FIRE MANAGEMENT PLAN

For

Gates of the Arctic National Park and Preserve

ALASKA

April, 2014

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Gates of the Arctic National Park and Preserve

FIRE MANAGEMENT PLAN

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1.0 INTRODUCTION

1.1 Reason for the Fire Management Plan

The following Fire Management Plan (FMP) is a specific action plan for the implementation of agency-wide and park-specific policies. As stated in Director's Order 18 (DO-18), the National Park Service(NPS) specifies that, "Each park with burnable vegetation must have an approved Fire Management Plan that will address the need for adequate funding and staffing to support its fire management program. Parks having an approved Fire Management Plan and accompanying National Environmental Policy Act (NEPA) compliance may utilize wildland fire to achieve resource benefits in predetermined fire management units. Parks lacking an approved Fire Management Plan may not use resource benefits as a primary consideration influencing the selection of a suppression strategy, but they must consider the resource impacts of suppression alternatives in their decisions." Accordingly, this plan is intended to facilitate the achievement of the goals and objectives identified in the General Management Plan (GMP) and Resource Management Plan (RMP) for Gates of the Arctic National Park and Preserve. As stated in the GMP, "The overall natural resource management objective is to maintain natural features, environmental integrity, and the dynamics of natural processes operating within the Park/Preserve." Objectives are then derived from the combination of the GMP and the goals of the integrated park programs which clearly state "to allow fire to fulfill its role as a natural process to the fullest extent possible while protecting human life, private property, and cultural and natural resources that warrant protection" (RMP 1994: pg.5). Since 1983, guidance for fire management activities within the Park/Preserve has come from a series of statewide interagency plans developed cooperatively by the National Park Service, the Bureau of Land Management, the Alaska Department of Natural Resources, the Alaska Department of Fish and Game, the U.S. Forest Service, the U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, and Native Regional and Village Corporations. This Fire Management Plan, in turn, comprises a park-specific action plan; as such, it will be used in conjunction with the current Alaska Interagency Wildland Fire Management Plan (AIWFMP) to direct all personnel engaged in fire management actions within the Park/Preserve toward the fulfillment of the goals and objectives specified by the Park/Preserve's RMP.

Authority for the implementation of this Fire Management Plan originates with the Organic Act of the National Park System, August 25, 1916. The act states that the primary goal of the National Park Service is to preserve and protect the natural and cultural resources found on lands under its management in such a manner as will leave them unimpaired for future generations. Current service-wide fire management policy is specifically expressed in Director's Order 18 (DO-18), the attendant Reference Manual (RM-18), The National Park Service Management Policies (January 16, 2008), Interagency Standards for Fire and Aviation Operations, National Interagency Mobilization Guide, Interagency Business Management Handbook, Guidance for Implementation of Federal Wildland Fire Management Policy (February 13, 2009), Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide, and Interagency Fire Program Management Qualifications Standards and Guide. The Fire Management Plan for Gates of the Arctic National Park and Preserve (GAAR) complies fully with these directives.

The actions described within this plan also meet the requirements of the National Environmental Planning Act (NEPA), the National Historic Preservation Act (NHPA), and the Alaska National Interest Lands Conservation Act (ANILCA). Compliance with these acts will be demonstrated as follows:

- The 2014 GAAR Fire Management Plan is a rewrite of the 2003 FMP with minor changes that reflect the new fire management policy's in the RM-18.

- The 2003 FMP EA is accompanied by a Summary Evaluation and Findings document (Appendix C.2), and an assessment of the impacts of the proposed actions upon subsistence activities in a 810 (a) Summary Evaluation and Findings.

- A Programmatic Agreement among Gates of the Arctic National Park and Preserve, Wrangell-St. Elias National Park and Preserve, Yukon-Charley National Preserve, the Advisory Council on Historic Preservation, and the Alaska State Historic Preservation Office specifies the actions to be taken by the three park units in conjunction with their Fire Management Plans for compliance with the National Historic Preservation Act.

