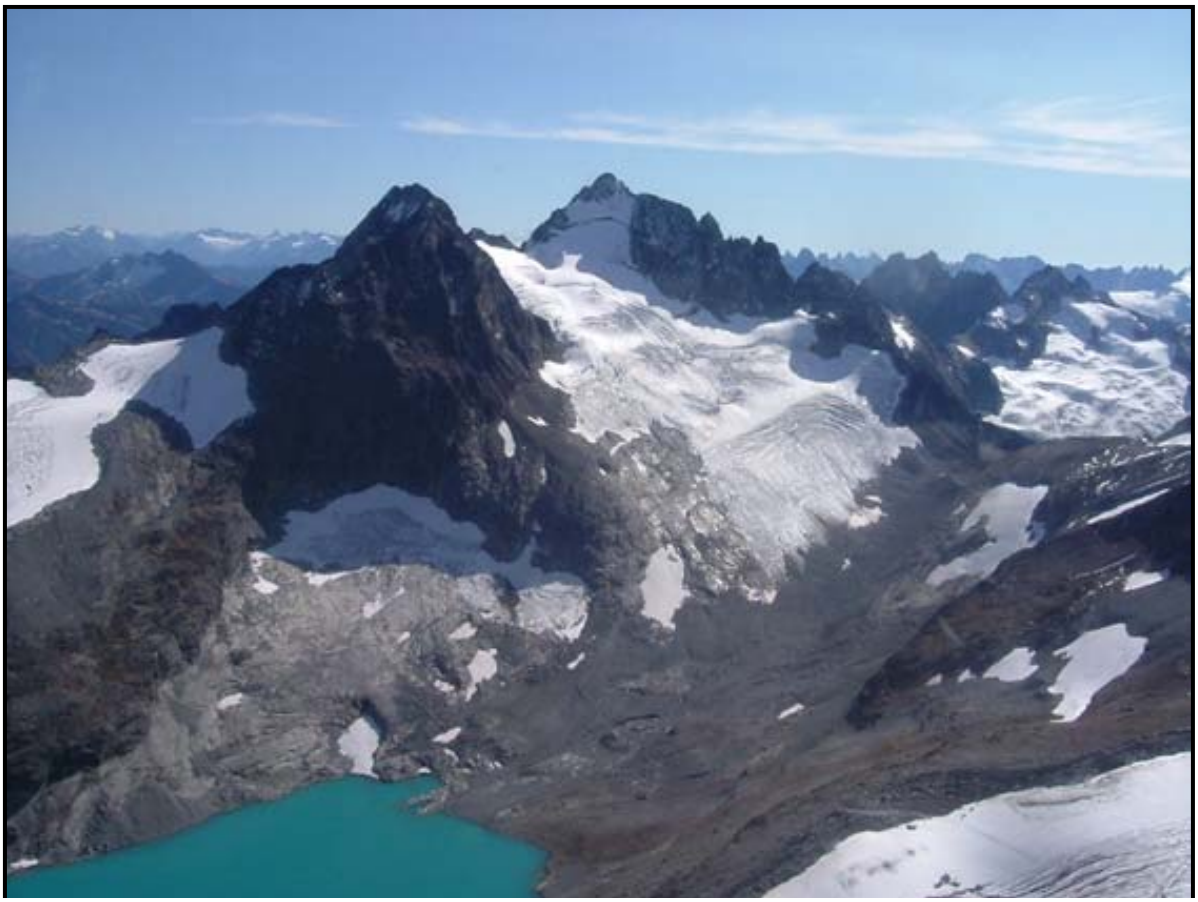
North Cascades National Park

National Park Service
U.S. Department of the Interior

Environmental Assessment

Improve Meteorological Monitoring in Alpine Environments

September 2007



Silver Glacier on Mount Spickard, Silver Lake in foreground. Photograph by: Robert Burrows, September 2005

Public Availability
Comments on this Environmental Assessment must be postmarked or submitted via the internet, fax or hand delivery *no later than Wednesday, October 17, 2007*. Questions regarding this proposal should be directed to Jon Riedel, Geologist (360.854.7330;jon_riedel@nps.gov).

If you wish to comment, you may submit your comments by any of the following methods:

By mail or hand delivery to: Superintendent
North Cascades National Park Service Complex
810 State Route 20
Sedro-Woolley, WA 98284

By fax to: (360) 856-1934

Via the internet (Planning Environment and Public Comment website; PEPC):
http://parkplanning.nps.gov/noca/

Using PEPC: At the PEPC web site, you should select the specific project for which you wish to comment, in this case "Improve Meteorological Monitoring in Alpine Environments". During the public comment period you will find the full text document, an on-line comment form and instructions for submitting comments under the Documents and Links tab. Please use the on-line comment form to submit your ideas, questions or comments.

Please submit internet comments as an ASCII file avoiding the use of special characters and any form of encryption. Please also include your name and return address in your Internet message. If you do not receive a confirmation from the PEPC system that we have received your Internet message, please contact Cathi Jones (360.854.7314; cathi_jones@nps.gov) or Roy Zipp (360.854.7313; roy_zipp@nps.gov).

Freedom of Information
Our practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Individual respondents may request that we withhold their home address from the rulemaking record, which we will honor to the extent allowable by law. There also may be circumstances in which we would withhold from the rule-making record a respondent's identity, as allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. However, we will not consider anonymous comments. We will make all submissions from organizations, or businesses, and from individuals identifying themselves as representatives of officials of organizations or businesses, available for public inspection in their entirety.

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Chapter I. Purpose of and Need for Action

Purpose and Need

Weather and climate are key drivers in the structure, composition, and function of the North Cascades' ecosystem. Weather and climate patterns in the North Cascades are strongly influenced by the mountainous topography of the North Cascade Range, and the maritime influence of the Pacific Ocean, creating extreme variability with elevation and distance. This variability is not fully captured by the current network of climate and hydro-meteorological monitoring stations because the few advanced[1] monitoring stations are sparsely distributed and located at low to mid-elevations (1650-4600 ft) (Appendix A, Figures 1 and 2).

The purpose of this proposed action is to expand the meteorological monitoring network to gather better information on weather, climate and precipitation patterns. This action is needed to support North Cascades' long term ecological monitoring program, and to improve understanding of watershed processes and glacier dynamics in response to global climate change.

Goals and Objectives

Meteorological data collected at North Cascades National Park Complex are relied upon by many agencies, institutions and individuals, including researchers, federal land mangers and hydroelectric operations. The data are used to monitor climate change, ecosystem response to climate change, improve hydroelectric project efficiency, and for weather and flood forecasting.

The following objectives were developed to ensure that the meteorological monitoring network meets these minimum requirements:

- A well distributed monitoring network that captures the spatial and temporal variability of the region's climate.
- A network that collects a full suite of meteorological parameters, including temperature, precipitation, snow depth, solar radiation and wind speed and direction.
- Year-round, near-real-time data collection
- A network whose installation and maintenance has minimal impact to the ecosystem functions and wilderness character of the park.
- A network that can be safely maintained and operated by the personnel engaged in the monitoring.

[1] The term *advanced* is being used to describe climate stations that monitor multiple parameters, continuously, in near real-time.

Decision to be Made

In accordance with NPS regulations and policies regarding implementation of the National Environmental Policy Act (NEPA), the NPS will decide whether or not to implement the proposed action.

The Superintendent, North Cascades National Park Service Complex, will be the recommending official. The Regional Director, NPS Pacific West Region, will be the deciding official.

Background

North Cascades National Park Service Complex (hereafter, the Complex or NOCA) is located in the heart of the greater North Cascades Ecosystem in northwestern Washington. The Complex is composed of three units that are managed as one: North Cascades National Park (505,000 acres), Ross Lake National Recreation Area (117,000 acres), and Lake Chelan National Recreation Area (62,000 acres). Both the park and recreation areas were established in 1968 with variation in the enabling legislation (PL 90-544) for each unit type. North Cascades National Park was created "In order to preserve for the benefit, use, and inspiration of present and future generations certain majestic mountain scenery, snowfields, glaciers, alpine meadows, and other unique natural features…"[16 U.S.C. §90]. Further, the purpose of the Lake Chelan and Ross Lake National Recreation Areas were created "In order to provide for the public outdoor recreation use and enjoyment…and for the conservation of the scenic, scientific, historic, and other values contributing to public enjoyment of such lands and water…"[16 U.S.C. §90a & 90a-l].

The mission of the North Cascades National Park Service Complex is a follows:

"As a unit of the National Park Service, the North Cascades National Park Service Complex is dedicated to conserving, unimpaired, the natural and cultural resources and values of North Cascades National Park, Ross Lake National Recreation Area and Lake Chelan National Recreation Area for the enjoyment, education, and inspiration of this and future generations. We also share responsibility for advancing a great variety of national and international programs designed to help extend the benefits of natural and cultural resource conservation and outdoor recreation." (NPS 2000b)

Special land designations inside the Complex include Wilderness areas and Research Natural Areas. In 1988 over 93 percent (635,000 acres) of the Complex was designated as the Stephen Mather Wilderness (PL 100-668). The NPS is directed to manage the area to protect and perpetuate its wilderness resources and to provide a special wilderness experience "involving outstanding opportunities for solitude or a primitive and unconfined type of recreation." Research Natural Areas (RNA) established in the early 1970s provide examples of undisturbed ecosystems for scientific research. There are five designated Research Natural Areas in the Complex, including the Silver Lake RNA.

A centerpiece of Ross Lake National Recreation Area is the Skagit River Hydroelectric Project, which consists of the Gorge, Diablo and Ross Dams, reservoirs, powerhouses and transmission lines. The hydroelectric project began in 1921 with the construction of Gorge Dam and by 1961 all three dams were complete. Licensed to the City of Seattle and operated by Seattle City Light

(SCL), these dams provide Seattle with approximately 20 percent of its electricity. Jurisdiction of the hydroelectric projects is by the Federal Energy Regulatory Commission, whose authority is also stated in the Complex's enabling legislation.

Puget Sound Energy (PSE) operates two dams on the Baker River. Although the two dams lie outside the Complex, the river's headwaters lie within the park. The Lower Baker Dam was completed in 1925 and the Upper Baker Dam was completed in 1959. The Baker River Project supplies power to approximately 57,249 homes a year; which consists of 2.6 percent of Puget Sound Energy's total annual generation.
(http://www.pse.com/energyEnvironment/EnergySupply_ElectricityHydro.aspx)

Regional Climate and Meteorology

Climate in the North Cascades Range is characterized by extreme spatial and temporal variability. This variability requires an extensive network of monitoring stations to accurately evaluate and understand the region's weather and climate. An improved understanding of the region's weather and climate would assist in the management of natural resources, provide a better understanding of the impacts of climate change, enhance the efficiency of hydropower power production and enable better forecasting of flood events in the Skagit River watershed

The overall climate characteristics of the region are influenced by the region's topography and by its proximity to the Pacific Ocean (Weber et al. 2005). The Cascade mountain range acts as a major barrier that intercepts much of the moisture from storms off of the Pacific Ocean, creating a large gradient in precipitation between the western slopes (wet) and eastern slopes (dry) of these ranges. Local relief within the park averages 6500 feet, many of the west-slope valley floors are within a 1000 feet of sea level and the highest peaks exceed 9000 feet above sea level (asl), with correspondingly large gradients in temperature and precipitation (Weber et al. 2005).

There are two major divides of the North Cascade Range; these divides form broad boundaries between the continental climate of the east slopes and the maritime climate of the west. The divides separate flow between the Fraser River, Columbia River, and Puget Sound river basins. These divides also create the large interior drainage basin of the Skagit River, which has characteristics of both continental and maritime climates.

Precipitation is highly seasonal, with approximately 80% of the total annual precipitation delivered between November and March. Most of this precipitation falls as snow, which typically exceeds a depth of 15 feet at altitudes above 3500 feet asl. The summer season (particularly July through September) is marked by persistent drought. These environmental gradients result in a large variety of plant and animal communities and ecosystems in Pacific Northwest (Weber et al. 2005).

At higher elevations of the Cascade mountain range, annual snowfall totals can regularly exceed 50 feet. The annual snowfall record for the entire nation is at Mt. Baker Ski Area, just northwest of NOCA. During the winter of 1998-1999, the ski area received 1140 inches of snowfall (Leffler et al. 2001).

The spatial variability of climate in the region can be demonstrated by comparing the snow survey at Hozomeen Lake (2600ft) and Browntop Ridge (6000ft). Although these two sites are within 7 miles of each other, their average maximum snow water equivalent (SWE) differs remarkably, with 10.3 inches compared to 62.1 inches respectively. Another example can be seen by comparing the annual precipitation at Diablo Dam (890ft) and Ross Dam (1240 ft), with a total of 79.13 inches compared to 57.91 inches respectively.

The influence of glaciers on North Cascades National Park (NOCA) and regional hydrology is immense in both the quantity and timing of discharge of glacial melt water. Post et al. (1971) estimated that glaciers contribute 650 thousand acre feet to streamflow annually in the North Cascades alone. Glacial melt water delivery peaks during the hot, dry summers in the Pacific Northwest, buffering the region's aquatic ecosystems from seasonal and inter-annual droughts.

Peak river flows tend to be associated with the snowmelt in late spring /early summer and the heavy rain in late fall /early winter. The largest flood events tend to occur in the late fall /early winter resulting from a weather event coined "The Pineapple Express". The Pineapple Express is a Pacific subtropical jet stream that brings warm moist air from Hawaii to the Pacific Northwest. Many of these events coincide with major arctic troughs, often leading to major snowmelt flooding, with warm tropical rains falling on frozen, snow laden ground.

The El Niño/Southern Oscillation (ENSO) is the major source of inter-annual climate variability in the Pacific Northwest while the Pacific Decadal Oscillation (PDO) is the predominant source of inter-decadal climate variability. Each PDO phase typically lasts for 20-30 years. Studies indicate that the PDO was in a cool phase from approximately 1890 to 1925 and 1945 to 1977. Warm phase PDO regimes existed from 1925-1946 and from 1977 to (at least) 1998. Pacific climate changes in the late 1990's have, in many respects, suggested another reversal in the PDO.

Climate Change

Weather and climate are key drivers in ecosystem structure, composition, and function. Climate is a primary driver of almost all physical and ecological processes by controlling ecosystem fluxes of energy and matter as well as the geomorphic and biogeochemical processes underlying the distribution and structures of these ecosystems (Jacobson et al. 1997, Schlesinger 1997, Bonan 2002). Global and regional-scale climate variations will have a tremendous impact on natural systems (Chapinet al. 1996; Schlesinger 1997; Jacobson et al. 2000; Bonan 2002).

Climate change could have a tremendous impact to natural systems, underlining the need for a better understanding of the regions climate. In areas of the West that have substantial snow accumulation in winter, warming has resulted in reductions in spring snowpack, earlier spring snowmelt, increased runoff in winter and less runoff in summer, earlier peak runoff and soil moisture recharge, and changes in natural flooding regimes. (Hamlet, A. F. 2006). These changes significantly affect the natural ecosystems of the region. Sensitive high-elevation ecosystems, including glaciers, will be the first areas to experience change. Such changes could be detrimental to salmon rearing, migration and spawning by increasing scouring events, reducing the freshet, and increasing incidences of low summer flows. Increased summer in-stream temperatures may exceed tolerable limits for coldwater fish populations. Increased

stratification in lakes, Puget Sound, and the coastal ocean could decrease nutrient availability. Future changes in coastal and marine habitat are uncertain. (Mote, et al., 2005).

Next to Alaska, the state of Washington has the highest amount of glacier cover in the United States (Weber et al. 2005). The glaciers in the North Cascades are, however, melting rapidly in response to recent climate changes. A 1998 inventory of glaciers in North Cascades National Park estimates a 44 percent decline in the last 150 years (Granshaw 2001). Glaciers greatly influence the habitat and hydrologic characteristics of these regions. Glaciers are the sole habitat for certain species (Hartzell 2003). Many aquatic species in the NCCN benefit from the buffering influence that glaciers provide to hydrologic systems during seasonal and inter-annual droughts (Meier 1969; Meier and Roots 1982).

Based on empirical data and modeling, Stephenson, et al (2006) predict several significant changes in western mountain ecosystems during this century associated with climate change. These include smaller glaciers, changes in species composition (in particular to sensitive high elevation ecosystems), increase in flood events and wildfires. McKenzie et al. (2004) predicts an increase in the extent and severity of wildfire due to increased temperatures and drying fuels. This will be compounded in areas where fuels have accumulated for several decades in the absence of fire.

Vital Signs and Climate

Knowing the condition of natural resources in national parks is fundamental to the National Park Service's ability to manage park resources. National Park managers across the country are confronted with increasingly complex and challenging issues that require a broad-based understanding of the status and trends of park resources as a basis for making decisions, working with other agencies, and communicating with the public to protect park natural systems and native species. Vital signs monitoring is a key component in the Service's strategy to provide scientific data and information needed for management decision-making and education. Vital signs also contribute information needed to understand and to measure performance regarding the condition of watersheds, landscapes, and marine resources, and biological communities.

The NPS uses the term "Vital Signs" to describe select physical, chemical, and biological elements and processes of park ecosystems that represent the overall health or condition of the park; they may also be park attributes that are highly valued but not necessarily indicative of general park health. Park vital signs monitoring is designed to inform managers of the condition of water, air, geologic resources, plants and animals, and the various ecological, biological, and physical processes that act on those resources. The broad-based, scientific information obtained through monitoring will have multiple applications for management decision making, research, restoration, education, and promoting public understanding of park resources. Climate is a vital sign and in addition is a primary environmental driver for the other vital signs, and an important component of the North Cascades Long Term Ecological Monitoring Program.

Regional Climate Monitoring Networks

Numerous weather and climate monitoring stations are established throughout the Complex and adjacent to its boundaries (Appendix, Figure 1). These are operated and maintained by different agencies in cooperation with the National Park Service. The monitoring of remote high-elevation environments is accomplished using snow survey (snow courses and aerial markers),

Snowpack Telemetry (SNOTEL), and glacier mass-balance measurements. These monitoring methods are suited for rugged mountain climates in remote areas. Other climate monitoring networks in the Complex require low elevation sites, proximity to power, routine maintenance and/or are limited to seasonal use; these include the National Weather Service Cooperative Network, U.S. Climate Reference Network, and Remote Automated Weather Stations. For the purpose of this document we are concerned with the monitoring of high elevation remote subalpine, alpine, and glacial environments.

Both the snow survey and SNOTEL networks are installed and maintained by the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS). Two hydroelectric utilities, Seattle City Light and Puget Sound Energy, rely heavily on the snowpack data to efficiently manage energy production, reservoir levels, and water releases.

Currently, there are four SNOTELs and five snow survey sites within the Complex boundaries (Appendix A, Figure 1 and Table 1). An additional ten SNOTELs and 11 snow survey sites are in the North Cascades region (Appendix A, Figure 1 and Table 2). Except for the Mt. Baker and Washington Pass SNOTELs, all of the monitoring sites are accessed exclusively by helicopters.

Snow Survey

The cooperative snow survey program was initiated in 1935 by the Natural Resource Conservation Service to aid in forecasting summer water supplies. A snow survey site can be either a snow course or an aerial marker. A snow course is a permanent sampling transect that represents snowpack conditions at a given elevation in a given area. Manual snow surveys require two-person teams to measure snow depth and water content at designated snow courses. A particular snowpack may have several courses. Generally, the courses are about 1000 ft long and are situated in small meadows protected from the wind. Parameters measured are limited to snow depth and snow water equivalent (SWE). Measurements generally are taken on or near the first of every month during the snowpack season from January to June. The snow courses in the Skagit Basin are generally visited 6 times during the winter, with an occasional fall maintenance visit (approximately every 3-4 years). Maintenance at snow course sites involves primarily tree-pruning at helispots and in the snow course transect. Locations that are too hazardous or costly to measure on the ground can be equipped with aerial marker towers that can be read from aircraft. The aerial marker sites rarely require any maintenance or calibration visits.

Of the five snow survey sites in the Complex, three are snow courses and two are aerial markers (Easy Pass and Jasper Pass). Approximately 19 landings and 12 low elevation overflights in the Stephen Mather Wilderness are required to operate the snow survey network annually.

Snowpack Telemetry Program (SNOTEL)

In 1977, NRCS began developing an advanced network of automated radio telemetry data sites for collecting snow survey data in the mountainous regions of the Western United States. This Snowpack Telemetry (SNOTEL) network provides NRCS with near real-time data using automated remote sensing.

The major purpose of the SNOTEL network is to aid in providing long-term climatic information to support water supply forecasting, detect short and long-term trends, and to provide basic

hydro-climatic information in support of water resource management functions. In addition, data are used for flood forecasting models by National Weather Service/NOAA. Parameters measured are snow water equivalent (SWE), snow depth, precipitation, and temperature. Additional data such as solar radiation, wind speed and direction, and soil moisture can also be collected. The information collected by the telemetry system and snow surveyors is translated into water supply forecasts that NRCS State offices issue monthly from January to June in cooperation with the National Weather Service.

A SNOTEL station includes a pressure sensing snow pillow assembly for measuring snow water equivalent, a storage precipitation gage, an instrument shelter, and two free standing towers that support a radio transmission antenna, solar panels, and instrumentation. SNOTELs uses meteor burst communications technology to collect and communicate data in near real-time (Appendix A, Figure 3).

After a new SNOTEL station is installed, site visits occur for calibration and maintenance. If the SNOTEL is replacing a snow course, six calibration visits are needed annually for 5-years to establish a correlation; subsequent winter trips are then reduced to 2-3 landings per year. If the SNOTEL is replacing an aerial marker, three calibration visits in winter are needed for 3-5 years; subsequent winter trips are then reduced to an as needed basis. All SNOTELs also require an annual maintenance visit in the fall to replace the anti-freeze solution used by the precipitation gage, calibrate equipment, and maintain the helispot and solar window (which may include tree-pruning). Conversion of a snow survey site to SNOTEL can reduce helicopter use by 2-6 flights per year per site.

In 1989, the NRCS established the Snow Course Reduction Plan intended to improve data quality, personnel safety, data gathering efficiency and cost of their hydro-meteorological monitoring by converting snow surveys to SNOTELs and removing unnecessary or duplicate snow survey sites.

