Leader's Intent Statement

Gifford Pinchot National Forest Supervisor Johanna Kovarik

Stewarding for public safety and the outstanding geologic, ecologic, and cultural resources of the Mount St. Helens National Volcanic Monument is an essential part of our work on the Gifford Pinchot National Forest. Improving the safety, integrity, and function of the Spirit Lake Outflow after 40 years of operation is a critical part of that work. The agency investment of assembling current information about Mount St. Helens, Spirit Lake and the Toutle-Cowlitz River System, as well as seeking public and stakeholder values regarding this dynamic system is crucial as the Forest Service begins environmental analysis for the Spirit Lake Outflow Safety Improvement Project.

The Spirit Lake Outflow Engineering Feasibility Analysis, Tribal Consultation and Collaboration, and Stakeholder Engagement are all essential components that will provide a firm foundation for the team to develop alternatives for a resilient Spirit Lake Outflow that considers the values and needs of the people and the ecological system of the Toutle/ Cowlitz River drainages and Mount St. Helens.

The alternatives will be informed by:

- Government to Government Consultation with the Tribes,
- An integrated effort in identifying concerns, issues, and values from the community as well as adjacent management and regulatory agency missions, and
- Identification of potential Spirit Lake Outflow options as informed by an Engineering Feasibility Analysis.

As we strive to gain public input, the team looks forward to engaging with those interested in being a part of exploring a resilient solution to managing the outflow from Spirit Lake.

Agency Roles on this Project

United States Forest Service

The United States Forest Service, Gifford Pinchot National Forest, is responsible for managing Spirit Lake Outflow, and deciding on outflow improvements. The Forest Service is the lead agency in preparing the NEPA document.

The Project falls within the Mount St. Helen's National Volcanic Monument, which is within the Gifford Pinchot National Forest.

Army Corps of Engineers

The Army Corps of Engineers has engineering expertise and has been the GPNF's contractor in implementing its decisions with respect to Spirit Lake Outflow.

The Corps manages the sediment retention structure downstream of Spirit Lake. Any changes to the conditions at the sediment retention structure would require a Rivers and Harbors Act Section 408 permit from the Corps.

United States Geological Survey

The United States Geological Survey is the science advisor to GPNF. The USGS conducts research at Spirit Lake and in the National Volcanic Monument, including water level gauges at Spirit Lake, seismic activity of the area, and sensors on the tunnel via the Cascades Volcano Observatory.

Purpose of the Project

The purpose of the Project is to provide for the safety of downstream communities by reducing the risk of flooding and mudflows from a failure of the Spirit Lake debris blockage.

Following the 1980 eruption of Mount St. Helens, Spirit Lake's natural outlet to the Toutle River system was blocked by the landslide and debris flow from the eruption. The Spirit Lake tunnel was constructed under emergency conditions to address the imminent public safety threat posed by rising water levels in Spirit Lake. The tunnel is in an area of volcanic, geologic, hydrologic, and seismic hazards.

The geological pressures on the tunnel have caused rock heave, compression, cracking, and support failures, necessitating periodic repairs. As the tunnel ages, it will require more frequent and longer closures for repair to prevent failure. It is not expected to remain serviceable without significant repair and/or upgrade.

A failure of the tunnel would result in rising lake levels that could exceed the maximum safe operating level, at which point pressure from rising water levels could force the breaching of the natural debris blockage, putting the downstream population of approximately 50,000 people at risk of catastrophic flooding and mudflows.

Primary Needs to Meet the Project Purpose

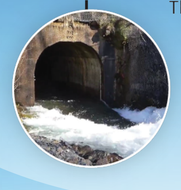
- Accommodate lake level rise from a flood event without exceeding the maximum safe level
- Improve access reliability to outflow infrastructure.
    - Current access takes 4.5 hours and requires a combination of travel modes including high-clearances passenger vehicles, UTVs, and boat.
    - Heavy equipment cannot be mobilized to the inlet for repairs.
    - The area is under snow a significant portion of the year. Helicopter access is often not viable or safe due to poor weather conditions.
    - Moving, floating, 40-acre log mat frequently prevents boat access.
- Create outflow redundancy such that if one method is closed for repair, the lake will remain at safe levels.
- Reduce long-term operation and maintenance burden. The existing tunnel has required repeated significant challenging and costly repairs and is not resilient in the long-term.

History of the Spirit Lake Outflow Tunnel

1980: Mount St. Helens erupts, causing widespread damage and loss of 57 lives. Blast debris blocks the outlet to Spirit Lake, and the lake can no longer drain.

1982: Impounded waters of Spirit Lake rise dangerously and FEMA fears a catastrophic flood from a potential breach of the debris blockage is imminent. The US Army Corps of Engineers (Army Corps) deploys barge-mounted pumps to remove water from the lake.

1985: A tunnel is bored through Harry's Ridge to create a new outlet for Spirit Lake water. This addresses the immediate dangers of the lake overflowing and release of the debris blockage to downstream communities.

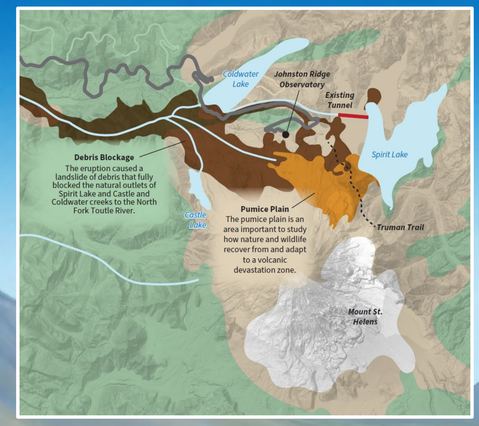


1989: The Army Corps builds a sediment retention structure on the North Fork Toutle River to counteract ongoing sedimentation in the area's rivers by slowing the flow of water to allow debris to settle rather than be carried downstream.

1995 & 1996: Major tunnel repairs are required for two consecutive years. During these efforts, Spirit Lake is unable to discharge. Rising water levels approach the maximum safe operating levels where pressure on the natural debris blockage increases, and creates concern about potential future tunnel failure and the downstream consequences.

2016: Major tunnel repairs noted during annual inspections are addressed. As in 1995 and 1996, Spirit Lake water levels approach maximum safe operating levels while repairs are underway.

2021: The U.S. Forest Service (USFS), Gifford Pinchot National Forest is seeking a long-term solution to managing Spirit Lake water levels. As the responsible agency, the Forest Service must address the consequences of the aging tunnel, and a single lake outlet.



Harry's Ridge

Mount St. Helens

4500'

Harry's Ridge
Vertical exaggeration 2x

Spirit Lake

Inflow

Shear Zones are areas of intense geological pressure that affect the tunnel

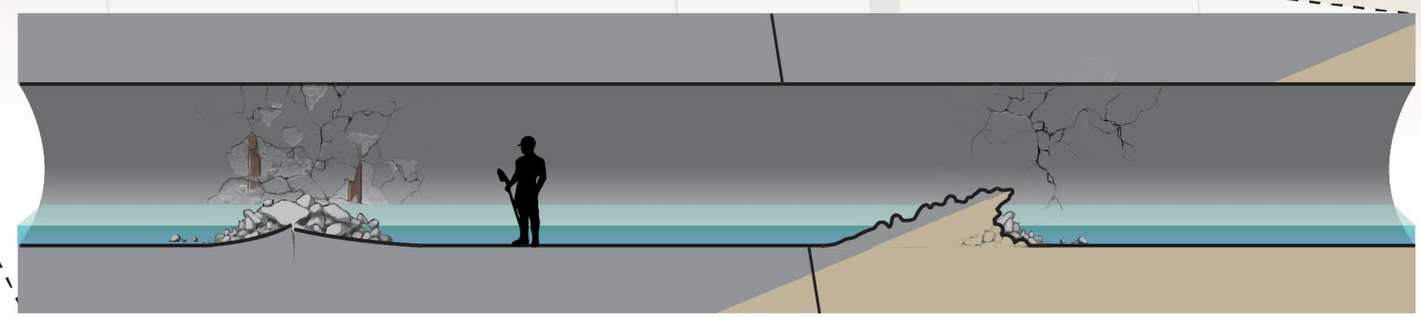
Tunnel

Tertiary Dike

Outflow

Area prone to damage

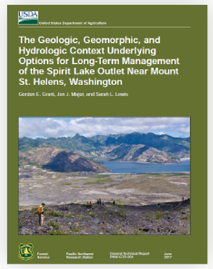
3000'



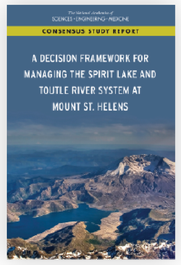
The normal operating lake level elevation is 3,440 ft. If the tunnel becomes inoperable, lake levels will rise. When lake levels reach 3,506 ft elevation, lake water will come into contact with the base of the pyroclastic deposits leading to seepage erosion through the blockage. Lake water pressure on these fragile deposits could result in destabilization and a breach of the debris blockage, resulting in potentially catastrophic flows of water and volcanic debris downstream, also called a lahar.