- The NPS will consult with the State of Alaska Historic Preservation Officer (SHPO) of the 2014 GAAR FMP policy updates.

1.2 General Description of the Park

1.2.1 Purpose of the Park/Preserve

As early as 1950, some Alaskans and many conservationists made recommendations to the National Park Service for the creation of an Arctic Wilderness Park (Brown 1988). The publicized accounts of many of the scientists who were studying both the natural and cultural landscapes of this northern part of Alaska served to awaken the general public to the beauty of Alaska, as well as the threats to the land in the form of rapid development. In 1980, with the passage of the Alaska National Interest Lands Conservation Act (ANILCA), Gates of the Arctic National Park and Preserve (GAAR) was formed.

As defined by ANILCA, Gates of the Arctic's foremost purpose is:

> To maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural features; to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and to other wilderness recreation activities; and to protect habitat for and the populations of fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds.

Truly a wilderness park, GAAR is considered an unspoiled area of natural beauty, with foremost value placed on the undeveloped nature of the entire Park/Preserve. Significant resources include two National Natural Landmarks: Walker Lake and Arrigetch Peaks, and six National Wild and Scenic Rivers: the North Fork of the Koyukuk River, Tinayguk River, John River, Alatna River, Kobuk River and Noatak River. GAAR is one of the last Park/Preserve areas conducive to wilderness adventure, where visitors can experience a sense of solitude, isolation, and extreme natural beauty.

National Park Service Management Policies: Chapter 6.1 states "The National Park Service will manage wilderness areas for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness. Management will include the protection of these areas, the preservation of their wilderness character, and the gathering and dissemination of information regarding their use and enjoyment as wilderness. The public purpose of wilderness in the national parks includes the

preservation of wilderness character and wilderness resources in an unimpaired condition, as well as for the purposes or recreational, scenic, scientific, education, conservation, and historical use".

GAAR is also recognized as an area of significant scientific value with regard to vegetative communities and fish and wildlife populations. Wildlife biology, ecology, botany, and numerous other disciplines acknowledge the unique opportunity for scholarship that is possible in GAAR. As a result, maintaining the natural ecosystem within the Park/Preserve is a primary priority in all management decisions.

Although only a small portion of GAAR (less than 5% of the total area) has been adequately surveyed for cultural resources, the entire Park/Preserve has the potential to greatly contribute to our understanding of the past. Currently, over 1600 prehistoric and historic archaeological sites have been identified, many of which have exceptional scientific value. Systematic archaeological surveys are planned for the upcoming field season and beyond, and will serve to further identify significant cultural resources within GAAR.

Figure 1: National Park Service Units in Alaska, Gates of the Arctic, Vicinity Map

1.2.2 Management Environment

1.2.2.1 Land ownership, significant resources, mission and management direction

Land Ownership

Gates of the Arctic National Park and Preserve encompasses 8,307,051 acres, of which the federal government manages 97%. Much of the remaining land belongs to Arctic Slope Regional Corporation and Doyon, Ltd. Other ownership categories include local village corporation tracts, state-owned submerged lands, allotments, and patented/unpatented mining claims. Located north of the Arctic Circle, this remote Park/Preserve lies within the central Brooks Range, and is one of the Nation's largest wilderness parks. The village of Anaktuvuk Pass is located in the mountains near the Park/Preserve's northern border and is the only established community within the boundary of GAAR. The community of Bettles/Evansville is the field operations center for GAAR, located south of the Park/Preserve. Other nearby communities include Coldfoot and Wiseman, located to the east of the Park/Preserve on the Dalton Highway. Access is mainly by commercial air services or private aircraft, however, some visitors access the Park/Preserve by foot from Anaktuvuk Pass, Coldfoot or Wiseman.

