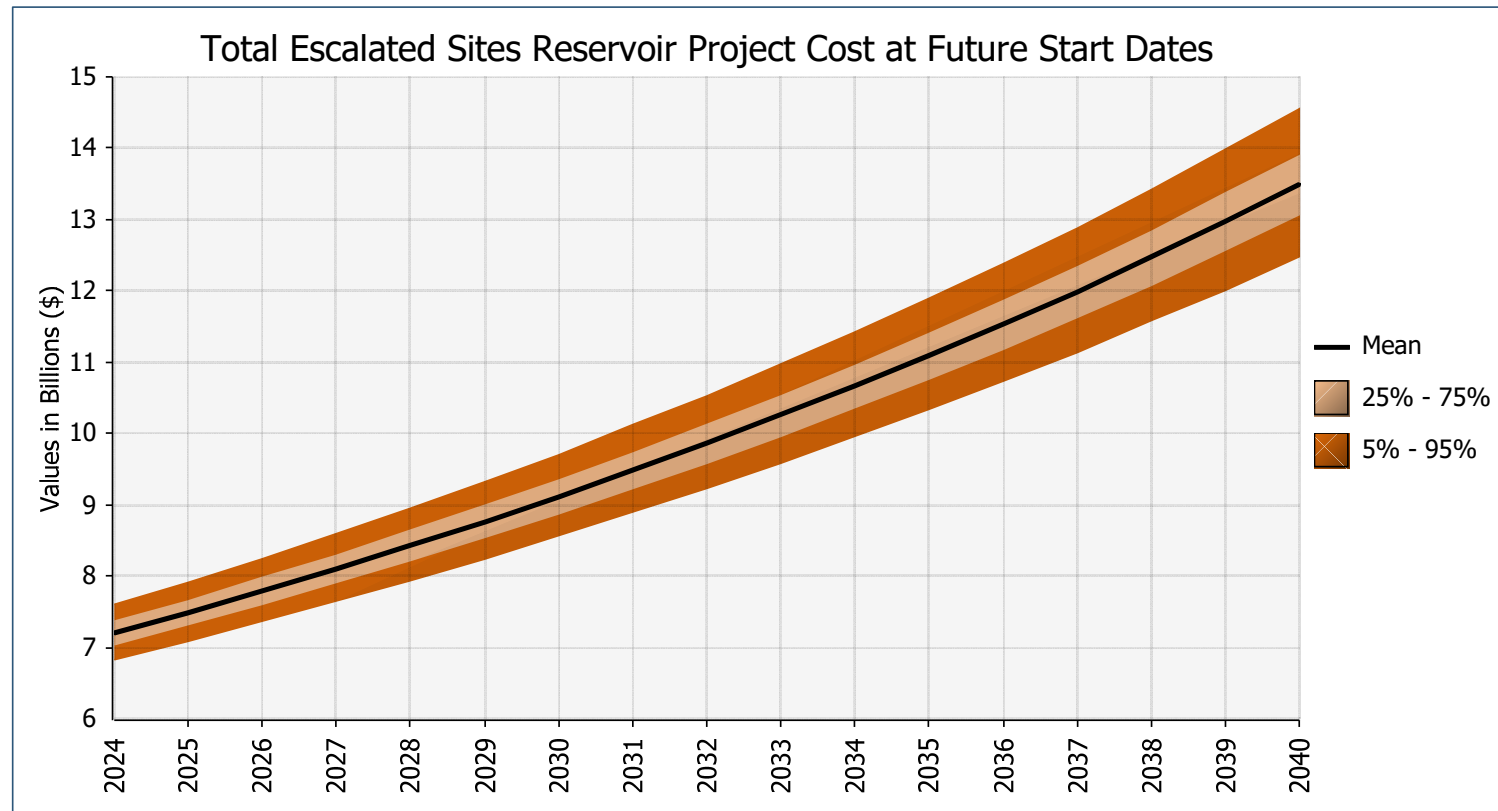
Probability Density Chart



Cumulative Probability Chart

TOTAL SITES CAPITAL COST ESCALATION BY START DATE

Risk and Uncertainty Analysis Trend Chart



Total project costs escalated using uniform distribution of between 2.5% and 5.5% (equally likely)