Foundational Studies and Decision-Making Framework

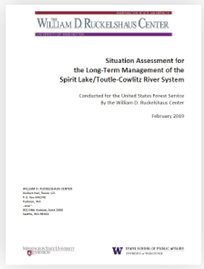
The Spirit Lake and Mount St. Helens area has been the subject of extensive research efforts focusing on understanding the unique geological and ecological aspects of the region as well as identifying and collaborating with a diverse array of stakeholders whose interests and communities are impacted by tunnel management decisions.



2017: The **USFS Pacific Northwest Research Station** publishes a semiquantitative risk assessment that explores the three principal regional hazards (floods, earthquakes, and eruptions) as they relate to the Spirit Lake debris blockage and potential tunnel solutions.



2018: Inspections of the outflow tunnel indicate a need for millions of dollars in repairs to avoid failure. The **National Academies of Sciences, Engineering, and Medicine (NASEM)** publishes a comprehensive report proposing decision-making processes to address the long-term safety and management issues related to the Spirit Lake tunnel and the Toutle River system.



2019: The USFS commissions the **William D. Ruckelshaus Center** to draft a Situation Assessment for the "Long-Term Management of the Spirit Lake/Toutle-Cowlitz River System". Interviews are conducted with stakeholders from public, private, tribal, and nonprofit entities. Common themes and sub-themes are identified in values and preferences for how to manage the challenging system.

2020: USFS completes the NEPA process for the **Spirit Lake Tunnel Intake Gate Replacement and Geotechnical Drilling Project**. This Project is separate from the Spirit Lake Outflow Safety Project. The Tunnel and Gate replacement project is a maintenance and safety project and includes repairing the tunnel inlet, building temporary roads to the work area, and conducting geotechnical drilling. This work is currently underway and scheduled for completion in 2027.

2021-2024: USFS conducts stakeholder engagement in parallel with engineering feasibility analysis of potential outflow options prior to beginning the NEPA compliance process. Based on the NASEM Report recommendations, the **Spirit Lake, Toutle/Cowlitz River Collaborative** was created as a system-level entity to lead a collaborative multi-agency, multi-jurisdictional effort with the goal of addressing sediment management and risks associated with catastrophic flood in the Spirit Lake and Toutle/Cowlitz River system.

The NASEM Report provides advice for the decision-making process happening now.

NASEM recommended "*Multi-Criteria Decision Analysis*" as the essential tool in managing the Spirit Lake and Toutle River system.

Multi-Criteria Decision Analysis

Balancing Science, Engineering Feasibility, and Stakeholder Values

- Provide a firm foundation for agency decision-makers to develop draft alternatives for a resilient Spirit Lake Outflow solution.
- Integrated effort including public and stakeholder values and adjacent management and regulatory agency missions identified through an enhanced outreach process.
- Balance scientific values, engineering objectives and constraints, and input from interested parties, agency, and government.

USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Gifford Pinchot National Forest

Resources and Values

SPIRIT LAKE OUTFLOW SAFETY IMPROVEMENT PROJECT Existing Environment: Resources and Values

Spirit Lake plays an important role in the hydrologic, ecologic, and human environments of the Mount St. Helens region. Numerous resources and values are present in the area, including public safety, fish and wildlife, research opportunity, heritage, and recreation. These resources require active management by federal, tribal, state, and local governments, each with their own priorities and mandates. The overarching objective of the proposed tunnel safety project is to protect downstream communities from a potentially catastrophic flood/release event. The Project must balance the varying stakeholder interests to arrive at a solution (Alternative) that addresses the long-term use and values of the area. This figure illustrates some of the key stakeholder values present around Spirit Lake, Mount St. Helens, and the Toutle River system.

Public Safety: Cowlitz County
Ensure safety of downstream communities and focus on economic stability and growth.

Sediment and Flood Control: US Army Corps of Engineers
Manages eruption-related sediment in the North Fork Toutle and Cowlitz rivers to prevent downstream flooding and provide for the safety of downstream communities.

Sensitive Biological Resources
Wetlands, trout, and plants are just some of the sensitive biological resources in the area.

Debris Blockage
The eruption caused a landslide of debris that fully blocked the natural outlets of Spirit Lake and Castle and Coldwater creeks to the North Fork Toutle River.

Recreation
Johnston Ridge Observatory provides stunning views of the volcano, lake, and pumice plain and receives thousands of annual visitors. Education and interpretive materials teach visitors about the history of the Monument. Many trails crisscross the Gifford Pinchot National Forest providing numerous vantage points and experiences to visitors and recreation users.

Public Safety
U.S. Forest Service manages Spirit Lake Tunnel and infrastructure to regulate outflow of Spirit Lake for safety of downstream communities.

Coldwater Lake

Johnston Ridge Observatory

Existing Tunnel

Spirit Lake

Castle Lake

Truman Trail

Pumice Plain
The pumice plain is an area important to study how nature and wildlife recover from and adapt to a volcanic devastation zone.

Mount St. Helens

General Wildlife
Elk are a focus of conservation as well as a cherished game animal and elk viewing is a popular activity among Monument visitors.

Cultural Resources
This active volcano has been listed as a Traditional Cultural Property in the National Register of Historic Places due to the sacred significance of the site to tribes from time immemorial.

Balancing Safety, Research, Nature, Economy, Heritage, and Recreational Use in the Spirit Lake Area

Public Safety

The tunnel was built in an emergency capacity to address the immediate danger of Spirit Lake overflowing after the Mount St. Helens eruption blocked its natural outlet. During the tunnel's lifespan, it has maintained the level of Spirit Lake at a safe elevation. The lake only approached its maximum safe operating level when the tunnel was closed for extended repair. Therefore, a reliable outlet is needed that would not require repeated and expensive interventions and extended tunnel closures. The area around Mount St. Helens, including Harry's Ridge where the tunnel is located, is geologically active with evolving subsurface conditions and shifting geologic structure. The tunnel crosses both strong and weak rock along faults and shear zones. The geological pressures in these weak zones have caused rock heave, compression, cracking, and support failures, which have necessitated periodic major repairs.

The tunnel is subject to geologic pressures and will require extended closures for repair. If the tunnel fails, the result would be rising lake levels that could exceed the maximum safe operating level, at which point pressure from rising water levels could force the release of the natural debris blockage, putting the downstream population of approximately 50,000 people at risk of catastrophic flooding and mudflows (lahars). The overall purpose of this project is to find a long-term solution to this issue to improve the safety of downstream communities.

Pumice Plain Research Area

The aftermath of the Mount St. Helens eruption in 1980 offered a unique opportunity to study how nature and wildlife recover from and adapt to a volcanic devastation zone. There are few places in the world that offer comparable research value to academics, conservationists, and students. Mount St. Helens provides a study of volcanic recovery similar only to sites such as Surtsey Island in Iceland, an UNESCO World Heritage Site. The U.S. Forest Service Pacific Northwest Research Station has led research efforts for over 40 years.

The Forest Service has specific measures within the Gifford Pinchot National Forest Land and Resource Management Plan (Forest Plan) with the goal of "protecting the geologic, ecologic, and cultural resources, allowing geologic forces and ecological succession to continue substantially unimpeded. Permit scientific study, research, recreation, and interpretation" (Forest Plan, IV-99). There are about 30 ongoing research studies in the pumice plain, and more than 300 peer-reviewed papers on ecosystem responses to volcanism have been published. The majority of this research pertains to ecological succession, biological community assembly, biological organization, biotic interactions, stream developments, soils, and small mammals.