Lands ownership and/or management adjacent to GAAR fall under the following categories:

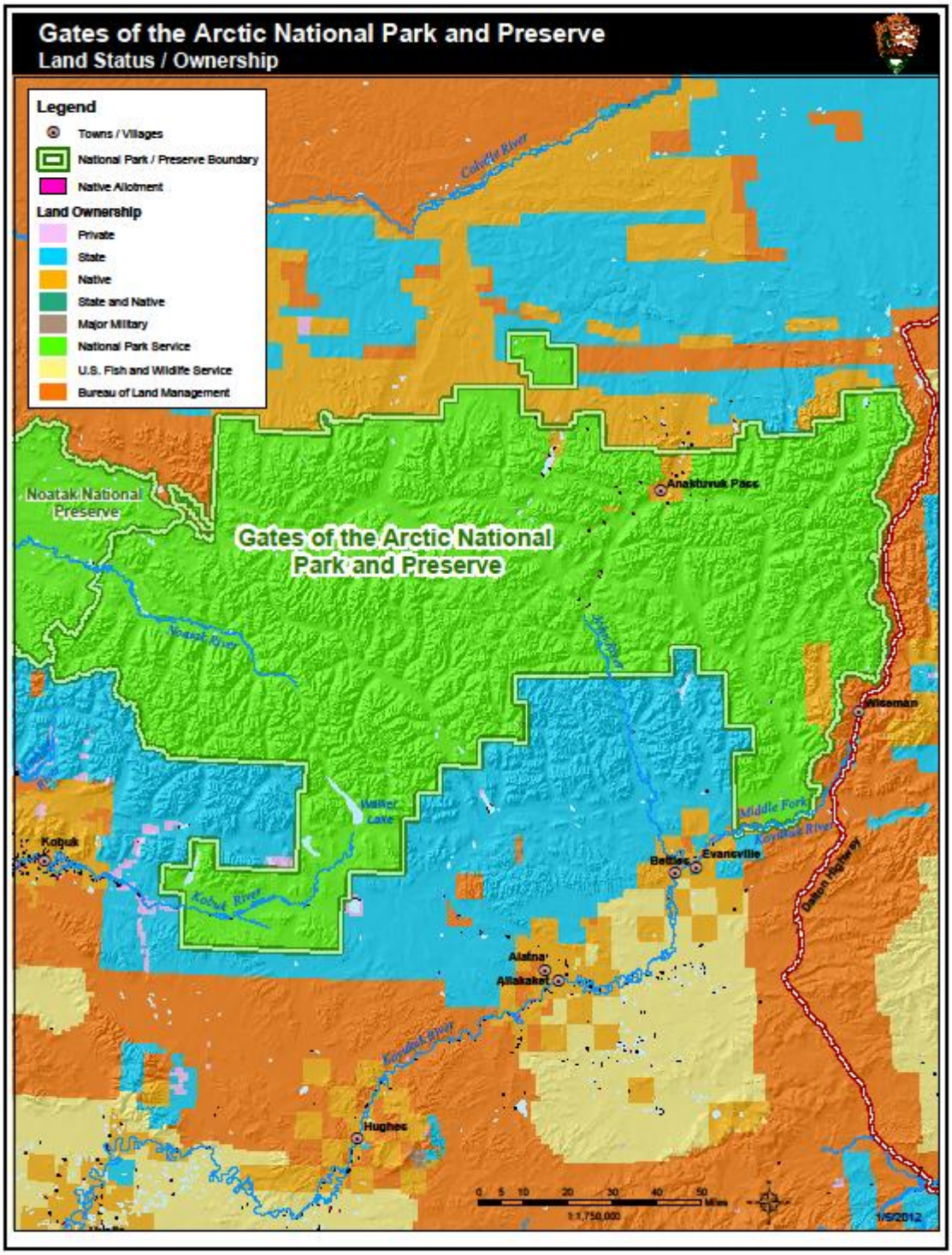
- Trans-Alaska Utility Corridor (BLM)

- State of Alaska (owned and selected lands)
- Noatak National Preserve (NPS)
- Alaska National Petroleum Reserve
- Arctic Slope Regional Corporation
- Doyon Limited Regional Corporation
- Nunamiut Village Corporation
- Other Native-owned land
- Other Native-selected land

Primary wildland fire suppression efforts in all of these areas are the responsibility of the BLM - Alaska Fire Service.

