MT. BAKER HIGHWAY SCENIC BYWAY MANAGEMENT PLAN

NATURAL FORCES THAT INFLUENCE THE CORRIDOR

1. Geologic hazards
2. Hydrology
3. Tributaries crossing SR 542
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Natural forces that influence the corridor

The geology of the Pacific Northwest is varied, and its expression in the landscape is a major factor in the scenic beauty of this region. The Pacific Northwest landscape has been shaped by plate tectonics and millions of years of volcanic activity. These events were followed by catastrophic ice-age floods and mountains rising as a result of earthquakes. The most visible remains of this activity are the rugged Cascade Mountain Range, which still exhibits thermal activity. Mount Baker is the most northern of Washington's volcanoes and one of the area's most unique features.

These natural forces - and their impact on the SR 542 corridor - are explained in more detail below.

Geologic hazards

The Mount Baker area is laced with geologic hazards typical of a place in the shadow of an active volcano, and along the winding path of a major river, the Nooksack. Years of glacial advance, retreat, melt and hydrologic carving have created land that is largely composed of alluvial material, susceptible to landslides and liquefaction in the case of an eruption and associated earthquake. Geological and natural conditions, particularly with respect to alluvial fans, surface water, wetlands, and steep slopes create roadway hazards. Below is a listing of those found in this area:

Lahars and debris flows — Dense slurries of water-saturated debris originating at a volcano such as Mount Baker are often called lahars. These lahars can form with or without an eruption. They are caused by heavy rainfall, melting of snow or ice, glacial outburst floods, and/or overtopping of crater lakes. Structural changes such as a collapse of the volcanic cone can also cause debris to move downslope, creating a hazard to roadway. These lahars can move as fast as 65 miles per hour depending on mass and slope, and tend to follow drainages (such as the Nooksack River valley). Large debris flows are extremely rare. Avalanches and debris flows are common but remain very close to their source and are often smaller in size.

Alluvial fan deposits — Alluvial fan deposits are fan-shaped formations formed by rivers and streams at the base of valleys and ravines where they flatten out and deposit their sediment. During winter storm events, the streams can become choked with sediment or log debris and create a dam.

Landslides — This is an area is extremely vulnerable to landslides due to its dramatic landscape: steep slopes and deep valleys. Landslides have occurred frequently along the roadway in the past and will likely continue to occur.

Earthquakes — Due to its close proximity to Mount Baker, this area is vulnerable to earthquakes and the resulting hazards associated with earthquakes. Tremors could set off any of the geologic hazards listed above and cause liquefaction of susceptible soils.

Volcanic activity and glaciers – Mount Baker is the most isolated of the Cascade volcanoes. It rests on a foundation of non-volcanic rocks in a region that is largely non-volcanic in origin. Since the last Ice Age, the area around the mountain has been largely ice free, but the mountain itself remains heavily mantled with snow and ice. After Mount Rainier, it is the most heavily glaciated of the Cascade volcanoes, the volume of snow and ice being greater than that of all the other Cascades volcanoes (except Rainier) combined. Due to its many glaciers, local Native Americans gave Mount Baker a name meaning "White Steep Mountain." The present-day cone sits atop a similar older volcanic cone called Black Buttes volcano which was active between 500,000 and 300,000 years ago.

During the last 10,000 years, there have been at least two or more lava flows, at least eight mudflows and a pyroclastic flow. Mount Baker erupted on several occasions during the 19th century, and its most prominent crater, Sherman Crater, may have formed in the 18th or early 19th century. Most hydrothermal activity at Mount Baker is concentrated within Sherman Crater. This activity, in the form of steam and flows of hot rock and gas, increased significantly in March 1975 and caused concern that an eruption might be imminent. The activity diminished somewhat by 1978. Mudflows remain the most likely hazard from the volcano. Avalanches of snow and rock debris from the rim of Sherman Crater have swept down Boulder Glacier at least six times since 1958. *(*Go Northwest- http://www.gonorthwest.com/Washington/cascades/mt_baker/mt_baker.htm)

Glaciers/snowfall- Glaciers are present in this area, but have not posed a threat to the roadway beyond the normal glacial melt associated with spring. Mount Baker also has significant seasonal snowfall. In 1999, it set the record of the snowiest places in the world, as well as setting the world record for snowfall in a single season. (1,140 inches/95 feet). Every year provides snow clearing challenges that are necessary to open the access to Artist Point.

