Potential Projects for Flood Mitigation

Sediment Removal

Examine Process for Dam Removal in Sediment Accumulation

1. Toxic Substance Potential
2. Impact of silt/sediment release
3. Impact on Groundwater
4. Impact on Kardon Park

Thomas Moore Dam Removal

Sediment Transport Project

Sediment refers to the conglomerate of materials, organic and inorganic, that can be carried away by water, wind or ice . While the term is often used to indicate soil-based, mineral matter (e.g. clay, silt and sand), decomposing organic substances and inorganic biogenic material are also considered sediment . Most mineral sediment comes from erosion and weathering, while organic sediment is typically detritus and decomposing material such as algae .

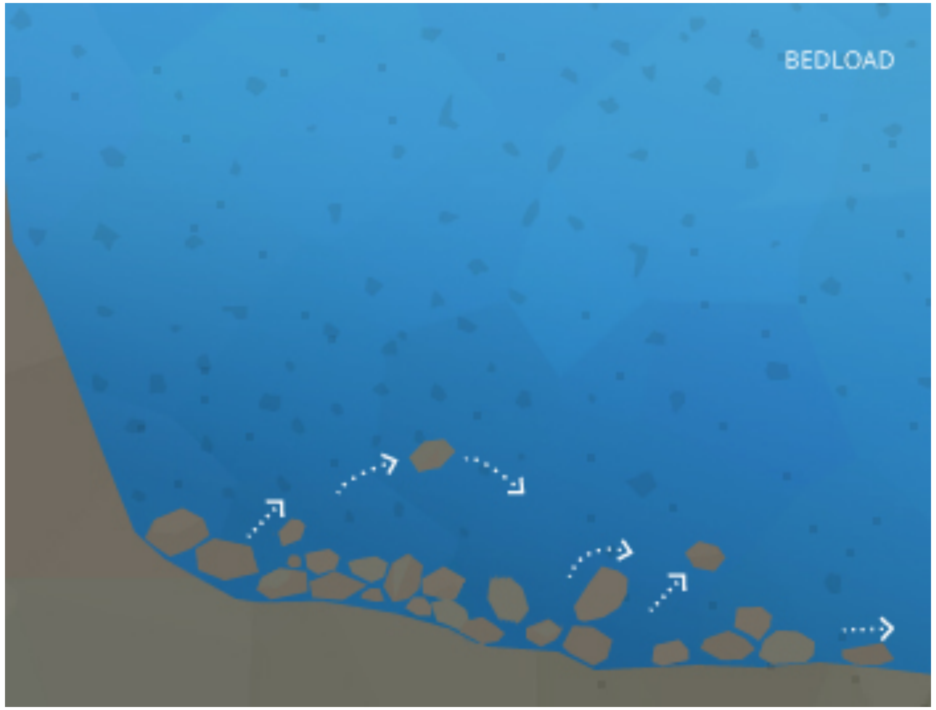
These particulates are typically small, with clay defined as particles less than 0.00195 mm in diameter, and coarse sand reaching up only to 1.5 mm in diameter . However, during a flood or other high flow event, even large rocks can be classified as sediment as they are carried downstream . Sediment is a naturally occurring element in many bodies of water, though it can be influenced by anthropogenic factors .

What is Sediment Transport?

Sediment transport is the movement of organic and inorganic particles by water. In general, the greater the flow, the more sediment that will be conveyed. Water flow can be strong enough to suspend particles in the water column as they move downstream, or simply push them along the bottom of a waterway . Transported sediment may include mineral matter, chemicals and pollutants, and organic material. Another name for sediment transport is sediment load. The total load includes all particles moving as bedload, suspended load, and wash load.

