National Park Service
U.S. Department of the Interior

CLIMATE*Friendly* PARKS

North Cascades National Park Service Complex Action Plan

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NORTH CASCADES NATIONAL PARK SERVICE COMPLEX BECOMES A CLIMATE FRIENDLY PARK

The Challenge of Climate Change

Climate change presents significant risks and challenges to the National Park Service. At North Cascades National Park Service Complex, increased temperatures and changing precipitation patterns may alter the natural ecosystems, and change both the habitats available for species and resources available for park visitor recreation.

Scientists cannot predict with certainty the general severity of climate change nor its impacts. However, the current warming trend suggests that the problem is real and should be taken seriously. Average global temperatures on the Earth's surface have increased about 1.3°F throughout the last century (between 1906 and 2005), and 11 of the 12 warmest years on record have occurred in the last 12 years (1995 to 2006).[1] The single leading cause of this warming is the buildup of greenhouse gases (GHGs) in the atmosphere — primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) — which trap heat that otherwise would be released into space.

The continued addition of CO_2 and other GHGs to the atmosphere will raise the Earth's average temperature more rapidly in the 21st century; a global average warming of 4-7°F by the year 2100 is considered likely.[2] Rising global temperatures will further raise sea levels and affect all aspects of the water cycle, including snow cover, mountain glaciers, spring runoff, water temperature, and aquatic life. Climate change is also expected to affect human health, crop production, animal and plant habitats, and many other features of our natural and managed environments.

Joining the Climate Friendly Parks Program

As a participant in the Climate Friendly Parks program, North Cascades National Park Service Complex belongs to a network of parks that are putting climate friendly behavior at the forefront of sustainability planning in national parks. By conducting a GHG emission inventory, setting a GHG emission reduction goal, developing this Action Plan, and committing to educate park staff, visitors, and community members about climate change, North Cascades National Park Service Complex is serving as a model for climate friendly behavior within the National Park Service.

North Cascades National Park Service Complex, as a member of the Pacific West Region, is involved in the first regional effort within the National Park Service to become carbon neutral. The Pacific West Region has a long-term vision of having all of its parks operate in a carbon neutral manner and a short-term goal to have all parks become Member Climate Friendly Parks by completing GHG emission inventories and preparing Action Plans by 2010.

It is within the context of this vision that North Cascades National Park Service Complex aims to:

Reduce GHG emissions from park operations to 35% below 2007 levels by the year 2016

Encourage climate friendly behavior among park staff and visitors.

Preserve to the highest degree possible the park's natural and cultural resources and infrastructure by increasing resilience to climate change.

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[1] IPCC 2007. Climate Change 2007: The Physical Science Basis. Intergovernmental Panel on Climate Change, Geneva Switzerland. Available online at: http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_FAQs.pdf

[2] IPCC 2007. Climate Change 2007: The Physical Science Basis. Intergovernmental Panel on Climate Change, Geneva Switzerland. Available online at < http://ipcc-wg1.ucar.edu/wg1/wg1-report.html>

To achieve these objectives, the park has established four goals:

Goal 1: Reduce greenhouse gas emissions that result from activities within and by the park.

Goal 2: Increase climate change education and outreach efforts.

Goal 3: Develop and implement a plan to adapt to a changing climate.

Goal 4: Continuously evaluate and improve performance in the Climate Friendly Parks program.

Action Plan Overview

This Action Plan lays out the specific actions North Cascades National Park Service Complex will take to affect climate change by meeting the goals specified above. The Action Plan does not provide detailed instructions on how to carry out each of the proposed actions; rather, it provides the framework needed to meet North Cascades National Park Service Complex's emission reduction, education, and adaptation goals. The adoption of this plan creates an opportunity for the park to devote resources to pursue the actions contained within this Action Plan.

The Action Plan begins with a discussion of the GHG emission inventory that North Cascades National Park Service Complex prepared to understand its contribution to climate change. After presenting the GHG emission inventory results, the Action Plan presents the goals that North Cascades National Park Service Complex has set for addressing climate change as well as a detailed list of actions the park will take to realize those goals.

Greenhouse Gas Emissions at North Cascades National Park Service Complex

The following section presents a summary of the findings of North Cascades National Park Service Complex's greenhouse gas emission inventory.

GREENHOUSE GAS EMISSION INVENTORY AT NORTH CASCADES NATIONAL PARK SERVICE COMPLEX

Naturally occurring GHGs include CO_2, CH_4, N_2O, and water vapor. Human activities (e.g., fuel combustion and waste generation) lead to increased concentrations of these gases in the atmosphere.

Greenhouse Gas Emissions

GHG emissions result from the combustion of fossil fuels for energy and transportation purposes, the decomposition of waste and other organic matter, and the volatilization or release of gases from various other sources (e.g., fertilizers and refrigerants).

North Cascades National Park Service Complex completed a GHG emission inventory using the Climate Leadership in Parks (CLIP) Tool provided by the CFP program. The CLIP Tool uses data on the activities that occur within the park that produce GHG emissions (i.e., emission sources) and methodologies established by the Intergovernmental Panel on Climate Change (IPCC) to estimate GHG emissions. Emission sources included in the GHG inventory include stationary and mobile fossil fuel combustion, electricity purchases, solid waste disposal, wastewater treatment, and refrigeration and air conditioning use. For the purposes of preparing an action plan, these sources are grouped into four sectors – Energy, Transportation, Waste, and Other. North Cascades National Park Service Complex completed emission estimates for these sources from its own facilities, vehicles, equipment, etc. (i.e., Park Operations) as well as from the activities of visitors, concessionaires, and other operations inside the park (e.g., Seattle City Light).

In 2007, North Cascades National Park Service Complex's GHG emissions totaled 5,818 metric tons of carbon dioxide equivalent ($MTCO_2E$). This total includes emissions calculated from park operations, visitors, concessionaires, and other activities. As Figure 1 and Table 1 demonstrate, the largest emission sector for North Cascades National Park Service Complex is Transportation - totaling 5,208 $MTCO_2E$. In Figure 1, emissions for each sector have been divided between the emitting entity (i.e., "Visitors and Concessioners", and "Park Operations"). The majority of transportation emissions result from visitor vehicle travel within park boundaries. The National Park Service (NPS) strives to provide public access to unimpaired parks and, as part of the NPS mission, continues to welcome people to the parks and provide for public enjoyment. The NPS will work with visitors, other agencies, and organizations to find ways to reduce GHG emissions from transportation to and within the park. However, reducing emissions from private and commercial vehicles is a public policy issue beyond the sole capacity of North Cascades National Park Service Complex. The ability to reduce GHG emissions from transportation will be shaped by the park's ability to obtain higher mileage and lower emission vehicles from the General Services Administration (GSA, from which the majority of the fleet is leased) and by changes in emissions from private and commercial vehicles used by the public. Reduction in emissions from private and commercial vehicles will, to a large degree, depend on personal choices in response to incentives created by market forces, legislation, regulations and public information.