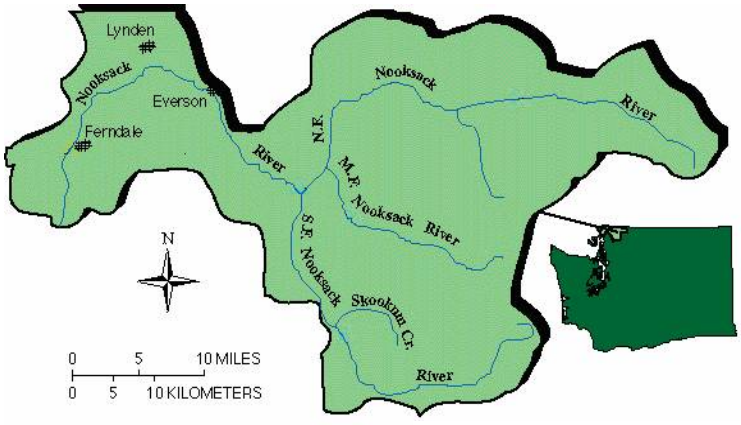
2008 snow clearing to Artist Point

Hydrology

As you travel along SR 542, the beauty and power of natural water systems are everywhere. Streams and rivers in the area originate primarily from melting snowpack, and their volume and intensity greatly vary between seasons. The upper elevations include many waterfalls and rapid turbulent rivers which intensify with spring runoff.

Nooksack River

The north fork of the Nooksack River rises in central Whatcom County north of Mount Shuksan in the western part of North Cascades National Park. It flows generally west, passing north of Mount Baker. The Nooksack river has three main forks; the north fork, middle fork, and south fork. The Nooksack is approximately 75 miles (120 km) long. All three forks originate in the Mount Baker Wilderness.

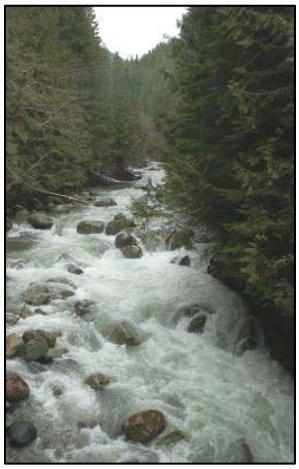


Wikipedia /US Government Map

The Nooksack's north basin originates from the east Nooksack Glacier, at the base of Mount Shuksan, and flows 30 miles to its confluence with the Middle Fork of the Nooksack. It drains 293 square miles area with an annual runoff estimated at more than one million acre feet. Its high flow period is between October and March. It slow flow periods occur twice, once during mid-winter when tributaries are frozen and precipitation is primarily snow and then again in the late summer or early fall. There are more than 100 tributaries- including primary contributions from Wells, Glacier and Canyon Creeks- that contribute to the north fork's volume. Elevations in the basin range from 300 near Deming to 932 feet in Glacier, rising to 10,778 foot at the peak of Mount Baker. Most of the tributaries of the North Fork are fed from melting snowpack and glaciers. Sixty three glaciers covering 16 square miles are located in the Nooksack Basin and provide natural water storage and help maintain summer flows. While the melting ice does help rivers maintain flow during the drier months, glacial ice melt contributed to the turbidity of the river and its tributaries. (Credit to Whatcom County Planning Department- Foothills Sub-area Plan)

Tributaries are part of a dynamic waterway system along this corridor, which have the potential to severely compromise the structural integrity of the roadway. Constant annual maintenance is required to keep these channels clear of rock and debris. The USFS and WSDOT have worked cooperatively where annual maintenance action has been needed and on continued efforts to keep these channels clear, with consideration for aquatic resource and National Forest road

access needs. The simplification and acknowledgement of this process has helped streamline regular maintenance work.



At Nooksack Falls, the river flows through a narrow valley and drops nearly 100 feet into a deep rocky river canyon.

Continuing to flow west, the North Fork receives several tributaries including Wells Creek, Glacier Creek, and Canyon Creek, before the river turns briefly south. The middle fork and south fork join within a few miles of one another. The middle fork joins first, creating the Nooksack River proper. The south fork joins just east of Deming in the Nooksack Indian Reservation. The lower river flows into Bellingham Bay and, via the Strait of Juan de Fuca and the Strait of Georgia, the Pacific Ocean.

Nooksack River above the Falls

The river supplies hydroelectricity near its source and at Nooksack Falls. The river is also blocked on the middle fork by the city of Bellingham to divert water into Bellingham's drinking water supply.

The Nooksack River drains an area of the Cascade Range around Mount Baker, near the Canadian border. For most of its course, the North Fork is paralleled by SR 542.