SNOTEL sites have operated in NOCA from as early as 1979 to the present. There are currently four SNOTEL sites in, three of which were former snow courses. Most recently, the snow survey at Beaver Pass was converted to a SNOTEL, with the National Environmental Policy Act (NEPA) process supporting a Finding of No Significant Impact that was issued on September 27, 2001.

Glacier Mass Balance Monitoring

The National Park Service began measuring the mass balance of four glaciers at North Cascades National Park in 1993. The four glaciers monitored are located at the headwaters of four watersheds, each with large hydroelectric dams. The glaciers are Noisy, Silver, North Klawatti and Sandalee Glaciers. The glaciers range in elevation from 5600 to 8800 feet, and also a range in climatic conditions from maritime to continental. The glaciers are visited three times annually to measure winter accumulation and summer melt. Measurements are taken at a series of points down the centerline of the glacier, and then integrated across the entire glacier surface to determine mass balance for the entire glacier. Glacial contribution to runoff for the four watersheds is estimated from the mass balance measurement.

A helicopter is used to transport personnel and heavy equipment during the spring (April) and fall (September) trips. The glaciers are accessed by foot for the summer (June/July) site visits.

Limitations of Current Monitoring Network

In 2003, the NPS sponsored the North Coast and Cascade Climate Monitoring Workshop, which was attended by university researchers, and various federal, state and local agencies. Participates of the workshop identified the lack of and the need for high elevation climate monitoring at North Cascades National Park. The existing network of advanced climate and hydro-meteorological monitoring stations is sparsely distributed and located at low to mid-elevations. The Complex, with an area of 684,000 acres and relief of 8800 ft, has four advanced climate stations located at an elevation of 1650-4600 ft. The term "advanced" is being used to describe meteorological stations that monitor multiple parameters, continuously, in near real-time. Currently at NOCA, the only advanced climate stations are SNOTELs. The highest SNOTEL is Park Creek Ridge at 4600 feet. With over 41% of North Cascades National Park's landmass existing above this elevation, much of the park is not represented by these data (Appendix A, Figure 2). In addition, the Complex's boundaries include environments west, central and east of the Cascades crest, where a wide spectrum of environments exists from moist maritime to arid continental. The highest hydro-meteorological station is Browntop Ridge at 6000 feet. However, Browntop Ridge is a snow survey site and collects only snow depth and snow water equivalent data once a month during the winter, typically from January to June.

Table 1. Remote High Elevation Climate Monitoring Stations *within* North Cascades National Park Complex

Map Key #	Site Name	Elevation	Period of Record	Data	Data Measurement Frequency	Wilderness/ Non-Wilderness Sites
1	Beaver Creek Trail	2200 ft	1944-Present	Snow depth, SWE	Monthly, during Jan.-May	Wilderness
2	Beaver Pass	3620	2002-Present	Precipitation, Snow depth, SWE, Temperature *[replaced snowcourse (1944-2002)]*	Continuous, year-round	Wilderness
3	Browntop Ridge	6000 ft	1970-Prsent	Snow depth, SWE	Monthly, during Jan.-May	Wilderness
4	Easy Pass AM	5200 ft	1959-Present	Snow depth	Monthly, during Jan.-May	Wilderness
5	Hozomeen Camp	1650	2001-Present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round	Non-Wilderness
6	Jasper Pass AM	5400 ft	1959-Present	Snow depth	Monthly, during Jan.-May	Wilderness
7	Meadow Cabins	1900 ft	1945-Present	Snowdepth, SWE	Monthly, during Jan.-May	Wilderness
8	Park Creek Ridge	4600	1979-Present	Precipitation, Snow depth, SWE, Temperature *[replaced snowcourse (1928-1979)]*	Continuous, year-round	Wilderness
9	Thunder Basin	4297	1988-Present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round	Wilderness

Map Key #	Site Name	Elevation	Period of Record	Data	Data Measurement Frequency	Wilderness/ Non-Wilderness Sites
				[replaced snowcourse (1948-1988)]		

Table 2. Remote High Elevation Climate Monitoring Stations *adjacent to* North Cascades National Park Complex

Map Key #	Site Name	Elevation (ft)	Period of Record	Data	Data Measurement Frequency
10	Cloudy Pass AM	6500	1927 - present	Snow depth, SWE	Monthly, during Jan.-May
11	Devils Park	5900	1950 - present	Snow depth, SWE	Monthly, during Jan.-May
12	Docke Butte AM	3800	1959 - present	Snow depth	Monthly, during Jan.-May
13	Elbow Lake	3200	1996 - present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round
14	Freezeout Creek Trail	3500	1944 - present	Snow depth	Monthly, during Jan.-May
15	Granite Creek	3500	1971 - present	Snow depth, SWE	Monthly, during Jan.-May
16	Harts Pass	6500	1982 - present	Precipitation, Snow depth, SWE, Temperature *[replaced snowcourse (1941-1982)]*	Continuous, year-round
17	Lyman Lake	5900	1980 - present	Precipitation, Snow depth, SWE, Temperature *[replaced snowcourse (1928-1980)]*	Continuous, year-round
18	Marten Lake	3600	1959 - present	Snow depth, SWE	Monthly, during Jan.-May
19	MF Fork Nooksack	4980	2003- present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round
20	Miners Ridge	6200	1989 - present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round
21	Mt. Baker Ski Area	4220	1988 – present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round
22	Mt. Blum AM	5800	1965 - present	Snow depth, SWE	Monthly, during Jan.-May
23	Rainy Pass	4780	1982- present	Precipitation, Snow depth, SWE, Temperature *[replaced snowcourse (1930-1982)]*	Continuous, year-round
24	Rocky Creek	2100	1959 - present	Snow depth	Monthly, during Jan.-May
25	Schreibers Meadow	3400	1959 - present	Snow depth	Monthly, during Jan.-May
26	SF Thunder Creek AM	2200	1959 - present	Snow depth, SWE	Monthly, during Jan.-May
27	Swamp Creek	4000	1988 - present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round
28	Washington Pass	6630	1989 – present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round

Map Key #	Site Name	Elevation (ft)	Period of Record	Data	Data Measurement Frequency
29	Watson Lakes	4500	1959 - present	Snow depth, SWE	Monthly, during Jan.-May
30	Wells Creek	4200	1996 - present	Precipitation, Snow depth, SWE, Temperature	Continuous, year-round

Issues and Concerns

On May 23, 2007, the NPS released a public scoping newsletter describing the climate monitoring proposal to agencies, tribes and interested organizations and individuals. The public scoping period lasted from May 24, 2007 to June 24, 2007. The Skagit Valley Herald publicized the details of the public scoping newsletter on May 24, 2007. The scoping letter encouraged the involvement of the public in identifying issues and concerns related to the expansion and enhancement of the climate monitoring network in the Complex. Three comment letters (including e-mail) were received from the public. All three commenter's recognized the need for a better understanding of climate and climate change. One commenter supported an expanded climate network regardless of the foreseeable impacts. The other two commenter's were concerned primarily with the impacts of the stations and associated helicopter operations on wilderness and the natural resources

Key issues are summarized below. These issue statements, derived from public and staff comments, are intended to help focus the environmental impact analysis and identify the specific impact topics to be analyzed in the Environmental Consequences section of this EA.

- **Adverse impacts to biological and physical resources.** Representative comment: *"[the preferred alternative] will degrade park resources, in addition to the park resources currently identified as areas of concern. The resources that also need protection include …quality of wildlife habitat, and wilderness qualities of Silver and Noisy Glacier, as well as Browntop Ridge and Easy Pass."* This issue will be addressed in the Environmental Consequences section for each alternative.

- **Adverse impacts to wilderness values such as solitude and natural sounds during SNOTEL installation and maintenance.** Representative comment: *"…issues surrounding the backcountry experience in undeveloped areas, such as ensuring solitude and wilderness experiences should be considered when preparing the EA."* This issue will be addressed in the Wilderness and Visitor Use statements in the Environmental Consequences section

- **The additional monitoring sites are in close proximity to one another and may be unnecessary and excessive**. Representative comment: *"I wonder why there is a need for SNOTEL sites at Easy Pass and Browntop Ridge –they seem rather proximate to each other."* This issue is addressed in the Purpose of and Need for Action section and the Regional Climate and Meteorology section.

- **Need for monitoring of climate change to make informed management decisions.** Representative comment: *"[The preferred alternative] should be a top priority…Climate change is already affecting our natural resources. It is extremely important to monitor those changes so that realistic plans for the future are in place."* This issue is addressed in the Purpose of and Need for Action section and the Regional Climate and Meteorology section.

- **Mitigation for impacts of any action should be a priority, in particular helicopter flights and visual impacts to wilderness.** Representative comment: *"Mitigating the impact of the proposed structures at Easy Pass and Browntop should be the number one concern and priority...It seems to me that 4 helicopter visits annually is excessive"* This issue will be addressed in the Mitigation section

- **Impacts to bats and hibernating species should be addressed in the EA.** Representative comment: *"The EA should disclose possible effects to wildlife from the operation of 4 SNOTEL units, such as bats and hibernating species."* This issue will be addressed in the Wildlife statement in the Environmental Consequences section

- **Employee Health and Safety.** Installation and maintenance of meteorological monitoring stations and equipment presents risks to employee health and safety.

Issues Considered but Dismissed

The following issues identified during the public scoping are beyond the scope of this environmental impact analysis.

- **Impacts to water and air resources should be addressed in the EA.** This issue was considered but dismissed because no surface water resources are in any of the project areas. The use of helicopters and gas-powered equipment during installation and maintenance would have a short-term and negligible effect on air quality.

- **Impacts to night skies should be addressed in the EA.** Representative comment: *"The resources that also need protection include night skies, quality of wildlife habitat, and wilderness qualities of Silver and Noisy Glacier, as well as Browntop Ridge and Easy Pass."* Protection of night skies visibility is becoming an increasing concern in many NPS units because night sky visibility is continuing to decline as human development encroaches upon NPS lands. This issue was considered but dismissed because none of the stations have any exterior lighting and would not affect night skies.

Relevant Laws and Policies

Various laws, regulations, and policies govern the nature and scope of management actions that are acceptable in the national parks, recreation areas, and designated wilderness. Relevant portions are described in this section.

The Wilderness Act of 1964

Section 2(c) (4). "A wilderness…may also contain ecological, geological, or other features of scientific, educational, scenic or historical value."

Section 4(b). "Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use."
Section 4(c). "Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

PL 100-668. The Washington Park Wilderness Act of 1988

Section 202 Hydroelectric Projects. "Nothing in this Act shall be construed to supersede, repeal, modify, or impair the jurisdiction of the Federal Power Commission under the Federal Power Act … in the lands and waters within the Skagit River Hydroelectric Project, Federal Energy and Regulatory Commission Project 533, including the proposed Copper Creek, High Ross, and Thunder Creek Elements of the Project; and the Newhalem Project, Federal Energy and Regulatory Commission Project 2705, within the Ross Lake National Recreation Area …and existing hydrologic monitoring stations necessary for proper operation of the hydroelectric projects listed herein."

PL 90-544. Enabling Legislation for North Cascades National Park Complex

Title I – North Cascades National Park, Section 101. "In order to preserve for the benefit, use, and inspiration of present and future generations certain majestic mountain scenery, snowfields, glaciers, alpine meadows, and other unique natural features…"

Title II – Ross Lake and Lake Chelan National Recreation Areas, Section 201/202. "In order to provide for the public outdoor recreation use and enjoyment…and for the conservation of the scenic, scientific, historic, and other values contributing to public enjoyment of such lands and water…"

Sec. 505. "Nothing in this Act shall be construed to supersede, repeal, modify, or impair the jurisdiction of the Federal Power Commission under the Federal Power Act (41 Stat. 1063), as amended (16 U.S.C. 791a et seq.), in the recreation areas."

National Park Service Management Policies

1.9.1.4 Employee Safety and Health. "The safety and health of employees, contractors, volunteers, and the public are core Service values. In making decisions on matters concerning employee safety and health, NPS managers must exercise good judgment and discretion and, above all, keep in mind that the safeguarding of human life must not be compromised. The Service must ensure that all employees are trained and informed on how to do their jobs safely,

and that they have the necessary clothing, materials, and equipment to perform their duties with minimal personal risk."

4.1.1 Partnerships. "The Service will pursue opportunities to improve natural resource management within parks and across administrative boundaries by cooperating with public agencies…"

4.3.1 Research Natural Areas. **"**Research natural areas contain prime examples of natural resources and processes, including significant genetic resources that have value for long-term observational studies…Activities in research natural areas generally will be restricted to non-manipulative research, education, and other activities that will not detract from an area's research values."

4.4.2.3 Management of Threatened or Endangered Plants and Animals: "The Service will survey for, protect, and strive to recover all species native to national park system units that are listed under the Endangered Species Act. The Service will fully meet its obligations under the NPS Organic Act and the Endangered Species Act to both pro-actively conserve listed species and prevent detrimental effects on these species."

4.4.2.1 NPS Actions that Remove Plants and Animals: "Whenever the Service removes plants or animals… [it] will seek to ensure that such removals will not cause unacceptable impacts to native resources, natural processes, or other park resources."

4.7.2 Weather and Climate. "Parks containing significant natural resources will gather and maintain baseline climatological data for perpetual reference."

6.3.4.3 Environmental Compliance. "Managers contemplating the use of aircraft or other motorized equipment or mechanical transportation within wilderness must consider impacts to the character, esthetics, and traditions of wilderness before considering the costs and efficiency of the equipment."

"In evaluating environmental impacts, the NPS will take into account wilderness characteristics and values, including the primeval character and influence of the wilderness; the preservation of natural conditions (including the lack of man-made noise); and assurances that there will be outstanding opportunities for solitude, that the public will be provided with a primitive and unconfined type of recreational experience, and that wilderness will be preserved and used in an unimpaired condition. Managers will be expected to appropriately address cultural resources management considerations in the development and review of environmental compliance documents impacting wilderness resources."

6.3.5 Minimum Requirement. "All management decisions affecting wilderness must be consistent with the minimum requirement concept." "When determining minimum requirement, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience."

6.3.6 Scientific Activities in Wilderness. "The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the agency's responsibilities to preserve and manage wilderness."

6.3.6.1 General Policy. "The National Park Service has a responsibility to support appropriate scientific activities in wilderness, and to use science to improve wilderness management. The National Park Service recognizes that wilderness can and should serve as an important resource for long-term research, study, and observation of ecological processes and the impact of humans on these ecosystems. The National Park Service further recognizes that appropriate scientific activities may be critical to the long-term preservation of wilderness."

"Scientific activities are to be encouraged in wilderness. Even those activities (including inventory, monitoring, and research) that involve a potential impact to wilderness resources or values (including access, ground disturbance, use of equipment, animal welfare, etc) should be allowed when the benefits of what can be learned outweigh the impacts on the wilderness resource or values. However, all such activities must also be evaluated using the minimum requirement concept and include documented compliance which assesses impacts against benefits to wilderness. This process should assure the activity is appropriate and utilizes the minimum tool required to accomplish project objectives."

"Research and monitoring devices (e.g., video cameras, data loggers, meteorological stations) may be installed and operated in wilderness if (1) the desired information is essential for the administration and preservation of wilderness, and cannot be obtained from a location outside of wilderness without significant loss of precision and applicability; and (2) the proposed device is the minimum requirement necessary to accomplish the research objective safely."

6.3.10.1 Administrative Facilities. "Administrative facilities may be allowed in wilderness only if they are determined to be the minimum requirement necessary to carry out wilderness management objectives and are specifically addressed within the park's wilderness management plan or other appropriate planning documents."

8.4 Overflights and Aviation Uses. "Limit official use of flights over parks to those…essential management activities in cases where there are no practical alternatives or when alternative methods would be unreasonable. Full consideration will be given to safety; wilderness management implications; impacts on resources, values or visitors;…and overall cost-effectiveness."

Director's Order and Reference Manual 41: Wilderness Preservation and Management

"Scientific activities are to be encouraged in wilderness, provided that the benefits of what may be learned outweigh the negative impacts on other wilderness values."

North Cascades National Park Wilderness Management Plan

Section 1: Minimum Tool. "Non-power tools will be preferred. The Wilderness District Ranger will have final approval for the use of power tools. All contracts will consider use of non-power

tools. Any use of power tools will be limited as far as possible to before the 4th of July and after Labor Day. All power tools will use a modified muffler that reduces decibel level below 4. Power tools will be limited to chain saws, brushers, rock drills, chain saw winches, and explosives. Contractors will be required to meet these standards."

"Aircraft may only be used if stock use is not permitted on trails, trail conditions prevent stock use, or it is impractical to use stock and there is no other practical way to accomplish the work. Aircraft use will be confined to Monday through Thursday and as much as possible to before the 4th of July and after Labor Day."

Chapter II. Management Alternatives

This chapter describes the alternatives developed to fulfill the purpose and need as described in Chapter 1. Included in the alternatives is the *No Action* alternative, as required by the National Environmental Policy Act (NEPA). The *No Action* alternative is used as a baseline from which to measure the impacts of the other *Action* alternatives. The *"Preferred Alternative"* is the proposed action. It is the alternative that park management believes does the best job of satisfying the objectives as laid out in the Purpose of and Need for Action section. The *Environmentally Preferred Alternative*, required by NPS guidelines, is the alternative that "… causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural and natural resources." Impacts are listed for comparison in the Summary of Impacts section.

Alternative A. Continue Current Management

Under the No Action Alternative, no additional climate stations would be established in North Cascades National Park Complex. The NPS, SCL and PSE would continue to collect basic climatologic data through the current network using existing SNOTELs, snow-courses, aerial markers, and glacier mass balance data. Snow courses and aerial markers would continue to be used as they historically have been. Browntop Ridge, Easy Pass and Jasper Pass would remain snow survey sites and continue to provide monthly snow depth and snow water equivalent measurements from January through June (Appendix A, Figure 4).). There would continue to be no high-elevation weather stations in the 684,000 acre Complex.

Snow courses are generally visited 6 times by the NRCS during the winter for measurements, with an occasional fall maintenance visit (approximately every 3-4 years). Aerial markers require 6 low elevation over flights annually to take snow depth measurements. Due to their remoteness and for safety concerns, access to the sites is provided by helicopter (snow courses) or fixed-winged aircraft (aerial markers). For the purpose of this analysis, it is assumed the operation of the snow survey sites in this alternative would continue to require a total of 6-7 wilderness landings and 12 low elevation over flights annually. The aerial marker towers at Easy Pass, Browntop Ridge and Jasper Pass would remain. Maintenance of the Browntop Ridge snow course transect and helispot would continue.

Alternative B. Upgrade and Expand the Meteorological Monitoring Network (Preferred Alternative)

Summary

Under Alternative B, the National Park Service, in cooperation with Seattle City Light, Puget Sound Energy and the Natural Resource Conservation Service would implement the following actions:

- Convert the existing Browntop Ridge snow course and Easy Pass aerial marker to SNOTEL stations;
- Install basic climate monitoring stations near Silver Glacier and Noisy Glacier;

- Discontinue use of the Jasper Pass aerial marker and remove equipment (within 5 years of Easy Pass upgrade).

Browntop Ridge and Easy Pass SNOTELs

The NPS would replace existing snow survey sites with snow telemetry sites at Browntop Ridge and Easy Pass. These would be long-term monitoring stations located within federally designated wilderness. The advance hydro-meteorological stations would measure temperature, precipitation, solar radiation snow depth and snow water content (Appendix A, Figure 3). The stations would consist of:

- An instrument shelter (4'x 4'x16' tall)
- A 24-foot tall, three-foot diameter precipitation gauge
- Two towers (16 and 30ft.)
- A leveled 20-foot diameter earthen pad for a 10-foot square steel snow pillow assembly
- A marker pole
- Three shallow underground fluid lines

The snow pillow assembly is composed of four stainless steel pillows that are approximately four by five feet and 2.5 inches thick. A leveled 20-foot diameter earthen pad would be created for the assembly using native soils and imported gravel and sand, some ground disturbance would occur. Each pillow holds 25 gallons of a 50/50 water and antifreeze solution. Soilcon Instrument Antifreeze is used, which is primarily ethanol and propylene glycol (MSDS provided in Appendix F). The precipitation gauge would use 12 gallons of antifreeze that is changed, along with accumulated precipitation, annually each fall season. One tower supports a radio transmission antenna and solar panels while another supports a wind speed-measuring device. The three underground lines (buried six inches below the surface) run from the instrument shelter to the snow pillow, the wind speed antenna tower, and the precipitation gauge. Towers will be powder-coated brown to lessen visibility. Each station's footprint would be approximately 60-75 feet in diameter (Appendix A, Figures 5 and 6).

Installation for the Easy Pass SNOTEL would occur in late fall 2007, with the Browntop Ridge SNOTEL being installed in fall 2008 or 2009. The installation would be conducted by NRCS personnel. It would take six people approximately two days to install the SNOTEL station at each site (perhaps fewer people the second day). A resource manager from the park would be on site to direct the installation crew away from sensitive areas at the site and monitor excavations. Work crews would not overnight at the installations sites.

For Easy Pass, the supplies and equipment would be trucked to a staging area/ landing zone near Baker Lake (USFS) and then flown by helicopter to the site. An estimated 12 to 14 round trip flights from the landing zone near Baker Lake would be required to complete the work. Eight to ten of those would be long line loads with cargo suspended below the aircraft; the helicopter would not land on those flights. The flight path would follow the Baker River to Easy Pass, approximately 15 miles (Appendix A, Figure 9). Estimated flight time from Baker Lake to Easy Pass is 12 to 15 minutes. The flight path would be over the northern portion of Baker Lake, the Baker River Trail, and Sulphide Campground.

For Browntop Ridge, the supplies and equipment would be trucked to a staging area/ landing zone at Hozomeen Campground on Ross Lake before being flown by helicopter to the site. An estimated 12 to 14 round trip flights from Hozomeen would be required to complete the work. Eight to ten of those would be long line loads with cargo suspended below the aircraft; the helicopter would not land on those flights. The flight path would follow south along Ross Lake before heading west, following the Little Beaver Creek to the site. The flight of 14 miles would take an estimated 12 to 15 minutes of flight time between Hozomeen and Browntop Ridge (Appendix A, Figure 10). The flight path would fly over Hozomeen, Silver Creek, Little Beaver and Perry Creek Campgrounds, northern Ross Lake, and the Little Beaver Trail.