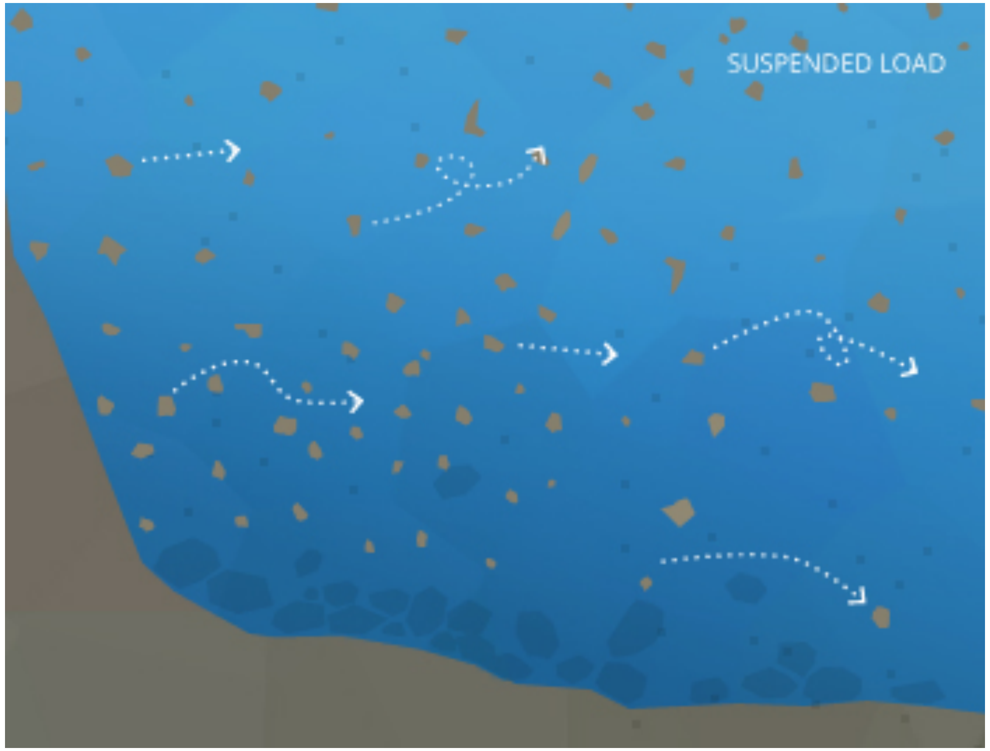
Bedload

Bedload is the portion of sediment transport that rolls, slides or bounces along the bottom of a waterway. This sediment is not truly suspended, as it sustains intermittent contact with the streambed, and the movement is neither uniform nor continuous. Bedload occurs when the force of the water flow is strong enough to overcome the weight and cohesion of the sediment. While the particles are pushed along, they typically do not move as fast as the water around them, as the flow rate is not great enough to fully suspend them. Bedload transport can occur during low flows (smaller particles) or at high flows (for larger particles). Approximately 5-20% of total sediment transport is bedload. In situations where the flow rate is strong enough, some of the smaller bedload particles can be pushed up into the water column and become suspended.



