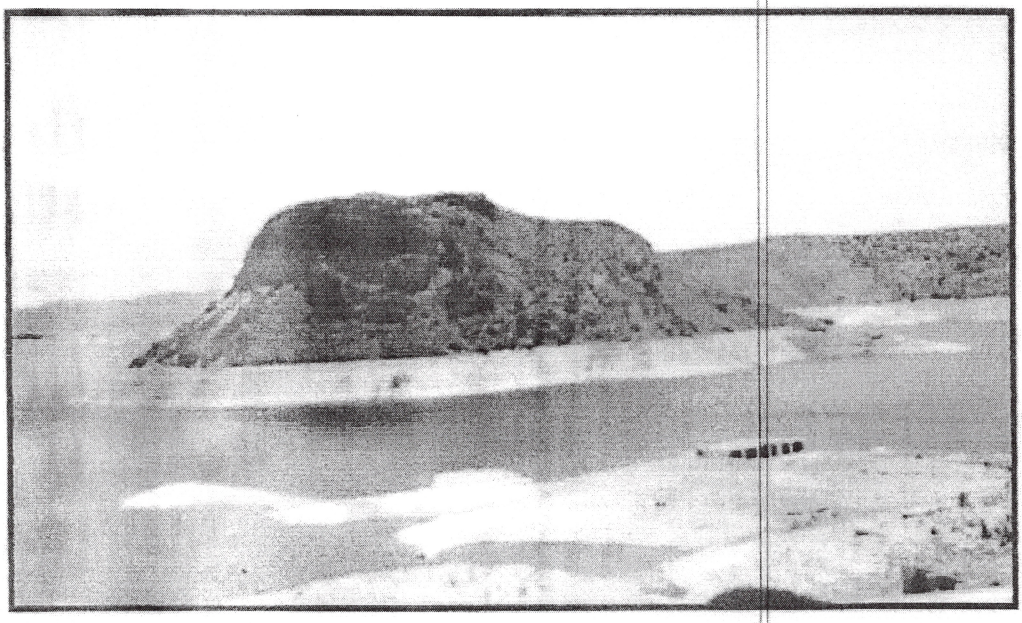
RECLAMATION

Managing Water in the West

Elephant Butte Reservoir Sediment Removal Feasibility and Temporary Channel Summary

Request from Matt Meagher



U. S. Department of the Interior
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MISSION STATEMENTS

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Front Cover Photo Caption – Photo of low water level at Elephant Butte Reservoir. Photo taken in 2002.

Sediment Removal at Elephant Butte Reservoir to Increase Reservoir Storage Capacity November 2004

Background

Efforts to explore options for increasing Rio Grande Project storage at Elephant Butte are not new. Over the years, Rio Grande Compact Commissioners from the State of Texas have sought answers to the question of what to do about the loss of project storage. Options that have been considered include, but are not limited to, construction of new dams upstream, re-operation and increased storage of existing Corps of Engineers Dams namely, Abiquiu, Cochiti, and Jemez Canyon, dredging of Elephant Butte, and deep aquifer storage to minimize evaporation to name a few. The purpose of this summary will be to focus on sediment removal (i.e. dredging) at Elephant Butte.

Elephant Butte Dam and Reservoir are located on the Rio Grande approximately 45 miles south of Socorro, New Mexico and 4 miles north of Truth or Consequences, New Mexico. The nearest upstream flood and sediment control facility on the mainstem of the Rio Grande is Cochiti Dam which is located approximately 180 miles upstream. The U.S. Bureau of Reclamation (Reclamation) completed construction and began operating Elephant Butte Dam in 1915-16. At that time the storage capacity was approximately 2.63 million acre-feet. According to the most recent reservoir sediment survey (USBR, 2000b) performed in 1999 there is approximately 2.02 million acre-feet of storage capacity. This amounts to a reduction of approximately 611,000 acre-feet of storage in 84 year period between surveys. This amount of storage loss translates to about 986 million cubic yards of sediment deposition (not considering further sediment consolidation over time).

USBR(2000b) indicates between the most recent 1999 survey and a reservoir survey done in 1988, approximately 42,000 acre-feet of sediment have been trapped. This translates to an average annual rate of sediment accumulation of about 3700 acre-feet per year or about 6 million cubic yards per year.