At Browntop Ridge, calibration flights would occur monthly from January through June for the first 5-years, subsequent winter trips would then be reduced to 2-3 landings per year. At Easy Pass, three calibration visits would be needed for 3-5 years; subsequent winter trips would then be reduced to an as needed basis. Regardless, all SNOTELs would require an annual maintenance visit in the fall. After the initial calibration period, removal of remnant snow survey equipment, including aerial marker towers, would occur.

Noisy and Silver Glacier Climate Stations

The NPS proposes to install climate stations near Silver and Noisy Glacier (Appendix A, Figures 7 and 8). These would be long-term monitoring stations located within federally designated wilderness. These stations would provide near real-time meteorological data, including temperature, wind speed and direction, relative humidity, snow depth and solar radiation. The sites would consist of:

- A single 20-foot tower with supporting bracket
- One 80w solar panel
- Two 12” x 14” x 4” fiberglass weatherproof enclosures for dataloggers and electronics
- Batteries
- A meteor-burst antennae

A single tower would be attached to a base plate, which would be anchored into the bedrock. Four holes (1.5” diameter) would be drilled into the bedrock, through which the base plate would be bolted and cemented. A support bracket for the tower, requiring three additional holes, would be bolted to nearby bedrock block. The holes would be drilled by NPS personnel using gas powered rock-drills. Concrete would be mounded at the tower’s base for ballast (approximately twelve 80lbs bags of concrete). Attached to the tower would be meteorological instrumentation, two fiberglass enclosures, a solar panel, meteor-burst communication antenna. The footprint of the station would be consisting of only the tower. Towers would be powder-coated brown to lessen visibility. All equipment would be coated with a hydrophobic Velox coating to prevent disruptive accumulation of hoar frost and icing of equipment.

Installation of the Noisy Glacier climate station would occur in fall 2007, with the Silver Glacier climate station being installed in 2008 or 2009. The installation would be conducted by both NPS and NRCS personnel. The NPS would be responsible for drilling holes into the bedrock used for anchoring the tower; this would take two people approximately one day to complete. The NRCS would install the tower, tower ballast, instrumentation, communications and electronics; this would take two people approximately two days to complete at each site. A resource manager

from the park would be on site to direct the installation crew away from sensitive areas at the site. Work crews would not overnight at the installations sites.

For Noisy Glacier, the supplies and equipment would be trucked to a staging area/ landing zone near Baker Lake (USFS) and then flown by helicopter to the site. An estimated ten round trip flights from the landing zone near Baker Lake would be required to complete the work. Eight of the flights would be long line loads with cargo suspended below the aircraft; the helicopter would not land on those flights. The flight path would follow Hidden Creek, a tributary of the Baker River, to Noisy Glacier, approximately 10 miles (Appendix A, Figure 9). Estimated flight time from Baker Lake to Noisy Glacier is 10 minutes. The flight path would include the northern portion of Baker Lake.

For Silver Glacier, the supplies and equipment would be trucked to a staging area/ landing zone at Hozomeen Campground on Ross Lake before being flown by helicopter to the site. An estimated ten round trip flights from the Hozomeen staging area/landing zone would be required to complete the work. Eight of the flights would be long line loads with cargo suspended below the aircraft; the helicopter would not land on those flights. The flight path would follow south along Ross Lake before heading west, following the Silver Creek to the site. The flight of 10 miles would take an estimated 10 minutes of flight time between Hozomeen and Silver Glacier (Appendix A, Figure 10). The flight path would fly over Hozomeen and Silver Creek Campgrounds, and northern Ross Lake.

At both climate stations, 2-3 winter calibration visits would be conducted for a maximum of 5 years. After this period, only one flight would be needed annually to maintain the site, this visit would occur in conjunction with the fall glacier monitoring trip.

Decommission of Jasper Pass Aerial Marker

Decommission of the Jasper Pass aerial marker would include the removal of all associated equipment and discontinuation of monthly overflights during monitoring season. Decommission of this site would be possible only with the installation of a SNOTEL at Easy Pass. In order to correlate the Easy Pass SNOTEL with Jasper Pass, equipment and measurements would need to continue at Jasper Pass for 5-years. After this time, the remaining snow survey equipment would be removed and over-flights would cease. An estimated 2-3 flights would be needed to remove the snow survey equipment. Removal would occur during the fall. Helicopter operations would be based from Newhalem. The flight route would follow Goodell Creek to Jasper Pass (Appendix A, Figure 11).

Rational for Site Selection

The conversion of Easy Pass (5200ft) to a SNOTEL would improve climate monitoring in the Baker and Chilliwack River drainages. It would also allow for the removal of the Jasper Pass aerial marker. The conversion of Browntop Ridge (6000ft) to a SNOTEL would improve climate monitoring in the north central region of the Complex, a unique environment which partially lies in the rain shadow of peaks to the west. These sites already have some level of disturbance associated with decades of snow surveys. In addition, installing SNOTELs at former snow survey locations allows for a continuous historical data record for that site.

The Noisy Glacier climate station would be the highest station on the western edge of the North Cascades at 6230 feet. Positioned on the western front of the Cascades range, this station would provide data from the wettest region of the Complex. The Silver Glacier climate station would be the highest near-real time climate station in the Washington Cascades at 7600 feet. This site is located within the Silver Lake Research Natural Area and would provide researchers important and accurate data. By locating these climate stations near two glaciers that are used for mass balance monitoring at NOCA, accurate local data would be available to help researchers further understand glacier response to climate variations.

Table 3. Summary of Helicopter Use

	Installation	Calibration	Data Collection	Maintenance
Alternative A				
Snow Course	NA	NA	6 landings	1 landing every 3-4 yrs
Aerial Markers	NA	NA	6 over flights	0
Glacier Monitoring	NA	NA	2 landings	0
Alternative B				
SNOTELs	12-14 (8-10 sling loads, 4 landings)	6 landings for 5 years at for upgraded snow courses; 2-3 landings for 3-5 years at upgraded aerial markers	2-3 landings/yr at upgraded snow courses; as needed at upgraded aerial markers	1 landing/yr (for both types)
Climate Stations (w/ glacier monitoring)	10 (8 sling loads, 2 landings)	2-3 landings for 5 yrs	Data collected during glacier monitoring visits (2 times/yr)	Maintenance completed during fall glacier monitoring visit

Mitigation Measures

To minimize resource impacts, the mitigation measures listed below would be followed for all action alternatives, and are analyzed as part of the action alternatives. These actions were developed to lessen the potential for adverse effects of the proposed action.

Station Design

All infrastructure components chosen for this project will be the least intrusive models available in terms of size, color and overall design. Infrastructure installation will minimize ground disturbance, excavation and helicopter flights. If less intrusive methods not identified in this document become feasible, they would be preferred to more intrusive methods. Stations would be decommissioned or improved as equipment or the site becomes obsolete.

Helicopter Use and Flight Paths

Timing, frequency and flight paths for helicopter activity will be conducted to minimize impacts to resources and visitor use. Helicopter flights will be restricted to weekdays after Labor Day and before the Fourth of July, periods of less visitor use. During installation and maintenance, flight paths will occur at higher elevations, lessening disturbance to any visitors and wildlife. When reasonable, flight paths will be routed to avoid trails, campsites, and areas of higher visitor use. Annual maintenance flights to the Silver and Noisy Glacier stations would occur in conjunction with the spring glacier mass balance flights, thereby lessening the number of landings. After the initial five-year calibration period, the conversion of snow courses and aerial markers at Browntop Ridge and Easy Pass would decrease flights to 1-4 annually per site. The decommission of the Jasper Pass aerial marker is intended, in part, as a mitigation action, reducing annual overflights from six to zero. During installation of the "Preferred Alternative" sites, a press release would inform visitors of the planned helicopter operations sites, to further minimize potential impact.

Reducing Visible Intrusions

All tower heights will be the minimum height necessary to achieve the desired needs. The instrument shelter and precipitation gauge at the SNOTEL sites and the towers at all the sites will be painted brown in an effort to camouflage them from view. The Easy Pass SNOTEL would be positioned on the south side of the ridge, shielding its view from Copper Ridge and Copper Lookout. The Browtop Ridge SNOTEL towers and instrument shelter will be sited on the south facing side of large vegetation to shield them from views on popular climbing routes to the north.

Reducing Audible Intrusions

All power tools would adhere to the North Cascades Wilderness Management Plan (1989) by using a modified muffler that reduces decibel levels below 4.

Protecting Whitebark Pine Trees

Whitebark pines trees will not be cut for any reason (e.g., to provide maximum sun exposure to solar panels, to position equipment shelter, etc).

Controlling Non-native Plants at Project Areas

Installation of the SNOTELs may provide vectors for the introduction of non-native plants through equipment, sand or fill material, boots and /or helicopter skids. Involved parties will make an effort to clean equipment (including helicopter), clothing, and personal gear of all weed seeds. A monitoring program for the project areas would be conducted for 5 years post construction by NPS personnel and would occur in conjunction with the annual maintenance visit by the NRCS in the fall. No additional flights or landings to the site would be required to implement the monitoring.

Antifreeze Leakage at SNOTELs

A stainless steel snow pillow assembly will be used instead of the older style Hypolon rubber snow pillows. No leaks of stainless steel snow pillows have been reported. Although there have been a few instances of leaks of the older style Hypolon rubber snow pillows, there have been no reports of impact to wildlife or vegetation. In addition, the stainless steel pillow requires less antifreeze to operate. For antifreeze, a propylene glycol and ethanol mix is used (the ethanol is

needed to thin the propylene glycol to a specific gravity of 0.98, which prevents the separation of the rain water and anti-freeze). It is anticipated that in the future that load cell technology will eliminate the need for antifreeze-filled snow pillows.

Alternatives Considered but Rejected

The following alternatives were initially considered but were later rejected as reasonable alternatives because they do not fulfill the Purpose, Need and Objectives of this EA:

Discontinue Use of the Sites

Seattle City Light and Puget Sound Energy have depended on these sites for planning and operation of their respective hydroelectric projects for more the 47 years. Abandoning these sites would have a negative impact on their operations. In addition, the National Park Service would not be collecting climate data that is important to the management of natural resources and to the understanding of climate change in North Cascades National Park and the Stephen Mather Wilderness.

Relocate to Another Site Outside Wilderness

There are no alternative sites at high elevations in the vicinity that are outside designated wilderness. Consistent long-term data from the same sites are critical to several programs including ecological monitoring and runoff forecasting.

Prohibit helicopter use for calibration and maintenance

There are no established trails to any of these sites; all overland travel would have to be done by foot, through rugged steep terrain, requiring 2-3 days of travel to reach the site. The size and weight of the equipment and gear used during the fall maintenance visit are in excess of 500lbs, further complicating logistics and travel. The use of overland travel during the initial 5-year calibration visits would have the same difficulties as the fall maintenance visit, with the additional danger of traveling on and through very dangerous terrain prone to avalanches.

Partial Implementation of the Preferred Alternative

Partial implementation would not satisfy the needs for the climate monitoring network. The needs of the network are for well-distributed stations, which provide near-real time data that are located at a variety of elevations. These sites were chosen because of their elevation, their unique locations that allow for a well distributed climate network and the quantity of historical data from previous snow surveys. The elimination of either of the glacier climate stations would remove the high alpine monitoring aspect of the network. The elimination of either SNOTEL would return these sub-alpine sites to seasonal monitoring of limited parameters.

Environmentally Preferred Alternative

The environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment, and that best protects, preserves, and enhances historic, cultural, and natural resources. The NPS is required to identify the environmentally preferred alternative that will promote the national environmental policy expressed in NEPA (Sec. 101 (b)). The alternative must:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
2. Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
3. Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
4. Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
5. Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Alternative B would be the environmentally preferred alternative. Climate change could have a tremendous impact to the natural systems of the region. Although there are foreseeable impacts caused by Alternative B, these impacts are outweighed by the short term and long-term benefits of having a more complete understanding of the Complex's climate, micro-climates and the resource impacts due to climate change. Data provided from these stations would assist resource managers in their decision making. Alternative does not meet the climate monitoring needs of the Complex resource managers. In addition, Alternative B would ultimately result in fewer helicopter flights within wilderness than Alternative A. Assisting the regions hydro-electric projects will aid in the efficient use of water resources thereby lowering dependence on other sources of electricity.

Chapter III. Affected Environment

This chapter describes the resources and values within the Project Area expected to experience environmental impacts upon implementation of either of the alternatives. The topics used to describe the resources and values will be used to structure the impact analysis provided in Chapter IV.

Project Area

The project area lies within the North Unit of North Cascades National Park, one of three units of North Cascades National Park Service Complex. The Project Area specifically includes the alpine and sub-alpine environments of Noisy Glacier, Silver Glacier, Easy Pass, Browntop Ridge and Jasper Pass. This would encompass the construction area, flight paths and landing zones at each site. The construction areas include the foot print of the climate station, the landing zone near the climate station and disturbed areas associated with construction and foot traffic. The SNOTEL footprint for Browntop Ridge would be approximately 60 feet in diameter and for Easy Pass 75 feet in diameter. The glacier climate station footprint would be approximately two feet in diameter (tower plus batteries).

The snow survey sites at Easy Pass, Browntop Ridge and Jasper Pass all have one 30 foot tower with an attached aerial marker. Additionally, Browntop Ridge has snowcourse signs and placards. A twin prop, fixed-wing aircraft is used by PSE to take 6 monthly measurements during the winter from the aerial markers at Easy Pass and Jasper Pass. On-the-ground visits to the site are rarely needed. Six monthly measurements are taken at the Browntop Ridge snowcourse each winter. A helicopter is used to transport personnel to the site for taking measurements. An additional maintenance visit is needed every 3-4 years

Stephen Mather Wilderness

Established by Congress in 1988, the Stephen Mather Wilderness encompasses some of the most rugged terrain in the northern Cascade Range. Ninety three percent, or 634,614 acres, of the park complex is designated as wilderness. All three existing snow survey sites are located within designated wilderness. In addition, the climate stations near Silver and Noisy Glacier, proposed under Alternative B, are also in designated wilderness.

The NPS uses the following four classes or “zones” to manage recreational use within the Stephen Mather Wilderness: Day Use Areas, Trailed/Established Camp Areas, Crosscountry I Areas, and Crosscountry II. All three existing snow survey sites and the sites proposed under Alternative B are located within the Crosscountry II zone. Areas within this zone are managed to be most pristine, with little evidence of human presence. There is little day use, and the opportunity for solitude is high. There are no maintained trails near Easy Pass, Browntop Ridge or Jasper Pass and are they are not near a popular destination, like a common climber’s route. Silver Glacier is located on the north side of Mt. Spickard, and Noisy Glacier is on the north side of Bacon Peak. There are no maintained trails near these sites; however both mountains are destinations for climbers. The level of use is difficult to quantify, but is suspected to be light to moderate relative to other mountaineering destinations in the Complex.

Natural Sounds

Natural sound is an important value in North Cascades National Park and the Stephen Mather Wilderness. The most frequent source of unnatural noise in the Complex is from aviation, power boat operations and vehicle traffic. Non-emergency helicopter flights are restricted during the period of July 4 to Labor Day. From January to June, monthly helicopter landings occur to measure snow courses. Park administrative use of helicopters includes such activities as search and rescue, fire management, trail maintenance, and scientific research. Search and rescue and fire management helicopter operations may occur at any time. Helicopter use within the Complex, including non-wilderness, averages 256.8 hours of flight time a year (See Appendix E).

A report on the effect of aircraft overflights at several National Park Service areas (National Park Service 1995) indicated that backcountry visitors were more affected by noise of aircraft than were visitors to frontcountry areas where there are higher levels of unnatural sounds. Survey results indicated that only about 20% of the front-country visitors heard aircraft while about 40% of backcountry day use visitors and 70% of backcountry overnight visitors heard aircraft. Similarly, of the backcountry overnight visitors about 35% indicated they were annoyed by hearing aircraft, 30% said it interfered with their enjoyment and 45% said it interfered with natural quiet. At North Cascades National Park 437 visitors were interviewed and 17% reported hearing aircraft.

Vegetation and Soils

The Silver and Noisy Glacier sites are located in the alpine, with little to no vegetation, and no vascular plants. Browntop Ridge and Easy Pass sites are located in the subalpine. With subalpine fir (*Abies lasiocarpa*) as the dominate tree and an understory of heather (*Phyllodoce empetriformis* and *Cassiope mertensiana*) and huckleberry (*Vaccinium deliciosum*).

Browntop Ridge is a mosaic of tree islands and open meadows, with relatively little rock and approximately 70-100 percent vegetation cover. Dominate tree species are subalpine fir and Engelmann spruce (Picea engelmannii). Scattered individuals of Whitebark pine (*Pinus albicaulis*) are also present at this site. Understory species are dominated by of heather (*Phyllodoce empetriformis* and *Cassiope mertensiana*), huckleberry (*Vaccinium deliciosum*) and partridgefoot (*Luetkea pectinata*).

The Easy Pass site is dominated by subalpine fir with mountain hemlock (*Tsuga mertensiana*), silver fir (*Abies amablis*) and Alaska yellow cedar (*Chamaecyparis nootkatensis*). Understory species are dominated by of heather (*Phyllodoce empetriformis* and *Cassiope mertensiana*), huckleberry (*Vaccinium deliciosum*) and partriagefoot (*Luetkea pectinata*).

Soils at Browntop and Easy Pass are spodosols, while there are no soils developed on the bedrock at the Sivler and Noisy glacier sites.

Rare and Sensitive Plants

A sensitive plant survey was conducted at the Brown Top Ridge and Easy Pass sites on September 6, 2006 by NPS personnel. The extent of survey included all areas that would potentially be disturbed by the placement and construction of the SNOTELs. The Silver and Noisy Glacier sites were not surveyed because these sites and the immediate surrounding areas are devoid of vascular plants. The survey period was appropriate for the identification of most plant species. A complete species list of plants observed at Browntop Ridge and Easy Pass is found in Appendix B. A list of sensitive plants that could potentially be found in the proposed project areas is located in Appendix C. No State or Federally listed plants were observed.

Wildlife

The park complex's wildlife checklists, wildlife observation database, high lakes surveys and several recent park inventories, including forest carnivores (Christophersen et al. 2005), bats (Christophersen and Kuntz 2003), small mammals (Bjorklund 1983), landbirds (Siegel et al. 2004), autumn raptor surveys (Bjorklund and Drummond 1989), and a vertebrate inventory (Kuntz and Glesne 1993) were used to describe species found in the project areas.

The Easy Pass and Jasper Pass sites are located within alpine/subalpine habitat, which is dominated by subalpine fir, mountain hemlock, heather, and huckleberry. Species likely to be found at these sites include raptors, such as the Cooper's hawk, sharp-shinned hawk, red-tailed hawk, northern harrier, and American kestrel; songbirds, such as the Clark's nutcracker, gray jay, hermit thrush, American pipit, Townsend's warbler, and dark-eyed junco; other birds, such as the sooty grouse, rufus hummingbird, and northern flicker; and mammals, such as the little brown myotis, hoary marmot, Townsend's chipmunk, Douglas squirrel, heather vole, long-tailed weasel, and mountain goat.

The Browntop Ridge site is located within alpine/subalpine habitat, which is dominated by subalpine fir, mountain hemlock, whitebark pine, huckleberry, and Oregon boxwood. Some of the species likely to be found around these sites include raptors, such as the sharp-shinned hawk, golden eagle, and American kestrel; songbirds, such as the mountain chickadee, winter wren, hermit and varied thrush, yellow-rumped and Townsend's warblers, chipping sparrow, fox sparrow; other birds, such as the sooty grouse, rufous hummingbird, and northern flicker; and mammals, such as the little brown myotis, hoary marmot, pika, coyote, mule deer, and black bear.

The Silver and Noisy Glacier sites are located in alpine habitat with little to no vegetation. Some of the species likely to be found around these sites include white-tailed ptarmigan, grey-crowned rosy finch, American pipit, golden eagle and mammals such as mountain goats and pikas.

There is no known concentrated migration route for birds within the park complex, but rather a documented small number of birds moving across dispersed areas. The northern Cascades landscape presents a broad array of north-south ridges that are used by raptors as well as passerines (songbirds) to migrate in a dispersed fashion.

Special Status Species

There are 27 fish or wildlife species that have special status within park complex boundaries. Seven of the 27 species are federally listed under the Endangered Species Act. All 27 species are listed by the State of Washington as either threatened, endangered, or candidate species. A summary table of the listings can be found in Appendix D. Profiles of listed species that may be affected by this proposal are provided as follows:

Mammals

Special status mammals analyzed include the Gray Wolf, Grizzly Bear, Canada Lynx, and California Wolverine.

Gray Wolf *(Canus lupus) Federal Status: Endangered, State Status: Endangered.*
Wolves are highly social animals with large home ranges that include a variety of habitat types. Key components of wolf habitat include: (1) sufficient, year-round prey base of ungulates and alternate prey (i.e., beaver and smaller mammals), (2) suitable and somewhat secluded denning and rendezvous sites, and (3) sufficient space with minimal exposure to humans. Wolf distribution is largely influenced by distance from human activity, and wolves are highly susceptible to human-caused mortality.

Wolves were previously extirpated from the North Cascades, but in the past 20 years, the animals have been seen roaming in the vicinity of Ross Lake (NPS 2004). Locations of other sightings in the North Cascades include the Pasayten Wilderness, Twisp River drainage of the Okanogan National Forest, and Glacier Peak Wilderness. There is currently no recovery plan for wolves in the North Cascades.

Grizzly Bear *(Ursus arctos) Federal Status: Threatened, State Status: Endangered.*
Grizzly bears are habitat generalists whose key habitat requirements are the availability of food and isolation from humans (USFS 1989). The bears usually move along an elevation gradient to take advantage of seasonal foods. Grizzlies commonly use low-elevation riparian areas and wet meadows during spring and higher elevation meadows, ridges, and open brush fields during summer. Forests become a more important habitat component during late summer and fall.