TOTAL CAPITAL COSTS AT NEAR FUTURE START DATES

Start Date Statistics (\$ Billion)

2024:

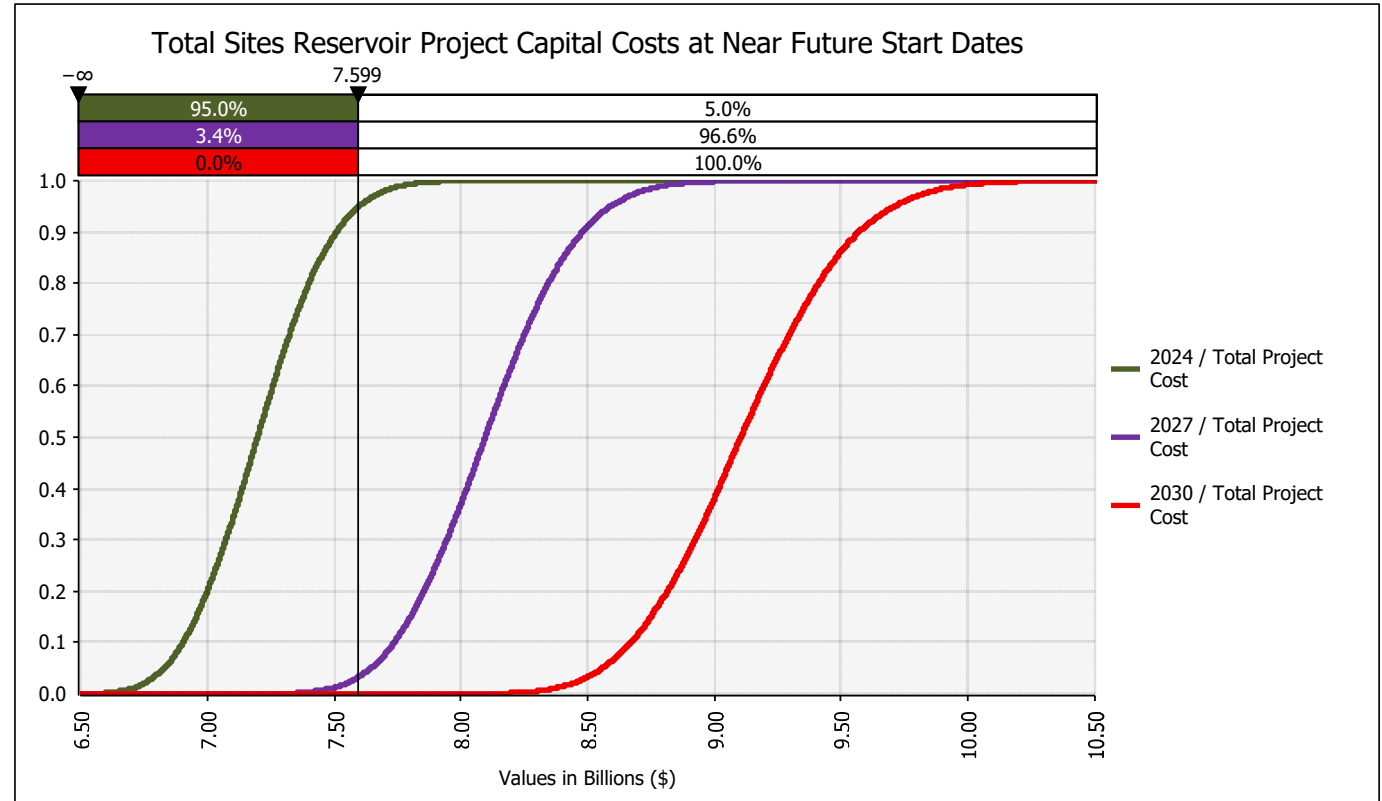
5% ≤ \$6.8
50% ≤ \$7.2
95% ≤ \$7.6

2027:

