TZA Water Engineers
a Lamp Rynearson Company
12596 W. Bayaud Ave., Ste. 330

February 1, 2018

Cynthia Lefever
Jackson Lake Reservoir & Irrigation Company
218 East Kiowa Avenue # A
Fort Morgan, CO 80701

Re: Jackson Lake Bathymetric Survey Feasibility Report

Dear Cindy:

TZA Water Engineers, a Lamp Rynearson Company (TZA) is pleased to provide this draft report for review and comment by the Jackson Lake Reservoir and Irrigation Company (Jackson Lake) Board members.

Background

Jackson Lake Reservoir is a 2,411surface-acre reservoir located two miles northeast of Orchard, in Morgan County CO. Jackson Lake Reservoir was built in the early 1900s as a storage facility for irrigation water. Construction on the dam commenced in 1905 as an earthen embankment dam approximately two miles long. Several years later it was observed that high winds from the north were causing significant erosion of the earthen dam structure. To address this erosion issue, concrete erosion protection and a parapet wall were added to the earthen dam in 1913.

In the 1940s and 1950s, the dam facing was maintained by pushing sand up from the bottom of the lake onto the facing. This process was repeated annually as wind carried the sand back into the lake over the year, leaving the facing exposed.

In the 1990s Smith Geotechnical did a series of studies testing the compaction of the dam to search for voids in the structure. In 1994, a dam re-facing project was commenced, resulting in soil-cement being installed along the majority of the dam facing for wave protection.

In 1994 and again in October of 2002, Jackson Lake identified an area of “dead storage” that is not usable in a severe drought. The dead storage has been created over the years from sediment entering the reservoir from the inlet flows, from deposition of material in the reservoir, and from windblown deposits.

TZA worked with Jackson lake to obtain funding to prepare a feasibility report to increase usable storage in the reservoir and this draft report provides results of that study.

Current Project

In recent decades, it has become apparent that sediment deposition in Jackson Lake has resulted in considerable storage having lost connection with the outlet structure. Sediment deposition around the outlet tubes and the dam in September of 1994 is shown on the following photo mosaics:

Outlet works – September 1994

Outlet works facing east along the dam – September 1994

Dead Storage Area – October 2002

This sediment deposition has resulted in an approximate storage loss of 1,850 ac-ft, leaving a usable storage of approximately 27,650 ac-ft. The elevation break for the dead storage is approximately 4,426.5' msl. Dead storage in the center of the reservoir is unavailable to water users and this report identifies three options to eliminate or greatly reduce dead storage.

In 2017 TZA was contracted to conduct a bathymetric survey of the bottom of the reservoir, and assess options for dredging access to the dead storage section of the reservoir.

To characterize the sediment deposition, TZA conducted a bathymetric survey utilizing a surveying instruments with the assistance of the Colorado Parks and Wildlife (CPW) staff and boat. Field work for the bathymetric survey took place over 5 days in the summer of 2017. The reservoir was gridded and the CPW boat was equipped with a HydroLite-TM Echosounder Kit. The CPW boat was run over the reservoir with the single beam sonar Echosounder to produce point cloud survey data that was tied to a Trimble R8 GPS. The Trimble R8 GPS was used to perform a standard survey around the perimeter of the reservoir.

Dredging Options

Several options were assessed that would allow the draining of the dead pool, as detailed by the survey work conducted. These are described as Options 1 through 3. Options 1 and 2 are hydraulic dredging options that would be conducted with a "full reservoir", and include the use of a Turbidity Barrier for depositing the dredged material into the reservoir (net zero balance). Options 1a, 2a, and 3 would require the reservoir to be emptied and relatively dry so that mechanical dredging operations can be performed. Options 1a, 2a, and 3 would entail hauling the dredged spoils to a location outside of the reservoir footprint. For purposes of this feasibility report we have assumed that disposal of dredged materials would be within approximately 2 miles of the reservoir site.

Option 1

Option 1 is a trapezoidal channel running from the dead pool to the outlet with a bottom width of 50 feet and side slopes of 4:1. This channel would create positive draining from the low point in the dead storage area to the lake outlet to the south as shown on the Option 1 Figure. Due to water levels during the survey, the exact invert elevation of the outlet pipe on the lake side was impossible to record. An elevation of 4417 feet was estimated based on the survey of the outlet invert on the downstream side. The channel slope could be adjusted based on the actual invert elevation once that elevation can be surveyed. Dredged material was planned to be deposited in an area east of the proposed dredge channel as shown on the Option 1 Figure.