According to the USFWS (2004), the North Cascades region contains habitat that is capable of supporting a self-sustaining population of grizzly bears. However, only a "remnant" population remains, incapable of enduring without active recovery efforts, including possible augmentation with bears from other areas. A recovery plan for North Cascades was approved in 1997, but has not been implemented due to lack of funds. Critical habitat for grizzly bears has not been designated in the area. All proposed sites are located in suitable grizzly bear habitat, but there have been no documented sightings in the past 10 years.

Canada Lynx *(Lynx canadensis) Federal Status: Threatened, State Status: Threatened.*
Lynx are associated with subalpine and boreal forests throughout their range (Witmer et al. 1998; Aubry et al. 1999). The species requires a mosaic of forest seral stages connected by stands suitable for travel cover. Lynx use late-seral forests for denning and rearing young and use

early-seral forests for foraging (Aubry et al. 1999). Primary prey includes snowshoe hares, although lynx will take other prey, particularly when hare density declines.

Lynx generally use higher elevation (above 3,000-4,000 feet) lodgepole pine, subalpine fir, and/or Engelmann spruce forests. A forest carnivore survey completed in 2005, targeting forest carnivore species (including lynx) did not document lynx. There is evidence that lynx may occasionally wander as far west as Mount Baker.

California Wolverine *(Gulo gulo luteus) Federal Status: not listed, State Status: Candidate.* California wolverines occur in low densities, mostly in subalpine and alpine habitat zones. However, they can be found in silver fir and other lower elevation forests. Current research being conducted near the east border of the park is following the movements of two collared animals.

Birds

Special status birds analyzed include the Ferruginous Hawk, Golden Eagle, Merlin, Northern Goshawk, Pileated Woodpecker, and Vaux's Swift.

Ferruginous Hawk *(Buteo regalis) Federal Status: not listed, State Status: Threatened.* Ferruginous hawks are a declining grassland-steppe species. In the park complex, they have been documented only as migrants. While ferruginous hawks are probably rare fall migrants at high elevation sites along the eastern edge of the Complex (including at proposed SNOTEL sites).

Golden Eagle *(Aquila chrysaetos) Federal Status: not listed, State Status: Candidate.* This species is uncommon in the North Cascades Range, occurring most frequently in subalpine/alpine habitats. A Washington state survey in 1985 revealed only 20 territories (11 occupied) in all of western Washington. Over 100 sightings of this species are recorded in the park complex's Wildlife Observation Database, most occurring as fall migrants.

Merlin *(Falco columbarius) Federal Status: not listed, State Status: Candidate.* The status of merlin in the Complex is uncertain. Smith et al. (1997) identifies the subspecies *Falco columbarius columbarius* as a potential rare breeder in high-elevation forests that mimic boreal forest conditions, that is Engelmann spruce and subalpine fir dominated forests. Park biologists have documented this species as a rare visitor in the Complex with all records occurring from late June through December (NOCA Wildlife Observation Database, NPS survey data). No evidence of nesting has been documented within Complex boundaries.

Northern Goshawk *(Accipiter gentilis) Federal Status: not listed, State Status: Candidate.* Goshawks are uncommon residents of the North Cascades. Dense, mature coniferous forests are the preferred nesting habitat of this species. Nests are typically built in the largest trees of the nest stand (Reynolds et al. 1982) and can be in either deciduous or coniferous trees. Smith et al. (1997) found that this species is most common along the east-slope of the Cascades. Goshawks have been documented throughout the Complex in suitable habitat, though, based on observational data, they appear to be more common in the Lake Chelan National Recreation Area (NOCA Wildlife Observation Database). However, no systematic surveys of the Complex have been completed for this species.

Pileated Woodpecker *(Dryocopus pileatus) Federal Status: not listed, State Status: Candidate*. This species is common in mid-seral and late-seral forests, mostly at low and moderate elevations. It is much less common in subalpine fir and mountain hemlock forest communities. Key habitat needs include the presence of large snags used for nesting and roosting. Siegel et al. (2004) documented pileated woodpeckers in all conifer or mixed deciduous-coniferous forests for low elevation up to and including the mountain hemlock cover type.

Vaux's Swift *(Chaetura vauxi) Federal Status: not listed, State Status: Candidate.*
Vaux's swift is a fairly common summer visitor to the Complex (NOCA Wildlife Observation Database). This swift prefers to breed in coniferous and mixed coniferous/deciduous forests (Bull and Collins 1993). It is more common in old-growth forests than in younger stands (Manual and Huff 1987). Vaux's nest and roost in hollow trees. It is an aerial forager that spends much of its time in flight just above the forest canopy or over water hawking ants, bugs, flies, moths, spiders, and aphids.

Vaux's swift occurs in the Complex from mid-April through September, though it is more common during the months of June, July, and August (Kuntz et al. 1996). It is found both east and west of the Cascade Crest, though it is more common on the west slope of the Cascades.

Amphibians

Special status amphibians analyzed include the Western Toad and the Columbia Spotted Frog.

Columbia Spotted Frog *(Rana luteiventris) Federal Status: Candidate, State Status: Candidate*. The Columbia spotted frog is nearly always found in or near a perennial water body (required for breeding) such as a spring, pond, lake or stream backwater. It is most often associated with non-woody wetland plant communities (sedges, rushes and grasses). Breeding occurs in February or March at lower elevations of eastern and western Washington but does not occur until late May or early June at higher elevations. Males are not territorial and may gather in large groups of 25 or more at specific locations in a pond. Females usually lay their eggs adjacent to or mixed with other egg masses. The gelatinous masses are only partially submerged. Eggs are typically deposited in the same locations in successive years. Sometime during their first summer, the tadpoles transform into small froglets about ¾ inch (16-23 mm) in length (Leonard et al. 1993). Olson, et al. (1997) list dates of oviposition as March – June (laid communally), and metamorphose three to four months after eggs are laid.

In the Complex the Columbia spotted frog has been found throughout the lower Big Beaver Valley (1,600 feet) in appropriate wetland habitat and up middle McMillan Creek beaver ponds (2,500 feet) and lower Luna Creek ponds (2,700 feet). On the east side of the crest they have been documented at Dagger Lake (5,500 feet) and a wetland 0.3 mile downstream; McAlester Lake (5,500 feet), McAlester Pass Pond (6,000 feet), and upper Kettling Lake (5,550 feet) (Holmes and Glesne, 1997,1998,1999).

Western Toad *(Bufo boreas) Federal Status: not listed, State Status: Candidate.*
Western toad habitat ranges in elevation from sea level to 7,000 feet. Oviposition sites and aquatic habitat include lakes, springs, ponds, wetlands, stock ponds and slow-moving parts of

streams. Terrestrial habitats are forests, grasslands and along streams. Western toads are most common near marshes and small lakes, but they may wander great distances through dry forests or shrubby thickets. Outside of the breeding season, western toads are nocturnal, spending the day buried in the soil, concealed under woody debris, or in the burrows of other animals.

Recreation and Visitor Use

On average, about 400,000 people visit the Complex annually, mostly between the months of June and October. The largest concentration of visitors (90%) is along the State Route 20 corridor in Ross Lake National Recreation Area. Backcountry visitor activities include hiking, backpacking, mountaineering, horseback riding and fishing. There are 386 miles of maintained trails, and approximately 135 camps with over 300 tent sites along the trails. Although 93 percent of the Complex is designated wilderness, non-wilderness areas remain remote with higher expectations of solitude from Complex visitors.

Visitation in the vicinity of the snow survey sites and the proposed alternative sites is difficult to estimate, but likely low. There has been an annual average of 21,100 overnight backcountry visitors within the park complex over the last three years. Visitation numbers on overnight backcountry use are collected via the backcountry permit system, but reliable estimates of backcountry day use do not exist. Access into the high country is limited in the winter months; most visitation occurs from May or June through October when there is less snow. During the winter months, visitation drops dramatically. Much of the park becomes inaccessible due to heavy snowfall, avalanche danger and road closures. State Route 20 is closed between Ross Dam at milepost 134 and Early Winters at milepost 178 from about mid-November to mid-April.

The average visitor use nights[2] for selected campsites and cross-country zones that potentially could be impacted by the alternatives and associated helicopter use is shown in Table 4. Day use is not included, although because of remoteness of the areas, it is negligible. For the months shown, most use (except for Sulphide Camp) was in June and September. The Depot Cross Country Zone is probably under reported, because many users do not get permits for this area.

Table 4. Average Visitor Use Night Data for Selected Campsites and Cross- Country Zones, 2003-2006

	Potential Visitor Use Areas Impacted by Alternatives (*Camp or Cross Country Zone*)	**Three Year Averages, 2003-2006**		
		January - June	*September - October*	*Total Average*
Browntop Ridge	Silver Creek Camp*	45.75	52.5	98.25
	Boundary Bay Camp*	26.5	39.5	66
	Little Beaver Camp*	94.25	124.25	218.5
	Perry Creek Camp*	28	20.75	48.75
	Total	*194.5*	*237*	*431.5*
Easy Pass	Sulphide Creek Camp	53.5	24.5	78

[2] Visitor use night = each night a visitor who obtains an overnight backcountry permit stays in the backcountry. For example, a two-person party that goes on a five-day backpacking trip equates to eight visitor use nights (four nights x two people = eight visitor use nights).

	Potential Visitor Use Areas Impacted by Alternatives (*Camp or Cross Country Zone*)	Three Year Averages, 2003-2006		
		January - June	*September - October*	*Total Average*
	Easy Ridge XC	5	19	24
	Pioneer Ridge XC	1.5	2.5	4
	Total	*60*	*46*	*106*
Jasper Pass	Terror XC	8.5	8.5	17
	Crescent Creek XC	3.75	1	4.75
	Despair XC	3	4	7
	Depot XC	11.75	3	14.75
	Total	*27*	*16.5*	*43.5*
Silver Glacier	Silver Creek Camp*	45.75	52.5	98.25
	Spickard XC	0.5	0	0.5
	Total	*46.25*	*52.5*	*98.75*
Noisy Glacier	Bacon XC	11	1.5	12.5
	Berdeen XC	1	4	5
	Total	*12*	*5.5*	*17.5*
Front Country Staging Areas/ Helispots	Hozomeen Campground*			
	Baker Lake Campground*			
	Total			

* Indicates non-wilderness camp or cross-country zone

Cultural Resources

Cultural resources in the Complex include prehistoric and historic archeological sites and objects, historic sites and structures, cultural landscapes, and traditional cultural properties or ethnographic resources. Even the most rugged and remote areas of the park contain sensitive archeological resources. Surveys are conducted to inventory archeological sites prior to any undertakings. Currently, 260 prehistoric sites have been identified, some dating older than 8,500 years. As a result of these studies, it is now widely recognized that the extensive subalpine landscape of the North Cascades contributed importantly to Northwest Coast Indian economies.

An archeological survey was conducted at the Browntop Ridge and Easy Pass sites on September 6, 2006 by NPS personnel. The extent of the survey included all areas that would potentially be disturbed by the placement and construction of the SNOTELs. No culturally significant materials were found. As a precaution, North Cascades National Park would have an archeologist present during any ground disturbance at the Easy Pass site. The Silver and Noisy Glacier sites were not surveyed because of the unlikelihood of preservation of artifacts in high alpine environments with little or no soil. In addition the climate stations will be bolted to bedrock, with little to no ground disturbance.

Socioeconomic Considerations

Presently, Seattle City Light and Puget Sound Energy rely on snow pack data from Browntop Ridge, Easy Pass and Jasper Pass for operation and planning of the Skagit River and Baker River Hydroelectric Projects. The amount of snow water equivalent for the entire watershed is

estimated from the SNOTEL and snow survey data; combined with estimated melt and runoff, the utilities determine when and how much power to produce, in addition to balancing recreation needs of visitors to the reservoirs and releasing enough water to support salmon needs. The quality of snow pack and weather data are directly related to the efficiency of their operations and costs. Many local communities, including Lyman-Hamilton, Birdsview, Rockport, and Concrete are susceptible to flooding. Snow pack data are also used by the National Weather Service for flood forecasting in the Skagit watersheds and in aids in preparing citizens in local communities to meet flood conditions.

Chapter IV. Environmental Consequences

This chapter contains an analysis of the environmental consequences that could occur under each alternative. Each resource described in Chapter 3 has been analyzed for the direct, indirect, and cumulative impacts that might occur as a result of implementing one of the alternatives. Direct impacts are caused immediately by an action and they occur in the same place as the action. Indirect impacts are caused by the action but they occur later in time or farther away in distance from the action. Cumulative impacts have additive effects on a particular resource; they include impacts of actions in the past, present, and the reasonably foreseeable future. NEPA also requires an analysis of the type (beneficial vs. adverse), duration (short-term vs. long-term), and intensity (degree of severity) of impacts to affected resources.

Impact Analysis Methodology

In this chapter, the impacts of each alternative on each resource are identified, and the context, duration, and intensity of impacts are defined. The duration and intensity of impacts were determined using field investigations, literature, and the best professional judgments of NPS staff members. Impacts are quantified in numbers when possible, and are described qualitatively based on intensity and duration. The following definitions and criteria are used to describe the intensity of impacts:

Negligible. Imperceptible, not measurable, or undetectable
Minor. Slightly perceptible or measurable but limited in extent. Without further actions, impacts reverse and the resource would return to the previous condition
Moderate. Readily apparent and measurable but limited in extent. Without further actions, impacts would eventually reverse and the resource would return to the previous condition. Individuals of a species would be harmed or killed, with slightly measurable impacts to the population or surrounding community
Major. Substantial and measurable, highly noticeable, and affecting a large area. Changes would not reverse without active management. Entire communities of species would be measurably affected.
Impairment. The impact harms the integrity of park resources or values (not allowed according to NPS Management Policies)

This EA uses the following terminology to describe potential impacts to special status wildlife species:

No effect. The proposed action would not affect a listed species or designated critical habitat.
May affect / not likely to adversely affect. Effects on special status species are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or are completely beneficial.
May affect / likely to adversely affect. When an adverse impact to a listed species may occur as a direct or indirect result of proposed actions and the effect is not discountable or beneficial.

Is likely to jeopardize proposed species / adversely modify proposed critical habitat. The appropriate conclusion when the NPS or the US Fish and Wildlife Service identifies situations in which the proposal would jeopardize continued existence of a proposed species or adversely modify critical habitat to a species within or outside the Complex.

Impacts to wilderness were assessed using the following four qualities that are based on wilderness legislation and are used to describe wilderness character:

Untrammeled: wilderness is ideally unhindered and free from intentional modern human control or manipulation.

Natural: wilderness ecological systems are substantially free from the effects of modern civilization.

Undeveloped: wilderness has minimal evidence of modern human occupation or modification.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation: wilderness provides opportunities for people to experience natural sights and sounds, solitude, freedom, risk, and the physical and emotional challenges of self-discovery and self-reliance.

Impairment

The NPS is required by law to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. Adverse impacts that constitute impairment are prohibited. Impairment is "an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts." [Management Policies 1.4.5]

An impact to any park resource or value may constitute impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents

Summary of Impacts

Impact Topic	Alternative A Continue Current Management	Alternative B. Upgrade and Expand Meteorological Monitoring (Preferred Alternative)
Wilderness	Impacted by presence of snow course markers and helicopter flights. Flights are made when visitors are not present along routes rarely used by visitors. Environmental information available on which to base management decision would be limited. Natural sounds disrupted by 7 helicopter flights annually. Visual impacts minor, snow surveys are unlikely to be seen.	Increased development or new structures at four wilderness sites would have minor to moderate impacts to the natural and undeveloped character of wilderness. Three existing aerial marker towers would be removed from wilderness. The climate stations are near wilderness destinations. Helicopter operations would be heavy during installation. After initial calibration period, annual flights would be reduced to 1-4 per station. Over the long-term, fewer flights needed to operate site than Alternative A. Improved climate data would assist researchers and NPS resource managers.
Vegetation/Soils	Minor impacts to vegetation and soils during infrequent site maintenance visits, and no sensitive plant species were identified at sites.	Minor trenching, ground leveling and vegetation trampling during SNOTEL installation. Minor vegetation trampling during SNOTEL calibration and maintenance. No sensitive plant species surveyed at proposed SNOTEL sites.
Wildlife	Potential disruption to wildlife from helicopter use.	Potential disruption to wildlife from helicopter use. Over the long-term, fewer flights needed to operate sites than with Alternative A.
Visitor Use	Minor impacts to visitor use associated with noise from helicopter use. Flight routes and the timing of work will limit any impacts.	Minor impacts to visitor use associated with noise from helicopter use. Flight routes and the timing of work will limit any impacts. Over the long-term, fewer flights needed to operate sites than with Alternative A.
Cultural Resources	No cultural resources surveyed at sites.	No cultural resources surveyed at sites.
Socioeconomic Effects	Significant benefits from improved flood forecasting and efficient hydroelectric operations.	Significantly better climate data benefiting resource management, climate change research, flood forecasting and efficient hydroelectric operations.

Alternative A. Continue Current Management

Wilderness Character

There are both short-term and long-term impacts associated with this alternative. Short-term noise from helicopter operations would be the most significant impact from this alternative. Opportunities for solitude would be impacted during winter snow surveys. Helicopter use would impact natural sight and sound values associated with wilderness character, but the impact would be minor since there are few visitors present in these areas during the period of use.

Since the helicopter would be flying at approximately 100 miles per hour, any particular spot along the flight route would be impacted for a very short time. In addition, because the flight operations would occur in October and from January through June, limited to weekdays, the number of people potentially impacted is minimal. As noted previously, most wilderness use in these areas occur from June through September. Flight routes would be designated to avoid visitor use areas and potentially sensitive wildlife areas, although the helicopter flight routes would be near Little Beaver trail and the Chilliwack trail. The elevation that the helicopter is expected to fly at plus the requirement of a minimum flight elevation of 500 feet above ground level would all help to reduce impacts.

The long-term impacts associated with this alternative are largely related to the viewshed surrounding each of the sites, and the impact on the untrammeled and undeveloped qualities of wilderness. The aerial marker towers although unlikely could potentially be visible to cross-country travelers from the ridges above and to the occasional visitor that comes across it. Browntop Ridge, Easy Pass and Jasper Pass are not common climbing routes for nearby mountains or destinations.

Noisy Glacier and Silver Glacier are two of four glaciers being monitored at North Cascades National Park. Mass balance measurements are taken three times a year. The spring and fall measurements require helicopter assess. Typically, one roundtrip flight is required per glacier per season, with work being completed within 4 hours. Silver Glacier is located on the north side of Mt. Spickard and Noisy Glacier is on the north side of Bacon Peak. Helicopter use would impact natural sight and sound values associated with wilderness character, but the impact would be short term and minor since there are few visitors present in these areas during the period of use.

Vegetation and Soils

Some sub-alpine vegetation near the Browntop Ridge site would be cut and trimmed every 3-4 years to prevent it from being overgrown. This is necessary to provide for unobstructed accumulation of snow in order to obtain representative measurements and to provide for safe helicopter access. Trampling of vegetation associated with foot traffic during maintenance visits is possible. Rare site maintenance may occur at the Jasper Pass and Easy Pass aerial markers, which could include minor vegetation clearing and/ or trampling of vegetation associated with foot traffic. However, no sensitive plant species were identified during a recent survey at the Easy Pass and Browntop Ridge sites. Although no invasive weeds have been found at the sites to date, they could be spread during maintenance visits. Weed seeds can be carried by the helicopter skids, work boots, clothing, or other materials. As a result, the impacts to vegetation

under the current system is minor, adverse, and of short duration. Geology and soils resources would not be disturbed and therefore no impacts at any of these sites.

Wildlife and Special Status Species

Temporary noise disturbance created by the use of helicopters during the winter measurement season is the most probable impact to all wildlife, including special status species. Though not documented within the park complex, a number of physiological and behavioral responses to aircraft overflights have been documented throughout the US (NPS 1994). Responses might range from a mild annoyance, as indicated by changes in body posture, to extreme panic and the need to escape. Some of these responses produce enough stress that they could potentially reduce an animal's fitness or ability to survive, especially when paired with other stressful events such as a harsh winter. Some of the known impacts of stress include heart-rate acceleration, energy loss, susceptibility to disease, and changes in metabolism and hormone balances. The long-term effects of chronic stress from overflights or other synergistic events have not been studied. Additionally, little is known about the impact of aircraft overflights on the hearing ability of most wildlife.

Although snow survey measurements are taken during the stressful winter and spring seasons, the amount of flight hours is limited to one day per month. Snow survey sites typically remain snow covered through June with little use by mammals during the winter months. Migratory birds begin to arrive at the end of May, although collision between birds and helicopter are unlikely because birds tend to readily avoid helicopters, and no impacts have been documented to date despite an extensive track record of helicopter use. Therefore, the impacts to wildlife under this alternative would be minor, adverse, and of short duration.

Special Status Species

This No Action alternative would have "no effect" on the following state and federally listed because they are considered out-of-range, the monitoring sites are located in unsuitable habitat or continued management would have no material impact on their habitat: Western Gray Squirrel, Keen's Myotis, Townsend's Big-eared Bat, Bald Eagle, Marbled Murrelet, American White Pelican, Western Grebe, Flammulated Owl, Lewis' Woodpecker, Black-backed Woodpecker, Bull Trout, Chinook Salmon, Pacific Fisher, Johnson's Hairstreak and Northern Spotted Owl.

This no action alternative "may affect, but is not likely to adversely affect the following listed species: Gray Wolf, Grizzly Bear, Canada Lynx, and California Wolverine. The determination is based upon the knowledge that these species are very rare in the Project Area, and impacts to their habitat would be limited to temporary disturbance from helicopters and personnel performing equipment maintenance within the immediate vicinity of the monitoring locations.

Visitor Use

Impacts to visitors would be mostly attributed to noise from aircraft during flights. Most helicopter activity will occur in wilderness areas; helicopter use in wilderness areas is discussed in the wilderness section of this chapter. Non-wilderness visitor use impacts would be mostly limited to annoyance associated with the aircraft noise. The snow survey sites are not near any established hiking trail or common climbing routes for nearby mountains or destinations; therefore any landings at the snow survey sites are unlikely to displace visitors.

