

# At the Intersection of Climate Change and Transportation Infrastructure: Developing Resilience in the Pacific Northwest's Largest National Parks

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## What is the Public Lands Transportation Fellows (PLTF) Program?

The PLTF program provides fellowships to recent graduates in a transportation-related field. The fellows are provided with a unique opportunity for career development and public service working directly with staff of Federal Land Management Agencies (FLMAs) on key visitor transportation issues. The assigned projects help the land units develop transportation solutions that preserve valuable resources and enhance the visitor experience. See footer for a list of sponsors.

## Abstract

- Climate change poses an array of challenges to transportation infrastructure in the Pacific Northwest.
- At Mount Rainier, North Cascades and Olympic National Parks, these challenges are **concentrated in major river corridors**, where flooding, debris flows, and related hazards frequently impact critical Park infrastructure.
- Many Park roads are located in valley bottoms and river floodplains, and run parallel to hazardous rivers.
- As these impacts occur, **public access, administrative operations and emergency services are severely disrupted**.
- In many cases, **climate-driven hazards are expected to continue to increase** in frequency and destructive capacity.
- The National Park Service's Transportation Planning Program is leading an effort to **develop resilient management strategies and secure long-term public access** across these iconic landscapes.

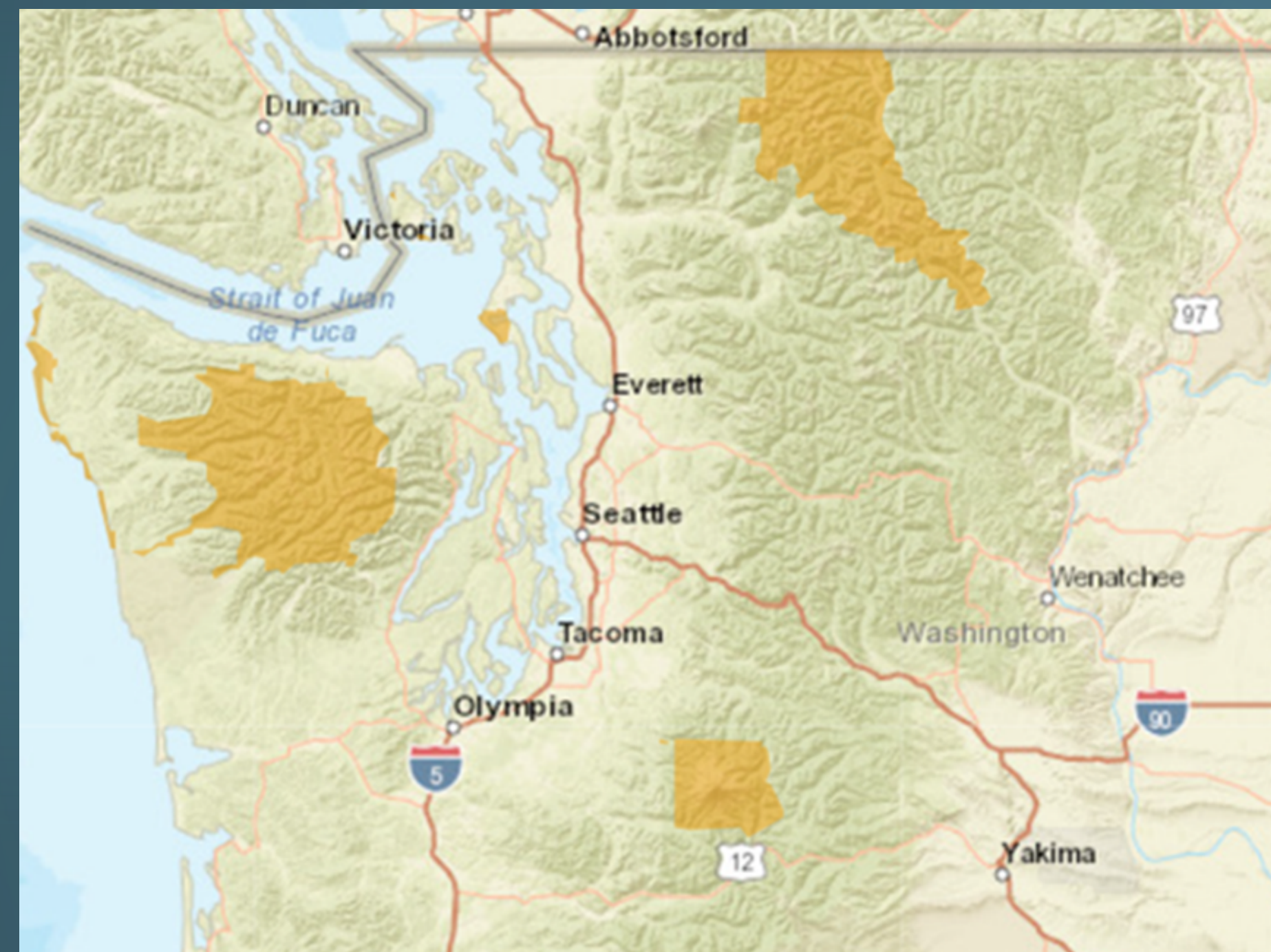


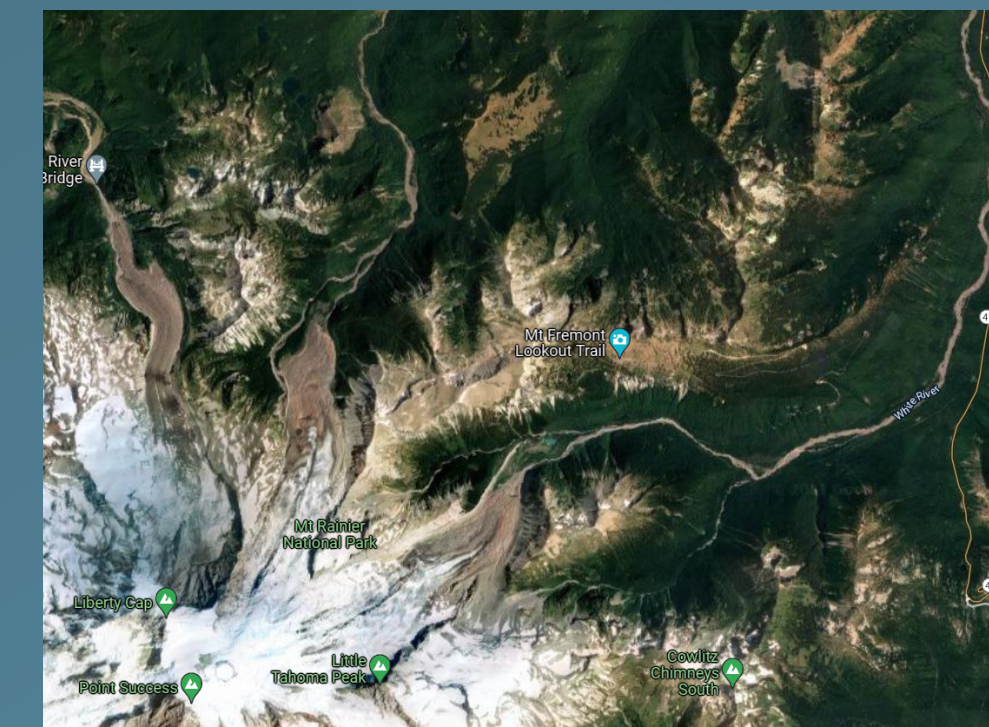
Image: Map of western Washington State with Mount Rainier, North Cascades and Olympic National Parks highlighted in yellow (source: NPS Navigator)

## Acknowledgements

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- Mount Rainier National Park Staff
- North Cascades National Park Staff
- Olympic National Park Staff

