
MONTEREY COUNTY WATER RESOURCES AGENCY
75
YEARS
1947
2022
Managing local water
resources for 75 years

SAN ANTONIO DAM

SPILLWAY REPLACEMENT PROJECT:
ALTERNATIVE ANALYSIS REPORT

By: Elise (Ramirez) Harden, PE
Senior Water Resources Engineer

OVERVIEW

- San Antonio Dam Background
- SA Spillway Replacement Mandate Timeline
- Alternative Analysis Process
- Alternatives Evaluated
  - Brief overview of each of the ten alternatives analyzed
- Findings and Evaluation Matrix
- Low Level Outlet Works
- Funding
- Timeline and next steps
- Questions

SAN ANTONIO DAM BACKGROUND

- Construction completed in 1967
- Storage at Elev. 780’ = 335,000 acre-feet
- Department of Water Resources Division of Safety of Dams Jurisdiction
  - Current National Inventory of Dams Condition Assessment: "Fair" (4/12/2019)
  - Extremely High Hazard Dam due to downstream population
- Regulatory Compliance Trends
- SA Spillway Replacement Project (req’d project)

SA SPILLWAY REPLACEMENT TIMELINE

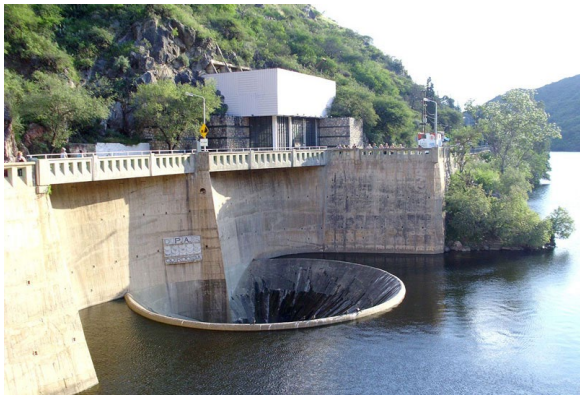
- Oroville 2017 (photo right)
- DSOD Spillway Condition Assessments 2017
- Agency Progress 2018-2022
- DSOD Letter 2022
  - Formal Mandate for full replacement
  - McMillen Contract BOD September 2023
- PMF Update January 2023
- Alternative Analysis June 2024

ALTERNATIVE ANALYSIS PROCESS

- Purpose of the report
- Considerations / Criteria
- Determine Evaluation Matrix within each criteria
- Assign Criteria Weights
- Evaluation of Alternatives
- Review outcomes

ALTERNATIVES EVALUATED

- There are many different types of spillways, many were eliminated early on during initial discussions with DSOD, feasibility, or technical reasons.
- A total of 10 alternatives were evaluated
- Options evaluated primarily included varying the spillway's:
  - Control structure
  - Location
  - Terminal structure



