USSD Position Statement on Reservoir Sediment Monitoring

Prepared by the USSD Committee on Hydraulics of Dams
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USSD Position

As a best management practice, the USSD encourages owners or managers of dams to develop and implement a reservoir sedimentation monitoring plan which includes regular surveys to estimate storage capacity. Such monitoring will document the rate and pattern of sedimentation, update reservoir surface area and storage capacity tables, and help estimate when sedimentation will begin impacting dam and reservoir facilities such as outlet structures, intakes, and recreational infrastructure.

Repeated topographic and bathymetric surveys of reservoir capacity are the most reliable method to monitor both the rate and spatial distribution of sediment accumulation.

Background

Dams and reservoirs are costly, essential, and irreplaceable infrastructure, but their long-term operation is often progressively impaired by sedimentation. Experience has amply demonstrated that essential reservoir infrastructure can be impacted by sedimentation even when only a small percentage of the capacity has been lost. This makes it essential to proactively collect and interpret capacity loss data to monitor the sedimentation process, helping owners avoid unwelcome surprises and crisis situations, while also providing necessary data to develop future strategies to sustain long-term operation.

Sediment yields vary greatly year-to-year. Trends of increasing or decreasing sediment inputs can occur over decadal timeframes, while a single large flood can deliver more sediment to a reservoir than multiple years of normal inflow. To capture changing sedimentation trends, methodological consistency between surveys is more important than achieving the maximum precision.

An initial baseline survey is recommended for any reservoir that has never been surveyed. To estimate the future capacity loss requires at least three capacity measurements at different times using identical methods and should encompass at least a five percent change in reservoir capacity. Because the rate of capacity loss can vary with time due to sediment

compaction and changes in watershed conditions, inflows, and reservoir operations, multiple surveys over time are needed to track the rate of capacity loss and better predict long-term sediment accumulation. Pre-construction surveys may use a different method than surveys following impounding the reservoir. When survey methodologies differ, direct comparison of survey results to estimate long-term capacity loss can be unreliable, particularly when volume changes are only a few percent.

One method to estimate the reservoir survey interval is provided by the equation below:

$$Interval = \frac{Impact\ Age}{10}$$

where, *Interval* = years between surveys and *Impact Age* = estimated reservoir age when sedimentation impacts begin to be felt (years).

For example, if the design sediment pool was estimated to fill in 100 years, and that is selected as the "impact" event, a survey interval of approximately 10 years would be recommended. As a practical matter, significant sedimentation normally occurs outside of the designated sediment pool. After an initial post-impoundment survey, subsequent surveys corresponding to approximately 2% or 3% increments in capacity loss may be considered reasonable. For a multi-purpose reservoir, this percent loss should be calculated as the capacity loss in the most-impacted critical pool (conservation pools often lose capacity much faster than flood pools). During reservoir drawdown, or in flood control reservoirs, both bathymetric and land survey (e.g., LiDAR) data will need to be combined to map the entire reservoir. Examples are described by Baker et.al. (2016) and Cooper et al. (2021).

Survey intervals ranging from 5- to 25-years are not uncommon, and the survey interval tends to get shorter as the sedimentation problem becomes more severe. Surveys will be more frequent in reservoirs having a more rapid loss of capacity or where sedimentation has a greater impact. In reservoirs with a significant sediment load, surveys are also recommended after major sediment- producing events like extreme floods and extensive wildfires.

Once a detailed full reservoir survey has been performed, sedimentation can be tracked using a limited number of fixed survey cross-section range lines disbursed along the reservoir, or by periodically running a longitudinal profile.

Resources and References

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