3.4% ≤ \$7.6
5% ≤ \$7.7
50% ≤ \$8.1
95% ≤ \$8.6

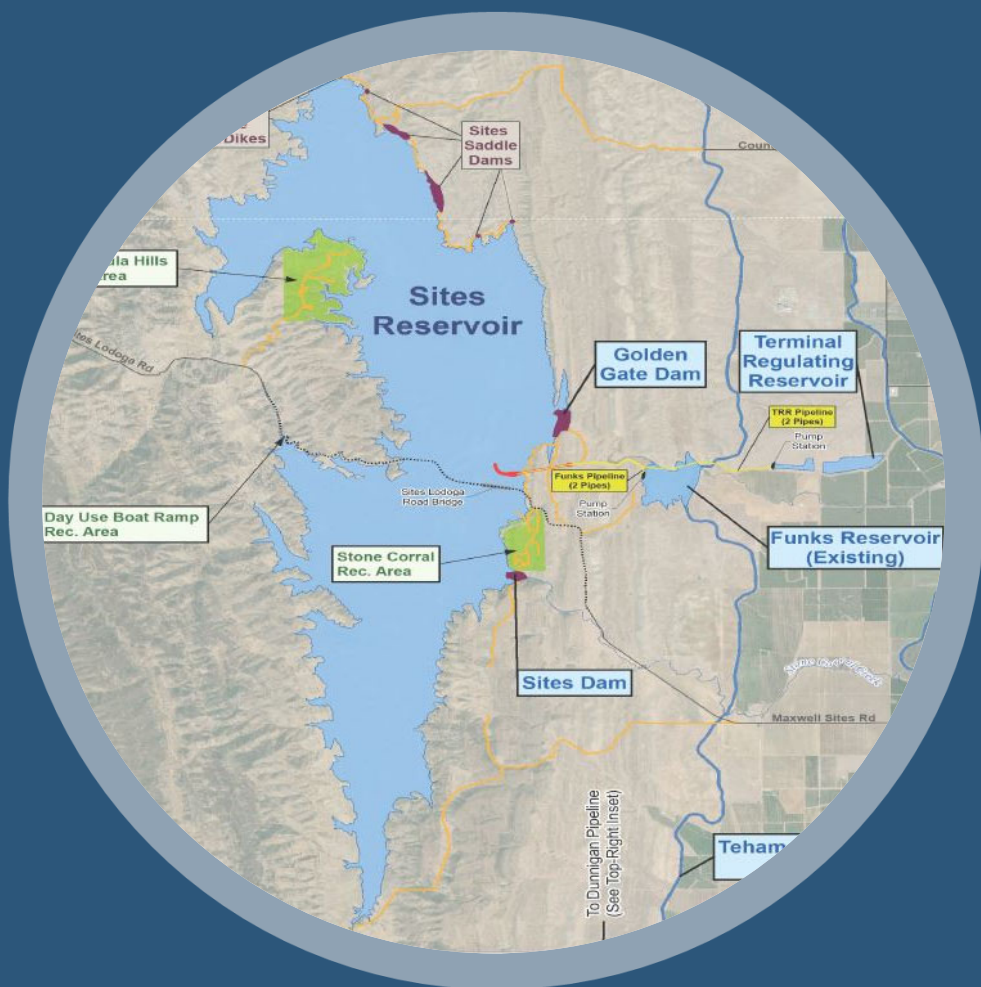
2030:

0% ≤ \$7.6
5% ≤ \$8.6
50% ≤ \$9.1
95% ≤ \$9.7





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QUESTIONS ?