CONTROL STRUCTURE

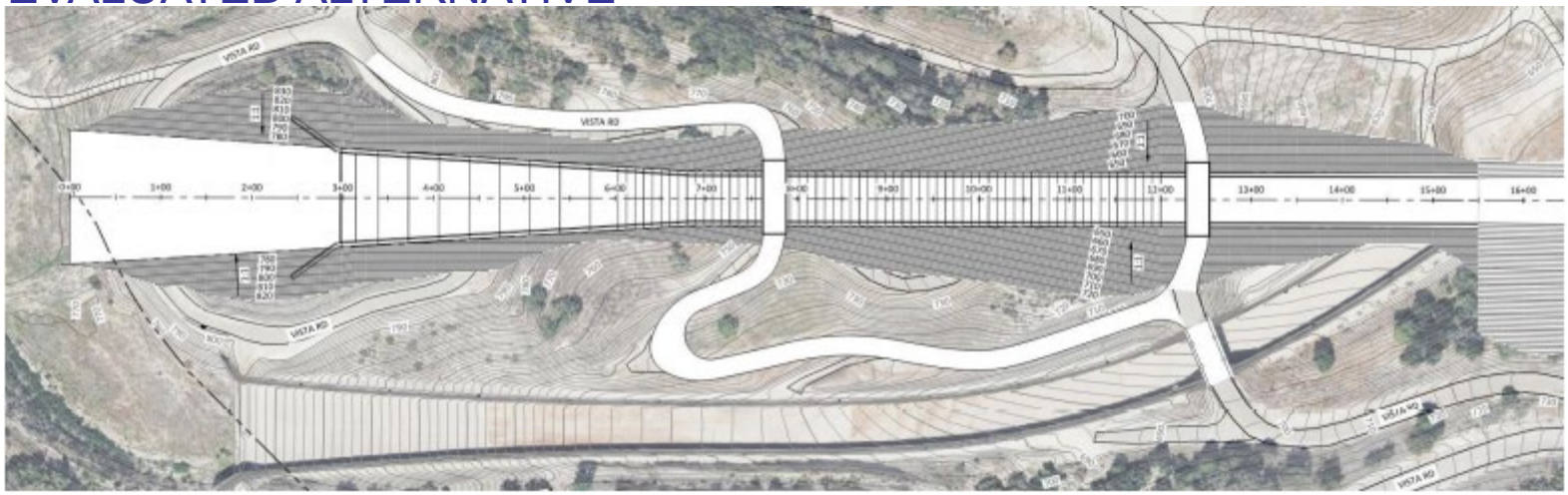
San Antonio Spillway 2006

Upper Salmon Dam Gated Spillway

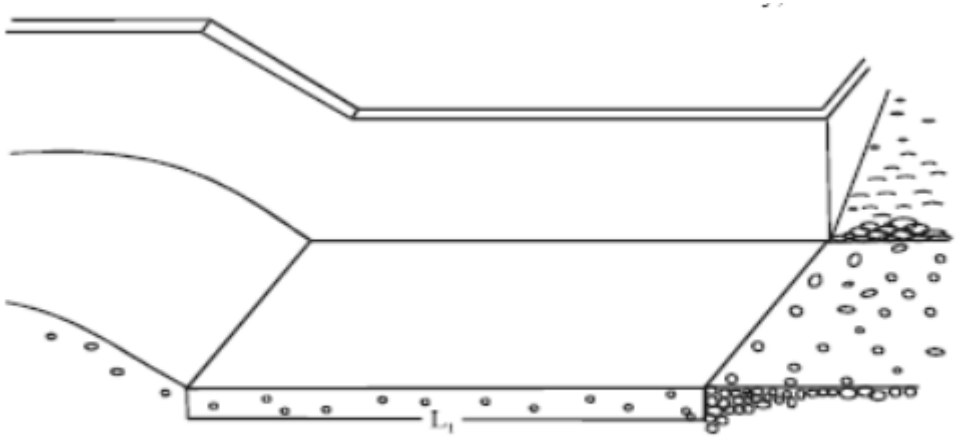
ALIGNMENT

EXISTING

EVALUATED ALTERNATIVE



TERMINAL STRUCTURE

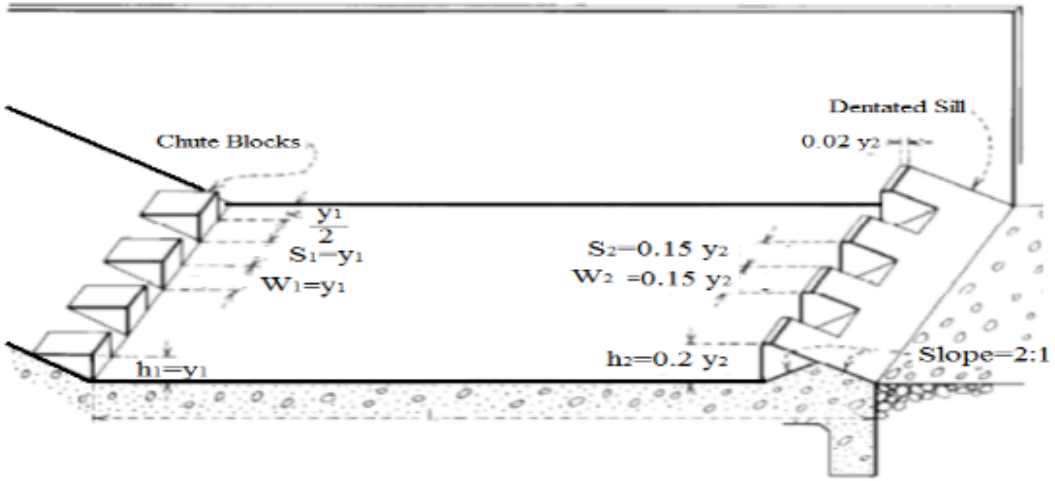


Type I basin dimensions

Stilling Basin Type I

It is a rectangular stilling basin with a horizontal bottom, no chutes, no baffles or sills, which include a classical hydraulic jump. Because of high costs that come from the basin length is large as well as the hydraulic jump is sensitive to downstream level variation and effects on safety, it is not recommended.