Methods and Costs of Sediment Removal

In the event that the removal of sediment deposits is undertaken below the Elephant Butte Reservoir pool to increase storage capacity a large scale effort will have to be undertaken. There are various methods for the removal of sediment material involving the use of both amphibious and land based equipment. If work is performed in wet conditions the use of hydraulic dredges, bucket drag lines, or amphibious excavators would be employed. If work is performed in dry conditions scrapers, dozers, loaders, and conventional excavators would be employed. Given the current conditions at Elephant Butte Reservoir a combination of both wet and dry sediment removal would most likely have to occur. The excavated materials would most likely have to be spoiled

or relocated to areas outside the reservoir pool boundary to achieve the most benefit. This relocation would involve either trucking dry sediment material or pumping wet sediment materials through a slurry pipeline to an upland location outside of the reservoir pool boundary. The average width of the reservoir is approximately 1.5 miles, therefore the material would have to be transported for a distance of at least 2.0 miles.

According to the 2004 RS Means Construction Cost data the following unit prices in dollars per cubic yard ($/cy) are identified for construction related efforts for sediment removal: hydraulic dredging $8 to $12; mechanical dredging $8 to $10; and dry excavation $2 to $4. Hauling costs are identified as being about $4 per cubic yard for a minimum total haul distance of 4 miles. Aggregating these unit costs into a general sediment removal cost translates into about $10-12 per cubic yard. This would amount to a sediment removal cost of at least $10-12 billion dollars or more. A final project cost would depend on many factors. Further analysis would be necessary to generate a more accurate cost.

Other Considerations

Other considerations for the long term spoil or storage of the removed sediments include land acquisition and environmental clearance. Assuming 611,000 acre feet is spoiled in a nearby established spoil area to a height of approximately 20 feet, the approximate foot print of the spoil pile would be about 48 square miles or about 31,000 acres. Assuming land value at $1000 per acre this would involve at least $31 million dollars for acquisition of land for a spoil area. The spoil area would most likely involve a permanent land fill which would have to be developed to avoid impacts to surrounding lands through fencing, contouring, compaction, revegetation, and providing for suitable site drainage and containment of surface runoff.

Environmental compliance requirements for such an endeavor would be very significant. An Environmental Impact Study would most likely have to occur to address all project activity related concerns which could involve at least $2-5 million dollars. Endangered species and Clean Surface Water Act compliance costs would be significant. Mitigation costs to offset impacts to fish and wildlife habitat would be significant.

Given all these factors, removal of 611,000 acre-feet of sediment could involve at least $12-15 billion dollars. In terms of increased reservoir storage, this translates to a cost of at least $20,000-25,000 per acre-foot. The estimated current value of water is approximately $100 per acre-foot of water (USBR, 2000a).

Design Life of Elephant Butte Reservoir

A cursory analysis of the current rate of sedimentation in Elephant Butte indicates that there should be enough useful reservoir space at least until the year 2320. This is based on a average rate of sedimentation of 3,200 acre-feet per year and a minimum project storage of 1,000,000 acre-feet below which Elephant Butte's effectiveness is questionable.

Conclusion

Given the high cost of sediment removal, it is likely more cost effective to explore other options such as increasing storage upstream, namely construction of new dams and increasing storage in existing dams.

References

RS Means, Construction Publishers & Consultants, 2004. RS Means Heavy Construction Cost Data 18th Annual Edition, Kingston, Massachusetts.

U.S. Bureau of Reclamation, January 2000. Allocation of Operations and Maintenance Expenses, Elephant Butte Dam and Reservoir, Rio Grande Project, Texas and New Mexico. (Net irrigation benefits were $97.94 per acre-foot.)

U.S. Bureau of Reclamation, August 2000. Elephant Butte Reservoir 1999 Sedimentation Survey, Rio Grande Project, Water Resources Services, Technical Service Center, Denver Colorado.