Seattle City Light

Seattle City Light operates four hydro-electric dams within North Cascades National Park Service Complex. These facilities generate electricity for in-park and out-of-park consumption. Only GHG emissions from in-park electricity consumption are included in the GHG inventory. Total electricity production in 2007 at these four locations was 2,776,044 MWh[1], of which, 6,588 MWh were consumed inside park boundaries. Based on an emission factor of 0.013 $MTCO_2E/MWh$[2], GHG emissions from in-park electricity consumption are 86 $MTCO_2E$ while GHG emissions from out-of-park consumption are 36,003 $MTCO_2E$.

1 – Personal communication between Ron Tressler (Seattle City Light, Environmental Affairs Division) and Chris Steuer (ICF International). April 2009.

2 – The emission factor presented is based on a Seattle City Light average that includes power purchases from other suppliers. This emission factor may be higher than a facility-specific factor for the four locations within NOCA park boundaries, and thus may result in an overestimate of GHG emissions.

Figure 2 and Table 2 present only the park operations emission inventory results, which exclude emissions from visitors and concessionaires. These emissions totaled 767 $MTCO_2E$, resulting from Energy (36 percent), Transportation (50 percent), Waste (11 percent), and Other (2 percent).

FIGURE 1

North Cascades National Park Service Complex's Estimated Total 2007 Greenhouse Gas Emissions by Sector

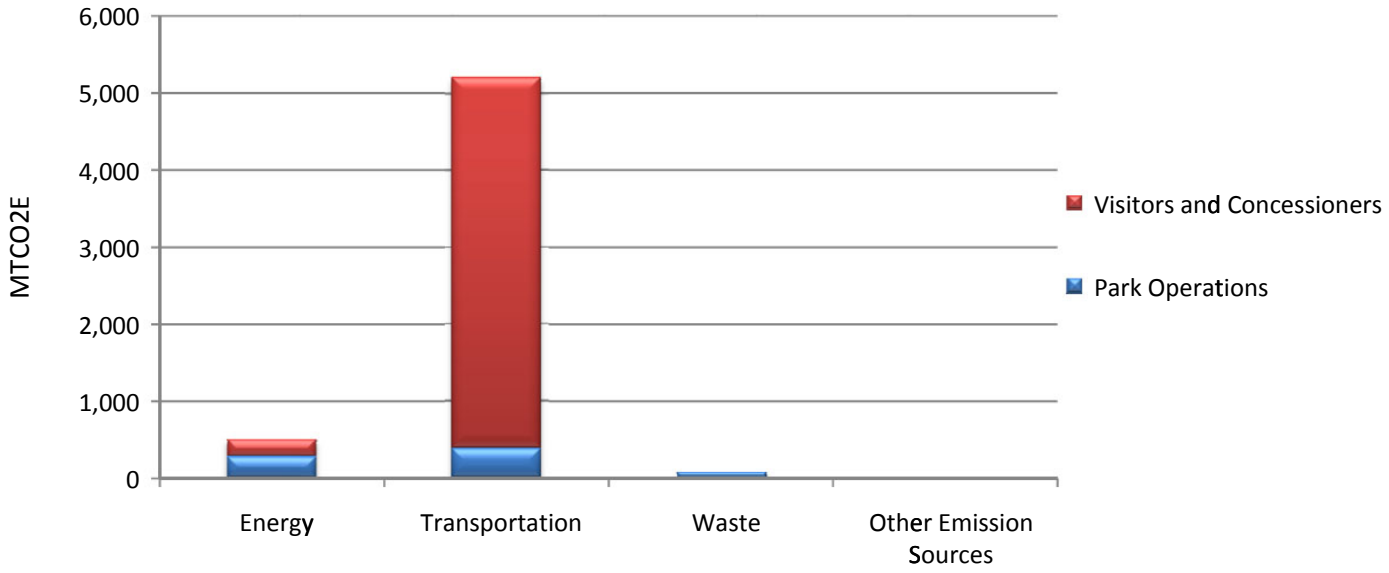

TABLE 1

North Cascades National Park Service Complex's Estimated Total 20007 Greenhouse Gas Emissions by Sector and Source

	Emissions ($MTCO_2E$)	% of Total
Energy	**505**	**8.7%**
Stationary Combustion	304	5.2%
Purchased Electricity	201	**3.5%**
Transportation	**5,208**	**89.5%**
Mobile Combustion	5,208	89.5%
Waste	**91**	**1.6%**
Solid Waste Disposal	91	1.6%
Wastewater Treatment	1	0.0%
Other Emission Sources	**14**	**0.2%**
Refrigeration	14	0.2%
Total Emissions	**5,818**	

FIGURE 2

North Cascades National Park Service Complex's Estimated Total 20007 Park Operations Greenhouse Gas Emissions by Sector)

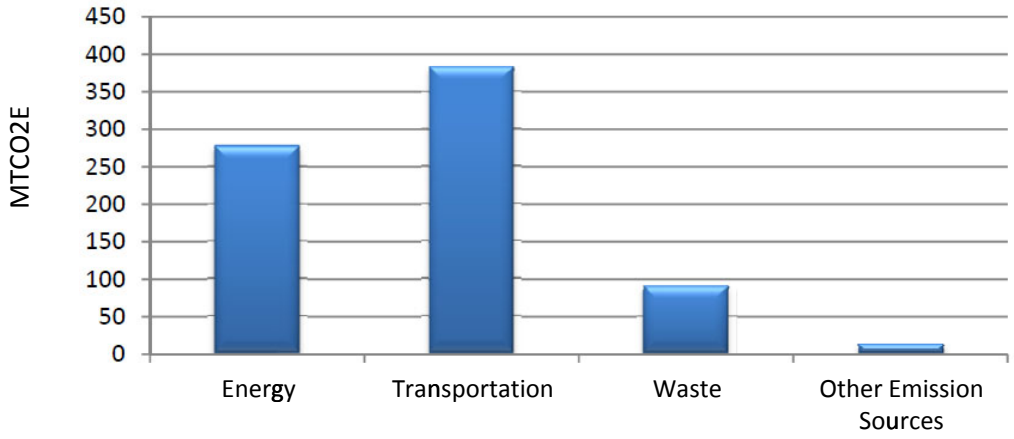

TABLE 2

North Cascades National Park Service Complex's Estimated Total 2007 Park Operations Greenhouse Gas Emissions by Sector and Source