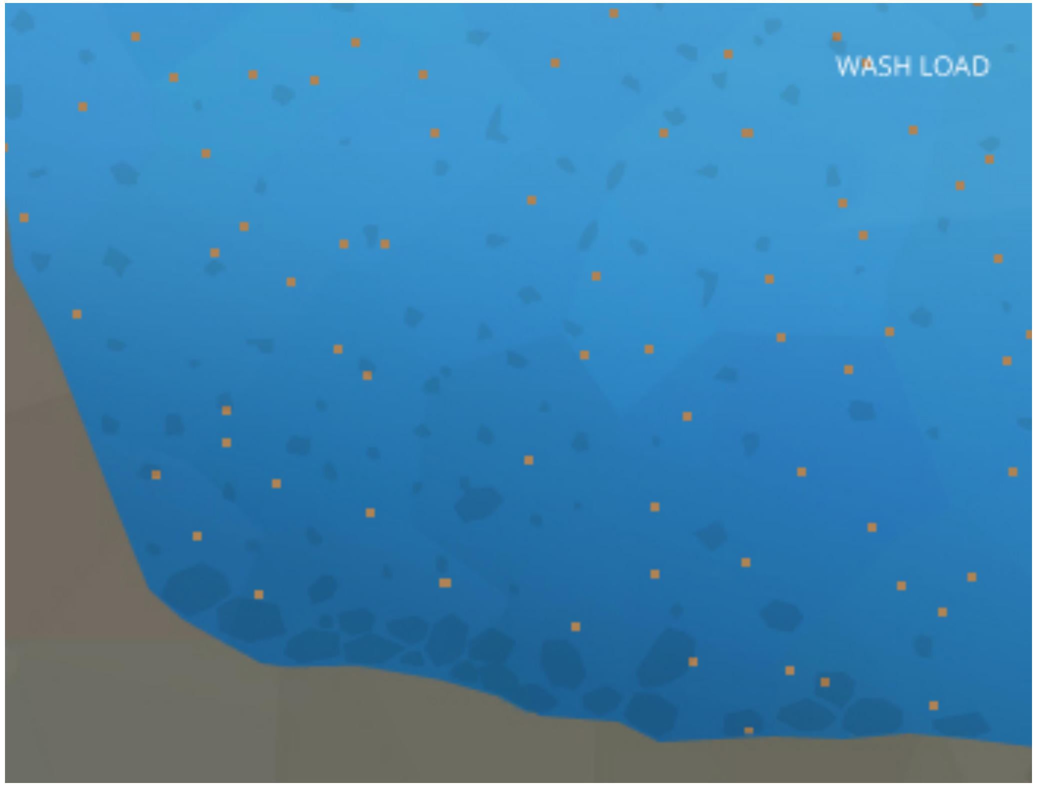
Suspended Load

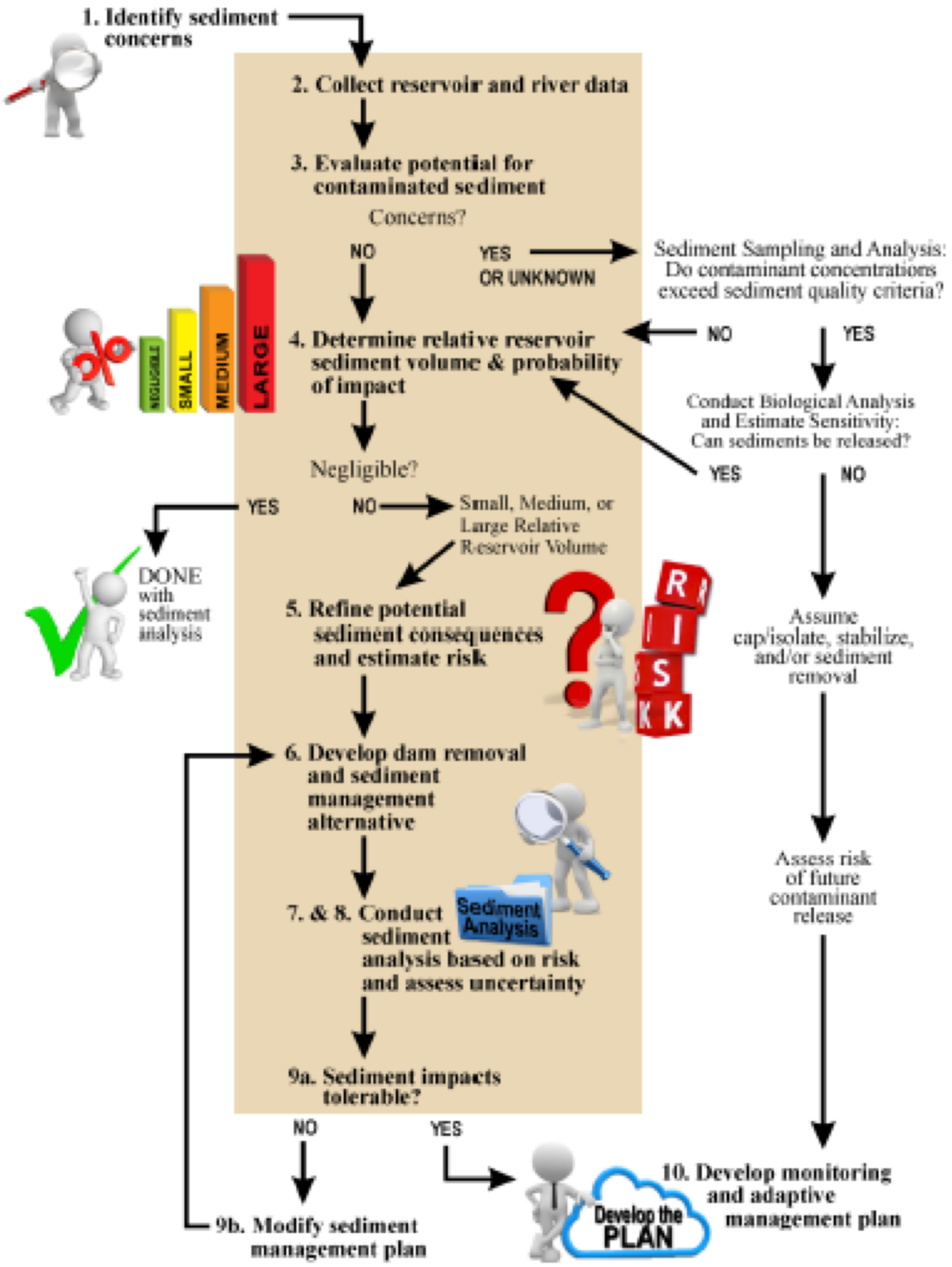
While there is often overlap, the suspended load and suspended sediment are not the same thing. Suspended sediment are any particles found in the water column, whether the water is flowing or not. The suspended load, on the other hand, is the amount of sediment carried downstream within the water column by the water flow. Suspended loads require moving water, as the water flow creates small upward currents (turbulence) that keep the particles above the bed. The size of the particles that can be carried as suspended load is dependent on the flow rate. Larger particles are more likely to fall through the upward currents to the bottom, unless the flow rate increases, increasing the turbulence at the streambed. In addition, suspended sediment will not necessarily remain suspended if the flow rate slows.