Landownership patterns in and adjacent to NPS administered lands provide some challenges to managing natural processes across Gates of the Arctic. Management direction differs for various landowners/land management agencies across Alaska thus an interagency planning effort was conducted to develop mutually understood procedures for developing response plans for any given area across landowners/jurisdictional agency boundaries. These specific planning and response procedures are identified in the Alaska Interagency Fire Management Plan, 2010.

Figure 2: Land Ownership, Gates of the Arctic

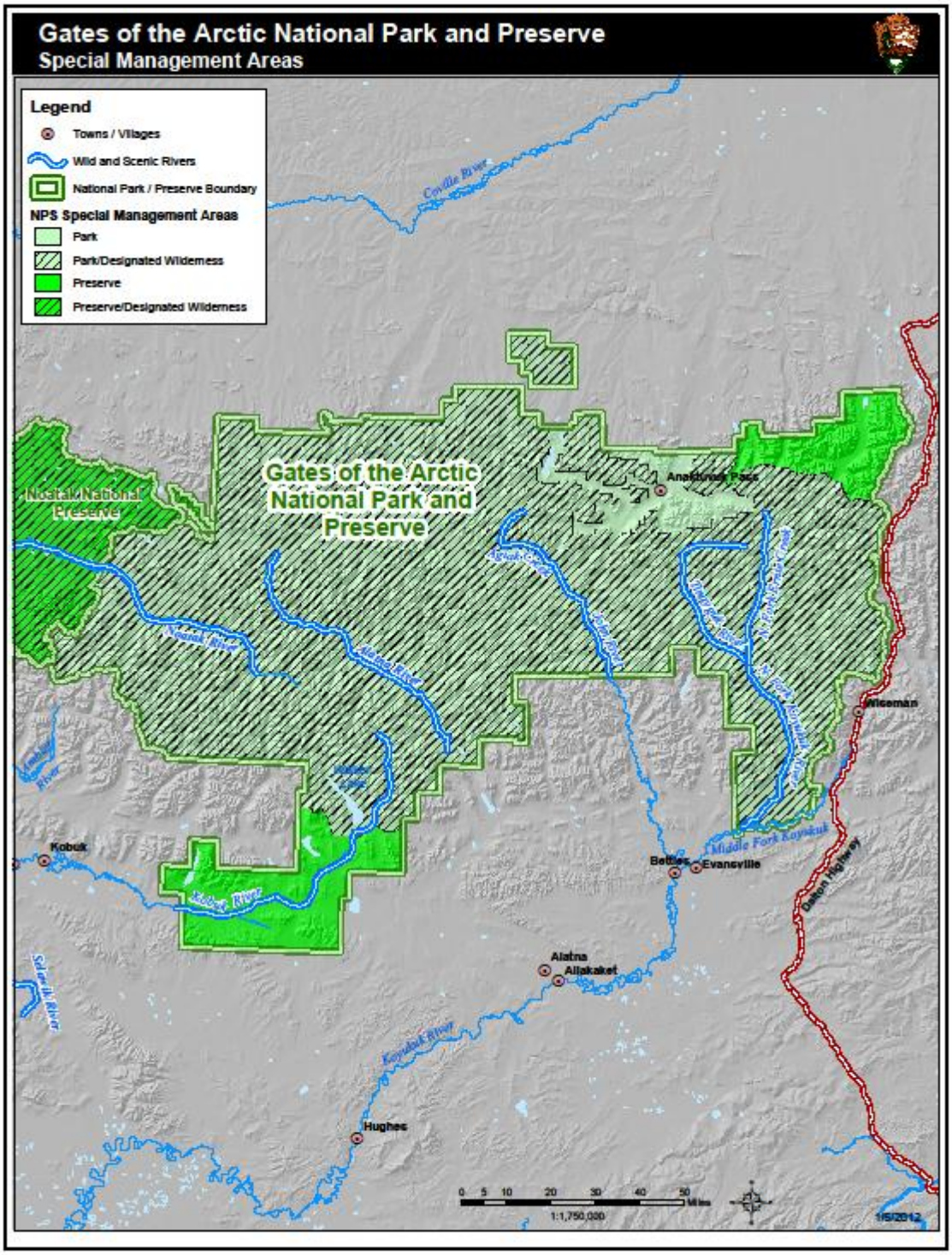


Wilderness - Gates of the Arctic National Park and Preserve encompasses 8,307,051. Within Gates 7,167,192 acres in designated wilderness. An additional 914,233 acres are currently listed as eligible wilderness. Approximately 97% of the Gates of the Arctic NPPr is designated or proposed wilderness. Therefore the vast majority fire management activities within its boundaries will conform to the basic principles of wilderness as described in Director's Order #41 and set for in ANILCA.

Wild and Scenic River - There are six rivers designated as Wild and Scenic with the Gates of the Arctic National Park and Preserve, these include: The North Fork of the Koyukuk River, The Tinayguk River, The John River, The Alatna River, The Kobuk River and The Noatak River. The North Fork of the Koyukuk flows from the south flank on the Arctic Divide through broad, glacially carved valleys in the rugged Endicott Mountains of the Central Brooks Range. The Tinayguk is the largest tributary of the North Fork of the Koyukuk. Both lie entirely within the pristine environment of Gates of the Arctic National Park. The John River flows south from Anaktuvuk Pass through Alaska's Brooks Range to the Koyukuk River just below Bettles Field/Evansville. The river runs through beautiful areas and a variety of ecosystems. Dedicated a wild and scenic river on December 2, 1980, the Alatna River drains the central Brooks Range. Wildlife, spectacular scenery and interesting geologic features abound along the river corridor. The Kobuk River flows from its headwaters in the