	Emissions ($MTCO_2E$)	% of Total
Energy	279	36.3%
Stationary Combustion	159	20.7%
Purchased Electricity	120	15.6%
Transportation	384	50.1%
Mobile Combustion	384	50.1%
Waste	91	11.9%
Solid Waste Disposal	91	11.8%
Wastewater Treatment	1	0.1%
Other Emission Sources	13	1.7%
Refrigeration	13	1.7%
Total Emissions	767	

How North Cascades National Park Service Complex is Responding to Climate Change

The following actions were developed during the Climate Friendly Parks workshop hosted by North Cascades National Park Service Complex on February 23rd and 24th, 2009 in order to meet the park's climate change mitigation, education, and adaptation goals.

GOALS AND ACTIONS

GOAL 1: REDUCE GREENHOUSE GAS EMISSIONS THAT RESULT FROM ACTIVITIES WITHIN AND BY THE PARK

North Cascades National Park Service Complex recognizes that through its role as a steward of valued natural and cultural resources, the park has a duty to reduce its own environmental impact and, in so doing, can serve as a role model for thousands of visitors each year. To reduce its impact on climate change, the park has identified and quantified those actions that take place inside park boundaries that emit GHG emissions, and planned the actions listed below to reduce these emissions. The actions are grouped according to the following GHG emission sectors: Energy Use Management, Transportation Management, and Waste Management.

The actions are organized and prioritized by sector, beginning with the most emissive sector. Within each sub-sector, the highest priority actions are listed first and were determined using the following criteria: implementation cost, emission reduction potential, visibility/educational value, and co-benefit potential (e.g., reduction in criteria air pollutants). In general, low-cost and no-cost actions are listed first, while those that require large capital investments and long payback periods appear later. North Cascades National Park Service Complex will implement, evaluate, and reprioritize these actions on an ongoing basis.

Transportation Management

Emission Reduction Goal: Reduce park operations transportation emissions to 40% below 2007 levels by 2016.

Reducing vehicle miles traveled, improving vehicle efficiency, and using alternative fuels can significantly reduce North Cascades National Park Service Complex's emissions. As the inventory results indicate, 50 percent of the park's GHG emissions from park operations are a result of transportation. The following strategies were developed to meet the park's transportation emission reduction goal:

1 Reduce fuel consumed by park staff vehicles and equipment

- Reduce business and intrapark travel through the use of webinars, scheduling joint meetings, or using video or teleconferencing during meetings.
- Formalize a policy that promotes flexiplace or flexischedule (e.g., telecommuting or carpooling). Include a plan for incrementally reducing vehicle miles traveled on an annual basis.
- Encourage employee use of alternative forms of transportation (e.g., bicycles or electric vehicles) to replace driving vehicles short distances. Develop guidelines to ensure appropriate vehicle use and selection.
- Continue to encourage staff carpooling, both to work and within the park. Utilize existing online systems to help with coordination.
- Identify areas to reduce or eliminate mowing and implement the most efficient method (e.g., solar-charged electric equipment) for any mowing that cannot be eliminated. Investigate replacing lawn with low-maintenance vegetation.
- Work with Information Technology staff to expand streaming internet capabilities for webinars or teleconferencing, take advantage of existing technologies that work within our bandwidth limitations, and identify if and when we need to expand bandwidth to meet park needs.

- Develop a Stehekin library of recorded webinars, TELNET classes, or workshops.
- Continue to replace engines with the most efficient technology in boats, snowmobiles, and other equipment.
- Undertake a fleet study to determine how to decrease petroleum consumption and increase the use of alternative fuels and hybrid vehicles in fleet. Implement recommendations.
- Work with the General Services Administration to obtain low-emission vehicles and reduce overall fleet emissions.
- Invest in a fuel-efficient vehicle for Stehekin employees to use when traveling outside the park.
- Work with Washington State Department of Transportation, Seattle City Light, and Highway 20 gas station vendors to expand availability of biobased fuels for park and visitor use. Ensure that biobased fuel does not rely on food-based vegetable byproducts.
- Reduce boat emissions through increased engine efficiency and transportation planning/routing (e.g., combine maintenance clean-up with ranger patrols at boat-in campgrounds).

2 Reduce visitor fuel use

- Educate the public about GHG emissions to help inform people's choices about energy use.
- Investigate opportunities for shuttle services along Cascade River Road. Weigh the costs of implementing and operating within-park public transportation against actual emission reduction during the decision-making process.
- Establish and promote efficiency guidelines for visitor boat use.
- Update transportation studies of within-park traffic to improve the accuracy of visitation data, which can then be used to better inform planning for visitor facilities.
- Partner with Skagit Transit and undertake a feasibility study to expand and encourage public transportation between the park and surrounding communities.
- In partnership with North Cascades Institute and Seattle City Light, establish a shuttle that goes between Sedro Woolley and the North Cascades Environmental Learning Center. Schedule park or partner events around shuttle transportation.
- Encourage Seattle City Light to use biodiesel in buses and boats for the Diablo Lake Adventure tour. Ensure that biodiesel does not rely on food-based vegetable byproducts.
- Participate in local transportation planning initiatives to link a potential within-park visitor shuttle to the Mount Vernon Skagit Transportation Center, providing visitors with contiguous public transportation from primary state transportation centers into and then throughout the park.

3 Other

- Develop idling guidelines and post in fleet vehicles (e.g., dashboard stickers for NPS and concessionaire vehicles). Unless required for vehicle operation, establish the park as a zero idling zone. Pair with an educational campaign to communicate "No Idling" messages throughout the park for both staff and visitors.