## Geology and Hydrology Summary

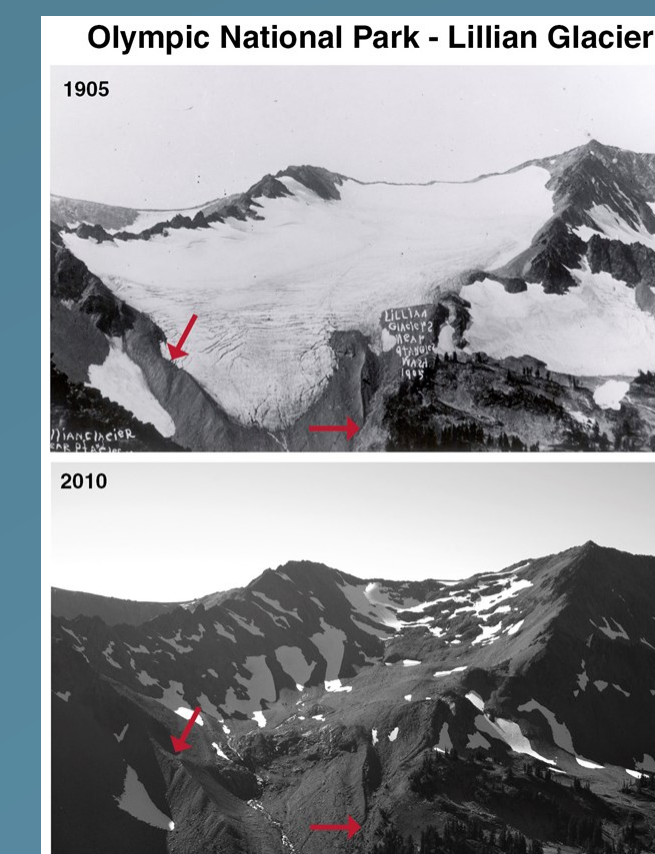
- Mount Rainier, North Cascades and Olympic National Parks are the most glaciated area in the contiguous United States.
- Rapid glacial recession causes Park river systems to behave erratically
- River channels fill in with sediment exposed by melting glaciers, which forces the rivers to migrate and find new paths .
- River course migration often puts the river directly in conflict with critical Park roads.



Images: left: Mount Rainier as seen from Tacoma Port (source: Wikipedia) right: large glaciers flowing down from Mount Rainier (source: Google Maps) Below: (source: nps.gov)

### Glacial Recession – Stark Statistics

- 32% decrease in glacial coverage at Olympic in only 30 years** between 1979 and 2009. (source: Olympic National Park)
- 18% of total glacial volume was lost in a 6-year period** between 2003 and 2009 at Mount Rainier.
- This is a rate of **3% volume loss per year** and a **600% increase** to the historical rate observed in the 1900s.
- (source: Mount Rainier National Park)



### Rivers Rising – Rapid Aggradation

- Vast amounts of sediment exposed by receding glaciers is brought down into the rivers.
- This sediment fills in the channel raises the base elevation of the riverbed.
- Some rivers at Mount Rainier are aggrading at roughly **10x the historic rate**,
- In some locations the river flows as high as **12 feet above the nearby parallel road**.

