C1.05 – Rehabilitation of Lake Dunlap Dam

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Introduction

PROJECT OVERVIEW

The purpose of the project is to select an aging dam and propose a method of rehabilitation. After the site selection, three design alternatives were analyzed to determine the best solution. Once an alternative was chosen, Envision was used to evaluate sustainability. Lastly, a cost analysis was run to determine the total cost of the project and if it falls within the budget.

BACKGROUND

The Lake Dunlap dam, also referred to as the TP-1 dam, is hydroelectric. It was constructed in 1928 and designed with three Bear Trap style spill gates. After roughly 90 years, on May 14th, 2019, the middle spill gate failed due to corrosion in the bottom hinges of the middle gate. Due to the failure, Lake Dunlap's water level fell about 7 feet.

SITE SELCECTION

The location of the dam rehabilitation is on Lake Dunlap in New Braunfels, Texas.

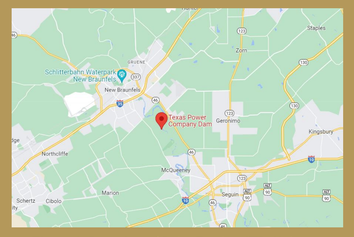

Figure 1: Location of Lake Dunlap (TP-1) dam

Proposed Plan

Figure 2: Aerial view of Lake Dunlap dam

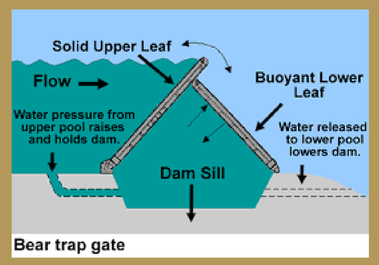

Figure 3: Schematic of previous Bear Trap style spill gate

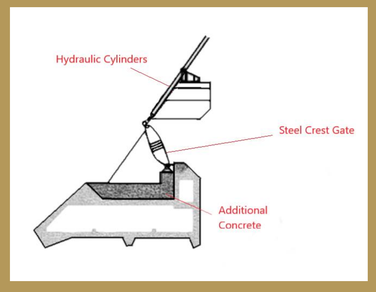

Figure 4: Schematic of new Hydraulic Crest spill gates

DESIGN CONSIDERATIONS

The community surrounding Lake Dunlap heavily rely on the dam for recreational use, so complete removal is not an option. The chosen design of replacing the spill gates with Hydraulic Crest gates will satisfy the community and the engineers. Public safety will be improved, and the hydroelectric capabilities of the dam will be restored.

DESIGN ALTERNATIVES

The three alternatives are: removal of the dam, complete reconstruction, or replacing the spill gates. The chosen alternative is to replace the spill gates on the existing dam structure. This alternative was selected because it was the most cost efficient and realistic option. The three spill gates will be modified from the Bear Trap design to Hydraulic Crest spill gates.

SUSTAINABILITY EVALUATION

Using the sustainability framework, Envision, the chosen alternative of replacing the three spill gates with Hydraulic Crest Gates was evaluated. Our original design did not meet the specified goal of 20% in each Envision category, so it was altered to include Fiber Optic Deformation sensors. With the added sensors, the design's Envision score increased to the Silver ranking due to increased public safety and preventative maintenance.

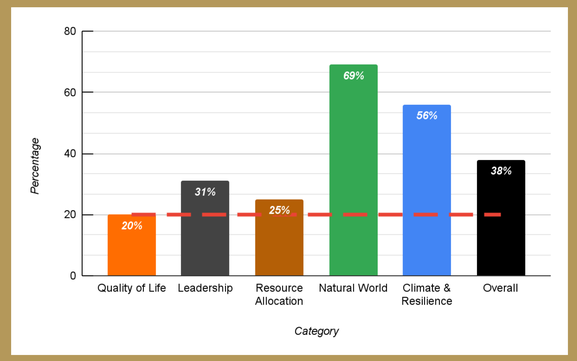

Figure 5: Final Score of alternative in each category by Envision Standards

Finances

CAPTIAL AND LIFE CYCLE COSTS

The capital and life cycle costs of the rehabilitation of the Lake Dunlap dam were estimated with the cost estimating software, RSMeans. Approximating the materials and quantity needed and using the unit costs provided by RSMeans, the capital costs were calculated to be approximately $17.3 million. Then with consideration of regular maintenance, the life cycle costs were calculated in the net present value (NPV).

$$PV = Initial\ cost + \Sigma MaintCost\left[\frac{1}{(1+i)^n}\right] + \Sigma RehabCost\left[\frac{1}{(1+i)^n}\right] - SV\left[\frac{1}{(1+i)^n}\right]$$

Initial Costs (Construction Costs) = $17,364,868.91

Maintenance Cost (about 1% of Construction Cost) = $173,648.69

Maintenance intervals every 10 years over 100 years

Value in 100 yrs in 2022 dollars = $17,727,083.48

Figure 6: NPV Equation and Calculations

SECOND SEMESTER PLAN

In the following semester, we plan to solidify our spill gate design. Which includes more feasibility analysis and drawings and specifications of the 3 Hydraulic Crest spill gates that we plan to implement.

Figure 7: Demoed spillway of Lake Dunlap dam from site visit on Nov. 4, 2022