The 1982 National Volcanic Monument Act and the 1985 Comprehensive Management Plan establish research and scientific study except when it may be necessary to protect public health and safety and to prevent undue modification of the natural conditions of the Monument."

Sensitive Species and Habitat

The Spirit Lake area provides potential habitat for species that are listed under the Federal Endangered Species Act, including gray wolf, North American wolverine, marbled murrelet, northern spotted owl, yellow-billed cuckoo, bull trout, monarch butterfly, and whitebark pine. Additional species, such as Van Dyke's salamander and mountain goat, are included on the Regional Forest Sensitive Species List.

Recreational Use

Mount St. Helens is a unique place, offering visitors the opportunity to view and experience the result of a massive volcanic eruption. Spirit Lake is in the middle of the Mount St. Helens National Monument which is part of the Gifford Pinchot National Forest. National Monuments are protected areas that are of great historical, cultural, and/or natural value. Thousands of visitors travel to see the devastation zone and recreate in the area. While Spirit Lake is not directly used for recreation (e.g., paddling, fishing), the lake plays an important role in popular recreation activities such as hiking, wildlife viewing, and limited big game hunting. The Truman Trail offers limited hiking access to the pumice plain along the western side of Spirit Lake.

Cultural and Religious Value

This active volcano has been listed as a Traditional Cultural Property in the National Register of Historic Places due to the sacred significance of the site to tribes from time immemorial.

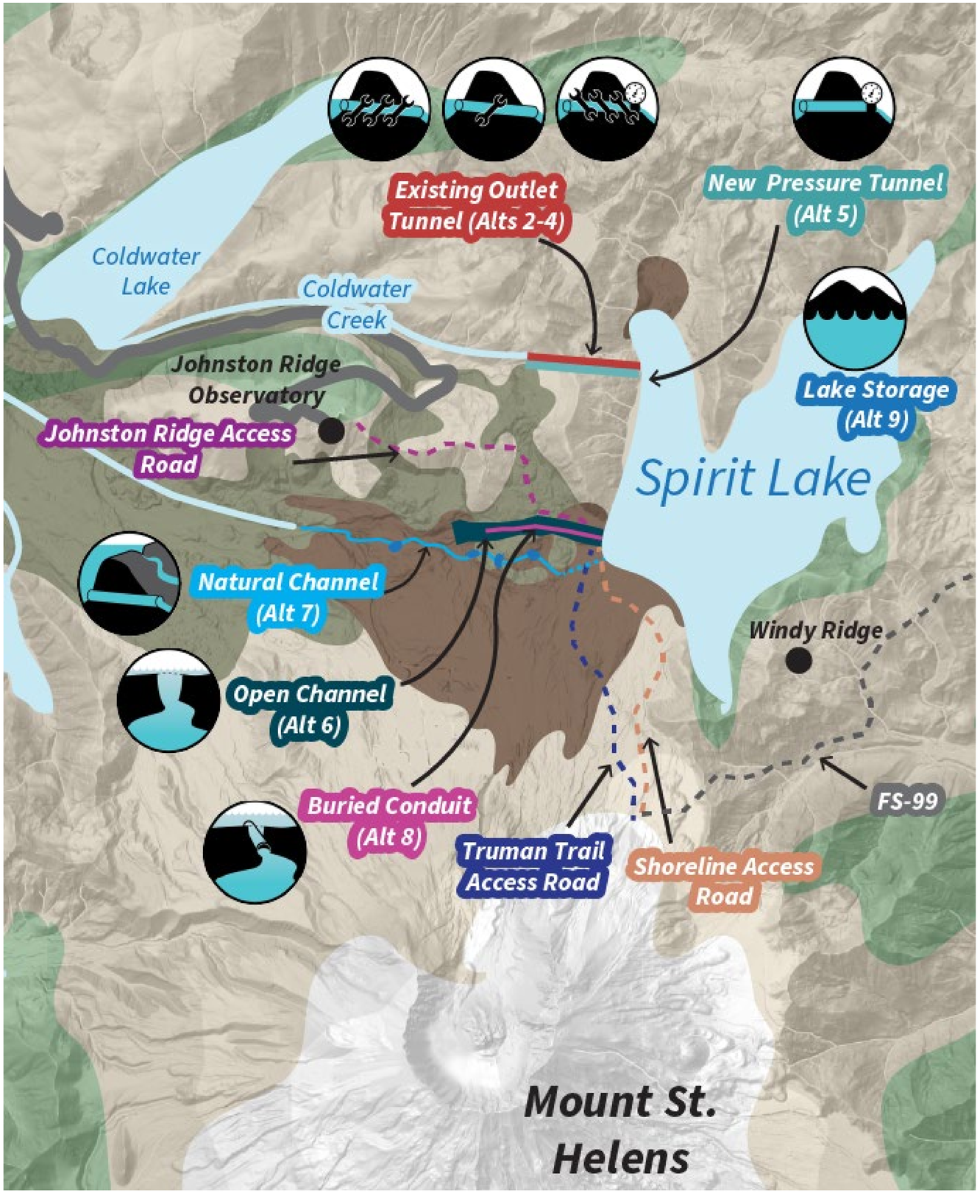
Local Economy

Tourists and visitors from across the world travel to Mount St. Helens and the local economy benefits greatly from these visitors. Visitors buy goods and services that support local business, including gas stations, restaurants, hotels, guide services, and outfitters. All these purchases generate tax revenues which fund schools, public services, and infrastructure improvements.