The Type II basin is designed for use on high dams, earth dam spillways (Froude numbers greater than 4.5). The chute blocks and end sill help reduce the basin length by 33%. The design includes blocks and dentate end sill. The end sill has a stabilizing effect and dissipative reason. The length of stilling basin is calculated.



Type II Stilling Basin

ALTERNATIVES EVALUATED

Alternative	
No.	Title
1	Do Nothing
2	Retrofit Existing Ogee Control Structure New Chute, Existing Alignment Retrofit Existing Flip Bucket
3	New Ogee Control Structure New Chute, Existing Alignment New USBR Type I Basin
4	New Ogee Control Structure New Chute, Existing Alignment New USBR Type II Basin
5	New Gated Control Structure New Chute, Existing Alignment New USBR Type I Basin

Alternative	
No.	Title
6	New Gated Control Structure New Chute, Existing Alignment New USBR Type II Basin
7	New Ogee Control Structure New Chute, Straight Through Hillside New USBR Type I Basin
8	New Ogee Control Structure New Chute, Straight Through Hillside New USBR Type II Basin
9	New Gated Control Structure New Chute, Straight Through Hillside New USBR Type I Basin
10	New Gated Control Structure New Chute, Straight Through Hillside New USBR Type II Basin

EVALUATION CRITERIA

The evaluation of each alternative was determined by the project team to include the following categories:

- DAM SAFETY
- OPERATIONAL IMPACT
- CONSTRUCTIBILITY
- ENVIRONMENTAL IMPACT
- DESIGN APPROACH
- COST

DAM SAFETY

Criteria	Definition
Dam safety – During Construction	Evaluates the potential impacts to dam safety risk during construction of the Project.
Dam safety – after construction	Determines the risk of loss of life or infrastructure in the event of a spillway failure. Additionally assesses the impacts of dam safety requirements associated with the alternative. This criteria has not been refined by a detailed PFMA.
Flood control	Considers if the proposed facility layout and operation would impact the flood control aspects of the Project.
DSOD permitting	Evaluates the potential for issues permitting the project with DSOD.

OPERATIONAL IMPACT

Criteria	Definition
Required maintenance	Estimates the level of maintenance required.

CONSTRUCTABILITY

Criteria	Definition
Space availability	Determines if sufficient space is available to support construction of the alternative features.
Access availability	Determines if adequate routes are available to access the site and complete the alternative construction.
Geotechnical Considerations	Considers potential geotechnical issues that could impact the alternative construction such as unstable slopes or unsuitable foundation materials.
Schedule	Considers the associated risks of construction schedule for the spillway chute.
Civil Grading	Evaluates the required quantity and complexity of civil grading required for the construction of the new spillway chute including access roads and general excavation.

ENVIRONMENTAL IMPACT

Criteria	Definition
Habitat impact	Determines if the construction activities would impact existing habitat areas within the alternative footprint, or within the reservoir.
Water release impact	Evaluates impacts on the ability to release water as a result of construction of the alternative.
Aesthetics	Evaluates visual impacts caused by construction activities and associated disturbance after construction.
Recreation	Identifies the impact to recreation opportunities on the reservoir.

DESIGN APPROACH

Criteria	Definition
Complexity	Reflects the complexity of the facility design and general operations.
Environmental permitting	Evaluates the potential difficulty for environmental permitting the project with associated regulatory agencies.
Long Term Impact to Existing Facilities	Evaluates long-term (post construction) impacts of the alternative to existing facilities such as the dam and outlet works.
Flexibility for future raise implementation	Evaluates the flexibility of the Project in the eyes of any potential spillway raise.
Location of fault	Evaluates the design considerations associated with the fault location and its proximity to the proposed structures.
Additional geotechnical investigations	Considers the level of effort for additional geotechnical investigations.
Physical model potential	Evaluates the relative complexity and potential need for physical modeling to evaluate potential hydraulic issues.
Downstream erosion	Evaluates the susceptibility of the selected design to initiate downstream erosion.

