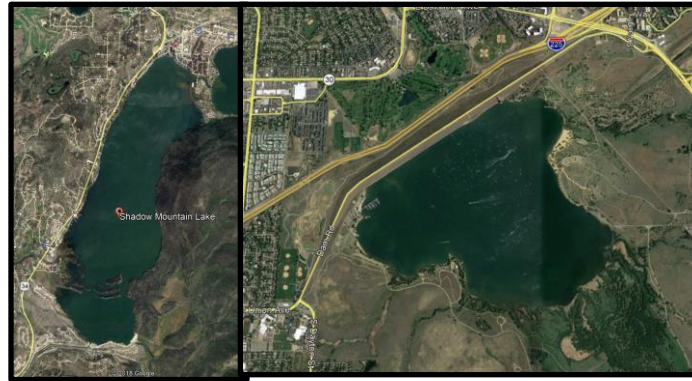




Application of Shallow Acoustic Reflection Seismic (Chirp) Data to Reservoir Storage: Can we revisit the past and plan for the future? – Phase II – Data Analysis and Applicability

Description

Federal agencies have recently begun to consider the applications of chirp data for reservoirs, of which there are nearly 800 managed between USACE and the Bureau of Reclamation. In cases where original reservoir surveys were not conducted at closure, the pre-impoundment bed topography is considered lost, buried by the continual deposition of sediments delivered to the reservoir from the watershed. Chirp has not been sufficiently tested in reservoirs to show value as a geomorphic assessment tool. This project represents the continued partnership with Reclamation to assess chirp data collected in FY20 at two



reservoirs, Shadow Mountain Reservoir (coarse sediments on bedrock), and Cherry Creek Reservoir (finer sediments on alluvium/bedrock). In this effort, the chirp results will be compared to current and previous surveys and sediment samples to make an initial assessment of the applicability in these conditions.

Figure 1. Shadow Mountain Reservoir and Cherry Creek Reservoir near Denver, CO.

Issue/Challenge To Address



Figure 2: Chirp sub-bottom profiler collecting data at Cherry Creek Reservoir, CO.

Chirp sub-bottom imaging has not been extensively applied in reservoir conditions. Efforts in FY20 resulted in the successful collection of chirp profiles in two reservoirs, which are characterized by different stratigraphy. Although these two reservoirs will allow initial determination of how well chirp systems can image pre-impoundment topography, they only represent a small example of the many different types of impoundment topography. The processed chirp data will be compared to existing pre-impoundment topographic profiles and related sediment cores in order to provide a first-order assessment of the potential success and transferability of

this method to reservoirs that differ in pre-impoundment morphology and/or sediment stratigraphy. Successful comparison of the chirp data with existing reservoir data at these sites will further indicate the potential success of this method to image pre-impoundment topography for locations without comparison data. Finally, with only two bed material conditions tested in FY20, the effectiveness of this method across all conditions still needs to be determined. Accordingly, additional opportunities for testing in diverse conditions should be explored.



National Regional Sediment Management Program Omaha District (NWO):



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Successes Lessons Learned

A workshop was held May 6-7, 2019 in Denver, CO to review the application of chirp data in reservoirs, plan for a collaboration with Reclamation, and take visit reservoirs at Strontia Springs and Cherry Creek. Brainstorming at the workshop resulted in Shadow Mountain Reservoir and Cherry Creek Reservoir being identified as ideal candidates to serve as pilot sites to test the applicability of chirp data collection in reservoirs. The workshop agenda is available upon request.

During Phase I in 2020, the project team reviewed existing survey and sediment core data from the reservoirs and developed a sampling plan to leverage much of the historical data for calibration. Successful collection of chirp subbottom imagery was completed August 18-21, 2020 at Cherry Creek Reservoir, and August 23-25, 2020 at Shadow Mountain Reservoir. Phase II in 2021 will focus on processing of these chirp data, and comparison to pre-impoundment surveys and/or sediment cores from each reservoir.

Projected Benefits Cost Savings Value Added

Current methods for determining reservoir pre-impoundment terrain include deep cores and, where applicable, ground penetrating radar. If chirp data proves acceptable in multiple geologic conditions, there may be significant cost savings, particularly with respect to greatly reducing or eliminating the need to collect cores. As part of the data analysis in Phase II, a basic cost comparison with current methods and repeated surveys throughout the reservoir history will be completed. Omaha District has developed an extensive report (in review as of this submittal) on multiple survey methodologies for Cherry Creek Reservoir applied in 2016. Adding chirp collection to this report will result in the most comprehensive comparison of survey methods at any USACE reservoir.

Flood Risk Management, Ecosystem Restoration, Water Supply, and Water Quality project purposes may all realize benefits from the application. Successful application of the methodology will result in an estimate of storage loss in the reservoir, and possibly knowledge about the stratification of sediment layers that can be tied to significant single events in history. Any estimate of future benefits gain/loss will require knowledge of these temporal changes in storage.

Expected Products

US Society on Dams Conference Presentation – April 2021
RSM IPR Participation and Presentation – August 2021
ERDC Tech Report “Application of Shallow Acoustic Reflection Seismic (Chirp) Data in Reservoirs for Area-Capacity Analysis” – Sept 2021

Stakeholders/Users

The successful application of this methodology could be used by any dam owner to establish the historic trend of sedimentation and make reservoir life estimations.

Leveraging Opportunities

The USACE Dredging Operations Technical Support (DOTS) program provided funding for travel and labor for both the workshop in 2019, and in support of the fieldwork conducted in August 2020.

Points of Contact

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Participating Partners

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