Snow surveys are typically conducted once a month from January to June. During the winter months, visitor use drops off dramatically. These sites become nearly inaccessible due to deep snow and avalanche danger. The number of visitors using camps along the flight path during this period is relatively low, with most use occurring in June (See Table 4). Helicopter flights would continue to be restricted to weekdays after Labor Day and before the Fourth of July, periods of less visitor use.

Visual impacts caused by the 30-foot tall aerial marker towers would continue to be unlikely because the towers are typically obscured by vegetation and terrain and not readily visible over long distances. Nonetheless, some sites could be visible to cross-country travelers from the ridges above and to the occasional visitor that comes across it. Due to their remote locations and that survey activities typically occur during the winter, any impacts would largely go unnoticed by visitors therefore resulting in a negligible adverse impact for a very short duration.

Cultural Resources

An archeological survey was conducted at the Browntop Ridge and Easy Pass sites on September 6, 2006 by NPS personnel. No culturally significant materials were found. There are no known impacts to cultural resources at any of the sites.

Socioeconomic Effects

Both SCL and PSE rely heavily on the snow survey/ SNOTEL network for their hydroelectric operations. The quality of snow pack and weather data are directly related to the efficiency of their operations and costs. SCL and PSE have used the snowpack data from these sites since 1959. Snow pack data are also used by the National Weather Service for flood forecasting in the Skagit watersheds and in aids in preparing people and their property to meet flood conditions. The positive economic benefits associated with the current monitoring program are difficult to quantify, but they are nonetheless substantial. These stations have a major, beneficial, long-term impact on hydroelectric operations and flood forecasting.

Conclusions

Resource impacts range from negligible to minor. Impacts to wilderness and visitor use range from negligible to minor. Impacts to cultural resources, soils and topography, vegetation, wildlife, health, and public safety would be minor. Impairment of resources or values would not occur under this alternative.

Impairment

No impairment to wilderness character, vegetation and soils, wildlife including special status species, visitor use, cultural resources or socioeconomics are expected under this alternative.

Alternative B. Upgrade and Expand the Meteorological Monitoring Network (Preferred Alternative)

Wilderness Character

The development of a SNOTEL station at Easy Pass and Browntop Ridge would have mixed impacts to wilderness character. Although the footprint of human development would increase, some development does already exist at these sites. The adverse impacts to the natural soundscape from helicopter operations would increase for the short-term during installation, but over the long-term would decrease due to the automated capabilities of SNOTELs. The installation of an Easy Pass SNOTEL would allow for the discontinuation of the Jasper Pass aerial marker, thereby eliminating the structures and flights associated with maintaining this site. Helicopter operations would potentially include adverse impacts to natural wildlife behavior and habits. Impacts to wildlife will be described further in the wildlife section of this alternative.

In regards to increased development, the footprint from each station and the number of associated structures would increase. These sites, although unlikely, could potentially be visible to cross-country travelers from the ridges above and to the occasional visitor that comes across it. The SNOTEL locations are not proximal to any established hiking trail. Neither Browntop Ridge nor Easy Pass is common climbing routes for nearby mountains or destinations. Structures of the SNOTEL would be brown in color to make them less obvious. Except for the solar panels, surfaces would be non-reflective.

In regards to the natural soundscape, the SNOTEL station itself would make no noise. Impacts to the natural soundscape would be from helicopter installation and calibration. Although, helicopter flights would be elevated over existing conditions during the installation of the sites, after a 5-year calibration period, a significant decrease in helicopter use would occur. Helicopter operations would be noticeable during the two days needed for installing each site. A total of 12-14 round trips are expected to shuttle equipment and personnel from their assigned staging areas to the installation sites. The flight paths for fly over a combined two designated wilderness camps: Sulphide Creek Camp, used to climb the popular Mount Shuksan; and Perry Creek Camp, along the Little Beaver Trail (Appendix A, Figures 9 and 10).

During installation, visitors would be advised of the planned operation. Because the flight operations for installation would occur in October, limited to weekdays, the number of people potentially impacted is minimal. As noted previously, most wilderness use in this area occurs from June through September. Aircraft use within the Complex is required to operate at a minimum flight elevation of 500 feet above ground level, which would help reduce impacts. During the first five years of operation, a maintenance flight would occur in October and monthly calibration flights would occur from January to June. Although these flights would impact the natural soundscape, it is unlikely that visitors would be present to notice. Potential impacts would be further mitigated by designating flight routes to avoid sensitive visitor and wildlife areas

The development of a climate station would impact wilderness and wilderness character, although such impacts would be minor. The long-term placement of a tower at each site would likely be the most significant impact from this operation. The impacts to the natural soundscape

from helicopter operations would increase for the short-term during installation, but over the long-term would decrease to current use. Helicopter operations would potentially include impacts to natural wildlife behavior and habits. Impacts to wildlife will be described further in the wildlife section of this alternative.

A new structure (one 20ft tower) would be established in wilderness, thereby increasing human development in wilderness. Although these locations are not proximal to any established hiking trail, nearby peaks are occasional destinations for climbers. The towers may be seen, although unlikely, from the summits of nearby Bacon Peak (Noisy) and Mount Spickard (Silver). The tower surfaces would be non-reflective and camouflaged with paint. The Silver Glacier climate station would be located with the Silver Lake Research Natural Area, a federally designated area established to provide an example of undisturbed ecosystem for scientific research.

In regards to the natural soundscape, the glacier climate stations would make no noise. Impacts to the natural soundscape of these areas would be from helicopter operations and installation; these impacts would be moderate but short-term. The impact area related to the natural soundscape would include the site and the helicopter flight routes.

Helicopter operations would be noticeable during the two days needed for installing each site. A total of 8-10 round trips are expected to shuttle equipment and personnel from their assigned staging areas to the installation sites. Flight paths would fly over no designated wilderness camps. The flight route for Noisy Glacier would follow the Baker Lake tributary, Hidden Creek, to Noisy Glacier (Appendix A, Figure 9). This flight route is chosen because of the lack of visitor use. The flight route for Silver Glacier would follow Ross Lake south and then west along Silver Creek to Silver Glacier (Appendix A, Figure 10).

During installation, visitors would be advised of the planned operation. Because the flight operations for installation would occur in October, limited to weekdays, the number of people potentially impacted is minimal. As noted previously, most wilderness use in this area occurs prior to October.

Annual calibration would occur in late September and in conjunction with already existing glacier mass-balance monitoring program flights; therefore no addition flights would be needed. During the first five years of operation, 2-3 calibration flights would occur during the winter. Although these flights would impact the natural soundscape, it is very unlikely that visitors would be present to notice. Aircraft use within the Complex is required to operate at a minimum flight elevation of 500 feet above ground level, which would help reduce impacts.

Vegetation and Soils

Localized removal of small trees, shrubs, and herbaceous sub-alpine vegetation would occur during installation of each SNOTEL station. In addition, vegetation would be trampled from foot travel and unloading of equipment from the helicopter. Vegetation around the station would be cut and trimmed every 3-4 years to prevent it from being overgrown and to open a window of clearance for operating the solar panels and transmission antenna.

The impact of the proposed action to geology and soils would be minimal. Installation of the instrument shelter and precipitation gauge would level a site approximately six feet by six feet and dig four postholes 12-18 inches deep. The structures would sit on concrete blocks or treated wood frames. Holes about two-foot square would be dug for the wind speed and radio antennae towers and filled with concrete. There would be one other posthole for the snow pillow marker pole. A 20-foot diameter soil pad would be cleared and leveled for the snow pillow. Weed seeds can potentially be carried by the helicopter skids, work boots, clothing, or other materials. Mitigation to control the introduction of non-native plants would limit potential impacts. The impacts to vegetation under the current system is minor, adverse, and of short duration.

Digging and backfilling would disturb the natural soil structure and stratigraphy and any soil organisms present. The sod would be preserved as much as possible for backfilling. Soil disturbance and loss of vegetation could encourage growth of invasive, non-native plants.

A leak of instrument antifreeze could contaminate the soil; however there have been no reported leaks from the new stainless steel pillows.

A single, free-standing 20-foot tower at each glacier climate stations would be bolted to the underlying bedrock. There is no vegetation or soil located at either site. No unique geologic resources exist at these sites.

Wildlife and Special Status Species

The factors that would impact wildlife under Alternative B are similar to those described in Alternative A, except the frequency and level of impact would vary. Disturbance created by helicopter use during the construction and calibration phases would be the most probable impact to all wildlife, including special status species. Though not documented within the park complex, a number of physiological and behavioral responses to aircraft overflights have been documented throughout the US (NPS 1994). Responses might range from a mild annoyance, as indicated by changes in body posture, to extreme panic and the need to escape. Some of these responses produce enough stress that they could potentially reduce an animal's fitness or ability to survive, especially when paired with other stressful events such as a harsh winter. Some of the known impacts of stress include heart-rate acceleration, energy loss, susceptibility to disease, and changes in metabolism and hormone balances. The long-term effects of chronic stress from overflights or other synergistic events have not been studied. Additionally, little is known about the impact of aircraft overflights on the auditory systems of most wildlife.

An increase in the number of helicopter trips would occur during construction at each site. Installation of SNOTEL sites would require 12-14 flights, Silver and Noisy climate stations would require approximately 10 trips, and an additional 2-3 flights would be needed to remove the Jasper Pass aerial marker. These flights would occur over two years in late September/ early October. Fall migration of birds occurs during this period, although collision between birds and helicopter are unlikely. The acute increase in helicopter operations would increase the likelihood of moderate impacts to wildlife; although helicopter use would occur over a short period of time (2-3 days per site) and therefore impacts would be short lived.

In addition to the construction flights, six calibration flights from January to June, and one October maintenance flight would occur annually for each SNOTEL for the first five years. There would be 3-4 calibrations flights to the glacier climate stations annually. After the five-year calibration period, helicopter flights would drop significantly to two annually per SNOTEL site, and one flight to the glacier climate stations. Helicopter use during the calibration period for this alternative would closely mimic current or the *No Action Alternative* use. Although the calibration measurements are taken during the stressful winter and spring seasons, the amount of flight hours is limited to one day per month. Snow survey sites typically remain snow covered through June with little use by mammals. Migratory birds are beginning to arrive at the end of May, although impact between birds and helicopter are unlikely. Therefore, the impacts to wildlife would be minor, adverse, and of short duration.

During construction, some wildlife, such as deer, birds, and small rodents, might be disturbed by the construction noise and activity in the areas, and may distance themselves from the activity. This would result in minor, adverse impacts of a short duration

Special Status Species

The "Preferred Alternative" would have "no effect" on the following state and federally listed because they are considered out-of-range, the monitoring sites are located in unsuitable habitat or continued management would have no material impact on their habitat: Western Gray Squirrel, Keen's Myotis, Townsend's Big-eared Bat, Bald Eagle, Marbled Murrelet, American White Pelican, Western Grebe, Flammulated Owl, Lewis' Woodpecker, Black-backed Woodpecker, Bull Trout, Chinook Salmon, Pacific Fisher, Johnson's Hairstreak and Northern Spotted Owl.

The Preferred Alternative "may affect, but is not likely to adversely affect the following listed species: Gray Wolf, Grizzly Bear, Canada Lynx, and California Wolverine. The determination is based upon the knowledge that these species are very rare in the Project Area, and impacts to their habitat would be limited to temporary disturbance from helicopters and personnel performing equipment maintenance within the immediate vicinity of the monitoring locations.

Recreation and Visitor Use

The "Preferred Alternative" would require 10-14 helicopter trips to each site for installation, with several more trips each season for operation and maintenance purposes. Visitors in the vicinity of either the staging areas or the installation sites would likely be displaced and disturbed more often during the construction phase, which would entail frequent helicopter use and loud equipment such as a rock drill. This level of disturbance would result in minor, adverse impacts for a short period of time (i.e., potentially the entire length of a visitor's stay). The staging area for equipment to be delivered and helicopter landing zone would be in Hozomeen and at Baker Lake (USFS), near campgrounds. Helicopter operations and construction would be conducted in a 2-day period for each site.

Relatively few visitors use camps along the flight path in October and from January through June. During the winter months, visitor use drops off dramatically. These sites become nearly inaccessible due to snow and avalanche danger. Helicopter flights will be restricted to weekdays after Labor Day and before the Fourth of July, periods of less visitor use. This level of disturbance would result in minor, adverse impacts for a short period of time.

Hunters in Ross Lake National Recreation Area could potentially be impacted by helicopter flights during the installation. During October, the proposed installation time, hunting season in the Ross Lake National Recreation Area is open for small game, black bear, cougar, and black-tailed deer (general firearm). Hunters would be most impacted near Hozomeen, but minimally impacted in the rest of the Recreation Area where the helicopter would be flying at a minimum of 500 feet above ground level. Because flights would take place during the week and not on the weekend fewer hunters would likely be affected. To further minimize potential impacts permitting officials at the NOCA Wilderness Office, in addition to a press release, would inform visitors of the planned helicopter operations. This level of disturbance would result in minor, adverse impacts for a short period of time

Cultural Resources

An archeological survey was conducted at the Browntop Ridge and Easy Pass sites on September 6, 2006 by NPS personnel. The extent of the survey included all areas that would potentially be disturbed by the placement and construction of the SNOTELs. No culturally significant materials were found. As a precaution, North Cascades National Park would have an archeologist present during any ground disturbance at the Easy Pass site. The Silver and Noisy Glacier sites were not surveyed because of the unlikelihood of preservation of artifacts in high alpine environments with little or no soil. In addition the climate stations will be bolted to bedrock, with little to no ground disturbance.

Socioeconomic Effects

The quality of snow pack and weather data are directly related to the efficiency and costs of hydroelectric dam operations. With the addition of four near-real time advanced hydro-meteorological weather stations, the quality of snowpack data would improve, thereby improving efficiency hydroelectric operations. The positive economic benefits associated with an improved monitoring network are difficult to quantify, but they are nonetheless substantial. These stations would have a major, beneficial, long-term impact on hydroelectric operations and flood forecasting. The utility estimates that improving hydrological monitoring in the Skagit watershed will enhance the efficiency of their operation by 1-3%. Improved efficiency of this project will reduce the costly need to purchase electricity from other utilities. Seattle City Light estimated that the Beaver Pass SNOTEL alone could save approximately $500,000 (in 1996 dollars) over a 20-year period. In addition, much of the electricity purchased from other utilities comes from gas and/or coal fired plants; SCL estimates that a 1% increase in efficiency would annually eliminate the introduction of 41,000 lbs. of CO2 into the atmosphere.

The region has history of flood events that have a strong impact to people and property. The largest flood events occur during “Pineapple Expresses”, when warm rain falls on snow. Accurate data on current snowpack depths would improve flood forecasting. Improved data would potentially increase the accuracy of flood forecasting. This would indirectly benefit residents and businesses whose property may be threatened by flooding. The primary benefit would be to provide more accurate warnings so that residents and business owners could make more informed choices as to how to secure their property and/or evacuate during a flood.

Cumulative Impacts

The cumulative impacts to selected resources, ecosystem functions and human values are described as follows:

Wilderness Character

The "Preferred Alternative" would expand the existing monitoring network inside the Complex and regionally by adding two SNOTELs and two climate stations. Within the Complex there already exist four SNOTELs and two other snow surveys. Adjacent to the Complex, there are eight SNOTELs and eleven snow surveys maintained by helicopter. The "Preferred Alternative" would add to the number of structures in wilderness associated with the SNOTEL network. Taken cumulatively, these additional structures would have a long-term impact to the undeveloped quality of wilderness to varying degrees, based on each individual's values and experience.

North Cascades National Park Complex is in the process of converting its current wideband radio system to a narrowband digital/ analog system. Conversion includes the construction of radio towers at four high elevation sites, including Copper Ridge, Desolation Peak, Ruby Mountain and McGregor Mountain. Construction will require approximately 18 flights to each of the four sites, totaling 72 flights, mostly occurring in a one week period. This proposed action would add four structures into the wilderness, and cause long-term, minor adverse cumulative impacts to the wilderness experience for some wilderness visitors.

Both the "Preferred Alternative" and the proposed radio conversion involve a period of concentrated helicopter use for transporting equipment and workers to their respective sites. Taken cumulatively, the concentrated use of helicopters would have a short-term impact to the solitude of wilderness to varying degrees, based on each individual's values and experience.

Over the long term, the conversion of snow surveys to SNOTEL stations would have a beneficial impact to wilderness because less helicopter use would be needed to maintain the sites than snow survey sites. The "Preferred Alternative" would further reduce long term helicopter use by replacing two snow surveys with SNOTEL stations.

Search and rescue, fire management, backcountry trails projects, law enforcement, and on-going research are activities that often utilize helicopters within the Complex (See Appendix E). Wilderness experience could be impacted by frequent helicopter activity in or nearby designated wilderness. Taken cumulatively, the use of helicopters would impact the solitude of wilderness to varying degrees, based on each individual's values and experience.

Vegetation and Soils

Cumulative impacts include minor tree pruning, trampling and/or removal of vegetation associated with the construction and maintenance of other SNOTEL stations, snow survey sites and the proposed radio conversion. In addition, social trails created along popular ridges and camps increase the rate of erosion by disturbing fragile soil crusts and/or trampling vegetation. Other impacts to vegetation include white pine blister rust and mountain pine beetle infestations.

Wildlife and Special Status Species

Over the long term, the conversion of snow surveys to SNOTEL stations has a beneficial impact to wildlife and special status species because they require less helicopter use to maintain the sites than snow survey sites. The "Preferred Alternative" would further reduce long term helicopter use by replacing two snow surveys with SNOTEL stations.

Although however diminished, the "Preferred Alternative" would still include helicopter use. Cumulative impacts from helicopter use would include temporary noise disturbance associated with installation, calibration and maintenance of the regional SNOTEL and snow survey network; the proposed radio conversion; search and rescue; fire management; backcountry trails projects; law enforcement; and on-going research (See Appendix E).

Though not documented within the Complex, a number of physiological and behavioral responses to aircraft overflights have been documented throughout the US (NPS 1994). Responses might range from a mild annoyance, as indicated by changes in body posture, to extreme panic and the need to escape. Some of these responses produce enough stress that they could potentially reduce an animal's fitness or ability to survive, especially when paired with other stressful events such as a harsh winter. Some of the known impacts of stress include heart-rate acceleration, energy loss, susceptibility to disease, and changes in metabolism and hormone balances. The long-term effects of chronic stress from overflights or other synergistic events have not been studied. Additionally, little is known about the impact of aircraft overflights on the auditory systems of most wildlife.

Another cumulative factor that could be impacting wildlife is climate change, especially at alpine and sub-alpine locations where habitat may eventually disappear due to rising temperatures and/or changes in amount and type of precipitation. White pine blister rust impacts whitebark pine in subalpine areas where it is a food source for Clark's nutcrackers, bears, and squirrels; and it provides nesting habitat for squirrels, northern flickers, and mountain bluebirds. Although some whitebark pines have shown resistance to white pine blister rust, they are still subject to infestation by mountain pine beetles, which have been able to move into the higher elevations where whitebark pine exists due to warmer temperatures associated with climate change.

Visitor Use

No cumulative impacts associated with visitor access to the Complex are anticipated with the "Preferred Alternative". The cumulative impacts from helicopter use to visitor experience are addressed under Wilderness Character.

Cultural Resources

No cultural resources are expected to be impacted by the "Preferred Alternative".

Socioeconomic Effects

The conversion of Browntop Ridge and Easy Pass to SNOTELs will join a larger network of advanced hydro-meteorological monitoring stations, including 12 SNOTELs that are either in or adjacent to the Complex. The cumulative effect would be an improved hydro-meteorological network that would have long-term beneficial impacts to research, flood forecasting and the efficiency of hydroelectric operations.

Conclusions

Resource impacts would range from negligible to moderate. Impacts to wilderness, as measured by the four qualities of wilderness character, range from negligible to moderate, and are based on the individual differences people have about wilderness. Visitor use would have impacts that range from minor to moderate. Cultural resources would not have any adverse effects. Soils, vegetation, health, and public safety would all have minor impacts, and some impacts to public safety would be beneficial. Impacts to wildlife would be moderate, and the proposed actions may affect but are not likely to adversely affect any special status species.

Impairment

No impairment to wilderness character, vegetation and soils, wildlife including special status species, visitor use, cultural resources or socioeconomics are expected under this alternative.

Consultation and Coordination

History of the Planning and Public Scoping Process

On May 23, 2007, the NPS released a public scoping newsletter describing the climate monitoring proposal to agencies, tribes and interested organizations and individuals. The public scoping period lasted from May 24, 2007 to June 24, 2007. The Skagit Valley Herald publicized the details of the public scoping newsletter on May 24, 2007. The scoping letter encouraged the involvement of the public in identifying issues and concerns related to the expansion and enhancement of the climate monitoring network in the Complex. Three comment letters (including e-mail) were received from the public. All three commenter's recognized the need for a better understanding of climate and climate change. One commenter supported an expanded climate network regardless of the foreseeable impacts. The other two commenters were concerned primarily with the impacts of the stations and associated helicopter operations on wilderness and the natural resources.

Internal scoping meetings with park staff and subject matter experts were held to provide a forum for comment during this same period. Comments from all sources have been used to identify key issues, which were then used to determine the scope of analysis and the impacts topics in this EA.

Agency Consultation

The National Park Service consulted with staff from Seattle City Light, Puget Sound Energy and Natural Resource Conservation Service regarding network and station needs and design, and installation planning.

List of Preparers and Contributors

Michael Larrabee, Physical Science Technician, prepared this EA. Contributors included: Roy M. Zipp, Environmental Protection Specialist; Jon Riedel, Park Geologist; Mignonne Bivin, Park Botanist; Bob Mierendorf, Park Archeologist; Bob Kuntz, Wildlife Biologist; Rosemary Seifried, Park Ranger; Cathi Jones, Skagit District Natural Resource Specialist; Anne Braaten, Cartographic Specialist.