Endicott Mountains and Walker Lake, through a broad valley. Located on the southernmost reaches of the Brooks Range, it passes through one of the largest continuous forested areas in the Park and Preserve. The Noatak River drains the largest mountain ringed river basin in America that is still virtually unaffected by human activities.

National Natural Landmarks - Two well established National Natural Landmarks exist in the GAAR. These include Walker Lake and Arrigetch Peaks. Walker Lake is a striking and scenic example of the geological and biological relationships of a mountain lake at the northern limit of forest growth. It is typical of the glacial lakes formed in rock basins or behind moraine dams along both flanks of the Brooks Range. There is representation of a full range of ecological communities from white spruce forest on the shores to the barren talus slopes 2000 feet above the lake. The Arrigetch Peaks have long been a landmark to the Nunamiut Eskimo people of northern Alaska. Carved by glacial ice and running water, the conspicuous granite pinnacles rise thousands of feet above the surrounding glacial valleys of tundra and boreal forest. The Arrigetch Peaks illustrate several phases of alpine glacier activities and reveal abrupt transitions from metamorphic to granitic rock.

Figure 3: Special Management Areas (Wilderness & Preserve Boundaries, and Wild River Designations)



Subsistence **-** ANILCA permits some uses that would not be permitted in most other NPS areas, particularly subsistence uses by local residents in the park and preserves. They provide residents with the opportunity to maintain a subsistence way of life as an integral part of a dynamic ecosystem. Thus special consideration should be given to these practices when considering appropriate fire management operations within the Park/Preserve.

Specific Park Unit Purpose Statement

"Subsistence uses by local residents shall be permitted in the park, where such uses are traditional, in accordance with the provisions of Title VIII." (ANILCA)

Sport Hunting **-** ANILCA permits some uses that would not be permitted in most other NPS areas, particularly sport hunting in the preserve.