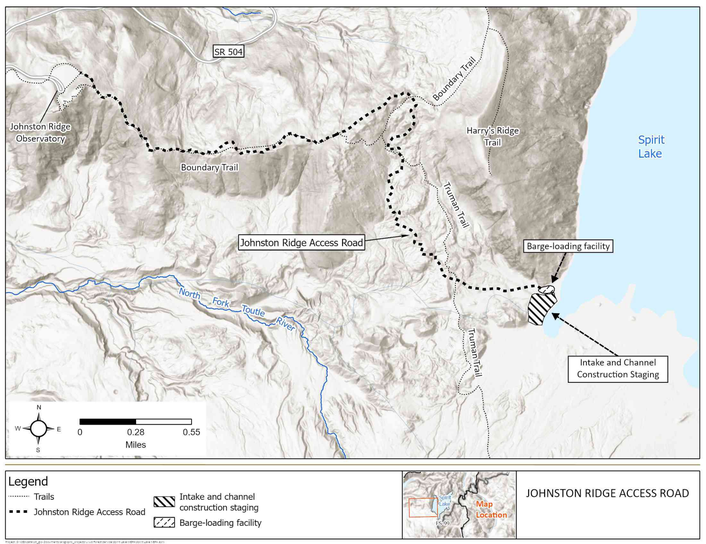



Proposed Alternatives



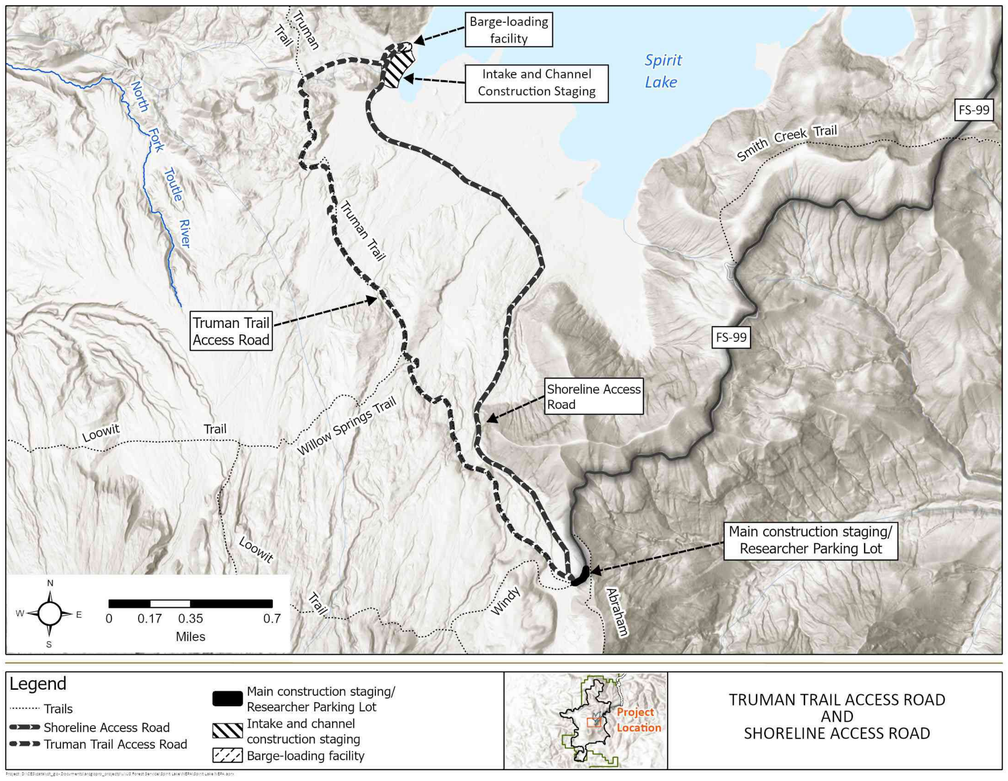
	Alt 1 - No Action. Current management plans would continue to guide management of the Project Area; no outflow redundancy constructed; routine inspections and required maintenance of the existing tunnel would continue.
	Alt 2 - Full Repair of Existing Outlet Tunnel to enlarge constricted JKL shear zone complex to restore full tunnel outflow capacity to 550 cfs and reinforce/repair all other parts of tunnel.
	Alt 3 – Minor Repair of Existing Outlet Tunnel. Repair of the existing tunnel only through the JKL shear zone complex.
	Alt 4 - Convert the Existing Outlet Tunnel to a Pressure Tunnel by installing a steel liner within the existing tunnel and constructing a flow control structure at downstream tunnel outlet.
	Alt 5 - New Pressure Tunnel through Harry's Ridge (parallel to existing tunnel) that would outflow to Coldwater Creek; maximum discharge of 1,000 cfs.
	Alt 6 – Mechanically Excavated Open Channel with cut slopes up to 250-feet-deep, and a 1,300-foot-wide floodplain resulting in 22 million cubic yards of loose material and 149-acre stockpile on the Pumice Plain.
	Alt 7 – Combination of a New Pressure Tunnel and Phased Formation of a New Habitat Channel. New pressurized tunnel with intake at 3,440 feet would function as the primary outlet, minor repairs to the existing outlet tunnel for redundancy, and later a phased natural habitat channel formation.
	Alt 8 - Buried Conduit within the Debris Blockage. Construct large, buried conduit through the debris blockage to serve as a redundant, emergency spillway.
	Alt 9 – Lake Storage. Increase safe storage capacity of Spirit Lake to provide a larger storage volume and longer time for repairs of the primary outlet to occur by lowering intake to 3,400 feet.

Access Road Options



Johnston Ridge Access Road

- Could be used for Alternatives 3, 4, and 5
- ~ 3.9-miles long, 16-feet-wide, from Johnston Ridge Observatory to barge-loading facility at Leech Cove
- Follows Boundary Trail alignment for first 1.9-miles
- Extensive cut and fills, engineered structures, stabilization structures, and switchbacks to accommodate the dynamic topography within the Spillover



Truman Trail Access Road

- Could be used for all alternatives
- ~3.5 miles long from Researcher Parking Lot to barge-loading facility
- Minimal new disturbance because it would follow the alignment of the temporary access road present for the ongoing Spirit Lake Tunnel Intake Gate Replacement Project
- For Alts 2-5 and 7: 16-feet-wide
- For Alts 6 and 8: up to 80-feet-wide during construction; restored to 16-feet-wide for permanent access

FS-99 Upgrades and Widening

- Alts 2-5 and 7: minor upgrades to unstable sections; no widening
- Alts 6 and 8: widening certain sections, creating wider curves for turn outs and switchbacks, downslope road embankment stabilization, pothole repairs, and drainage improvements to accommodate large construction equipment
- From Windy Ridge to Researcher Parking Lot - widening by cutting up the slope and upslope rock reinforcements, grading, and drainage improvements to improve road geometry, safety, drainage, stability, and all-season performance
- Alt 6: snow clearing to maintain all-season construction access
- Crosses Riparian Reserves, Late-Successional Reserves

Shoreline Access Road

- Could be used for Alts 3-5, 6, and 8
- ~2.98 miles long from Researcher Parking Lot to barge-loading facility
- Extensive stabilization where it crosses soft, saturated wetlands and unstable soils close to lake
- For Alts 3-5 : 16-feet-wide
- For Alts 6 and 8: up to 80-feet-wide during construction; restored to 16-feet-wide for permanent access

Existing Temporary Access Road for Tunnel Intake Gate Replacement Project

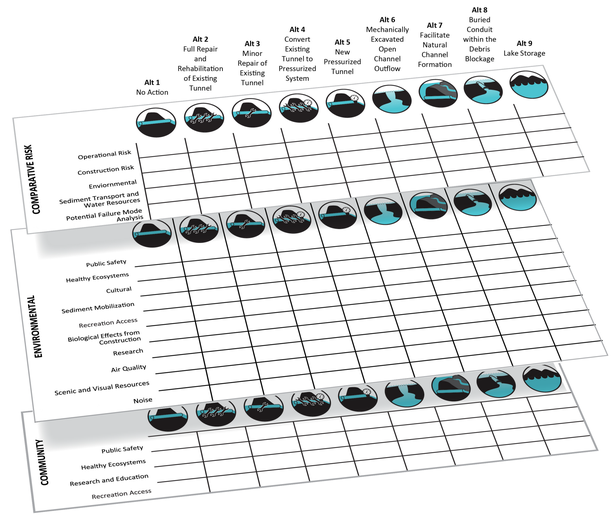
View from Truman Trail on Pumice Plain, facing north

View of road, looking south to Mount St. Helens. Road, stockpiles, equipment visible.

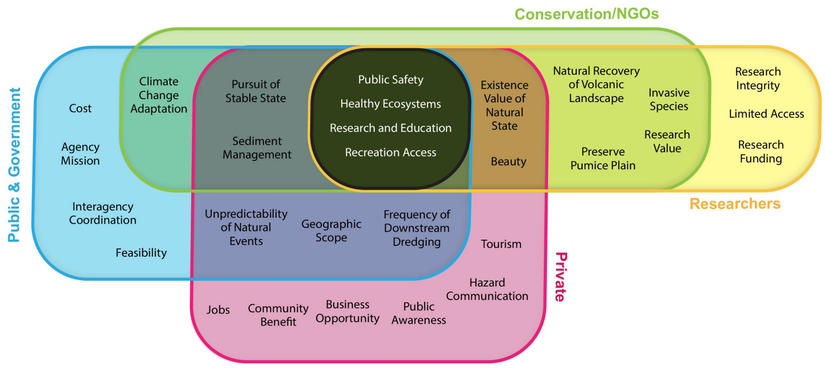
View from Johnston Ridge Observatory, facing south

Multi-Criteria Decision Analysis Tool

NASEM recommended development of a ***multi-criteria decision analysis tool (MCDA).*** The MCDA tool is meant to find balance among competing values and goals through dialogue and interaction with interested groups and individuals as well as technical experts and agency personnel. It takes into consideration technical concerns in addition to issues raised by participants. The MCDA framework is built around ***3 Key Dimensions: Community, Comparative Risk, and Environmental.***



Community: Stakeholder groups include researchers, public agencies/government agencies, tribes, non-governmental organizations and conservation groups, and private individuals and other interested parties. The Venn diagram shows the intersection of issues identified by stakeholders during NASEM engagement, Ruckelshaus interviews, and during the public comment period for the Tunnel Intake Gate Replacement Environmental Assessment: *public safety, species conservation, habitat conservation, and education*.



Comparative Risk: The technical hazard and risk considerations of engineering and design of construction and operation of each alternative. Each alternative has unique ground disturbance footprints and potential for sediment mobilization. There is no risk-free way to remove water from Spirit Lake. The exact means by which the debris blockage could fail involve more than one process occurring in a sequence of events that together lead to failure.

Environmental: Impacts to the natural and human environment, analyzed in the NEPA EIS. Impacts to resources range from none to major.