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Appendix A. Figures

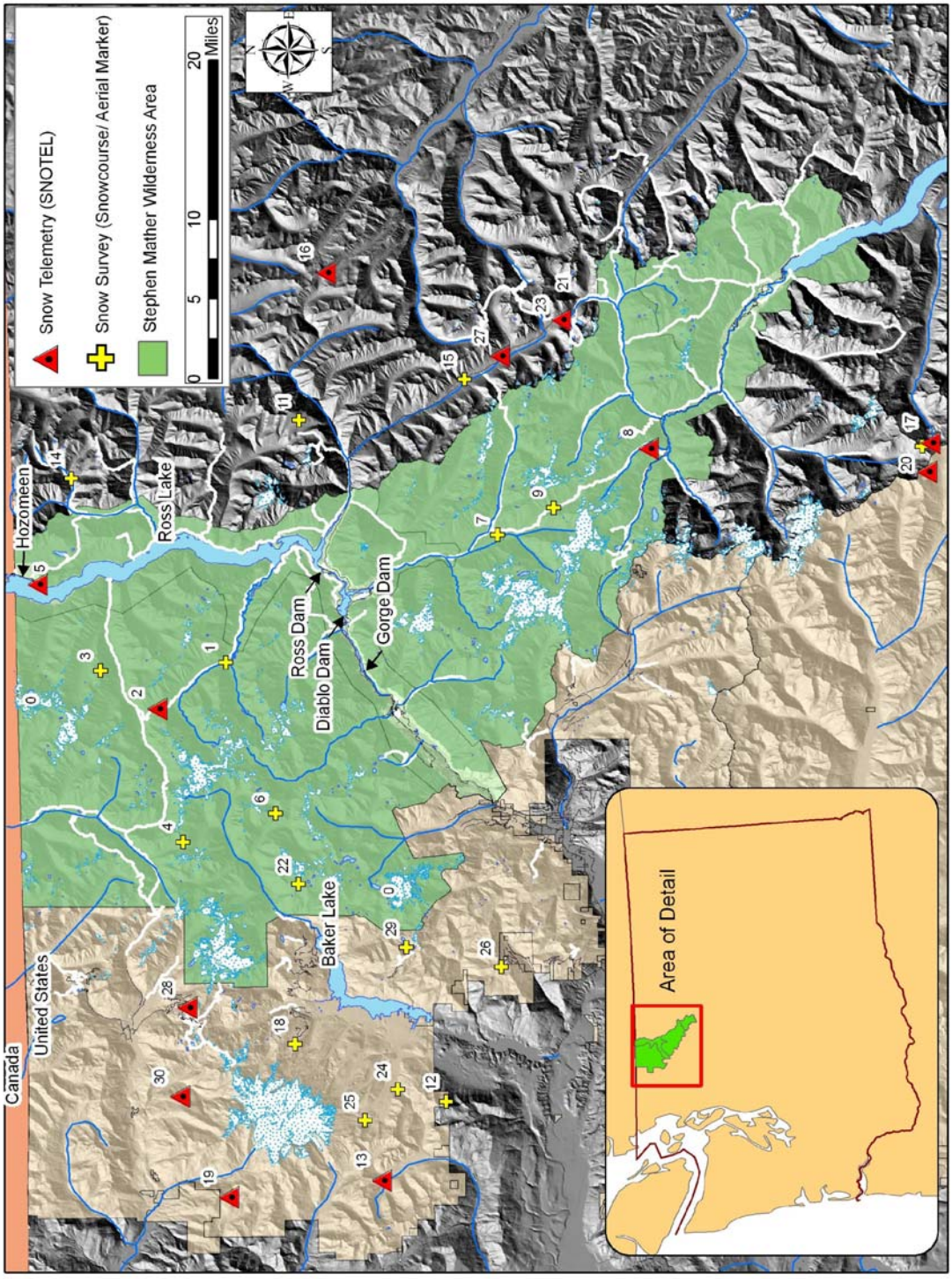


Figure 1. Locations of Existing SNOTEL and Snow Survey Sites

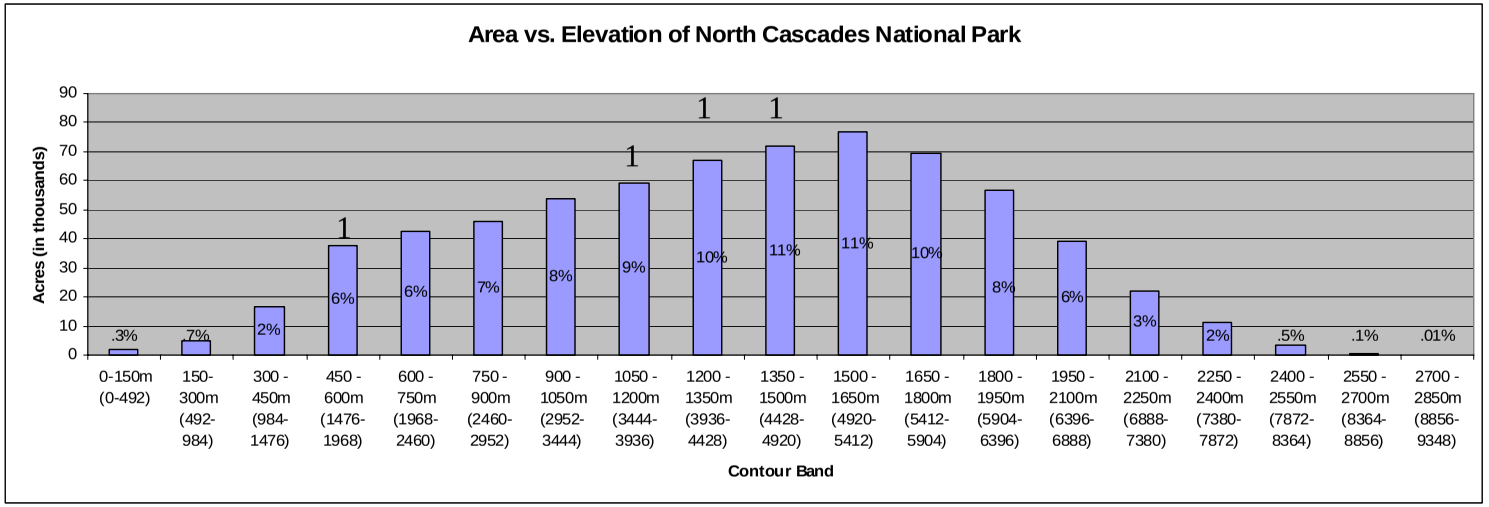
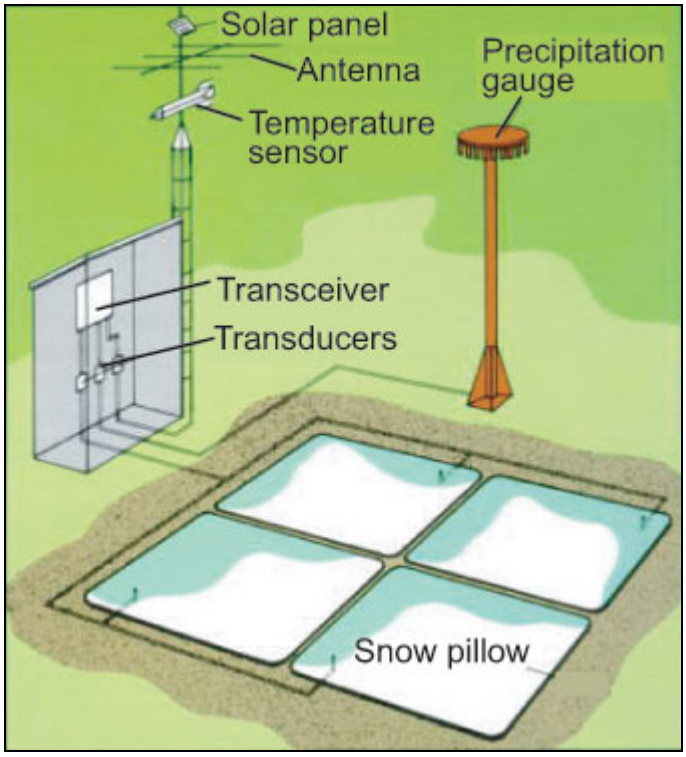


Figure 2. Area versus Elevation of North Cascades National Park. Number of SNOTELs in each contour band is displayed above column. Percentage of NOCA acreage in each contour band listed in center of column.



Source: USDA National Resource Conservation Service.