1.2.2.2 Overview of physical and biotic characteristics of park

Gates of the Arctic NPPr consists of unaltered landscapes, vast populations of animals and plants in intact ecosystems, and archaeological sites that document an estimated 12,000 years of human activity. As with other NPS-managed lands in Alaska, Congress set aside Gates of the Arctic National Park for its preservation and enjoyment, short of the point of impairment. In addition to the designated National Park, ANILCA also specified two contiguous National Preserves: the Gates of the Arctic National Preserve Eastern Unit (the Itkillik River Preserve) and the Gates of the Arctic National Preserve Western Unit (the Kobuk River Preserve). The primary difference between the two National Preserves and the National Park is that sport hunting and trapping is allowed in the Preserves, but not within the Park. However, subsistence use (including hunting and trapping) is allowed in both the Park and Preserves. By providing subsistence privileges to resident zone communities and rural users, Gates of the Arctic National Park and Preserve provides Alaska residents with the opportunity to maintain a subsistence lifestyle as an integral part of a dynamic ecosystem.

Specific Park Purpose Statement

"The purpose of Gates of the Arctic National Park and Preserve is to: Preserve the vast, wild, undeveloped character and environmental integrity of Alaska's central Brooks Range and to provide opportunities for wilderness recreation and traditional subsistence uses."

Physical

Gates of the Arctic National Park and Preserve include two very general physical components; 1) a portion of the Central Brooks Range, and 2) both hilly and low terrain on the northern and southern edges of the Brooks Range. Permafrost is often continuous in lower elevation areas but higher elevations and steeper slopes may or may not contain permafrost by virtue of aspect (through summer insolation), grain size, drainage, and disturbance regime (Sanzone 2006).

Biotic

Vegetation

The most conspicuous feature of the vegetation in GAAR is treeline at the northern limit of the conifer forest. Also, western and northwestern Alaska has long been recognized as having the richest array of vascular plants of any region in the circumpolar north (Hultén 1968). Lichens and bryophytes are a conspicuous and ecologically important element in

Alaska's Arctic parks, including GAAR. Nonvascular plants are likely to represent 75 to 80% of ARCN's flora (Neitlich and Hasselbach 1998, Waggoner NPFlora 1989).

Table 1: Percent Area Cover of GAAR by Vegetation Classes
Table sorted by most common vegetation type for Gates of the Arctic National Park and Preserve. Data derived from NPS ARCN 2009 Ecotypes GIS Dataset.

Vegetation ARCN Map 2009	% GAAR
060: Dryas Dwarf Shrub	25.77%
010: Partially Vegetated	20.50%
110: Dwarf Birch-Ericaceous-Willow Low Shrub	12.52%
310: White Spruce Forest	9.60%
150: Alder or Willow Tall Shrub	6.62%
120: Dwarf Birch-Tussock Shrub	6.61%
999: Shadow/Indeterminate	4.77%
020: Sedge-Dryas Meadow	4.30%
070: Ericaceous Dwarf Shrub	2.80%
320: Black Spruce Forest	2.67%
400: Fresh Water	0.89%
210: Paper Birch Forest	0.61%
500: Snow	0.58%
230: Spruce-Paper Birch Forest	0.51%
130: Dwarf Birch-Willow Low Shrub	0.31%
140: Willow Low Shrub	0.31%
030: Sedge Wet Meadow	0.30%
040: Sedge Fen	0.14%
100: Ericaceous Shrub Bog	0.11%
220: White Spruce-Balsam Poplar Forest	0.05%
200: Balsam Poplar Forest	0.04%
300: White Spruce-Lichen Woodland*	0.00001%

An important caveat to the information presented in Table 1 is that the 2009 Ecotype Map from which the values were derived does not appear to represent the proportion of spruce forest cover in GAAR which is actually white spruce-lichen woodland. The ABR vegetation map indicates that only .001% of the total area of GAAR consists of white spruce-lichen woodland. The 1999 Landcover Map produced by Ducks Unlimited appears to do a more accurate job of representing the true proportion of spruce forest cover in GAAR which is actually spruce-lichen woodland; this map indicates that 1.00% of the total area of GAAR consists of spruce-lichen woodland. The distinction between black and white spruce forests and white spruce-lichen woodland is important since spruce lichen woodland forest is utilized by caribou that graze on lichen.