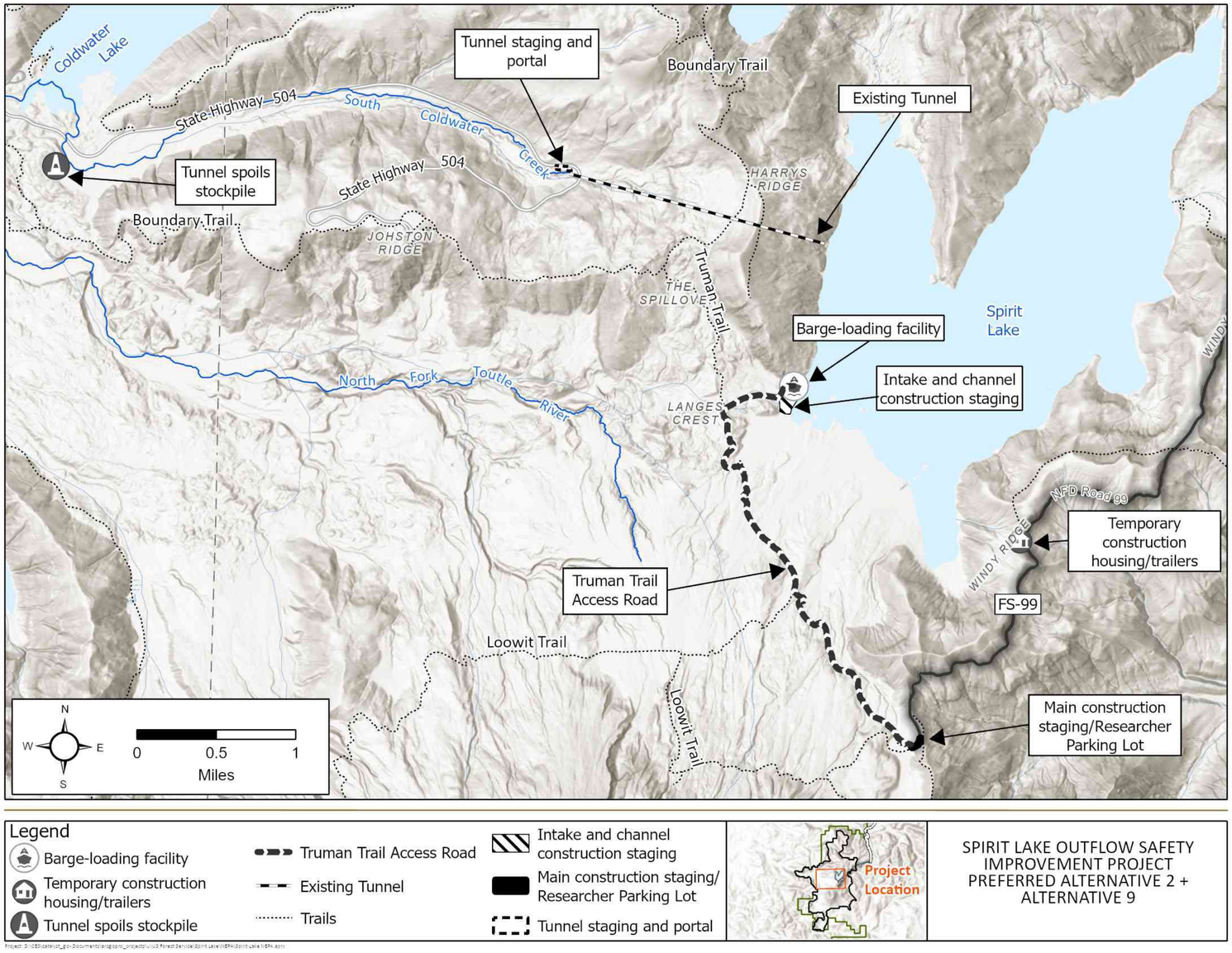
C = Construction, O = Operation	Alt 1: No action	Alt 2: Full Repair and Rehabilitation of Existing Tunnel	Alt 3: Minor Repair of Existing Tunnel	Alt 4: Convert Existing Tunnel to Pressurized System	Alt 5: New Pressurized Tunnel	Alt 6: Mechanically Excavated Open Channel Outflow	Alt 7: Phased Natural Habitat Channel Formation	Alt 8: Buried Conduit within the Debris Blockage	Alt 9: Lake Storage
	C O	C O	C O	C O	C O	C O	C O	C O	C O
Air Quality	◑ ○	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◑ ◑	○ ○
Botany and Invasive Plant Species	◑ ○	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◓ ◓	◑ ◑	◓ ◓	◑ ◑
Cultural and Heritage Resources	○	◔	○	●	●	●	◔	●	○
Fish and Wildlife	◑ ○	◓ ◓	◓ ◓	◓ ◓	◓ ◓	● ●	◓ ◓	◓ ◓	◑ ◑
Noise	◑ ○	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◑ ◑	○ ○
Public Safety and Risk	● ●	◓ ◓	◔ ◔	◓ ◓	◓ ◓	● ●	◑ ◑	◓ ◓	◑ ◑
Recreation (access)	◑ ○	◑ ◑	◑ ◑	◑ ◑	◑ ◑	● ●	◑ ◔	◑ ◑	○ ○
Recreation (Forest Plan conflicts)	○ ○	● ●	● ●	● ●	● ●	● ●	● ●	● ●	○ ○
Research	○ ○	● ●	● ●	● ●	● ●	● ●	● ●	● ●	◑ ◑
Sediment Transport and Water Resources	◑ ○	◑ ◑	◑ ◑	◑ ◑	◑ ◑	◑ ◔	◑ ◑	◑ ◑	○ ○
Soils	○ ○	◑ ◑	◑ ◑	◑ ◑	◑ ◑	● ●	◓ ◑	◑ ◑	◑ ◑
Visual Resources	○ ○	● ●	● ●	● ●	● ●	● ●	● ●	● ●	◑ ○
Wetlands and Riparian Areas	◑ ○	◑ ◑	◑ ◑	◑ ◑	◑ ◑	● ●	◓ ◑	◑ ◑	◑ ◑
Special Topics									
Potential Fish Passage to Spirit Lake	**N**	**N**	**N**	**N**	**N**	**Y**	**Y**	**N**	**N**

KEY

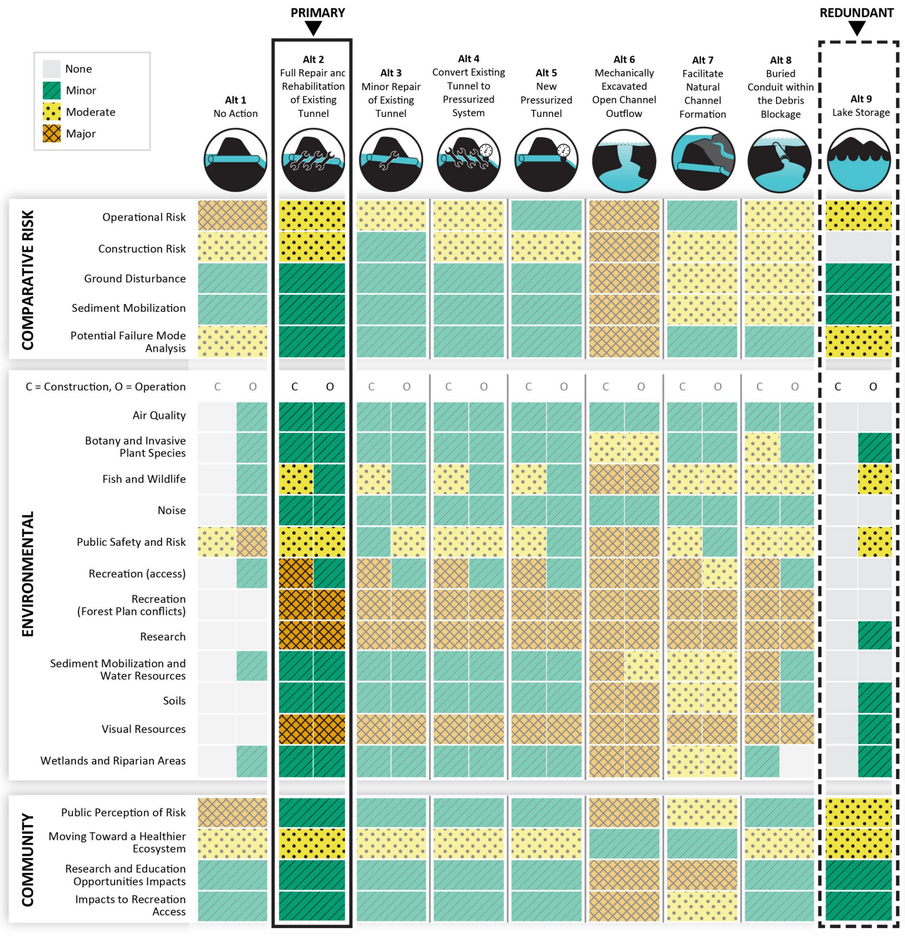
No impact ○ Minor impact ◑ Moderate impact ◓ Major impact ●

Yes **Y** No **N**

Preferred Alternative: 2 (Full Repair of Existing Tunnel) + 9 (Increased Lake Storage)



Applying the MCDA Tool



Alternative 2 prioritizes minimizing adverse environmental consequences:

- would re-use the existing temporary Truman Trail Access Road and therefore limit loss of long-term research plots, vegetation, fish and wildlife resources.
- impacts would be minor and primarily occur during construction (e.g., temporarily limited recreation access).