Figure 3. Typical SNOTEL Layout

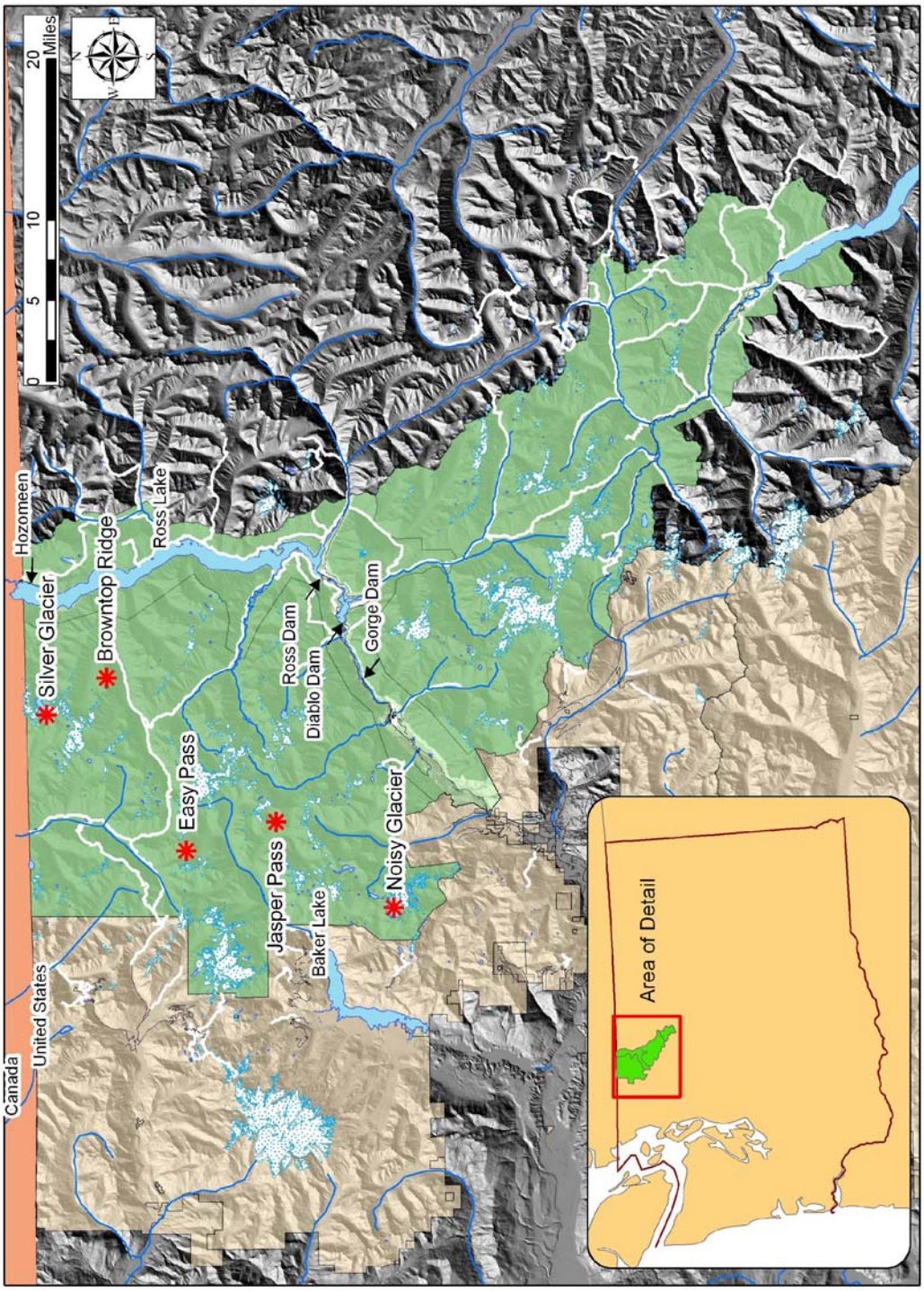


Figure 4. Locations of Proposed Climate Stations, Preferred Alternative

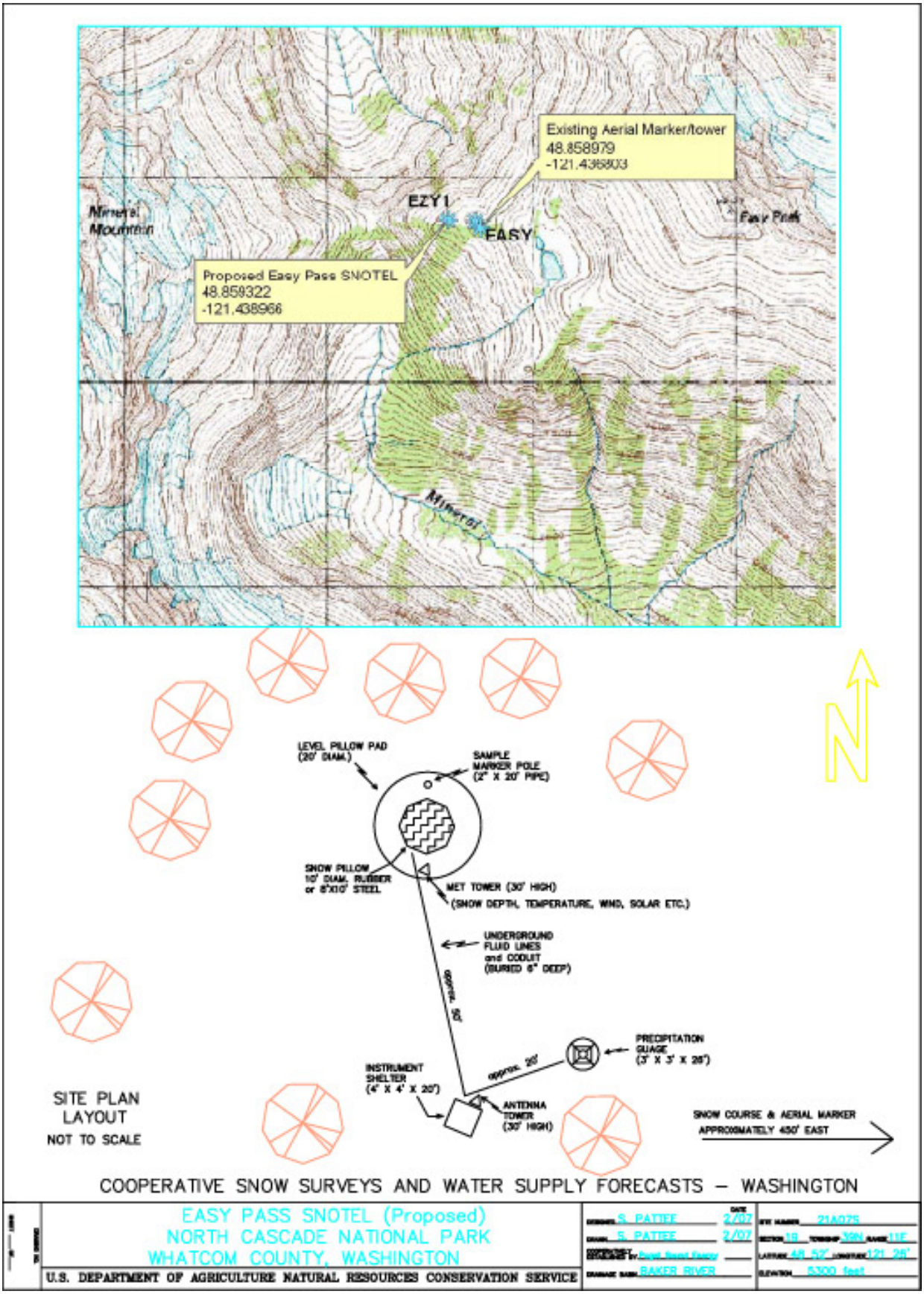


Figure 5. Site Layout of Proposed Easy Pass SNOTEL

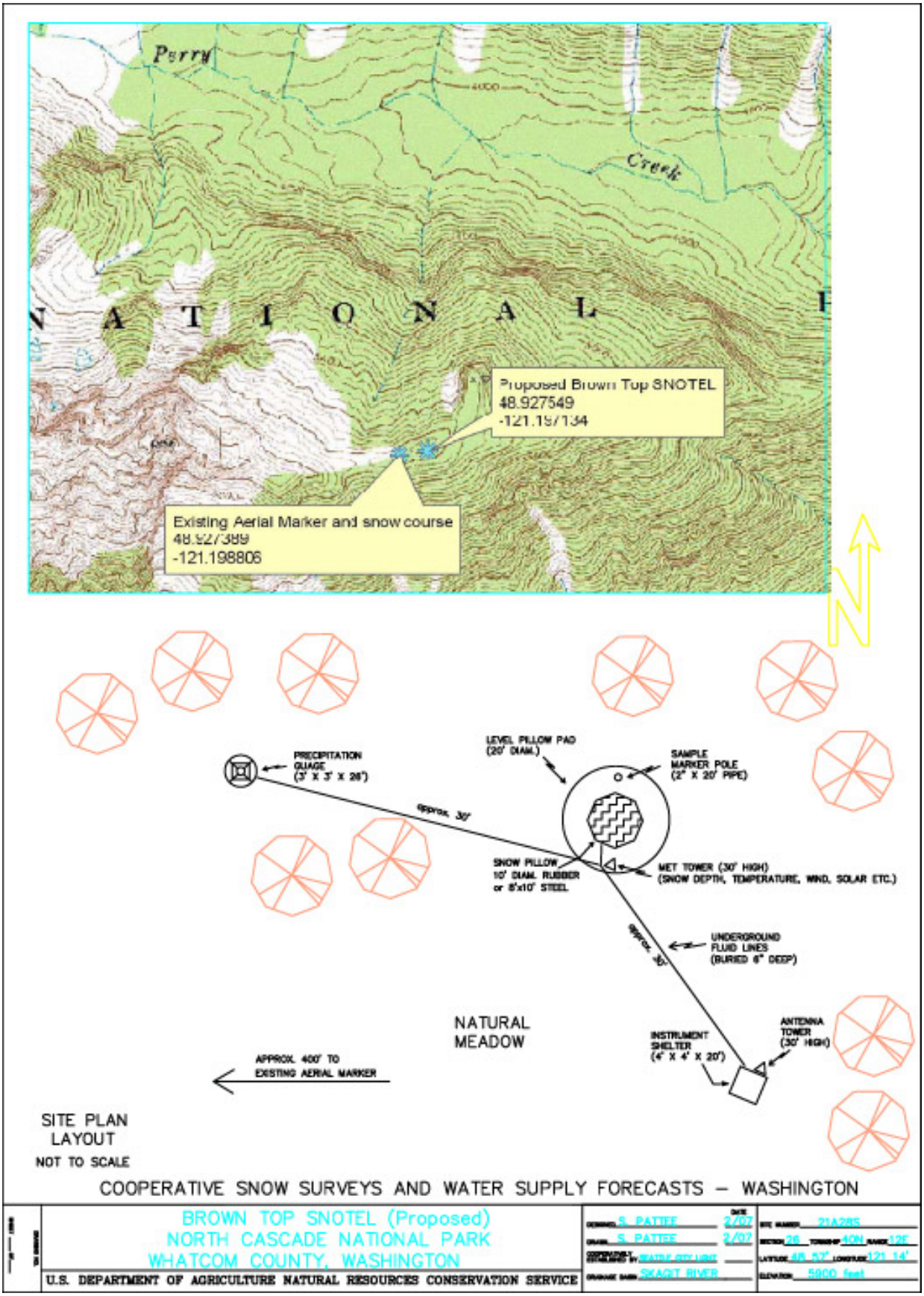


Figure 6. Site Layout of Proposed Browntop Ridge SNOTEL

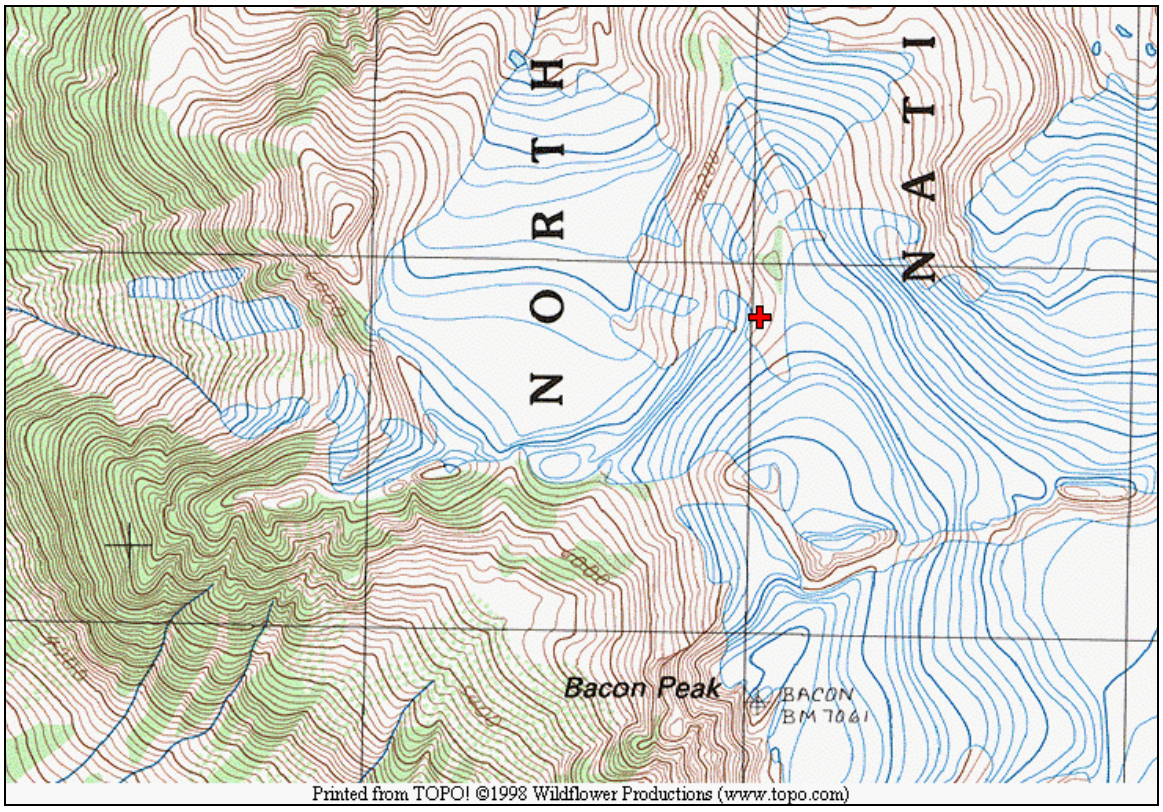
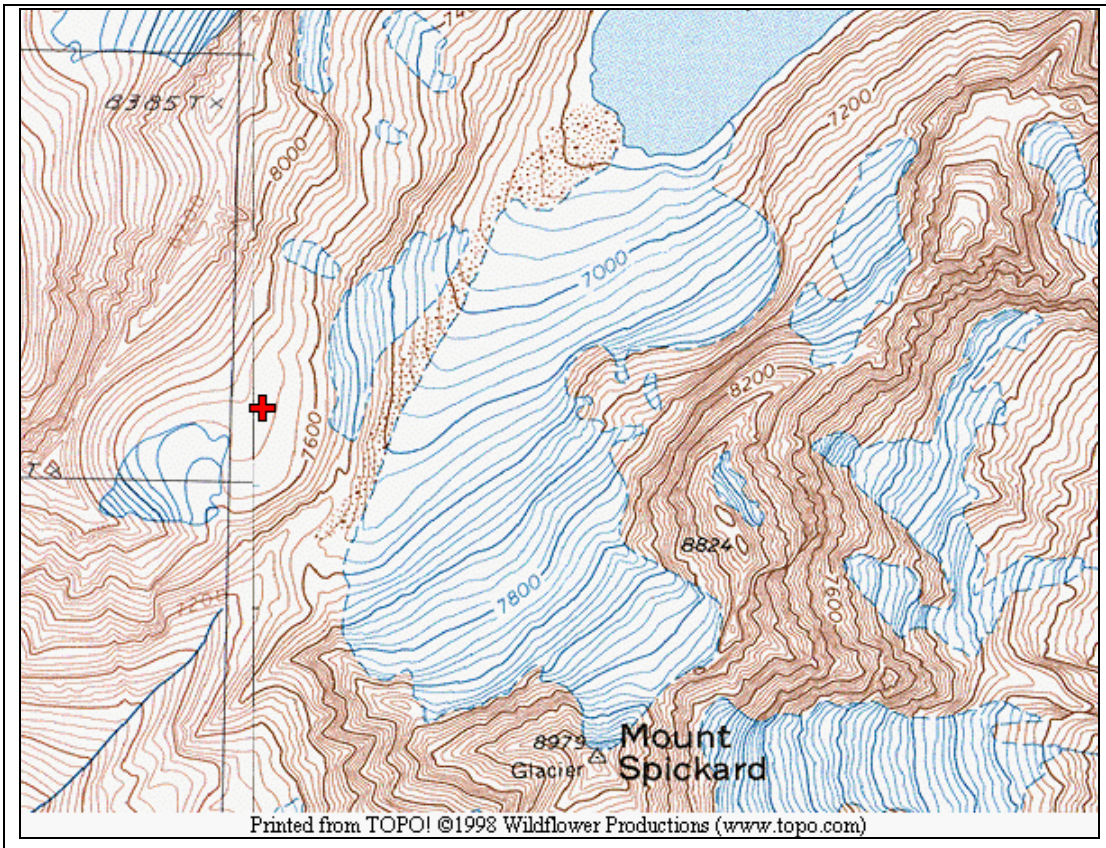


Figure 7. Proposed Location of Climate Station Near Noisy Glacier



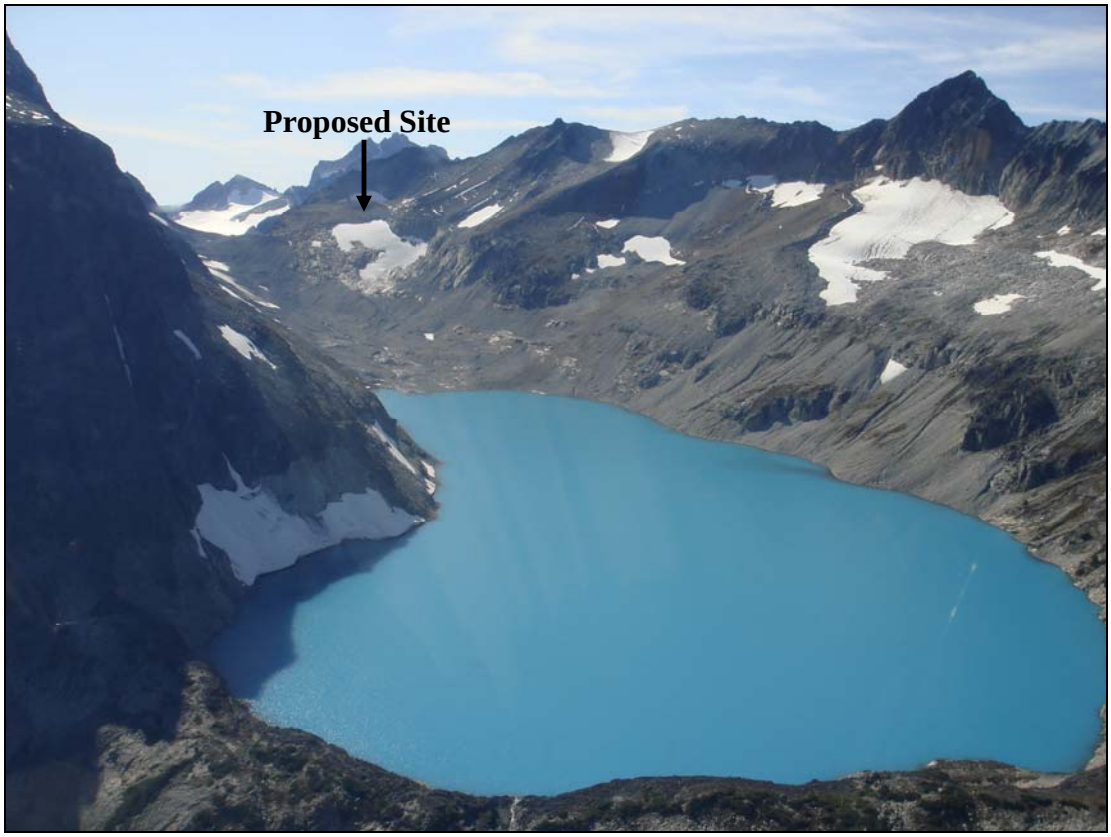


Figure 8. Proposed Location of Climate Station Near Silver Glacier

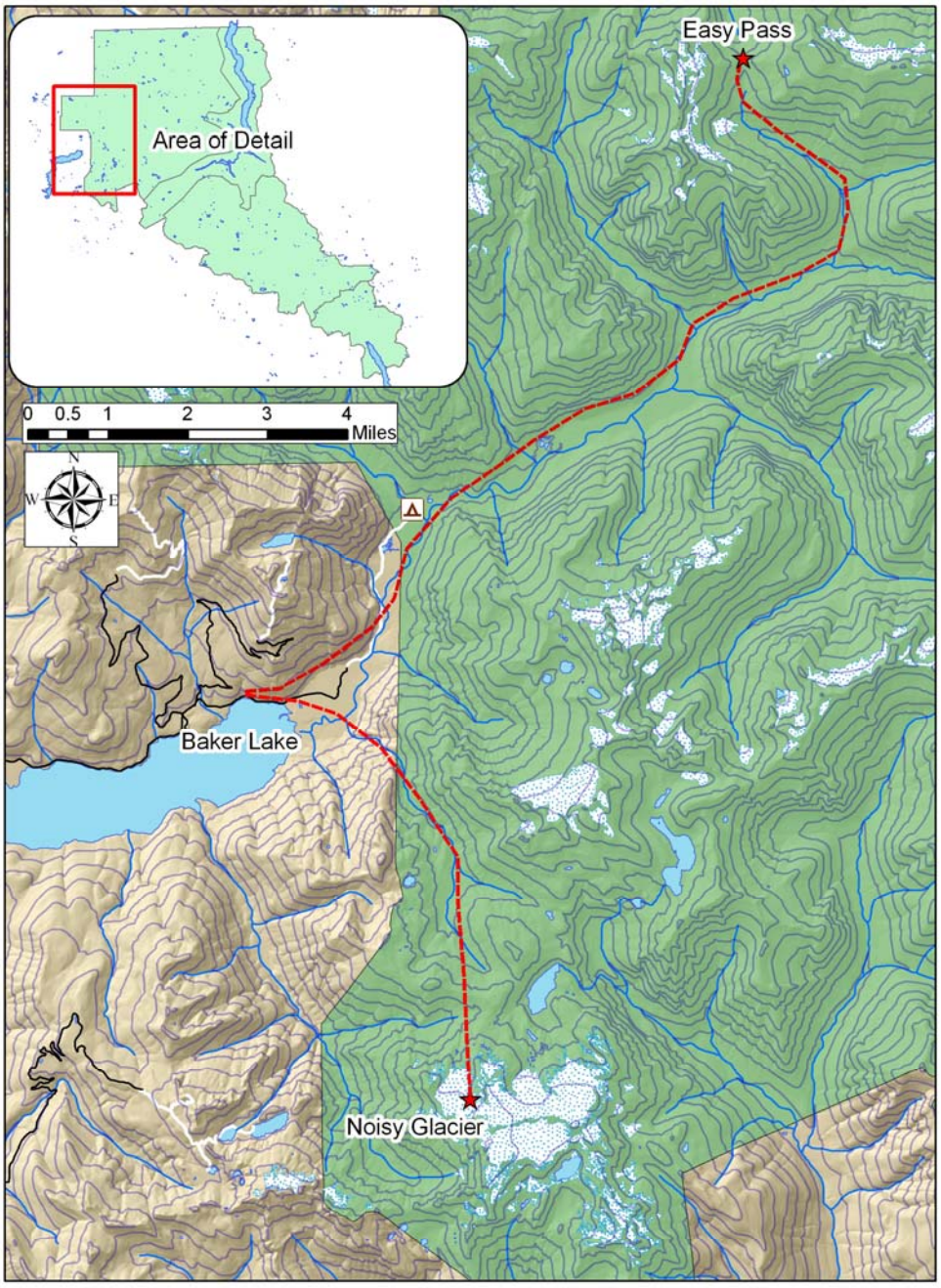


Figure 9. Helicopter Flight Route for Installation of Easy Pass SNOTEL and Noisy Glacier Climate Station

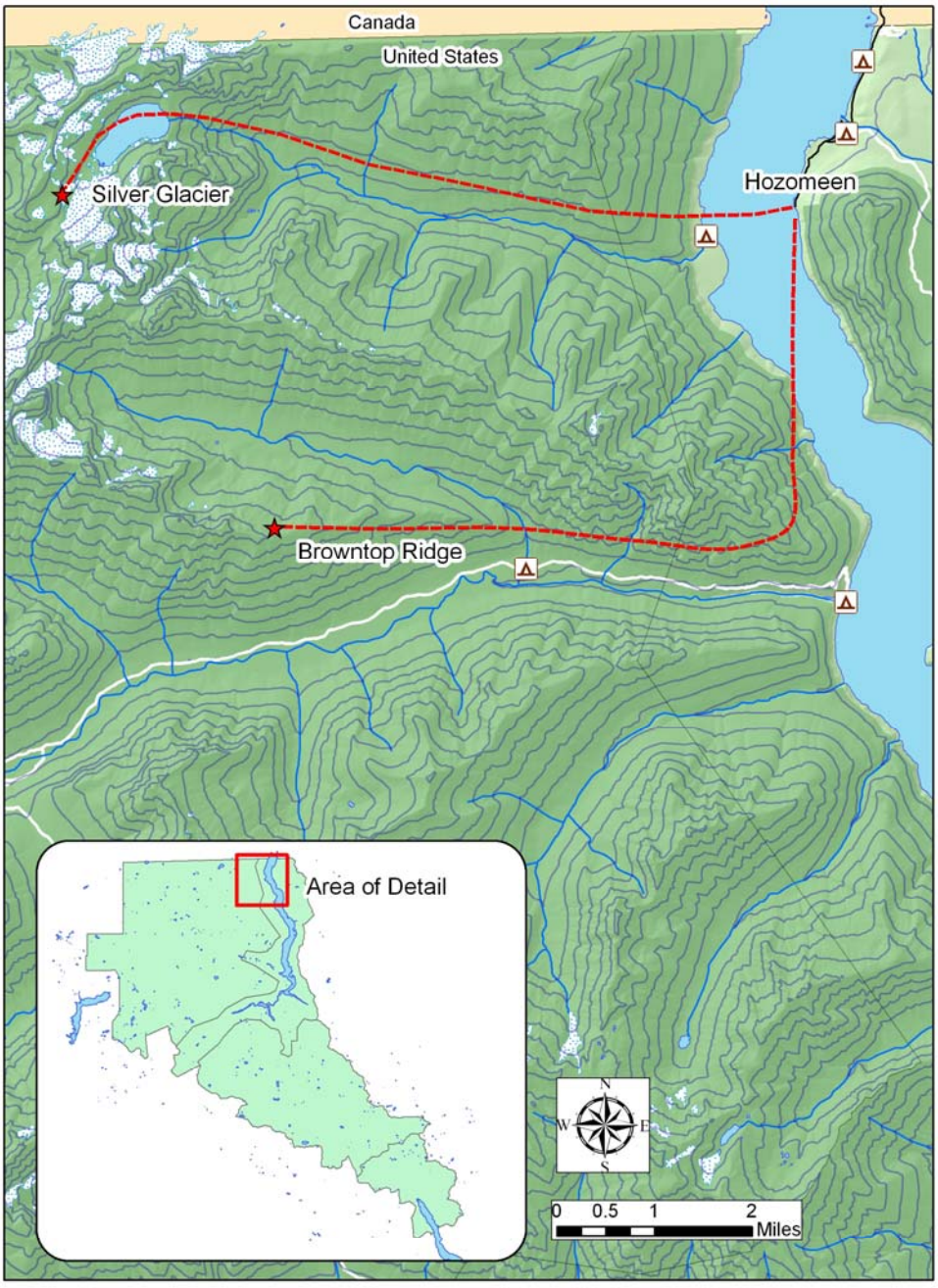


Figure 10. Helicopter Flight Route for Installation of Browntop Ridge SNOTEL and Silver Glacier Climate Station

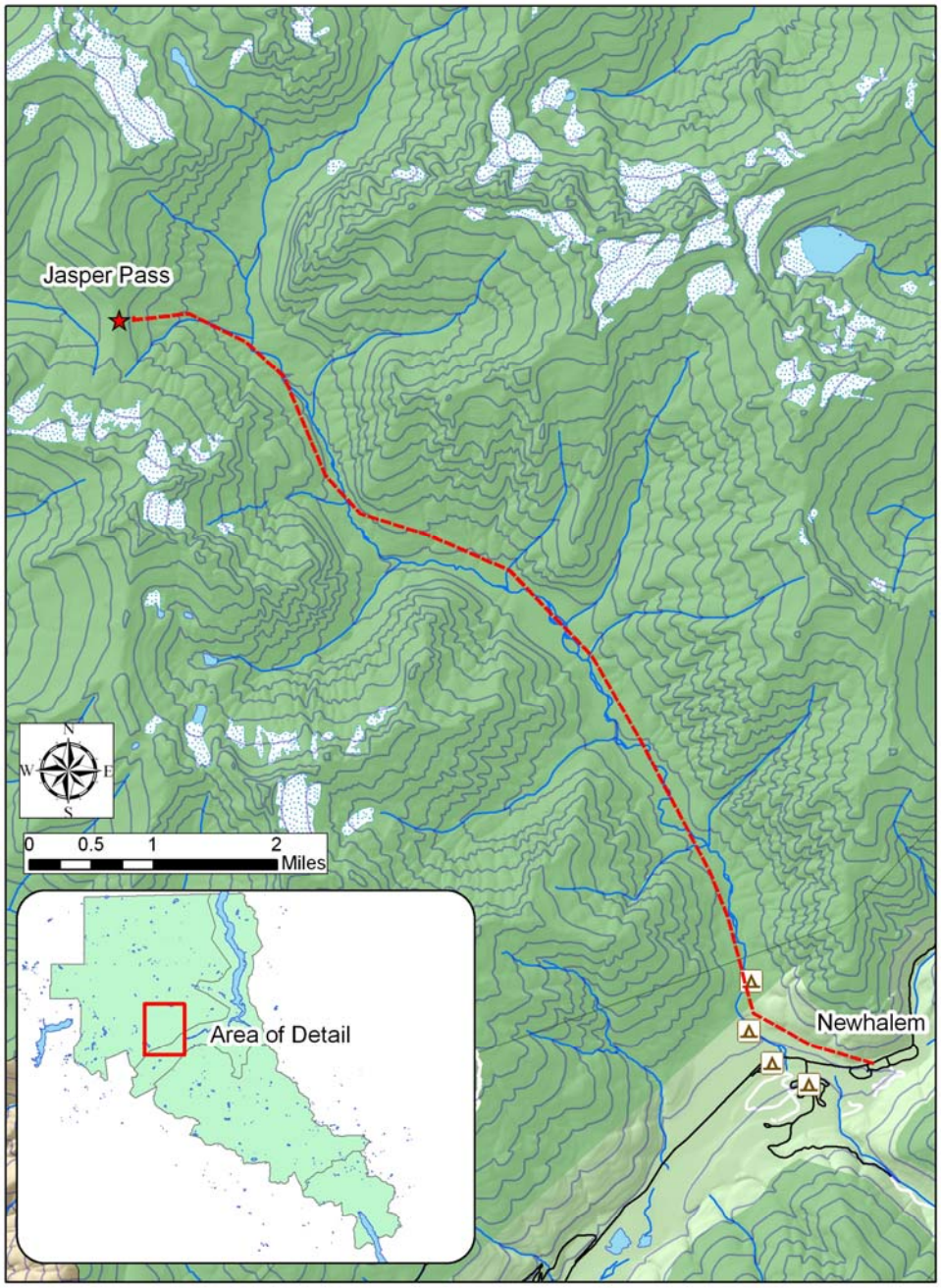


Figure 11. Helicopter Flight Route for Removal of Jasper Pass Snow Survey

Appendix B. Vascular Plant Species

Species observed in the vicinity of the Brown Top and Easy Ridge sites.

Abundance Codes: A = Abundant C = Common U = Uncommon R = Rare

Trees

Scientific name	Common name	Abundance
Abies amablis	silver fir	U
Abies lasiocarpa	subalpine fir	C
Chamaecyparis nootkatensis	Alaska yellow cedar	R
Picea engelmannii	Engelman spruce	C
Pinus albicaulis	whitebark pine	U
Tsuga mertensiana	mountain hemlock	C

Shrubs

Scientific name	Common name	Abundance
Cassiope mertensiana	white heather	A
Luetkea pectinata	partriagefoot	C
Phyllodoce empetriformis	pink heather	A
Vaccinium deliciosum	huckleberry	A

Forbs

Scientific name	Common name	Abundance
Hieracium gracile	hawkweed	R

Grasses, rushes and sedges

Scientific name	Common name	Abundance
Carex nigricans	black sedge	U
Carex spectabilis	Showy sedge	C
Juncus parryi	Parry's rush	

Appendix C. Potential Sensitive Plant Species List

This is a list of state listed sensitive plant species that could potentially be found in the proposed project areas.

Scientific name	Elevation	Habitat	Blooming time	State Status
Agoseris elata	5000'-7000'	Open moist woods, rocky or talus, shrubby slopes	June-August	Sensitive
Aster sibericaus	4000'-7200'	Open rocky gravelly places at high elevation	July-August	Sensitive
Campanula lasiocarpa	6500'-7000'	Rock crevices in alpine zones	July-August	Sensitive
Carex norvegica	4000'-6500'	Streambanks, seeps, moist meadows	July-August	Sensitive
Carex proposita	6000'-8000'	Open rocky slopes, ridges, often on talus	July-August	Threatened
Dodecatheon pulchellum var. watsonii	5500'-7500'	Meadows and rock out crops subalpine and alpine	July	watch
Draba aurea	6000'-7000'	Open to forested slopes, to alpine meadows	June-August	Sensitive
Erigeron humilis	High elevation	Tundra, snowbeds, moist to wet alpine sites	July August	De-listed 2003
Erigeron salsihii	6000'-8000'	Dry alpine ridges	July-August	Sensitive
Eritrichium nanum var. elongatum	7000'-9000'	Open rocky places	June-August	Sensitive
Gentiana glauca	7000'-8000'	Tundra, dry to moist alpine areas	July-September	Sensitive
Loiseleurua procumbens	6300'	Alpine slopes and subalpine meadows	July-August	Threatened
Potentilla diversifoia var. perdissecta	6500'-8000'	Montane to alpine, rocky slopes, meadows and streambanks	June-August	Sensitive
Ranuculus cooleyea	1500'-6000'	Moist slopes and rock crevices.	July-August	Sensitive
Salix tweedyi	5200-'7200'	Streambanks moist meadows in mid to high elevation meadows	June-July	Sensitive
Salix vestita var. erecta	High elevation	Open moist areas in springs or wetlands near or above timberline	July-September	Possibly extirpated
Saxifraga integrifolia var. apetala	5900'-6500'	Vernally moist meadows, seeps and ephemeral streams	March -July	Watch
Saxifraga rivularis	5500'-7000'	Damp cliffs, shaded rock outcrops, talus near snow banks, moist meadows	July-August	Sensitive

State Status of plant species is determined by the Washington Natural Heritage Program. Factors considered include abundance, occurrence patterns, vulnerability, threats, existing protection, and taxonomic distinctness. Values include:

E = Endangered. In danger of becoming extinct or extirpated from Washington.
T = Threatened. Likely to become Endangered in Washington.
S = Sensitive. Vulnerable or declining and could become Endangered or Threatened in the state.
X = Possibly extinct or Extirpated from Washington.
P1 = Priority 1. Rare nonvascular plant but with insufficient information to assign another rank.
P2 = Priority 2. Nonvascular plant of concern but with insufficient information to assign another rank.
R1 = Review group 1. Of potential concern but needs more field work to assign another rank.
R2 = Review group 2. Of potential concern but with unresolved taxonomic questions.
W = Watch. More abundant and/or less threatened than previously thought.