Mammals and Birds
Gates of the Arctic NPPr is one of five Park Units that comprise the Alaska Arctic Inventory and Monitoring Network (ARCN). The Inventory and Monitoring Program estimates ~42 species of terrestrial mammals within the boundaries of ARCN. The

species range in size from the tiny shrew (*Sorex yukonicus*) to brown bears (*Ursus arctos*) and moose (*Alces alces*). Most birds found in the ARCN are summer nesters or migrants, with only about a dozen species overwintering within the network. There is evidence supporting the presence of 177 bird species in ARCN, with individual parks containing between 114 and 132 species and as many as 12 to 26 species that have yet to be documented in one or more of the parks (NPSpecies 2004, Sanzone 2006).

Specific Park Purpose Statement
"The National Park Service will strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals as part of their ecosystems."

Sensitive Natural Resources
Due to the large size and difficulty of access to GAAR, knowledge of threatened, endangered, or candidate species is limited. A summary list of sensitive and potentially sensitive plant and animal is provided in Appendix C. One bird species, the Yellow-billed Loon, has been documented in GAAR and is currently under consideration for addition to the Federal register of Threatened or Endangered species. This species has been documented in a very limited number of locations within the park including the Southwestern Boot and the headwaters of the Alatna River. However, due to their mainly water-restricted habitat needs, fire and fire suppression activities have little potential to impact this species.

Additionally, several bird Species of Concern in Alaska (not listed or under consideration for Threatened or Endangered) have been documented in the park. Birds can be listed as Species of Concern because of; 1) population declines, 2) low population numbers, 3) loss of significant habitat and 4) lack of general biological information about the species. Species of Concern for the State of Alaska recorded to date in GAAR include: Harlequin Duck, Long-tailed Duck, Short-eared Owl, Bluethroat, Golden-crowned Sparrow, Gray-cheeked Thrush, Northern Shrike, Northern Wheatear, Rusty Blackbird, Smith's Longspur, and Yellow Wagtail.

Multiple botanical surveys have been conducted in GAAR. The park is considered rich in both landscape diversity and habitat. Although not listed as threatened or endangered, there are a number of plant species in Alaska that are ranked S1 (critically imperiled in the state), S2 (imperiled in the state) or S3 (vulnerable in the state) on the 2008 AKNHP Alaska Rare Plant List. Two species listed as critically imperiled in the state (S1) have been documented in GAAR; *Draba pauciflora* (G4S1) and *Festuca edlundiae* (G3G4S1). Both of these species occupy specific micro-sites in mostly rocky or sandy soils, gravel bars, scree slopes or rock outcrops. It is believed that in most years fire will not burn in these types of environments, thus fire poses little threat to the two species. However, exceptions to fire preclusion from these species' habitat could occur under very severe drought circumstances when fire behavior exceeds normal. Also documented in GAAR and listed on the Rare Plant List for the State of Alaska are an additional 9 species listed as S2 and sixteen species listed as S3.

It is worth noting that some areas and habitats in GAAR have not been thoroughly inventoried for plant species, and are considered worthy of further investigation. Ground disturbing suppression tactics pose a threat to fragile soil layers and to other ecosystem components. If these tactics are deemed necessary, the impact to sensitive natural resources will be mitigated through the use of minimum impact suppression tactics. Designated Incident Commanders and Agency Administrators will make every effort to

consult with appropriate resource advisors on the possible presence of any of these species and/or communities and appropriately adjust fire management strategy and tactics to minimize potential impacts. Further impacts and details on all the above species can be reviewed in the Environmental Assessment.