- Not responsive to the community value placed on creating a healthy ecosystem that would provide for potential future volitional fish passage between the North Fork Toutle River and Spirit Lake.

Primary Outflow: Full repair of the existing outflow tunnel:

- enlarging the constricted JKL shear zone complex to restore full tunnel outflow capacity to 550 cfs,
- preventive reinforcement of all other shear zones
- improvement of the lining along the lower third of the tunnel,
- and reduction of rock fall hazard in the vertical intake shaft.

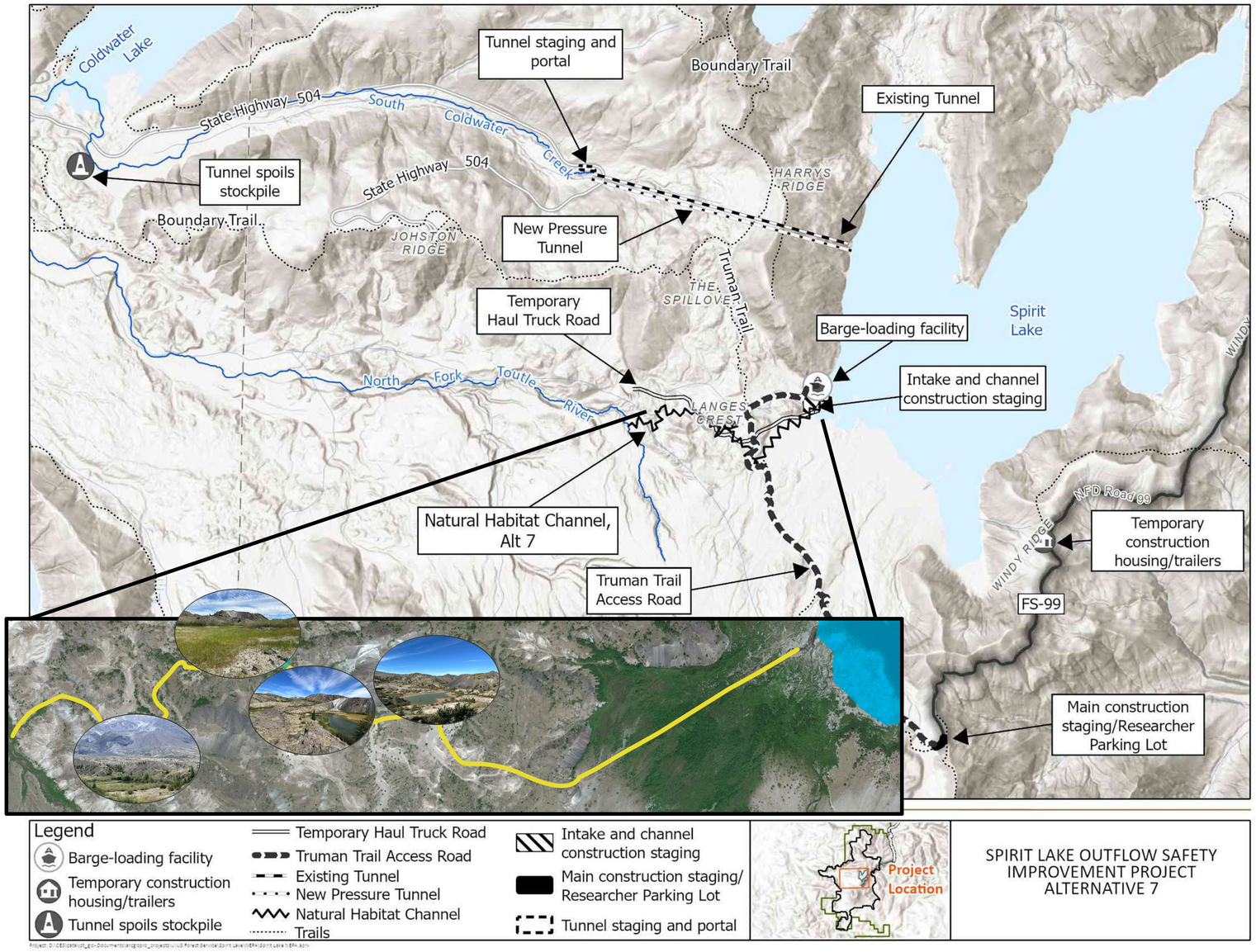
Construction Access: SR-504, Truman Trail Access Road

Permanent Access: Truman Trail Access Road

Redundant Measure: Lowered intake of the repaired existing tunnel (at 3,400 feet) would allow operating lake at a lower level (Alternative 9). This will increase the volume of water that can be stored in the lake, preventing the lake levels from exceeding the safe operating levels.

Siphons would also be available during future repairs if the lake reaches an unsafe level.

Preferred Alternative: 7 (New Pressure Tunnel + Phased Habitat Channel Formation)



Primary Outflow: New pressure tunnel parallel to existing tunnel through Harry's Ridge with an intake level at 3,400 feet

Redundant Outflow: Rehabilitate existing tunnel through the JKL shear zone

Construction Access: Truman Trail Access Road, temporary haul roads

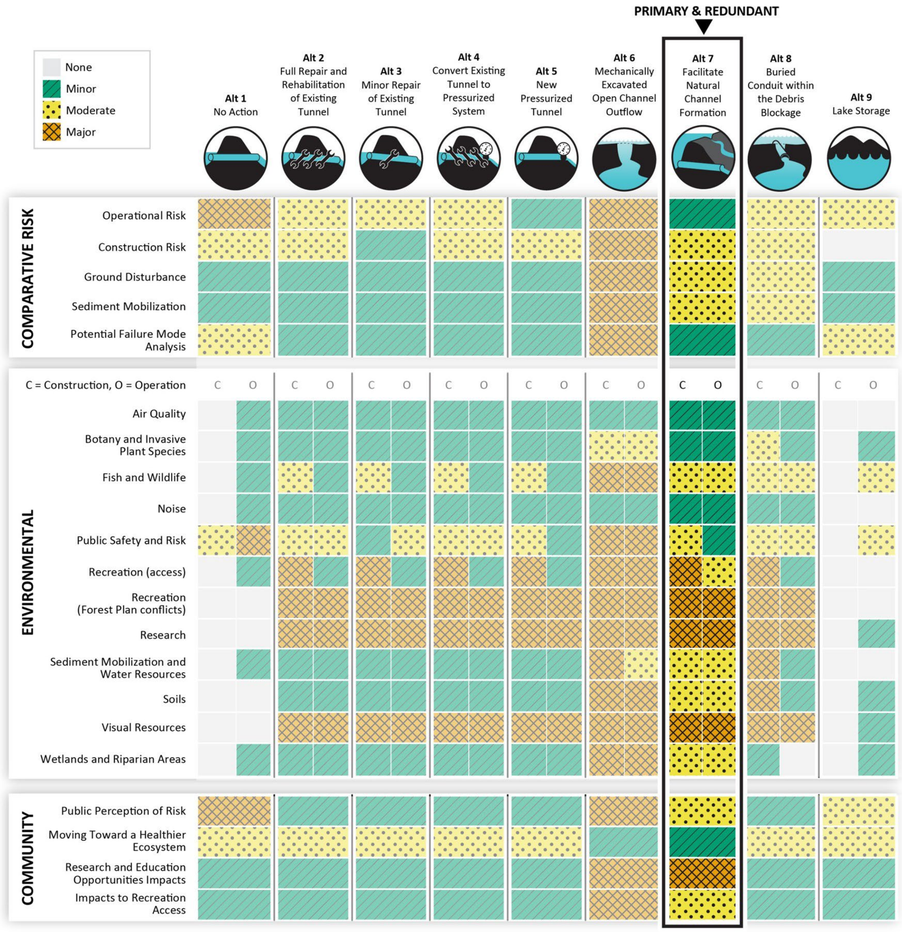
Permanent Access: Existing tunnel, Truman Trail Access Road

Natural Habitat Channel Formation: The concept of "*Engineering with Nature*" lets natural processes do the work with some engineered protections (e.g., riprap toe stabilization, bank protection) to limit risk from natural hazards, including geologic and geomorphic hazards.