- Work with visitor transportation providers (e.g., schools or concessionaires) to eliminate bus idling. Pair with an educational campaign to increase effectiveness.
- Install bike racks in front of park headquarters for employee and Highway 20 riders.
- Incorporate transportation infrastructure during the building and facility planning process (e.g., bike racks and lanes, alternative fuel stations, plug-ins, preferred parking for carpooling).

Energy Use Management

Emission Reduction Goal: Reduce park operations' energy use emissions to 37% below 2007 levels by 2016.

Improving energy efficiency and implementing alternative energy sources reduces park-based fuel use, lowers GHG emissions, decreases electricity consumption, and offers monetary benefits for the park. As the inventory results indicate, 36 percent of the GHG emissions from park operations result from energy consumption. Consequently, North Cascades National Park Service Complex will take the following actions to reduce energy-related emissions. In implementing these actions, the park will continually evaluate their costs and benefits, as well as their educational potential, and use the best available technologies and procedures.

1 Promote energy efficiency and energy conservation in park-owned facilities

- Minimize use of artificial lighting by taking advantage of natural lighting in existing structures. Design or retrofit buildings to utilize natural lighting as much as possible.
- Ensure that language in contracts, leases, or agreements reflects green priorities in energy and material use. Include energy efficiency as a rated factor in performance standards, when appropriate.
- Provide smart power strips for appropriate facilities and workspaces. Identify opportunities to shut off all network systems (e.g., printers) when not in use. Consult with Information Technology staff to identify opportunities for further reduction of power consumption.
- Educate and train park employees to identify and target weatherization and energy efficiency during scheduled, recurring comprehensive condition assessments (5-yr cycle) and annual condition assessments of park facilities. Prioritize weatherization of buildings identified by assessments as inefficient.
- Take advantage of rebates or grant opportunities offered by Seattle City Light or Puget Sound Energy to implement energy-saving audit recommendations.
- Inventory existing windows, prioritize and describe facility needs using the Facility Management Software System, and replace all single-pane windows with energy-efficient windows appropriate to the structure throughout the park.
- Install energy-efficient interior and exterior lighting coupled with light, photocell, or motion sensors in park facilities where safety and security allow for improvements. Ensure outdoor light pollution is minimized.
- Install energy-efficient hot water heating (e.g., solar or on-demand water heaters) in park residences and facilities.
- Implement Seattle City Light recommendations for the North Cascades Visitor Center to improve HVAC, lighting, and hot water heating systems.

- In partnership with Chelan Public Utility District, implement pertinent University of Washington recommendations (Kirchhoffer and Malte, *Balancing Energy Options in Stehekin, Washington*, University of Washington, June 2003) for improving energy efficiency and reducing energy use in Stehekin.
- Partner with the University of Washington, Puget Sound Energy, Seattle City Light, and Chelan Public Utility District to conduct park-wide energy audits.
- Conduct an energy audit of the Golden West Visitor Center.
- Implement energy audit recommendations for the Golden West Visitor Center using efficient methods and materials appropriate to historically significant buildings (e.g., replace single-pane windows and frames with energy-efficient alternatives that meet National Historic Preservation Act standards).
- Pursue energy-efficient improvements to contracts for leased space (e.g., implement zone-lighting separating egress-required lighting from workspace lighting, then develop a building-specific protocol for turning lights off after-hours in park headquarters building).

2 Produce clean energy or purchase electricity from a renewable energy provider

- Look for opportunities, then partner with Chelan Public Utility District, Seattle City Light, and/or Puget Sound Energy to install appropriate photovoltaic technology park-wide (e.g., at the wastewater treatment plant in Stehekin).
- Expand green energy purchases from Seattle City Light and continue green energy purchases from Puget Sound Energy. Encourage Chelan Public Utility District to offer green energy offsets to consumers.
- Develop a seven-year plan to install renewable energy systems within the park that, on an annual basis, will offset electricity consumption through the grid and have carbon-neutral lifecycle footprints (from manufacturing through the end of useful life).
- Investigate the use of micro hydro power where feasible (potentially only outside park boundaries, e.g., Olson Creek or Daylight Creek in Marblemount). If implemented, consider using as a demonstration for educational purposes.
- Encourage Chelan Public Utility District to use biodiesel in their Stehekin generator.

3 Other

- Ensure that the Environmental Management Team encourages and promotes energy conservation education and behavior among park concessionaires, partners, and employees.
- Reinvest dollar savings resulting from energy-efficiency improvements or projects identified in this action plan into additional conservation projects where budgets allow such flexibility.
- Perform a Seattle City Light energy audit of the North Cascades Environmental Learning Center.
- Implement energy audit recommendations for the North Cascades Environmental Learning Center.

Waste Management

Emission Reduction Goal: Reduce park operations waste emissions to 10% below 2007 levels by 2016 through waste diversion and reduction.

The connection between waste and GHG emissions may not be obvious. However, waste management — in the form of source reduction and solid waste reduction — can dramatically reduce GHG emissions. The less we consume in terms of products and packaging, the less energy is used and fewer GHGs are emitted. Additionally, reducing the amount of waste sent to landfills reduces CH_4 emissions caused by decomposition.

Diverting or reducing the park's waste stream through increased recycling efforts and waste management procedures will reduce the amount of waste sent to landfills, which are the largest human-generated source of CH_4 emissions in the United States. North Cascades National Park Service Complex's park operation activities emitted 91 $MTCO_2E$ from waste management in 2007. The following strategies were developed to meet the park's waste emission reduction goal:

1 Decrease waste through source reduction

- Encourage employees to select double-sided printing as the default setting on computers and identify ways to reuse single-sided paper.
- Purchase automatic duplexing printers to replace printers limited to single-sided printing.
- Consider a short-term solution that uses large, liquid-tight, animal-proof compactor containers to transport waste out of Stehekin.

2 Manage waste through composting, recycling, and combustion

- Continue to purchase and recycle environmentally-friendly printer cartridges.
- Promote the use of barrel composters, worm bins, and/or Earth Tubs at park facilities or residences in Stehekin.
- Return Tyvek envelopes to DuPont.
- Work with other national, state, county, or local parks to recycle propane canisters.
- Work with Stehekin Valley Ranch, Stehekin Landing Resort, and Stehekin Pastry Company to install an Earth Tub for organic waste. Connect with the Environmental Protection Agency and the Pacific West Region Environmental Programs Coordinator to determine if there are funding opportunities.
- Initiate recycling education programs in the Stehekin community.
- Ensure all front-country campgrounds have recycling corrals. Provide educational material guiding visitors in self-sort operations.
- Facilitate improvements to partners' recycling programs operating within park boundaries.
- Expand recycling capabilities at park headquarters by taking the lead in working with the building owner to increase recycling availability.
- Conduct a feasibility study to determine alternatives to burning woody debris from Ross Lake as a way to manage annual buildup.