The wash load is a subset of the suspended load. This load is comprised of the finest suspended sediment (typically less than 0.00195 mm in diameter). The wash load is differentiated from the suspended load because it will not settle to the bottom of a waterway during a low or no flow period. Instead, these particles remain in permanent suspension as they are small enough to bounce off water molecules and stay afloat. However, during flow periods, the wash load and suspended load are indistinguishable.

Turbidity in lakes and slow moving rivers is typically due the wash load. When the flow rate increases (increasing the suspended load and overall sediment transport), turbidity also increases. While turbidity cannot be used to estimate sediment transport, it can approximate suspended sediment concentrations at a specific location.





1. Identify sediment concerns
2. Collect reservoir and river data
3. Evaluate potential for contaminated sediment
Concerns?
NO
YES OR UNKNOWN
Sediment Sampling and Analysis: Do contaminant concentrations exceed sediment quality criteria?
NO
YES
4. Determine relative reservoir sediment volume & probability of impact
NEGLIGIBLE
SMALL
MEDIUM
LARGE
Conduct Biological Analysis and Estimate Sensitivity: Can sediments be released?
YES
NO
Negligible?
YES
NO
Small, Medium, or Large Relative Reservoir Volume
DONE with sediment analysis
5. Refine potential sediment consequences and estimate risk
RISK
Assume cap/isolate, stabilize, and/or sediment removal
6. Develop dam removal and sediment management alternative
Assess risk of future contaminant release
7. & 8. Conduct sediment analysis based on risk and assess uncertainty
Sediment Analysis
9a. Sediment impacts tolerable?
NO
YES
9b. Modify sediment management plan
Develop the PLAN
10. Develop monitoring and adaptive management plan

Many low-head dams have very little sediment trapped within their impoundments and, therefore, there is little risk of sediment impacts and no need for extensive sediment investigations.

The guidelines offer special simplified procedures to verify cases of negligible reservoir sediment where no additional analysis is necessary. Negligible reservoir sediment volumes are less than 10% of the average annual load, and similar to a typical alluvial feature (e.g. sand bar or gravel bar) in nearby river reaches.

Except for negligible sediment volumes, the potential for contaminants is evaluated using a screening survey. If there is no cause for contaminant concern and the reservoir sediment contains less than 10% clay and silt, then the probability of contaminated sediment can be considered low and additional contaminant testing and analysis is not necessary.

If contaminants are a concern, sediment chemistry sampling and analysis is conducted to determine if contaminants can be safely released into the downstream river without impairing human health or aquatic species.

If the contaminants cannot be safely released, mitigation must be implemented that often consists of removal and disposal of contaminated sediment or capping contaminated sediment in place with adequate protection from future seepage and erosion.

For cases considering release of reservoir sediment downstream, a key part of the guidance is using estimated risk of sediment impacts to drive decisions on the amount of data collection, analysis, and mitigation.

Risk is the product of the probability of sediment impacts and the consequence of those impacts should they occur. The probability of sediment impact is based on the relative reservoir sediment volume

(small, medium, or large).

The relative reservoir sediment volume is based on the ratio T_s, which represents the years of upstream sediment supply trapped within the reservoir. The years of trapped sediment is representative of the reservoir sediment volume and the river’s capacity to transport it.

A logarithmic scale is used to classify T*s* into
small (0.1 to 1 yr),
medium (1 to 10 yr),
large (greater than 10 yr)
relative reservoir sediment volumes.

Potential consequences are qualitatively determined through discussions among the project team and stakeholders and may be unique for released fine and coarse sediment volumes within the reservoir.

The recommended level of sediment investigations are proportional to the risk of sediment impacts. Conceptual models are recommended for every case, while more quantitative numerical modeling, physical modeling, and field experiments are recommended for higher risk cases.

A final step is to determine if the predicted sediment impacts are tolerable to stakeholders and decision makers. Uncertainty of key input parameters such as the reservoir sediment volume are reviewed as part of the discussion. The conversation should also include how potential benefits of released sediment and long-term restoration benefits of dam removal weigh against impacts that are potentially short-term. If predictions of sediment impacts are not tolerable, dam removal and sediment management plan can be revised, such as phasing dam removal to slow the rate of released sediment.

Other options include mitigation or predicted sediment impacts such as raising levees or temporary treatment of higher sediment concentrations. Once the sediment-related impacts are judged to be tolerable, then the guidelines recommend the development of a monitoring and adaptive management plan to help implement the project and inform planning of future dam removal projects.

Potential Sediment Locations

There is a need to investigate potential containments and stream channel modifications which may have had an effect on the ground water table in and around Beaver Creek

Potential Sediment Locations