Construction of the *primary pressure tunnel* allows for the future, phased construction of a pilot channel to initiate the process of new channel formation after the lake level has been drawn down to 3,400 feet. This would include controlled removal of part of the debris blockage to allow water entry. From there, the path of water flow would connect old channels where small ponds are currently present.

The habitat channel would be formed slowly over 10-20 years and would restore hydrological connection between Spirit Lake and North Fork Toutle River.

Applying the MCDA Tool



Alternative 7 prioritizes the community's identified value of enhancing ecosystem health: allows for creation of a habitat channel reconnecting the North Fork Toutle River to Spirit Lake, thus facilitating potential future volitional fish passage.

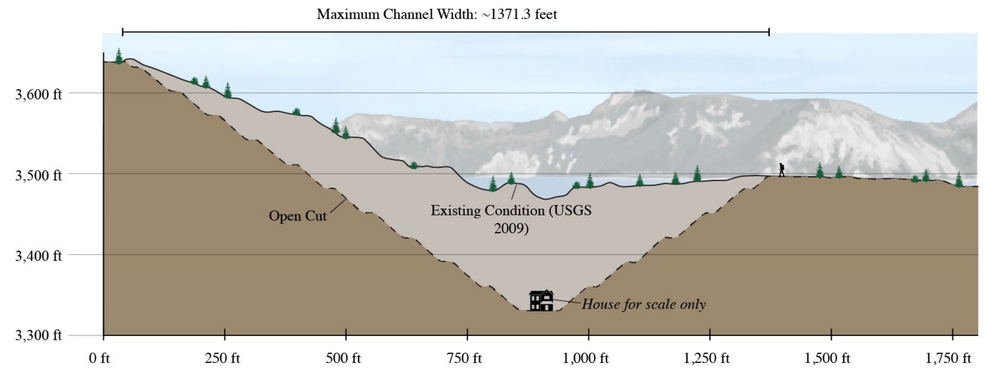
Among the safest operationally because it features pressure tunnel and additional tunnel outlet.

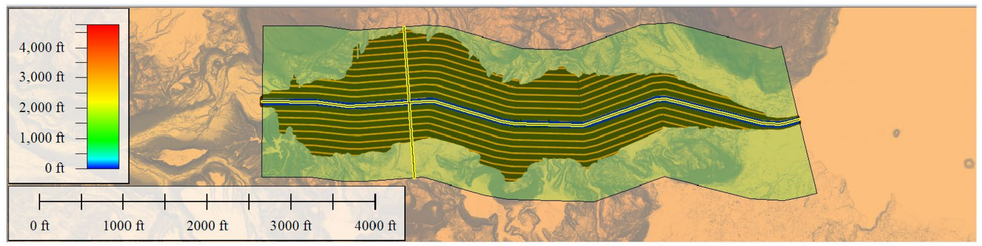
Includes excavation in the Pumice Plain and would impact some research plots.

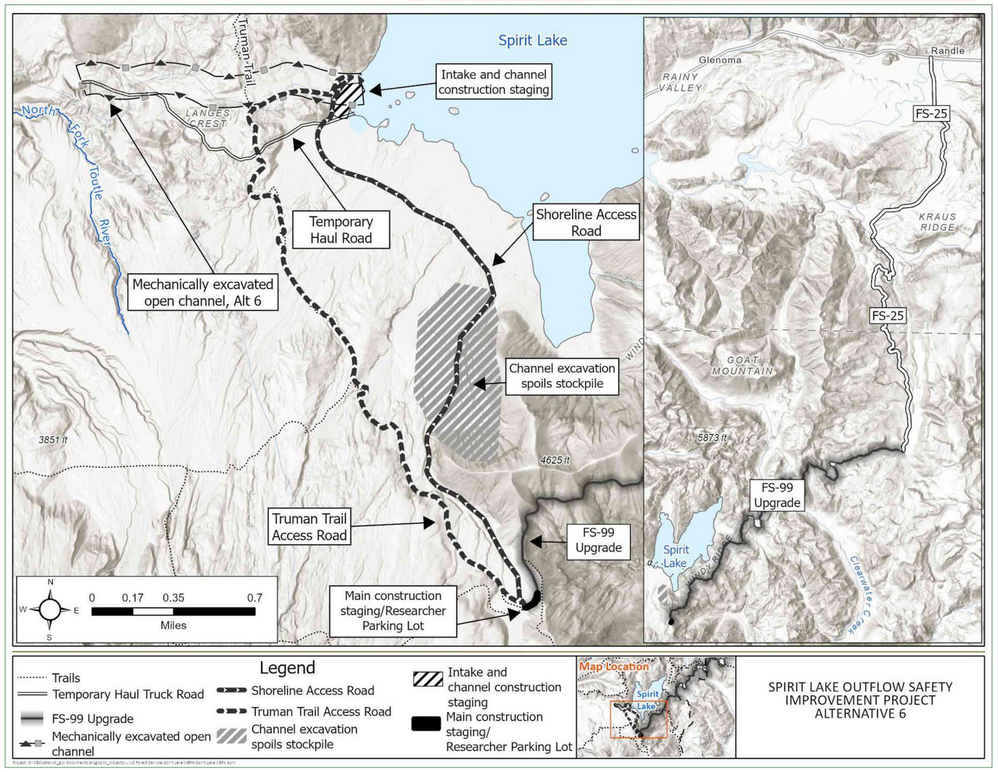
Like alternative 2, reuses the path of the existing temporary Truman Trail Access Road, limiting permanent access road impacts (e.g., loss of long-term research plots, vegetation, fish and wildlife).

Moderate sediment mobilization over time from phased habitat channel formation.

Alternative Found to be Functionally Infeasible
Alternative 6: Mechanically Excavated Open Channel Outflow







<u>Road Access:</u> An 80-ft-wide Truman Trail Access Road or Shoreline Access Road would provide access to the channel excavation and disposal site, respectively.

Extensive FS-99 upgrades and widening are also required to support very large construction equipment and would impact late-successional reserves along FS-99.

Primary Outlet: Excavation of a 6,450-ft long open channel with steep (2:1 horizontal to vertical) cut slopes up to 250-ft deep.

- Bottom width of the channel would be about 120-ft wide (40-ft wide channel bottom + 80-ft wide floodplain). *At its widest point, the channel would be over 1,300 feet across*.
- Would require extensive hardscaping with engineered concrete features for safety. The channel would not resemble a natural river but rather would look more like a very large manmade canal or spillway.
- Excavation of up to 22 million cubic yards of loose soils that would need to be permanently stockpiled on the Monument.
- *The permanent stockpile would be approximately 149 acres and up to 200 ft tall.*
- Construction would take approximately 10 years with winter shutdowns in years 1-4 and year-round construction once the lake level is lowered.

Applying the MCDA Tool

Alternative 6 is the least safe, most technically infeasible, and has the most severe, adverse environmental impacts of all the alternatives analyzed for both construction and operations.