- Designate a park employee who will take a leadership role in the park's effort to improve composting, recycling, and waste reduction, and incorporate this responsibility into his/her employee performance appraisal plan.

3 Reduce water use

- Investigate and potentially install timed (e.g., spring-loaded) and flow minimizing systems in faucets in campgrounds. Consider installing additional filters for systems where sediment could cause timed systems to malfunction.
- Replace existing restroom faucets and toilets with energy-efficient low-flow models.
- Replace existing water-using urinals with waterless urinals (or best technology) park-wide.

4 Other

- Ensure that all contracts include language that requires sustainable activities (e.g., recycling plans) in the performance standards, where appropriate.
- Actively communicate the importance of "Pack it in, pack it out" to Stehekin visitors.
- Establish a team to develop a long-term solution for efficiently and appropriately managing solid waste in Stehekin.
- Purchase maximum percentage recycled content, bleach-free paper that is available and compatible with existing printers and fax machines.
- Work with the Washington State Department of Ecology to use biosolids from the Stehekin wastewater treatment plant in designated areas of Stehekin to replace commercial fertilizer use.

GOAL 2: INCREASE CLIMATE CHANGE EDUCATION AND OUTREACH EFFORTS

North Cascades National Park Service Complex recognizes that the greatest potential impact the park can have on mitigating climate change is through public education. Climate change is a complex issue that the park can help communicate to the public. A better understanding of the problem and the benefits of reducing GHG emissions can motivate staff, visitors, and community members to incorporate climate friendly actions into their own lives. Thus, the park sees public education as an end goal of any climate initiative. From increasing the efficiency of public transportation to developing a green purchasing program, the actions North Cascades National Park Service Complex takes to address climate change serve as opportunities for increasing the public's awareness of climate change.

Park Staff, Partners, and Concessionaires

Developing a climate change education program for staff of the park, partners, and concessionaires is vital to increasing awareness about climate change among park visitors. By incorporating climate change education into staff-development programs and creating new opportunities to learn about climate change, North Cascades National Park Service Complex will reduce park emissions and provide visitors with the tools and resources they need to reduce GHG emissions at home and in their own communities.

1 Provide park staff, partners, and concessionaires with the knowledge and tools to educate visitors

- Create incentives (e.g., awards, recognition items) for staff to take sustainable actions.

- Incorporate climate change messages into staff training and responsibilities into division annual work plans and employee annual performance appraisal plans.
- Work with all Washington national parks through the North Coast and Cascades Research Learning Network to develop a concise climate change information resource that may contain training plans, talking points, fact sheets, references, examples of climate friendly actions, etc.
- Develop staff skills in presenting climate change issues via workshops, seasonal orientation, and trainings.
- Develop and include climate change messages in annual information packets provided to concessionaire and commercial use permittees so information can be shared with guests and visitors.

Visitors

Understanding climate change and its consequences is essential to initiating individual behavioral change. North Cascades National Park Service Complex realizes that it has a unique opportunity to educate the public in a setting free from many of the distractions of daily life. By using existing materials, developing park-specific materials, highlighting what the park is currently doing about climate change, and encouraging visitors to reduce emissions, North Cascades National Park Service Complex can play an important role in educating the public about climate change.

1 Incorporate climate change awareness into visitor education

- Work with North Cascades Institute to develop and implement programs (e.g., Parks Climate Challenge) that will educate people about climate change.
- Ensure that the climate change messages are incorporated into appropriate interpretive programs and materials (e.g., the Junior Ranger program, evening programs, the park website).
- Ensure that climate change messages can reach diverse audiences by translating written and audio-visual materials and employing multi-lingual staff.

2 Highlight what the park, its partners, and concessionaires are doing to address climate change

- Maintain an updated list on the park website of climate-friendly actions the park, partners, and concessionaires have taken.
- Highlight demonstrations of successful climate friendly projects (e.g., worm bins, recycling corrals, photovoltaic technology).
- Develop self-guided tours for visitors to see and learn from sustainable actions the park, partners, and concessionaires are taking.

3 Encourage visitors to reduce greenhouse gas emissions

- Encourage visitors to reduce, reuse, and recycle by placing appropriate signage on recycle and trash stations (e.g., “By recycling this aluminum can, you have saved X lbs of CO_2 from entering the atmosphere.”). Ensure signage is approved by the North Cascades National Park Service Complex Sign Committee and consistent with the most current Sign Plan.
- Encourage visitors to participate in the Do Your Part! for Climate

DO YOUR PART for CLIMATE *Friendly* PARKS

The Do Your Part! for Climate Friendly Parks program provides easy actions people can take to reduce emissions in their everyday lives.

Friendly Parks program (e.g., use social networking sites such as YouTube, Facebook, or MySpace).

Local Communities

The communities within and surrounding North Cascades National Park Service Complex can play a significant role in supporting the park's GHG reduction goals. As such, when appropriate, park, partner, and concessionaire staff will assist local communities with incorporating climate change messages into community events and find partners to promote climate change education at those events. Staff will use their knowledge of climate change resources to help local communities engage in climate friendly actions.

1 Encourage climate change awareness among the communities within both the park and the region

- Share climate change information such as actions, mitigations, and adaptation strategies with surrounding local and civic organizations.
- Create volunteer opportunities to work on climate change related projects by participating in research, mitigation actions, or site restoration.
- Encourage local communities to promote and support bikeable / walkable opportunities.
- Use media to advertise, celebrate, and raise awareness about climate change actions in the park.
- Participate in community and local events (e.g., Upper Skagit Bald Eagle Festival) to promote awareness of and increase participation in climate friendly activities.

