Conconully Safety of Dams Modification Project Final Environmental Assessment

Geology and Soils Impact Analysis Memorandum

November 2025

Analysis Area

The analysis area for geology and soils is the project area, including Conconully Dam, Conconully Reservoir, and the east bank of the reservoir from the cemetery to the dam, as shown in **Map 1-1** in **Appendix A** of the environmental assessment (EA).

Affected Environment

Geologic Hazards

Conconully Reservoir is located within the Sinlahekin Valley, a deep, glaciated canyon with steep rock sidewalls rising from a broad valley floor (Rinehart and Fox 1976). The surface geology of the project area is characterized primarily by glacial till[1] and mass-wasting[2] deposits from the Quaternary period, which spans from 2.6 million years ago to the present day. Bedrock consists of metamorphic rock formed by tectonic activity throughout the Mesozoic era, which occurred roughly 252 to 66 million years ago (Washington Geological Survey 2025). There are no active faults in the project area, though the inactive Salmon Creek Valley fault passes through the rock knob that forms the western abutment. A comprehensive description of geologic resources in the project area is provided in the Comprehensive Geology Report for Conconully Dam (Reclamation 2021).

Landslides are the downslope movement of rock, soil, or related debris by water and gravity. Landslides are an issue in Washington, especially in places with or near moderate to steep slopes, during times of heavy precipitation and during earthquakes (WSDNR, n.d.). The Washington Geological Survey has developed a landslide inventory protocol for the state, using both remote sensing technology and historical records. A 1990 geologic map indicates that one mass-wasting

[1] Glacial till and outwash refer to sediment deposited by historical glaciers and glacial meltwater.
[2] Mass wasting refers to the downslope movement of rock, soil, and debris due to gravity, often triggered by factors like heavy rain, earthquakes, or slope instability.

event has occurred within the project area, along Salmon Creek. Additional data regarding the timing and cause of the mass-wasting deposit are unavailable (Washington Geological Survey 2025).

Reclamation considers Conconully Dam, a puddle core embankment constructed using hydraulic fill methods, susceptible to liquefaction and increased risk of failure in the event of seismic activity. Such an event would constitute a geologic hazard and may cause mass wasting in the project area, particularly along Salmon Creek.

Soil Susceptibility to Erosion

Soils underlying the project area consist mostly of silt loam, ashy loam, and fine sandy loam from the Conconully, Donavan, Owhi, and Colville series. The Conconully, Donavan, and Owhi series are characterized by moderately to very deep, well-drained soils associated with volcanic ash and glacial till or outwash (National Cooperative Soil Survey 2009, 2011a, 2011b). Soil map units belonging to these series are distributed throughout the project area. The Colville series consists of very deep, poorly drained soils that formed in alluvium (National Cooperative Soil Survey 2008). Colville series soils within the project area are concentrated in Salmon Creek.

Soil erosion occurs when the top layer of soil (topsoil) is removed by wind or water, wearing away the surface of the soil. Soils on steep slopes are more prone to erosion. Within the project area, steep slopes, defined as exceeding a 15 percent gradient, occur along Salmon Creek.

Additionally, soils with a higher erodibility factor, or K-factor,[3] are more vulnerable to erosion by surface runoff. Generally, the soil K-factor ranges in value from 0.02 to 0.69, with soils highly susceptible to erosion holding a K-factor of approximately 0.40 (Institute of Water Research 2002; PNNL n.d.). Soil K-factor in the project area does not exceed 0.32, indicating that these soils are moderately susceptible to erosion by surface runoff.

While surface runoff is the primary mechanism of soil erosion, wind may also erode soils, particularly in semiarid environments in the project area. Soil susceptibility to wind erosion is influenced by various factors, including wind conditions, moisture, temperature, topography, soil erodibility, and surface disturbance (NRCS 2024). The Natural Resources Conservation Service places soils into wind erodibility groups to indicate their susceptibility to erosion by wind. Wind erodibility groups are numbered from 1 to 8, with soils highly susceptible to wind erosion in wind erodibility groups 1 or 2 (NRCS 2024). In the project area, there are 34 acres of soils (28 percent of the project area) in wind erodibility group 2; these soils are concentrated in the borrow area (**Map 2-2** in **Appendix A** of the EA). None of the soils in the project area are in wind erodibility group 1.

Soils and geology can be impacted by changes in the timing, intensity, and amounts of precipitation, which can increase rates of erosion. Increases in temperatures can result in more rapid soil drying and higher rates of wind erosion. Changes in climate could affect rainfall rates and temperature in

[3] The soil erodibility factor, also known as K-factor, represents a soil's susceptibility to erosion, specifically by water. Soil properties that influence the soil erodibility factor include soil texture, organic matter content, soil structure, and permeability.

the project area. These changes could result in impacts on the rate of soil erosion and the potential for landslides in the project area.

Soil Susceptibility to Compaction

The United States Department of Agriculture rates soils based on their susceptibility to compaction from the operation of ground-based equipment for site preparation activities when soils are moist. Soil compaction occurs when soil particles are pressed together more closely, relative to their original state. Compaction reduces the abundance of large pores in the soil by damaging the soil structure, which inhibits water and air from infiltrating and percolating through the soil. Thus, compaction hinders the soil's ability to hold water, in addition to increasing soil strength and hardness. These changes may adversely affect plant growth because they create unfavorable conditions for root penetration and the storage of nutrients, air, and water (NRCS Web Soil Survey 2025).