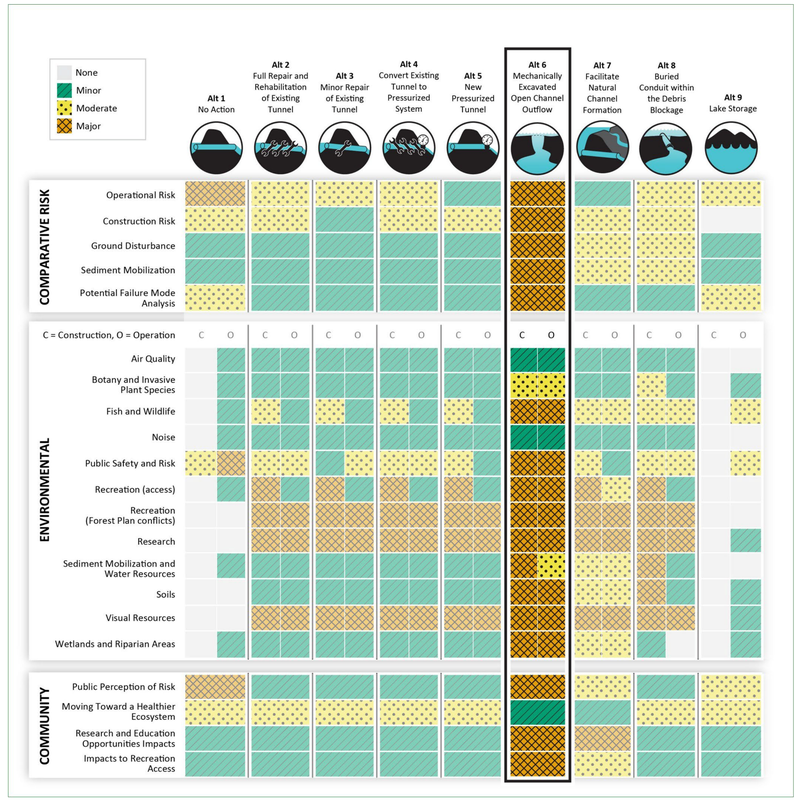
Community : This alternative has garnered support among stakeholders who prioritize ecosystem restoration and the potential for reestablishing fish passage between the North Fork Toutle River and Spirit Lake. *These same goals are more safely and sustainably addressed by Alternative 7* (phased natural channel), which was developed in collaboration with tribes and the Spirit Lake/Toutle-Cowlitz River Collaborative.

Engineering/Risk: Results in major, adverse effects across all comparative risk factors in the MCDA tool.

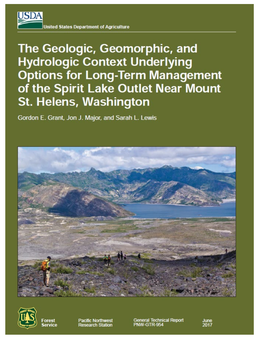
This finding is consistent with expert guidance provided in Grant et al. (2017) and Major et al. (2020), both of which *underscore the geomorphic instability and long-term failure potential associated with constructing a deep open channel across the debris blockage.*

Environmental: Major, permanent, adverse impacts to fish and wildlife, wetland and riparian areas, sediment release, public risk, recreation access, research, and visual resources.

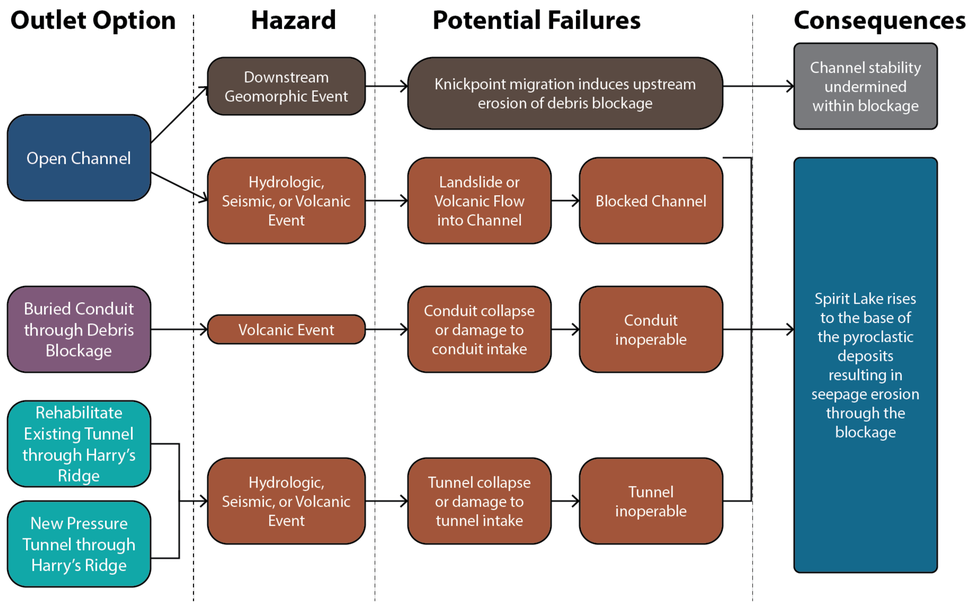
Would require major amendments to the 1985 Mount St. Helens Comprehensive Management Plan, 1990 Gifford Pinchot Land and Resource Management Plan, and Northwest Forest Plan. These amendments would entail extensive additional environmental review and conflict with long-standing protective designations for research, recreation, visual quality, and natural values on the Monument.



Public Safety and Risk



***"The Geologic, Geomorphic, and Hydrologic Context Underlying Options for Long-term Management of the Spirit Lake Outlet Near Mount St. Helens, Washington"* (Grant et al. 2017) identified ways outlet infrastructure could fail and lead to lake level rise and debris blockage breach, shown below.**



2017 Report Conclusions

- Open channel outlet options can fail via more pathways than tunnel outlets because open channels are exposed to more geomorphic variability and hazards from a wider range of natural processes. The range of potential ways a channel could fail are not as well understood as those for tunnels and conduits. The tunnel options represent a known infrastructure with a track record of maintaining safe lake levels.
- A buried conduit was used temporarily while the tunnel was constructed and performed well.
- An open channel can pass wider ranges of flows and outflow scales with inflow. Tunnels and conduits are limited by their diameter and do not scale with inflow.

Four Hazard Categories

1. Operational: impacts from seismic, volcanic and hydrologic events on long-term operations of the outlet system; timescales for access and intervention to address natural hazard events.

2. Construction: how each option ranks according to the geotechnical and construction conditions that could affect safety and timely completion of the project; differentiating criteria consider magnitude of surface exposure, length, and likelihood of geotechnical, groundwater, and surface water conditions; considers comparative uncertainty associated with geomorphology and dynamic landscapes.

3. Ground disturbance: unanticipated impacts, including permanent disturbance to relatively undisturbed areas and impacts due to access for construction and future maintenance, construction operations, and excavation materials disposal.

4. Sediment mobilization: unanticipated and extended sediment impacts to downstream stakeholders including the sediment retention system and Cowlitz River that could require a change in course of risk management approach.

Three General Risk Levels

- Major: Immediate emergency action is required. Exposure to this level of risk should be avoided if immediate action cannot be implemented.
- Moderate: Investigations and interventions are needed. Exposure to this level of risk should only continue with active monitoring and contingency plans that are reviewed and updated regularly.
- Minor: Exposure to this level of risk is acceptable with limited monitoring.

Consequence of hazard event occurs					
	4 – Intolerable – Could result in disaster	4	8	12	16
	3 – Undesirable – Serious impact and long-term effect	3	6	9	12
	2 – Tolerable – impacts are felt but have minimum long-term effect	2	4	6	8
	1 – Acceptable – minimal damage or no long-term effect	1	2	3	4
		1 – Improbable – Conceivable but not expected to occur (<10%)	2 – Unlikely – not expected but possible (11-25%)	3 – Moderately Likely – May occur occasionally (26-50%)	4 – Probable – will probably occur (>50%)
		Likelihood that the hazard event will occur			

Summary of Alternatives' Public Safety and Risk

Risk Category	**Alt 1** No Action	**Alt 2** Full Repair of Tunnel	**Alt 3** Minor Repair of Tunnel	**Alt 4** Convert Tunnel to Pressure Tunnel	**Alt 5** New Pressure Tunnel	**Alt 6** Mechanically Excavated Open Channel	**Alt 7** New Pressure Tunnel with Habitat Channel	**Alt 8** Buried Conduit through the Debris Blockage	**Alt 9** Lake Storage
Operational	Major	Moderate	Moderate	Moderate	Minor	Major	Minor	Moderate	Moderate
Construction	Moderate	Moderate	Minor	Moderate	Moderate	Major	Moderate	Moderate	Minor
Ground Disturbance	Minor	Minor	Minor	Minor	Minor	Major	Moderate	Moderate	Minor
Sediment Mobilization	Minor	Minor	Minor	Minor	Minor	Major	Moderate	Moderate	Minor