Option 2

Option 2 is a trapezoidal channel with the same alignment as Option 1, however the channel is 300 feet wide at the base, with 4:1 slopes on the sides, as shown on the Option 2 Figure. This channel would create positive draining from the dead pool to the outlet works. This would require a larger area, also planned to be located on the north side along the dam face to store the dredged material.

Option 3

Option 3 is an option proposed to dredge enough material to take the lake to its maximum decreed storage capacity of 36,000 AF as shown conceptually on the Option 3 Figure. This option requires considerably more dredging than Options 1 and 2, and since the goal of this option is to increase the storage volume of the lake, the dredge material would be required to be transported to a suitable offsite location within approximately 2 miles of the reservoir.

TZA worked with Newt Marine to obtain cost estimates for hydraulic dredging and with Concrete Express, Inc. (CEI) to obtain cost estimates for mechanical dredging. The dredge volumes and cost estimates for the different options are summarized in the tables below:

Table 1 - Comparison of Dredge Volumes

Dredge Option	Dredge Volume (CY)	Dredge Material Storage Location
1	122,000	Onsite - Within Reservoir
1a	122,000	Offsite - Within 2 mi.
2	515,000	Onsite - Within Reservoir
2a	515,000	Offsite - Within 2 mi.
3	9,900,000	Offsite - Within 2 mi.

Table 2 - Comparison of Budget Costs for Dredging Options

	Option	
Task	**1**	**2**
Mobilization/Demobilization	$600,000.00	$600,000.00
Cost per CY	$6.00	$6.00
Total Dredging	$732,000.00	$3,090,000.00
Turbidity Barrier $/lft	$36.00	$36.00
Turbidity Barrier Total	$122,040.00	$180,360.00
Contingency (10% of Cost)	$145,404.00	$387,036.00
Engineering Estimate	$75,000.00	$185,000.00
Total	$1,674,444.00	$4,442,396.00
Total Price per CY	$13.72	$8.63
Additional Storage Gained (AF)	1,850	1,850
Estimated Cost per Storage Gained ($/AF)	**$905.10**	**$2,401.30**

Table 3 - Comparison of Costs for Dry Reservoir Construction

	Option		
Task	**1a**	**2a**	**3**
Mobilization/Demobilization	$50,000.00	$50,000.00	$150,000.00
Load Spoils $/CY	$1.20	$1.00	$0.90
Haul (2 miles or less) $/CY	$4.00	$4.00	$3.00
Spread Spoils $/CY	$1.00	$1.00	$1.00
Total Dredging	$756,400.00	$3,090,000.00	$48,510,000.00
Land Cost*	**$122,000.00**	**$515,000.00**	**$9,900,000.00**
Contingency (10% of Cost)	$92,840.00	$365,500.00	$5,856,000.00
Engineering Estimate	$50,000.00	$100,000.00	$500,000.00
Total	$1,071,240.00	$4,120,500.00	$64,916,000.00
Total Price per CY	$8.78	$8.00	$126.05
Additional Storage Gained (AF)	1,926	2,169	7,986
Estimated Cost per Storage Gained ($/AF)	**$556.31**	**$1,899.54**	**$8,128.36**

* ***Land Acquisition Cost Estimate at $1.00 per cubic yard***

Summary

Of the Options considered, Option 1 has the lowest cost, however the width of the channel dredged would result in the shortest time until it would clog with sediment from stored water in the reservoir. Option 2 would alleviate this issue to a degree, as the additional width of the channel would require more sediment deposition before plugging, which would extend the operational life of the channel. This option incurs more cost due to moving considerably more earth than Option 1.

The cost of Option 3 is vastly more than Options 1 and 2, as the volume of dredge spoils moved is an order of magnitude higher, and additional costs would be incurred due to the requirement to move dredged material to some suitable offsite location. Option 3 has the benefit of increasing the available storage capacity by approximately 8,000 ac-ft, and would have the longest time before re-sedimentation might create issues with dead storage.

One method that could make Option 3 feasible is a municipal and/or industrial partnership. By increasing the storage capacity to that of the original reservoir, or potentially enlarging the reservoir storage volume, additional storage could potentially be sold or leased to an interested entity. This may allow Jackson Lake to recover some and/or all the construction costs.

Recommendations

We would recommend Option 2a, as this would yield the best combination of storage gain without the sediment clogging risks that Option 1 carries.

Option 3 would be feasible if you can find a partner to share the costs and if a win/win agreement can be reached.

If you have any questions regarding this report and/or the attachments, please contact me.

Sincerely,

Tom Dea

Tom Dea, P.E.
Senior Project Manager

Attachments

xx\E:\Projects\0417024 Jackson Lake Bathymetric\TECH\Jackson Lake Feasibility Report.docx