Appendix D. Federal and State Listed Wildlife

E=endangered, T=threatened, C=candidate species

Common Name	Scientific Name	Status (July 2007)	
		Federal	*State*
Gray Wolf	*Canus lupus*	E	E
Canada Lynx	*Lynx canadensis*	T	T
Grizzly Bear	*Ursus arctos*	T	E
Western Gray Squirrel	*Sciurus griseus*		T
Keen's Myotis	*Myotis keenii* *		C
Townsend's Big-eared Bat	*Corynorhinus townsendii*		C
California Wolverine	*Gulo gulo luteus*		C
Bald Eagle	*Haliaeetus leucocephalus*		T
Marbled Murrelet	*Brachyramphus marmoratus marmoratus*[1]	T	T
American White Pelican	*Pelecanus erythrorynchos*		E
Ferruginous Hawk	*Buteo regalis*		T
Northern Spotted Owl	*Strix occidentalis caurina*	T	E
Western Grebe	*Aechmophorus occidentalis*		C
Northern Goshawk	*Accipiter gentilis*		C
Golden Eagle	*Aquila chrysaetos*		C
Merlin	*Falco columbarius*		C
Flammulated Owl	*Otus flammeolus*[2]		C
Vaux's Swift	*Chaetura vauxi*		C
Lewis' Woodpecker	*Melanerpes lewis*		C
Black-backed Woodpecker	*Picoides albolarvatus*		C
Pileated Woodpecker	*Dryocopus pileatus*		C
Bull Trout	*Salvelinus confluentus*	T	C
Chinook Salmon	*Oncorhynchus tshawtscha*	T	C
Pacific Fisher	*Martes pennanti*	C	E
Columbia Spotted Frog	*Rana luteiventris*		C
Western Toad	*Bufo boreas*		C
Johnson's Hairstreak	*Mitoura johnsoni* *		C

* Presence uncertain

[1] Westside only

[2] Eastside only

Appendix E. North Cascades National Park Service Complex Flight Hours by Project

Mission	2004	2005	2006
Resources (Glacier proj)	9.3	11.6	12.9
Resources (Other)	8.9	6.5	10.1
Radio Conversion	0	7.4	16.9
Repeater Maintenance	13.1	8.4	16.6
Trails	47.8	45.0	32.3
Storm Damage	27.5	16.5	0
Search and Rescue	18.8	12.7	9.7
Law Enforcement	3.1	2.2	0
Fire Suppression	101.2 (both)		210.4 55.1 fixedwing
Fire non-suppression		109.6	11.8*
Hours without Fire	128.5	110.3	98.5
TOTAL	229.7*	219.9	320.7
	*discrepancy w/ fire hrs / aviation plan #s		*recon from MM; separate from Flick and non-Flick

These figures were tallied from a spreadsheet of charge codes to determine the mission or project. Some questions remain for accuracy especially for fire suppression hours, however the figures can be regarded as adequate for a general comparison of hours flown specific to project mission.

Appendix F. Material Safety Data Sheet

Material Safety Data Sheet
SOILCON INSTRUMENT ANTIFREEZE E29A

TEK CHEMICAL INC
3805 N MISSISSIPPI AVE
PORTLAND, OR 97227

EMERGENCY INFORMATION
(503) 288 6058
800-547-7015

SECTION I: PRODUCT IDENTIFICATION

PRODUCT NAME: SOILCON Instrument Antifreeze E29A
PRODUCT TYPE: Rain gauge antifreeze.

DOT DESCRIPTION: Antifreeze Preparation, Liquid
DOT HAZARD CLASS: Flammable Liquid, NA 1142

PRODUCT HAZARD: Health= 2, Fire= 3, Reactivity= 0, Special= 0
HAZARD RATING: 4= Extreme, 3= High, 2= Moderate, 1= Slight, 0= Insignificant

SECTION II: INGREDIENTS

INGREDIENT	(CAS#)	PERCENT	STEL	TWA
ETHANOL	64-17-5	39.0	N/A	1000 PPM
PROPYLENE GLYCOL	57-55-6	54.8	NONE	NONE
PROPYL ACETATE	109-60-4	2.39	250 PPM	200 PPM
ISOPROPANOL	67-63-0	1.91	500 PPM	400 PPM
BASIC VIOLET 10	81-88-9	0.01	1 MG/M3	1 MG/M3

COMPONENTS LISTED AS A SUSPECTED CARCINOGEN: BASIC VIOLET 10

SECTION III: PHYSICAL DATA

BOILING POINT: N/A
VAPOR PRESSURE: 44 MMHG
VAPOR DENSITY (air=1): heavier than air
SPECIFIC GRAVITY: < 1
PERCENT VOLATILES: 100%
EVAPORATION RATE (H20=1): N/A
APPEARANCE AND ODOR: Slightly viscous red liquid, mild non-residual odor

SECTION IV: FIRE AND EXPLOSION DATA

FLASH POINT (PMCC): 55 F
FLAMMABLE LIMITS IN AIR: LOWER: 5.5% UPPER: 31.5%
EXTINGUISHING MEDIA: Dry chemical, carbon dioxide, foam, or water fog. Class BC or ABC fire extinguisher.
SPECIAL FIRE FIGHTING PROCEDURES: Self-contained positive pressure breathing apparatus and protective clothing should be worn in fighting fires involving chemicals.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Extinguish all nearby sources of ignition because vapors may be moved by air currents to ignition sources distant from the handling point. This material may produce a floating fire hazard.
HAZARDOUS DECOMPOSITION PRODUCTS: May form carbon monoxide or carbon dioxide.

WARNING: Hot organic chemical vapors or mists are susceptible to sudden spontaneous combustion when mixed with air. Ignition may occur at temperatures below those published in the literature as "autoignition" or "ignition" temperatures. Ignition temperatures decrease with increasing vapor volume and vapor/air contact time, and are influenced by pressure changes.

Ignition may occur at typical elevated temperature process conditions, especially in processes operating under vacuum if subjected to sudden ingress of air, or outside process equipment operating under elevated pressure if sudden escape of vapors or mists to the atmosphere occurs.

Any proposed use of this product in elevated temperature processes should be thoroughly evaluated to assure that safe operating conditions are established and maintained.

SECTION V: HEALTH HAZARD DATA

HEALTH HAZARDS (ACUTE AND CHRONIC)
EFFECTS OF OVEREXPOSURE
EYES - May cause irritation, experienced as temporary discomfort in the eye, with excess blinking and tear production. There may be mild to moderate conjunctivitis, seen principally as an excess redness of the conjunctiva.

SKIN ABSORPTION - No adverse effects with normal skin contact; however, potentially harmful amounts of material may be absorbed across markedly abraded skin when contact is sustained, particularly in children.
SKIN CONTACT - Brief contact is not irritating. Prolonged contact, as from working wet with the material, may cause drying and cracking of the skin due to a defatting action.
INHALATION - High vapor concentrations may cause a burning sensation in the throat and nose, stinging and watering in the eyes. At concentrations which cause irritation, dizziness, faintness, drowsiness, nausea and vomiting may also occur.
INGESTION - May cause dizziness, faintness, drowsiness, decreased awareness and responsiveness, euphoria, abdominal discomfort, nausea, vomiting, staggering gait, lack of coordination, and coma.

EFFECTS OF REPEATED OVEREXPOSURE - Long term repeated oral exposure to ethanol may result in the development of progressive liver injury with fibrosis.
OTHER HEALTH HAZARDS - Repeated ingestion of ethanol by pregnant mothers has been shown to adversely affect the central nervous system of the fetus, producing a collection of effects which together constitute the fetal alcohol syndrome. These include mental and physical retardation, disturbances of learning, motor and language deficiencies, behavioral disorders, and small head size.

Basic violet 10 was carcinogenic to rats and mice in a lifetime feeding study.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE - Breathing of vapor and/or mist may aggravate asthma and inflammatory or fibrotic pulmonary disease. Because of its defatting properties, this material may aggravate existing dermatosis. Repeated exposures to ethanol may exacerbate liver injury produce from other causes.

NOTES TO PHYSICIAN - Symptoms vary with the alcohol level of the blood. Mild alcohol intoxication occurs at blood levels between 0.05% - 0.15% and approximately 25% of individuals will show signs of intoxication at these levels. Above 0.15% the person is definitely under the influence of ethanol and 50% - 95% of individuals at this level are clinically intoxicated. Severe poisoning occurs when the blood ethanol level is 0.3% - 0.5%. Above 0.5% the individual will be comatose and death can occur. The unabsorbed ethanol should be removed by gastric lavage after intubating the patient to prevent aspiration. Avoid the use of depressant drugs or the excessive administration of fluids. In the presence of hypoglycemia, administer 5% - 10% glucose intravenously, plus thiamine 100 mg intramuscularly. Hemodialysis is indicated if the blood ethanol is above 5 mg/ml. Naloxone may be useful to reverse clinical alcoholic coma and 0.4 - 1.2 mg intravenously may arouse ethanol-intoxicated patients.

EMERGENCY AND FIRST AID PROCEDURES:
IF ON SKIN - Thoroughly rinse exposed area with water. Remove contaminated clothing. Launder contaminated clothing before reuse.
IF IN EYES - Flush with large amounts of water for at least 15 minutes, lifting upper and lower lids occasionally. Get medical attention.
IF SWALLOWED - If conscious and a gag reflex is present, give two glasses of water and induce vomiting. If unconscious, do not induce vomiting. Seek the advice of a physician.
IF BREATHED - If affected, remove individual to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped give artificial respiration. Keep person warm, quiet and get medical attention.

PRIMARY ROUTES OF ENTRY: SKIN CONTACT

SECTION VI: REACTIVITY DATA

HAZARDOUS POLYMERIZATION: Will not occur
STABILITY: Stable
INCOMPATIBILITY: None known

SECTION VII: SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Extinguish and do not turn on any ignition source until area is determined to be free from explosion or fire hazards. Wear suitable protective equipment. Collect large spills for disposal. Flush small spills with water.

WASTE DISPOSAL METHOD
ANY SPILL - Incinerate in a furnace [illegible]. State and local regulations.
OTHER PRECAUTIONS - [illegible] readily biodegradable in a [illegible].

[illegible]

Material Safety Data Sheet
SOILCON INSTRUMENT ANTIFREEZE E29A

SECTION VIII: PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION - Self-contained breathing apparatus in high vapor concentrations

VENTILATION - This product should be confined within closed equipment. In which case general (mechanical) room ventilation should be satisfactory. Special, local ventilation is needed at points where vapors are expected to escape to the workplace air.

PROTECTIVE GLOVES - Wear resistant gloves such as neoprene.

EYE PROTECTION - Monogoggles.

OTHER PROTECTIVE EQUIPMENT - Chemical apron, eye bath and safety shower.

WORK/HYGIENIC PRACTICES - Ensure strict sanitary conditions are conformed to when working around chemicals. Protective clothing and equipment in accordance with 29 CFR 1910.132 and 29 CFR 1910.133.

SECTION IX: OTHER REGULATORY INFORMATION

The concentration shown are maximum ceiling levels (weight %) to be used for calculations for regulations. Trade Secrets are indicated by "TS".

FEDERAL EPA

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center of release of quantities of Hazardous Substances equal to or greater than the reportable quantities of (RQs) in 40 CFR 3024.

Components present in this product at a level which could require reporting under the statute are: NONE

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires emergency planning based on Threshold Planning Quantities (TPQs) and release reporting based on Reportable Quantities (RQs) in 40 CFR 355 (used for SARA 301, 304, 311, and 312).

Components present in this product at a level which could require reporting under the statute are: NONE

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires submission of annual reports of release of toxic chemicals that appear in 40 CFR 372 (for SARA 313). This information must be included in all MSDSs that are copied and distributed for this material.

Components present in this product at a level which could require reporting under the statute are: NONE

STATE RIGHT-TO-KNOW

CALIFORNIA Proposition 65
This product contains trace levels of Acetaldehyde, which the state of California has found to cause cancer.

MASSACHUSETTS: Under the Massachusetts Right-To-Know Law, hazardous substance and extraordinarily hazardous substances components present in this product which requires reporting are: -

EXTRAORDINARILY HAZARDOUS SUBSTANCES

CHEMICALS (=>0.0001%)	CAS NO	CONCENTRATION
ISOPROPANOL	67-63-0	1.91
METHANOL	67-56-1	7 PPM
ACETALDEHYDE	75-07-0	5 PPM

HAZARDOUS SUBSTANCES

CHEMICALS (=>1%)	CAS NO	CONCENTRATION
ETHANOL	64-17-5	39.0
N-PROPYL ACETATE	109-60-4	2.39

PENNSYLVANIA Under the Pennsylvania Right-To-Know Law, hazardous substances and special hazardous substances components present in this product which requires reporting are

HAZARDOUS SUBSTANCES

CHEMICALS (=>1%)	CAS NO	[illegible]
ETHANOL	64-17-5	-
N-PROPYL ACETATE	109-60-4	-
ISOPROPANOL	67-63-0	-

CALIFORNIA SCAQMD TITLE 443.1 VOC'S
VOC 315 G/L VAPOR PRESSURE 42 MM HG AT 20 C
TSCA: THE INGREDIENTS OF THIS PRODUCT ARE ON THE TSCA INVENTORY

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Do not get in eyes, on skin, on clothing
Keep container closed.
Wash thoroughly after handling

Keep away from heat and flame
Do not store near reactive chemicals.

The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice for a safe work environment.

The information accumulated herein is believed to be accurate at the time of preparation or prepared from sources believed to be reliable, it is the responsibility of the user to investigate and understand other pertinent sources of information, to comply with all laws and procedures applicable to the safe handling and use of product and to determine the suitability of the product for its intended use.

Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. Since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable federal, state and local laws and regulations.

DATE: September 18, 1992 NAME OF PREPARER: Richard G. Wilkerman

Appendix G. Minimum Requirement Analysis

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENTS DECISION GUIDE

WORKSHEETS

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act..."

– the Wilderness Act, 1964

Please refer to the accompanying MRDG *Instructions* for filling out this guide. The spaces in the worksheets will expand as necessary as you enter your response.

Step 1: Determine if any administrative action is necessary.

Description: Briefly describe the situation that may prompt action.

There is a need to improve the network of weather and climate monitoring stations within North Cascades National Park. Elevational and longitudinal gradients strongly influence weather and climate patterns in the Cascades. These variations are not accurately represented in the Park's climate data. It is necessary to understand trends and variability in weather and climate to better manage Park resources.

Currently most high elevation climate stations are snow-courses, which collect only snow depth and snow water equilivalent data, once a month from October through April. There is a need for more complex year-round climate data, including temperature, precipitation, solar radiation, and wind speed and direction. Although, there are three Snotel stations within NOCA, they exist only at mid-elevations (3620-4600 ft).

Improved meteorological data would be used by the National Park Service in monitoring impacts of climate change, fire management planning and operations, glacier monitoring, along with other natural resource research and management. Improved hydrometeorological data would assist the National Weather Service and U.S. Army Corps of Engineers in flood forecasting, and improve Seattle City Light and Puget Sound Energy's efficiency in power production.

To determine if administrative action is necessary, answer the questions listed in A - F in the following section:.

A. Describe Valid Existing Rights or Special Provisions of Wilderness Legislation

Are there valid existing rights or is there a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of action involving Section 4(c) uses? Cite law and section.

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:

The Wilderness Act of 1964

A wilderness…may also contain ecological, geological, or other features of scientific, educational, scenic or historical value. Sec. 2(c)(4)

Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use. Sec. 4(b)

The Washington Park Wilderness Act of 1988

Nothing in this Act shall be construed to supersede, repeal, modify, or impair the jurisdiction of the Federal Power Commission under the Federal Power Act … in the lands and waters within the Skagit River Hydroelectric Project, Federal Energy and Regulatory Commission Project 533, including the proposed Copper Creek, High Ross, and Thunder Creek Elements of the Project; and the Newhalem Project, Federal Energy and Regulatory Commission Project 2705, within the Ross Lake National Recreation Area …and ***existing hydrologic monitoring stations*** *necessary for proper operation of the hydroelectric projects listed herein.*

B. Describe Requirements of Other Legislation

Do other laws require action?

Yes: ☐ **No:** ☒ **Not Applicable:** ☐

C. Describe Other Guidance

Does taking action conform to and implement relevant standards and guidelines and direction contained in agency policy, unit and wilderness management plans, species recovery plans, tribal government agreements, state and local government and interagency agreements?

Yes: ☒ **No:** ☐ **Not Applicable:** ☐

Explain:

National Park Service Management policies (2001)
6.3.6 Scientific Activities in Wilderness. The statutory purposes of wilderness include scientific activities, and these activities are encouraged and permitted when consistent with the agency's responsibilities to preserve and manage wilderness.

6.3.6.1 General Policy. The National Park Service has a responsibility to support appropriate scientific activities in wilderness, and to use science to improve wilderness management. The National Park Service recognizes that wilderness can and should serve as an important resource for long-term research, study, and observation of ecological processes and the impact of humans on these ecosystems. The National Park Service further recognizes that appropriate scientific activities may be critical to the long-term preservation of wilderness.

Scientific activities are to be encouraged in wilderness. Even those activities (including inventory, monitoring, and research) that involve a potential impact to wilderness resources or values (including access, ground disturbance, use of equipment, animal welfare, etc) should be allowed when the benefits of what can be learned outweigh the impacts on the wilderness resource or values. However, all such activities must also be evaluated using the minimum requirement concept and include documented compliance which assesses impacts against benefits to wilderness. This process should assure the activity is appropriate and utilizes the minimum tool required to accomplish project objectives.

Director's Order and Reference Manual 41: Wilderness Preservation and Management
8. Scientific Activities in Wilderness
The statutory purposes of wilderness include scientific activities, and these activities are permitted when consistent with the agency's responsibilities to preserve and mange wilderness. The National Park Service has a responsibility to support appropriate scientific activities in wilderness, and to use science to improve wilderness management. The National Park Service recognizes that wilderness can and should serve as an important research for long-term research, study, and observation of ecological processes and the impact of humans on these ecosystems. The National Park Service further recognizes that appropriate scientific activities may be critical to the long-term preservation of wilderness. Accordingly, scientific activities are to be encouraged in wilderness, provided that the benefits of what can be learned outweigh any negative impacts on the wilderness resource or values

D. Describe Options Outside of Wilderness
Can this situation be resolved by an administrative activity outside of wilderness?

Yes: ☐ **No:** ☒

Explain:
Snotels would replace existing aerial markers and a snowcourse that are located in wilderness. These sites have a long period of record, by relocating important trends would be lost because the data could not be linked statistically. Meteorological stations would need to be located at long-term monitoring glacier sites, which are located within wilderness. High elevation, non-wilderness areas do not exist in the Park.

E. Wilderness Character

Is it necessary to take administrative action to preserve wilderness character, as described by the qualities listed below?

Untrammeled: **Yes:** ☐ **No:** ☒

Explain:

Undeveloped: **Yes:** ☐ **No:** ☒

Explain:

Natural: **Yes:** ☒ **No:** ☐

Explain:
Expanded and improved meteorological monitoring would increase the knowledge about these environments, and the impacts of climate change on wilderness resources, functions and values. This information could then be used to guide future management of the area.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:
Yes: ☐ **No:** ☒

Explain:

Other unique components that reflect the character of this wilderness:
Yes: ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

F. Describe Effects to the Public Purposes of Wilderness

Is it necessary to take administrative action in support of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Recreation: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Scenic: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Scientific: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Improved and expanded climate data will be used by a broad range of institutions, included but not limited to federal land mangers, researchers, and electric utilities.

Education: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:

Data from existing sites are currently used by a broad range of academic institutions. Improving the geographic scope of meteorological monitoring would further enhance research and educational opportunities.

Conservation: **Yes:** ☒ **No:** ☐ **Not Applicable:** ☐

Explain:
Improved and expanded climate data may assist land managers in decision making at the park level. It may also contribute further to our nation's understanding of climate change, and help to inform future policy and regulations intended to address climate change. The data would also assist the National Weather Service and U.S. Army Corps of Engineers in flood forecasting, and improve the efficiency hydropower production and help to offset greenhouse gas emissions.

Historical use: **Yes:** ☐ **No:** ☒ **Not Applicable:** ☐

Explain:

Step 1 Decision: **Is any administrative action necessary?**

Yes: ☒ **No:** ☐ **More information needed:** ☐

Explain:

Administrative action is necessary because meteorological data from higher altitudes are needed to enhance understanding of weather and climate patterns for a wide variety of research, management and operational purposes. Due to the wide variation in weather and climate, these data cannot be collected outside of wilderness.

If action is necessary, proceed to Step 2 to determine the minimum activity.

Step 2: Determine the minimum activity.

The alternatives for upgrading and expanding the meteorological monitoring network involve a choice between use of foot travel versus use of helicopters and fixed-wing aircraft for installation, maintenance and monitoring purposes.

With the appropriate provisions, training and expertise, all sites could be accessed by foot. However, access by foot would present unacceptable risks to NPS personnel given the extreme terrain and remote locations of the sites, particularly in winter. In addition, most of the equipment at the sites would be too heavy to pack in on foot even under ideal weather conditions. In light of these constraints, use of aircraft would be the minimum tool/activity necessary for administrative action. Details regarding limits on use of aircraft and other mitigation measures for protecting wilderness values are provided in the main body of the EA.

Approvals	Signature	Position	Date
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Recommended:	<s> Roy Zipp	Environmental Protection Specialist/Wilderness Committee Co-Chair	9/7/07
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Approved:	<s> Palmer Jenkins	Superintendent	9/7/07