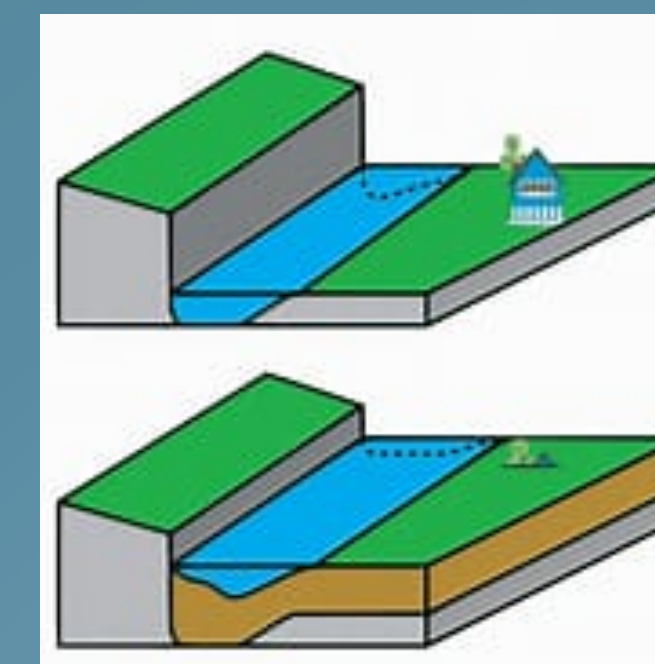


Image: River aggradation graphic- source- Wikipedia

## Climate Change Fuels Natural Hazards

### Changing Climate Signals

- Average temperatures across Western WA are expected to continue to rise, resulting in **continued glacial recession**, less snowpack, and more rain-on-snow.
- The **frequency, duration and intensity of large storm events is expected to continue to increase** across Western Washington.
- This increase will lead to accelerated aggradation and higher flows. (UW CIG)
- Atmospheric rivers, the most destructive storm events, are expected to increase in length, width and moisture transport capacity.
- More frequent large storms combined with existing glacial and river trends suggests **accelerated impacts to Park infrastructure**.

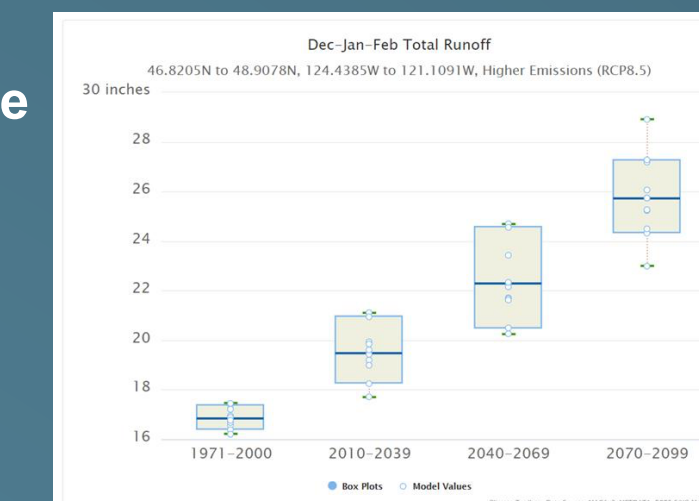


Image below: Example of river avulsion impacting roadway (red) Tahoma Creek at Mount Rainier- source: Mount Rainier NP

### Flooding

- Large storm events lead to high flows in the Parks, and frequently result in **flooding of roadways in floodplains**.
- Flooding has **increased in frequency and destructive capacity** in recent decades, and climate projections indicate this trend will continue.



### Rivers Changing Course

- As river channels fill with sediment, the river finds a new path and can dramatically change course (example in image below).
- This process is known as river avulsion, and has impacted roads at Mount Rainier, North Cascades and Olympic National Parks.



Image: 2006 washout of Nisqually Paradise road and Sunshine Point Campground. (source: The Chronicle)

## Management Challenges

- Wilderness boundaries in these Parks are based on the road alignment at the time of designation.
- As the floodplain landscape dramatically changes, the wilderness boundary does not change, and **roads are unable to reroute away from the hazardous rivers**.
- Funding for proactive, resilient road investment is very limited.
- ERFO funding stipulates building back in-kind and limits betterments, **diminishing the Parks' ability to mitigate future vulnerabilities**.
- Construction timing is limited by seasonality and regulation.



Images: Carbon River Road damages. (source: Pat McMahon)

## Engineering Solutions

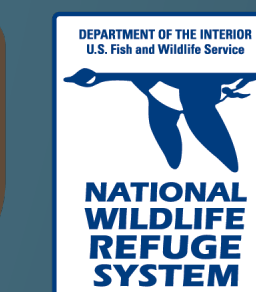
- Realign Park roads** away from increasingly hazardous rivers and floodplains.
- Implement woody debris like logs and root wads in rehabilitation.
- Include live planting of native plant species in bank stabilization efforts.
- Install culverts with removable grates on the road level for easier maintenance.

## Recommended Actions

- Develop a Long-Term Access and Connectivity Plan for Mount Rainier, North Cascades and Olympic National Parks.**
- Conduct vulnerability assessments on impacted roads.
- Evaluate existing access routes in terms of Park priority.
- Define acceptable modes of transportation and access for the public for each impacted route.
- Identify thresholds for impact, rehabilitation and investment tolerance .
- Maintain increased communication and collaboration between the three Parks, the NPS Regional office and the NPS National Office and collectively develop strategies for resilient infrastructure management.



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