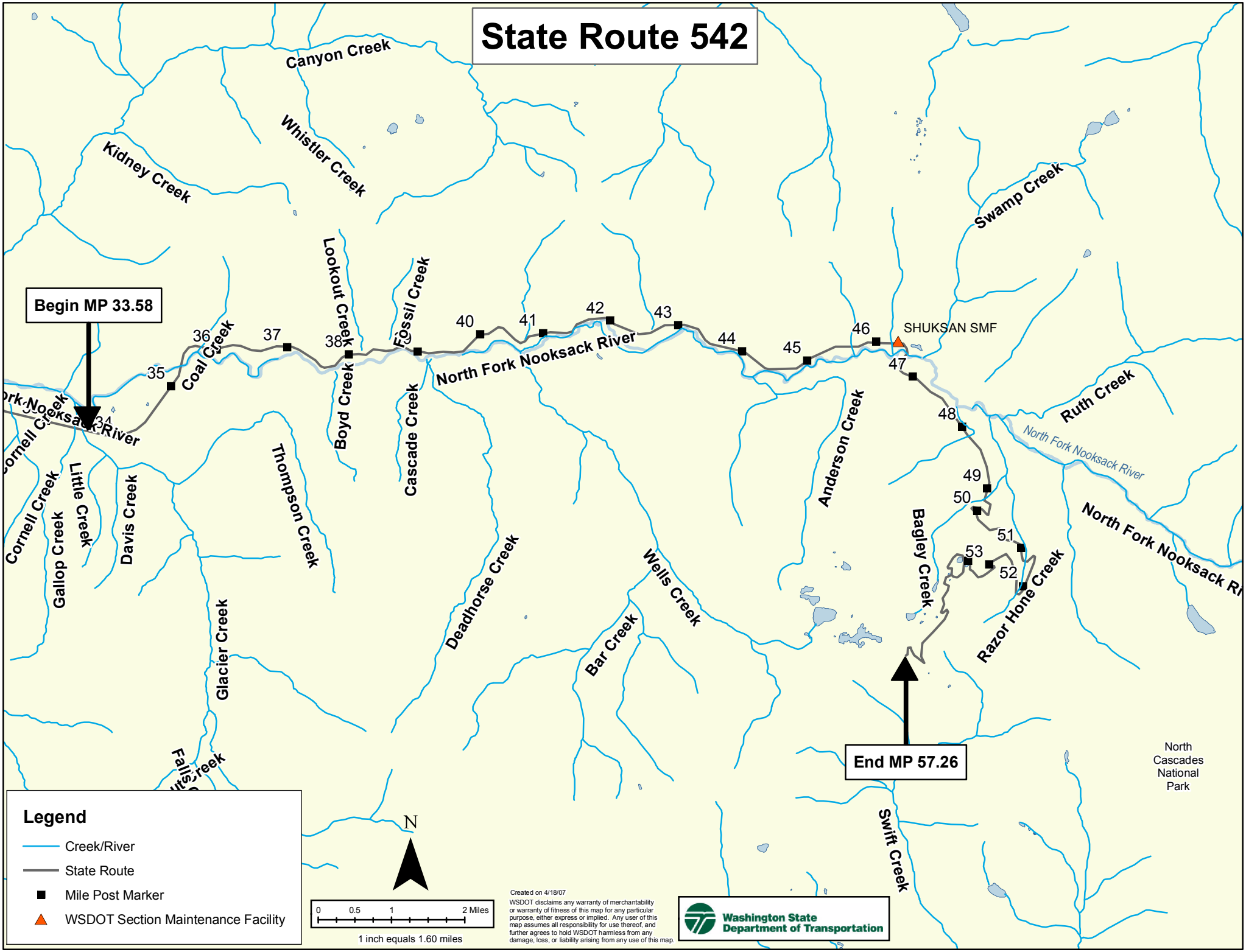
Nooksack River eroding steep bank

SR 542 lies adjacent to the north fork of the Nooksack River from MP 35 to MP 48 and crosses the Nooksack two times; once at MP 35.32 and at 46.55. The Nooksack is a natural aquatic system that provides habitat for several fish species as well as drinking water for the city of Bellingham.

Bank next to Nooksack River

Tributaries crossing SR 542

SR 542 has nine bridge crossings at tributaries flowing to the Nooksack at: Coal Creek at MP 36.74, Fossil Creek at MP 38.65, two half bridges at MP 43.2, and MP 43.23, Bagley Creek at MP 49.16, Galena Creek at MP 50.38, Razorhone Creek at MP 51.28, and Galena Creek at MP 53.65.



Map 4: SR 542 Tributary crossings

SR 542 is located immediately adjacent to Nooksack River. This system frequently erodes portions of the road during high flow events. Emergency repairs have been necessary, require immediate action and are often a temporary remedy for problematic site conditions. The WSDOT and the USFS have coordinated closely when emergency actions are needed to keep the roadway functioning and safe. Emergency repairs (usually the addition of riprap) often have environmental impacts within the stream channel that are not conducive to the long-term resource protection of the river and its floodplain. Chronic Environmental Deficiency retrofit projects are being undertaken in some of these areas to provide environmental enhancements and to address all the necessary resource protection needs within the project areas.

It is important to know of these hazards due to their potential impact to the SR 542 corridor.

Flood water across SR 542 in Fall 2006

Flooding

High flow events on the Nooksack challenge the roadway system and require diligent maintenance to keep SR 542 from washing out. The Nooksack River along with its many tributaries requires vigilant road work to keep the system functioning safely. These systems are adjacent to the roadway or cross the roadway, and sometimes require annual debris removal to keep the water in the channel and off the road. This process includes obtaining permits from WDFW including an on-site review. Activities occur in the mid summer of each year to comply with appropriate aquatic timing restrictions. This time was chosen because flows are low and aquatic and wildlife resources are least impacted.