Temporary Channel into Elephant Butte Reservoir
Summary of Channel Maintenance Activities
November 2004

Elephant Butte Reservoir is located on the Rio Grande approximately 45 miles downstream of Socorro, New Mexico and 30 miles north of Elephant Butte Dam. As part of the U.S. Bureau of Reclamation's (Reclamation) legislated authority, Temporary channels have been excavated to the Elephant Butte Reservoir Pool since the early 1950's. This work has been done in partnership with the New Mexico Interstate Stream Commission (NMISC). Conditions at the Elephant Butte Reservoir headwaters are such that a disconnection of the river channel to the reservoir pool occurs. Factors that cause the disconnection include excessive sediment deposition, vegetation encroachment, and a minimal valley slope. Channel maintenance activities ensure effectively delivery of water to the reservoir pool as well as alleviating problems in the upstream Rio Grande associated with sedimentation.

From the period of the late 1990's until current, the reservoir pool has receded approximately 23 miles due to extreme drought conditions. Reclamation and the NMISC began major channel rehabilitation efforts in this reach in 2000 to reconnect the river channel to the reservoir pool and increase water delivery. Activity on the Temporary Channel project is currently divided into three phases by channel reaches. In all 3 reaches there is currently a functional channel. The following is a description of each of the three phases and a summary of current activities:

1. Reach 1 – Reservoir Rangeline 28 to Nogal Canyon (Reach Length – 7.0 Miles) – Channel rehabilitation began in September 2000, from an area near the maximum upstream extent of the reservoir pool to Nogal Canyon. The width of this portion of channel is approximately 250 feet. This phase was constructed by Reclamation. Initial construction was completed in August 2004, and maintenance is ongoing.
2. Reach 2 – Nogal Canyon to the end of the Narrows (Reach Length – 11.0 Miles) – Channel rehabilitation began in January 2003. The width of this portion of the channel is approximately 150 feet. This phase was constructed by an NMISC contractor. Reclamation provided designs and construction oversight. Initial construction was completed in December 2003, and maintenance is ongoing.
3. Reach 3 - End of the Narrows to Elephant Butte Dam (Reach Length – 14 Miles) - Work in planned for early 2005. The total length for this phase is variable; the channel will extend to the reservoir pool location, which will vary depending on hydrologic conditions. Project permitting allows for channel maintenance all the way to Elephant Butte Dam, if necessary. The current reservoir pool location is about 4.0 miles below the Narrows. Work will be performed by an NMISC contractor. Reclamation will provide field engineering and construction oversight. The channel in this area has a greater tendency to maintain itself naturally (due to a steeper valley slope than the upstream reaches), the extent of construction should be much less than the upstream work. Planned activities consist primarily of removing debris and other

obstructions in the channel, straightening sharp curves, and reconnecting isolated side pools to the main channel.

Given the delta topography, river flows, reservoir and groundwater levels, and soils extreme site condition exist. Specialized construction equipment is utilized for all three phases involving amphibious excavators, low ground pressure dozers, and personnel and fuel transport air boats. A summary of estimated construction and annual maintenance costs for phase of the Temporary Channel is shown below.

TEMPORARY CHANNEL COST ESTIMATE SUMMARY - TABLE 1
RECLAMATION AND NMISC ESTIMATED CONSTRUCTION AND MAINTENANCE COSTS

Reach	Estimated Initial Channel Construction Cost	Estimated Annual Channel Maintenance Cost	Total Channel Length	Comments
Reach 1	$2,300,000	$750,000 to $1,250,000	7.0	Initial work involved channel excavation to a width of 250 ft. for entire 7.0 mile length, does not include access road construction and maintenance costs
Reach 2	$1,950,000	$1,000,000 to $1,500,000	11.0	Initial work involved channel excavation to a width of 150 ft. for 5.6 miles length with a natural channel already established through the Narrows
Reach 3	$250,000	$250,000 to $500,000	14.0	Initial work will involve minor debris removal, straightening curves, Maintenance of a 50 ft. pilot channel should be minimal due to steeper slope.

Annual maintenance cost can vary from year to year dependant on the annual spring runoff flow conditions and the reservoir pool location. During normal and high runoff years significant sediment deposition and channel berm overtopping and breaching can occur. As a result increased levels of channel maintenance is required. This typically occurs after runoff starting in July which may continue until the next spring runoff. Reach 2 has historically required the most channel work when the reservoir pool has been below the Narrows. This is due to the flatter valley slope immediately upstream of the Narrows.