COST

Criteria	Definition
Total capital cost	Considers the anticipated level of capital investment including construction, engineering, planning, regulatory and permitting, and administration that would be associated with the alternative implementation.
Project life	Evaluates the anticipated project life for the overall developed alternative
Lifecycle cost	Evaluates the cost for components that may need to be replaced during the project life cycle. Also considers the fiscal impact due to lost revenue associated with the lack of ability to store water in the reservoir and the lifecycle risk associated with the location of the Rinconada fault.

CRITERIA WEIGHTING

Criteria	Weight	Discussion
Constructability	20%	Constructability is also considered when developing the construction costs. When evaluating each alternative for constructability, the alternatives were on average very similar from one alternative to another.
Environmental Impact	5%	Considers the environmental impact for all alternatives is relatively small due to the already disturbed area associated with previous dam construction activities.
Operational Impact	20%	Considers the ability to maintain flood operations, required maintenance, and dam safety concerns after construction. The operational ability was considered an important consideration for this analysis.
Design Approach	10%	Considers major items related to the design process and long-term implications of each alternative.
Dam Safety	30%	Evaluates impacts to the level of dam safety risk both during and after construction. This criteria also considers potential issues which may make permitting with DSOD more difficult.
Cost	15%	Considers construction cost of the project in addition to overall project life and potential life cycle costs.

EVALUATION RESULTS – TOP 4

- Alternative 4 – **Score: 72.5** (Ogee, existing alignment, type II basin)
- Alternative 8 – **Score: 72.2** (Ogee, new alignment, type II basin)
- Alternative 3 – **Score: 71.6** (Ogee, existing alignment, type I basin)
- Alternative 7 – **Score: 70.9** (Ogee, new alignment, type I basin)

ESTIMATED COST – TOP 4

- Alternative 4 – **Score: 72.5** (Ogee, existing alignment, type II basin)
  - $50,647,000*
- Alternative 8 – **Score: 72.2** (Ogee, new alignment, type II basin)
  - $78,610,000*
- Alternative 3 – **Score: 71.6** (Ogee, existing alignment, type I basin)
  - $54,538,000*
- Alternative 7 – **Score: 70.9** (Ogee, new alignment, type I basin)
  - $90,190,000*

*$ values are estimated construction costs ONLY; total capital costs may range between 30% to +50% of the construction cost estimate.

SELECTED ALTERNATIVE

Alternative 4 – Score: 72.5 (Ogee, existing alignment, type II basin)
- **$50,647,000**

- Alternative 8 – **Score: 72.2** (Ogee, new alignment, type II basin)
  - $78,610,000

- Alternative 3 – **Score: 71.6** (Ogee, existing alignment, type I basin)
  - $54,538,000

- Alternative 7 – **Score: 70.9** (Ogee, new alignment, type I basin)
  - $90,190,000

DSOD will need to comment and approve selected alternative.

SAN ANTONIO LLOW

San Antonio Low Level Outlet Works (LLOW):

- Boat barrier buoy and log boom
- Bulkhead Gate
- Intake Structure Trash Racks
- Access Hatches
- Air Vacuum Valves
- Butterfly Valve Hydraulics
- Penstock Coating
- Low Level Discharge Valve

DWR Grant Application (local match req'd.)

NOTE: Anderson Dam

SA SPILLWAY FUNDING

Fund 116

- McMillen Contract for PMF and Alternative Analysis Report

Grant Funds

- **SB 104 Dept. of Water Resources $17m**
  - **$3m for San Antonio Spillway Design/Environmental Permitting**
- Pending Application for LLOW
- Anticipated Notice of Funding Opportunities for LLOW

SLO County

- Pays a percentage of the San Antonio Facility Maintenance Costs

Construction Funds

- To be determined

TIMELINE AND NEXT STEPS

- Presentations
  - Board of Directors June 2024
  - Reservoir Operations Committee June 2024
  - Board of Supervisors July 2024
  - SLO Water Commission August 2024
- Submit Alternative Analysis to DSOD July 2024
- Receive Comments from DSOD (Summer/Fall 2024)
- Request an Extension to November 2024 deadline for addressing the spillway deficiencies
- DSOD approval of design alternative and work plan
- Proceed with final design/environmental permitting
- Construction

QUESTIONS


MONTEREY COUNTY WATER RESOURCES AGENCY
75
YEARS
1947
2022
Managing local water
resources for 75 years