# Management of Reservoir Sedimentation for Long-Term Sustainability
## Subcommittee on Sedimentation
## National Reservoir Sedimentation and Sustainability Team
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The nation's 90,000 dams and reservoirs constitute a critical component of the country's infrastructure. These dams and reservoirs serve both to provide fundamental societal needs such as ensuring the stability of water and energy supplies and flood risk management for much of the country. This extensive system of hydrologic stability and control structures ensures water supplies for municipal, agricultural, and industrial use and for hydropower, flood risk management, navigation, and recreation. The system of dams and reservoirs, just as other critical aspects of the country's infrastructure such as the interstate highway and bridge system, affects virtually every part of this country in a profound and in many instances at an existential level. In many situations, the ability of communities to continue to exist in relative safety or grow crops is dependent upon such structures. Essential to our ability to ensure the capacity of this system to continue to meet these purposes, now and into the future, is the need to maintain adequate storage capacity. However, this capacity has been steadily degraded, at times at an alarming rate, as the nation's dams and reservoirs have been and are filling with sediment (clay, silt, sand, gravel, and cobble). Simply put, this pattern of continued, and in many instances, accelerated sedimentation threatens both the storage capacity and operational control of many reservoirs. Over the long-term, maintaining existing reservoir storage capacity and operational control may be the most cost effective and feasible strategy to maintain capacity, rather than having to construct more dams to replace lost capacity. In addition, failing to manage reservoir sedimentation can lead to downstream environmental and societal impacts. Reservoir sedimentation prevents sediment from reaching the downstream river, which can lead to erosion of the downstream channel. This erosion leads to the impairment of habitat for fish and wildlife, and a reduction of sediment delivered to coastal deltas and, in many instances, coastal shoreline erosion issues.

All rivers naturally transport sediment particles that are eroded from the upstream watershed. These sediment particles tend to deposit and accumulate in downstream reservoirs over time because of the reduced flow velocity and increased travel time of water through the reservoir pools. The long-term process of sediment accumulation is known as reservoir sedimentation. Sediment erosion and transport is a natural process, but erosion rates can be accelerated by human activities that disturb soils (e.g., mining, construction, tilling, grazing, etc.). The use of best land-management practices throughout the watershed can reduce erosion to rates that are closer to background levels. An increase in hydrologic variability, such as more severe and more frequent droughts and floods will typically lead to increased sediment erosion rates. Droughts cause additional stress to vegetation (possibly through increased incidence of wildfire) that would otherwise protect the soil from erosion. Floods erode and transport sediment at rates that are much greater than rates during lower-flow periods.

Reservoirs cannot physically trap sediment indefinitely. As the reservoir becomes filled with sediment, inflowing sediment will be transported through the reservoir and delivered to the downstream channel in an uncontrolled manner. A prudent, long-term sustainable goal for reservoir management is to pass

sediments to the downstream channel each year in a quantity approximately equal to the mass or volume of sediments entering the reservoir and, to the extent possible, with similar timing.

So long as sediments remain in place in an undisturbed state in the bed of a water body, such undisturbed sediments are not considered "pollutants" for purposes of Clean Water Act (CWA) regulation. However, if human intervention "dredges" or "discharges" those sediments, or releases such sediments downstream through a dam, those actions in certain circumstances may be regarded as "discharges of dredged or fill material" subject to regulation under CWA Section 404. Consequently, a CWA section 404 permit could be required for the discharge of dredged or fill material for sediment release and therefore the CWA can, in certain circumstances, regulate or limit the passage of sediment downstream from dams, especially if management actions would be taken to facilitate that passage. However, sediment management in reservoirs will more frequently entail the downstream release of sediment in limited and manageable quantities, re-establishing sediment flow along a stream which has been artificially deprived of sediment by dam construction. That sort of passing through a dam of sediments in limited quantities that are incidental to normal dam operations usually is not regulated at present under the CWA because such discharges are considered to be de minimis discharges. On August 19, 2005, the Corps issued Regulatory Guidance Letter 05-04, which discusses the circumstances under which a CWA section 404 permit is required for the release of sediments from a dam. Existing Clean Water Act section 404 permit processes can support sustainable reservoir sediment management activities.

While most large reservoirs have a designated sediment storage pool, as these zones become overfilled with sediment, it becomes highly desirable to focus on passing the inflowing sediment loads downstream of a dam to maintain active storage. This activity should be implemented considering the natural process of sediment continuity, independent of the method to accomplish it. Methods may include sediment sluicing, flushing, bypassing, venting, or dredging, with the selection of the appropriate strategy, or combination of strategies, being highly site-specific. Large volumes of previously deposited "legacy" sediments frequently need not be mobilized. Older sediments may remain entombed while inflowing sediments are managed for downstream release.

Sediments passed through a reservoir to the downstream channel may slow, stop, or reverse channel erosion and degradation trends. Downstream channel aggradation may be acceptable or desirable, so long as the aggradation does not cause unmitigated harm to people, property, or native species. For reservoirs that divert a significant portion of the stored water away from the downstream channel, the amount of sediment passed to the immediate downstream channel may have to be reduced to avoid excessive channel aggradation. Reservoir owners and operators are encouraged to work with other resource managers to develop a holistic and environmentally sustainable approach to sediment management that focuses on upstream and downstream sediment continuity.

We call upon local, state, and federal agencies to discuss these issues and to develop new guidelines, rules, and procedures by the year 2021, including the role of CWA section 404 permitting, for sustainable reservoir sediment management practices. This could include the permitting of pilot programs at specific dams and reservoirs. The objective of these new guidelines, rules, and procedures is to create a viable and more efficient regulatory process to permit implementation of sustainable

strategies to maintain reservoir storage capacity and to reduce or eliminate channel erosion downstream from a dam. The new guidelines, rules, and procedures should recognize the inevitable need to pass sediments downstream of dams in a responsible manner to preserve reservoir storage capacity and mitigate downstream impacts.