GOAL 3: DEVELOP AND IMPLEMENT A PLAN TO ADAPT TO A CHANGING CLIMATE

While every effort must be made to curb future impacts of climate change through GHG reduction actions such as those proposed in Goal 1, the impacts of climate change are now being seen around the globe. As such, it is important to develop and implement strategies to adapt to the effects of a changing climate in order to protect the natural, cultural, and infrastructure resources contained in our national parks. The actions presented in this section are the first step towards developing broader adaptation strategies.

When developing strategies for adaptation, it is important to recognize that the adaptation community is in its early stages, and the bodies of both scientific and planning knowledge on this subject are rapidly evolving. In general, the body of knowledge is currently coalescing around several key aspects of adaptation planning, which include: 1) establishing a measurable natural and cultural resource baseline, 2) developing key partnerships both between entities (e.g., National Park Service, U.S. Forest Service, non-governmental organizations) and between individuals (e.g., managers, policy makers, stakeholders, scientists) who will be affected by any actions taken, 3) identifying and developing adaptation strategies, 4) implementing adaptation strategies, and 5) revisiting and revising these strategies based on experience and updated science.

As discussed during the Climate Friendly Parks workshop, impacts of climate change on the park include increased temperatures, loss of glaciers and snowpack, changes in precipitation patterns, and altered stream flow patterns. Many of these impacts are interrelated, and this makes adaptation planning a complicated task. For example, increased temperatures and changes in precipitation can impact forest regeneration, forest productivity, species distribution, and large scale disturbance patterns from fire, insect outbreaks, and direct mortality. The potential for large scale disturbances of park resources and infrastructure highlights the need for proper adaptation strategy planning and implementation. The actions discussed below represent the beginning of this process for North Cascades National Park Service Complex.

Natural Resources

National parks contain, and have protected and preserved for decades, various ecological landscapes and representative species of the nation's biological diversity. The species that comprise these ecosystems and the landscapes they inhabit will respond to climate change. The actions below were developed in an effort to preserve and protect North Cascades National Park Service Complex's natural resources to the greatest extent possible. These actions are general approaches to natural resource protection; Appendix A identifies impacts to selected natural resources and planned actions to respond to climate change.

1 Implement an approach that encourages adaptation and improves the resilience of natural resources (for further actions, see Appendix A)

- Complete baseline species inventories and implement monitoring activities to inform and develop conservation strategies, particularly for those species in the communities where considerable change is expected – the subalpine and alpine zones of the park.

- Work with researchers, other agencies, and the public to develop spatial and temporal adaptation strategies for aquatic and terrestrial resources on a landscape scale. Although the Greater North Cascades Ecosystem (1-90 to Fraser River and from Puget Lowland to the Columbia) is our starting point, boundaries may be adjusted for different species – some species extend across much greater areas (e.g., wolves, wolverines, pollinators, whitebark pine) while others are focused in more concentrated areas (e.g., pika, ptarmigan, marmots).

- Integrate different temporal scales into adaptation strategies. Address short term (next 5 years), medium term (next 20 years) and longer term (50-100 years) strategies.

- Integrate individual research and monitoring projects as part of a broader holistic research and monitoring program. Utilize current research and monitoring to develop predictive models to inform park management.

- Create a dialog with adjacent agencies to develop criteria or common definitions regarding "migrating species" and "invasive/exotic species."

- Pursue resource restoration and rehabilitation projects such as invasive species removal, restoration of rare species, or reduction of unnatural fuel loads in park forests to promote greater ecosystem resilience.

Cultural Resources

The North Cascades National Park Service Complex also contains significant cultural resources in the form of archeological sites, historic structures, museum collections and archives, ethnographic resources, and cultural landscapes. The integrity of these cultural resources can be affected by physical changes in the landscape due to climate change. North Cascades National Park Service Complex has developed the following actions to preserve as many of the cultural resources within the park boundaries as possible.

1 Implement an approach that encourages preservation and adaptation of cultural resources

- Update, as necessary, the documentation for all significant cultural resources and review documentation for candidate cultural resources. Continue to monitor and assess documented and candidate cultural resources as well as related facilities (e.g., the Marblemount Curation Facility) to identify impacts of or vulnerability to climate change, then identify effective means of mitigation.

- In consultation with National Park Service cultural resource professionals, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Officer, evaluate the significance of cultural resources to develop preservation strategies to manage these resources in response to climate change impacts. Manage curatorial facilities

and repositories in an energy-efficient manner suited to the environmental preservation requirements of the collections and archives.

Infrastructure

To enable visitors to experience the park's resources, every park has a physical infrastructure that may include roads, trails, bridges, culverts, buildings, and utilities. This physical infrastructure represents a significant investment and can be impacted to varying degrees by climate change. North Cascades National Park Service Complex recognizes the potential for its infrastructure to be impacted and has developed the following actions to understand and plan for the impacts of climate change to better protect its physical resources.

1 Implement an approach that encourages adaptation of facilities (including transportation and structures)

- Re-evaluate design and location of facilities to ensure resilience from potential impacts of climate change. When possible, avoid geohazardous areas (e.g., debris cones, floodplains).
- Anticipate hazard trees and fire. Consider wildland fuel management needs as part of evaluating facility lifecycle costs; minimize risk through proper site location and design of facilities.
- Incorporate landscape principles and plantings to reduce reliance on non-renewable energy for climate control (e.g., use plantings to shade structures in the summer and allow maximal solar gain in the winter).
- Design all new construction and reconstruction to take maximal advantage of natural, environmental conditions (e.g., orienting buildings and structures to take advantage of natural light).
- Anticipate increased heating or cooling needs and develop ways to reduce the needs or meet them without increasing non-renewable energy demand or GHG emissions.

2 Implement an approach that encourages adaptation of utilities

- Assess increased impacts on water sources and drain fields or leach fields by collecting, interpreting, and utilizing surface water quality monitoring data. Implement necessary modifications based upon results (e.g., increase treatment level if high counts of fecal coliform are found).

3 Engage public in adaptation planning and implementation of strategies

- Regularly communicate with the public to develop an understanding of and gain support for inevitable difficult decisions made with respect to resources and infrastructure (e.g., relocating buildings, road, or campgrounds; seasonal closures of roads and trails).