Ninety one percent, or 109 acres, of soils in the project area are rated as having medium susceptibility to compaction; the remainder of soils are underwater. None of the soils in the project area are rated as highly susceptible to compaction. After soils are initially compacted by a first pass of equipment, the soils are able to support standard equipment with only minimal increases in soil density. The growth rate of seedlings present in the soil may be reduced following compaction.

Environmental Consequences

Methods and Criteria

Analysis Indicators

- Geologic hazards due to the presence of geologic features susceptible to landslides
- Soils with moderate or high susceptibility to erosion or accelerated soil loss based on K-factor, steep slopes, and wind erodibility groups
- Soils susceptible to compaction

Assumptions

- Best management practices (BMPs) and applicable environmental protection measures would be implemented to avoid or reduce erosion and compaction during construction.

Alternative A – No Action

Under the No Action alternative, no construction would occur. No new disturbance of soils or geologic features would occur. Soils and geologic features would therefore not be impacted by construction activities. If a seismic event occurred that caused the Conconully Dam to fail, soils may undergo mass wasting and erosion. Flooding caused by a dam breach would erode soils in the project area and cause major sediment transport.

Alternative B – Proposed Action

Under Alternative B, for up to 10 years following the completion of construction activities, there would be up to 40.8 acres of short-term disturbance while disturbed soils stabilize, and restored areas regrow vegetation and return to pre-construction conditions. Of these acres, a majority of soils (22.9 acres) are in wind erodibility group 2, which is highly susceptible to wind erosion, and 11.2 acres in wind erodibility group 6, which is not highly susceptible to wind erosion. Under Alternative B, 19.6 acres of permanent disturbance would result from the construction of the proposed facilities on the project site. Similarly, there would be a majority of soils in wind erodibility groups 2 and 6.

Geologic Hazards

Under Alternative B, construction of a stability berm using deep soil mixing reinforcement columns would improve the strength and resilience of the dam's foundation materials and decrease the likelihood of liquefaction and dam failure due to seismic activity, in turn lowering the potential for geologic hazards to occur. Compared with the No Action alternative, this component of Alternative B would result in a lower potential for geologic hazards from seismic events.

Alternative B would entail the excavation of 500 feet of rock slope downstream of the existing outlet works. Excavation is not expected to destabilize the rock slope or cause mass wasting, as available data do not indicate the presence of unstable geologic units in the project area. Therefore, rock slope excavation would likely not increase the risk of geologic hazards compared with the No Action alternative.

Soil Susceptibility to Erosion

Soils underlying areas of short-term disturbance may be susceptible to erosion from wind and surface runoff during the construction period, as construction activities would loosen or displace soils. Because soils in the borrow area are in wind erodibility group 2, they would be more susceptible to wind erosion as compared with soils in the rest of the project area. After the construction period, reclamation of disturbed areas would occur, reducing the likelihood of soil erosion over the short term. For example, following excavation and processing, the 7-acre excavated portion of the borrow area would be restored to the existing condition and sloped to a natural grade and the borrow area that would undergo surface disturbance would be stabilized to avoid excessive erosion, using methods such as revegetation (**Appendix E** of the EA), grading to drain runoff, and contouring to match the landscape. Additional erosion prevention and slope protection measures would include armoring the stability berm with gravel, cobbles, and boulders obtained from the borrow area.

Over time, soil susceptibility to erosion in areas affected by short-term surface disturbance would decrease as a result of ecological restoration actions described in **Section 2.2.2** of the EA, as improved vegetative cover and riparian habitat would increase soil stability and biophysical function.

To reduce the potential for soil erosion, Reclamation would implement the BMPs described in **Appendix F** of the EA during the pre-construction, construction, and post-construction processes. These BMPs include temporary sediment control and wind erosion control, revegetation, and standard erosion control measures typically implemented during road construction efforts.

Reclamation would also implement applicable permitting requirements described in **Section 2.2.2** of the EA.

Overall, compared with the No Action alternative, increased soil susceptibility to erosion would lead to minor, short-term impacts on soils due to surface disturbance associated with construction activities.

Soil Susceptibility to Compaction

The movement of heavy equipment and vehicles associated with construction may compact soils to a limited extent, given that soils in the project area are moderately susceptible to compaction. BMPs (**Appendix F** of the EA) would be implemented to minimize soil compaction, including the use of existing roadways or travel paths whenever possible and the minimization of the number of temporary access roads. Overall, relative to the No Action alternative, surface disturbance from construction activities under Alternative B would cause minor, short-term impacts on soils from increased soil susceptibility to compaction.

Alternative C – Preferred

Under Alternative C, there would be 43.0 acres of short-term disturbance associated with the regrowth of vegetation and soil stabilization, and 17.3 acres of permanent disturbance to the ground surface, with similar acres of soils in wind erodibility groups 2 and 6. Impacts on geology and soils in the project area would be similar to those described under Alternative B. However, the alignment of the outlet works under Alternative C would require less rock excavation, which would reduce the volume of rock that may potentially be destabilized during and immediately after excavation.

Acronyms

BMP	best management practice
EA	environmental assessment

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