GOAL 4: CONTINUOUSLY EVALUATE AND IMPROVE PERFORMANCE IN THE CFP PROGRAM

By taking the actions established in goals 1, 2, and 3 above, North Cascades National Park Service Complex plans to reduce its GHG emissions, educate park staff and the public, and begin adapting to the impacts of climate change. Achieving these goals will require that the park, its partners, and concessionaires evaluate their progress in implementing the identified actions, update and improve the actions on a continual basis, and revise this Action Plan on an annual basis. As part of the ongoing process of evaluation, the current version of this document will remain publicly available on both the Climate Friendly Parks and North Cascades National Park Service Complex websites for stakeholders to review and provide feedback. Ongoing evaluation and improvement actions include:

- Monitor progress with respect to reducing emissions. This will include performing subsequent emission inventories (using the CLIP Tool) to evaluate progress towards mitigation actions and goals stated in this action plan (Goal 1).
- Develop and/or refine climate change education and outreach efforts (Goal 2).
- Develop broader adaptation strategies using the actions presented in this Action Plan (Goal 3).
- Review and update this Action Plan on an annual basis.

CONCLUSION

North Cascades National Park Service Complex has the opportunity to serve as a model for approximately 450,000 visitors annually. This Action Plan summarizes the operational actions the park currently performs and/or commits to undertake to address climate change. Specifically, the park realizes its ability reduce its GHG emissions, educate and serve as a model for the public, and adapt to a changing climate. However, given that the majority of GHG emissions attributed to the park originate from transportation, the park also recognizes that any significant reduction in transportation-related GHG emissions will need to originate from large-scale emission reductions associated with private and commercial vehicles, an element that must be part of a larger national public policy goal. By seriously addressing other GHG emissions within the park and sharing its successes with visitors, though, North Cascades National Park Service Complex will help mitigate climate change far beyond the park's boundaries.

This Action Plan also serves as an important enhancement mechanism for the park's Environmental Management System (EMS). Realistic environmental commitments created by North Cascades National Park Service Complex staff and approved by the park's superintendent will significantly reduce the park's GHG emissions in the coming years. The mitigation and adaptation actions included in this plan have been developed in order to be directly transferable to the park's EMS. North Cascades National Park Service Complex's Action Plan thus provides an effective way to meet EMS goals.

The National Park Service faces an uncertain future due to the possible effects of climate change. However, by seriously addressing climate change impacts and reducing GHG emissions, North Cascades National Park Service Complex will limit its contribution to the problem while setting an example for its visitors. The actions presented in this Action Plan represent an aggressive first step towards moving North Cascades National Park Service Complex forward in the community of Climate Friendly Parks.

Please contact Kerri Cook, Facility Operations Specialist, with any questions, comments, or general feedback regarding this document.

Office: 360-854-7280
Email: Kerri_Cook@nps.gov

APPENDIX A. TABLE OF POTENTIAL IMPACTS TO NATURAL RESOURCES FOLLOWING CLIMATE CHANGE AND PROPOSED MANAGEMENT ACTIONS.

Discipline	Potential Impacts and Actions [1]
Hydrology & Water Resources	• Loss of glaciers and associated effects on the timing and quantity of buffering summer flows. • More winter precipitation falling as rain instead of snow, earlier snow melts, and associated changes in river flow that includes relative increases in the spring and relative decreases in the summer months (Mote et al. 2005, Barnett et al. 2008). ➢ Action: Increase research and monitoring to better understand linkages between climate and water resources patterns. ➢ Action: Install stream gages in high-elevation streams. ➢ Action: Synthesize available climate data. ➢ Action: Model available resource data to identify specific adaptive management actions to protect natural and physical resources (e.g., fish, bridges, infrastructure). • Ecological impacts to floodplain and riparian areas with decrease in spring flooding on higher elevation and east-side snowmelt streams. • Increases in frequency of heavy precipitation events; floods in western WA are expected to increase due to the combined effects of warming and increasingly intense winter storms (Hamlet 2009). • Changes in flood risks are likely to result in substantial changes in sediment transport and channel formation processes, and is likely to affect ecological processes that are sensitive to changes in the probability distributions of high flow events such as habitat stability, biodiversity, and trophic structure (Konrad and Booth 2005, Hamlet and Lettenmaier 2007). • Stream channel instability associated with adjustment to larger floods. • Warmer drier summers result in depleted groundwater resources and impacts to fish, wells, etc., particularly in Stehekin. ➢ Action: Improve outreach/education on water conservation with Stehekin residents and visitors. ➢ Action: Monitor wells and ground water in Stehekin. ➢ Action: Repeat Stehekin River channel surveys for the lower 10 miles. ➢ Action: Repeat wetland surveys in Stehekin River Valley to document changing conditions and develop adaptive management strategies. • Changes in regional water supply. • Increased precipitation and cloudiness.
Aquatic Ecosystems	• Warming temperatures will increasingly stress coldwater fish (at several life history stages) in the warmest parts of our region (Hamlet 2009). ➢ Action: Expand current monitoring of stream temperatures and fish species/populations to other selected sites. ➢ Action: Conduct an effectiveness and feasibility study to determine if Ross Lake Reservoir can be used to maintain cool stream temperatures on the main stem Skagit.

	➢ Action: Conduct research on the effect of glacier retreat on stream temperatures. • Potential to affect most freshwater life history stages of trout and salmon. Increased frequency and severity of flood flows during winter can affect over-wintering juvenile fish and incubating eggs in the streambed. Eggs of fall and winter spawning fish, including Chinook, Coho, Chum and Sockeye salmon and bull trout, may suffer higher levels of mortality when exposed to increased flood flows. Higher winter water temperatures could also accelerate embryo development and cause premature emergence of fry (ISAB 2007). • Nonnative fish species may increase in abundance or distribution due to warmer water temperatures. Examples of this include increased abundance of red side shiner in Ross Lake which then results in changes to the trophic structure (including non-fish species). ➢ Action: Conduct lake water temperature study (both spatial and temporal) and bioenergetic (i.e., food web) study on Ross Lake Reservoir. ➢ Action: Conduct research and monitoring on rainbow and cutthroat trout dynamics in the Stehekin watershed to investigate if climate change is influencing the introgression of rainbows and cutthroat. • Higher surface water temperatures exacerbate pollution issues. ➢ Action: Expand long-term water quality monitoring program to determine if the rate and quantity of pollutants contributed by snowpack is changing with changing climate. • Loss of summer/drought based water flow with loss of glaciers. • Shifting of aquatic habitat – elevation and latitude-changing species composition and habitats. ➢ Action: Partner with adjacent landowners and coordinate plants to take a regional view of salmon migration and develop adaptation guidelines. Create a dialogue with adjacent agencies to develop criteria or common definitions for migrating species and invasive/exotic species.
Vegetation	• Species composition and distribution of subalpine and alpine areas will change. Forest line and treeline may rise in elevation due to higher temperatures and decreased snowpack Subalpine meadows will change due to increased tree establishment and changes in forb:grass ratios. ➢ Action: Expand the subalpine monitoring protocol to include more sample areas with the park and to include monitoring of non-vascular species and effects of air pollution on high-elevation plants and soils. ➢ Action: Foster more short-term research at monitoring sites to increase understanding of processes and improve our understanding of potential changes in high-elevation plants communities. ➢ Action: Conduct research to determine how changes in plant communities will affect a variety of species that depend on this habitat (e.g., pollinators, pikas, marmots). ➢ Action: Create a dialogue with adjacent agencies to develop adaptation strategies on a landscape scale. • High-elevation atmospheric pollutants (and ozone levels) increase. • Increased invasive species. ➢ Action: Develop early detection and rapid response protocols for invasive non-native species to promote ecosystem health and increase resilience to climate change. ➢ Action: Identify which species are invasive and non-native versus species migrating in response to climate change. ➢ Action: Complete NEPA compliance to permit/enable park-wide invasive species management.

	• Warmer and drier climates may influence the frequency and location of pest species (mountain pine beetle attacks) in PNW forests. Climatic suitability for pests such as mountain pine beetle may increase at higher elevations. ➢ Action: Conduct a forest assessment to determine areas with highest susceptibility to insect outbreaks and use these data to identify potential management strategies. ➢ Action: Coordinate management strategies and actions with partners and adjacent land managers. • Species composition of forests may change in response to higher temperatures and drought stress. ➢ Action: Expand long-term monitoring protocol to include more replicates, more forest types, and more forest attributes to better understand forest changes in response to climate change. ➢ Action: Expand forest monitoring program to include changes in forest function in addition to forest structure. • Higher temperatures may result in increased mortality in whitebark pine populations due to white pine blister rust and increased distribution of mountain pine beetles. • Riparian forests may change in extent and composition due to reduced stream flows and higher temperatures.
Wildlife	• Changes in geographic distribution of wildlife species (i.e., latitude and elevation). An analysis of potential climate change impacts on mammalian species in the U.S. national parks indicates that on average about 8% of current mammalian species diversity may be lost. The greatest losses across all parks occurred in rodent species, bats and carnivores (Burns et al. 2003). Reduced snowpack may result in species such as coyotes expanding their distribution. ➢ Action: Update park's wildlife species inventory to include invertebrates and distribution of uncommon species. ➢ Action: Establish long-term monitoring program to document changes in species distribution and abundance across elevation, longitude, and latitude (e.g., Grinnell transects). ➢ Action: Monitor demography of bird species to understand influence of climate change on birds. ➢ Action: Conduct research and long-term monitoring on population dynamics of key wildlife species to understand magnitude of changes due to climate (e.g., pikas, ptarmigan, marmots, wolverines). ➢ Action: Develop a model to predict shifts in wildlife distribution in response to climate change and utilize this model to develop adaptive management strategies. ➢ Action: Create a dialogue with land management agencies across the North Cascades Ecosystem to develop and implement collaborative adaptive management strategies. • Fragmentation of large ecosystems may occur due to increased disturbance and vegetation changes, disrupting existing wildlife ranges (McCarty 2001). ➢ Action: Include land development and subsequent fragmentation of wildlife habitat in the Climate Change model being developed to predict range shifts in response to climate change. • Invasion by non-natives. ➢ Action: Identify which species will be defined as non-native or invasive versus those species that are migrating in response to climate change. Collaborate with adjacent agencies to encourage multi-agency definitions. ➢ Action: Develop early detection and rapid response management tools for invasive non-native species management to promote ecosystem health and increase resilience to climate change. ➢ Action: Conduct an inventory to determine which non-native species are already within the park and which species

	are in adjacent areas. Identify the highest priority species for monitoring and rapid response and implement management program. • Changes in timing of migration, reproduction, dormancy, and changes in productivity. Pollinator populations utilizing the subalpine areas may be affected by increases in tree islands and changing phenology of flowering plant species. ➢ Action: Implement the North Cascades N.P./Mount Rainier N.P. butterfly monitoring program. Expand monitoring sample design to 1) include more frequent sampling 2) include more study sites to increase sensitivity of monitoring program to temporal and spatial changes in pollinator climate responses.
Disturbance (fire, pests, pathogens, avalanche)	• Avalanche tracks may decrease due to decreases in winter snow pack resulting in changes in animal populations. ➢ Action: Map avalanche chutes, monitor their activity, and synthesize research data to develop more predictive models of avalanche frequency, magnitude, and locations. • Fire frequency and intensity may increase due to higher temperatures, increased drought, and decreased snow pack. ➢ Action: Incorporate information from emerging models into fire management planning and management strategies. If conditions change fire risk in different areas, change expectations for fire activity and effects on landscape-scale post-fire ecosystem responses. ➢ Action: Develop better understanding of influence of fire on distribution of exotic plant and wildlife species distributions in the context of shifting distribution of biota. • Fire: Increase in length of fire season, severity of fires, and number of acres burned; non-native invasive grasses provide continuous fuel beds and increase wildfire severity. There is high likelihood that this outcome will prove to be true, but some uncertainty still exists. With changes in the pattern of precipitation (more rain in extreme events) there may be variable response from non-native grasses. This could limit the frequency and extent of fires. • Pest/Pathogen: Increased winter temperatures facilitate pathogen/pest survival. ➢ Action: Identify areas where both non-native and native insects and diseases are likely to increase based on climate changes and develop management strategies. • Wind-fall. • Flooding.
Soil	• Changes in precipitation and snowpack may result in an increase in the frequency and magnitude of landslides, mudslides and sediment loading (Hamlet 2009). ➢ Action: Use current data to identify zones where we anticipate future events and incorporate these predictions into management planning. ➢ Action: Develop more frequent monitoring or research to study linkages between storm events and slide events. • Loss of glaciers may mobilize large reservoirs of fine sediments stored beneath them. • Less soil moisture during growing season (related to vegetation mortality and fire regimes in those two sections).

[1]Bolded actions are higher priority.