Specific Park Purpose Statement
"The overall objective for the management of cultural resources is to understand the long-term human use of the area, recognizing the importance of both physical remains and intangible associations in the story in the Gates of the Arctic Wilderness."

Cultural
GAAR contains over 1,500 archaeological sites that document an estimated 12,000 years of human activity. The variety of archaeological sites exemplified in GAAR range from 19th Century trapping and gold mining cabins to prehistoric tent rings, temporary campsites, and stone tool manufacturing sites.

National Register Eligible Sites
Two prehistoric properties are listed in the National Register of Historic Places. These are the Agiak Lake Caribou Hunting Cultural Landscape and the Itkillik Lake Archaeological District. The majority of the prehistoric sites in the park are surface sites that have the potential to be impacted by forest fires. Fifty-one historic properties have been determine eligible for listing in the National Register of Historic Places, and 12 are included in the park's LCS database (the LCS is a web based NRHP evaluated inventory of all historic resources in the units of the national park system having significance in which the NPS has legal interest). Protection status of these eligible cabins and sites are determined using the guidelines described above. As the condition of these sites change, their fire protection status will be reassessed.

In addition to the National Register of Historic Places, data on historic properties are maintained in a number of NPS lists and databases. These include, but are not limited to, the Archeological Site Management Information System (ASMIS), Cultural Landscapes Inventory (CLI), Cultural Sites Inventory (CSI), and List of Classified Structures (LCS). Protection status of eligible cabins and sites within these inventories and the National Register are determined using the guidelines described above. As the condition of these sites change, their fire protection status will be reassessed.

Undetermined National Register Status Sites
Most of these sites were visited in 2004 with the DOE's written in 2005 and signed in 2007. The most current list of sites and their status is in Appendix E. There are two updates for the list in Appendix E per Chris Allan, Historian, Gates of the Arctic National Park and Preserve/Yukon-Charley Rivers National Preserve. The Squaw Rapids Cabin (NORL-003B) and Upper Tinayguk Cabin (TINA-002) are undetermined. The Classen Cabin (WALK-003) is now ineligible.

Specific Park Purpose Statements
"Archeological research by others will be managed according to NPS management policies and applicable federal laws and regulations, which recognize archeological resources as irreplaceable resources that cannot be duplicated elsewhere."

Fire Protection/Maintenance/Restoration

The current GAAR Resource Management Plan (1994) comprises an action plan for the implementation of the goals outlined in the Park/Preserve's GMP. Resource oriented guidelines are given for the development of a fire management program for Gates of the Arctic National Park and Preserve.

With respect to fire management, the RMP identifies three especially relevant objectives: 1) to maintain the wild and undeveloped character of the Park/Preserve; 2) to maintain natural features, environmental integrity and the dynamics of natural processes operations within the park; and 3) to allow fire to fulfill its role as a natural process to the fullest extent possible while protecting human life, private property, and cultural and natural resources that warrant protection. Project statement GAAR-N108, contained within the RMP, specifies the development of an integrated fire management program. The main objective of the program is to incorporate the existing interagency suppression plan while also addressing park-specific suppression capabilities, including the possible use of wildland or prescribed fire for resource benefit and/or hazard fuels reduction. The integration of the interagency FMP with this park-specific Fire Management Plan will allow the continuation of a natural fire regime in GAAR.

The accomplishment of the three resource management objectives above will occasionally demand the prioritization of wildland fire management activities by the some GAAR staff. Large or complex wildland fire incidents may demand the involvement of many of the Park/Preserve personnel, in some cases for extended periods of time.

1.2.2.3 Role of fire in the park

Historic Role of Fire

An annual average of 4315 acres per year burns in GAAR and a total of roughly 626,525 acres have burned within and immediately around the park unit over the last 55 years. Climate, terrain, and vegetation strongly influence the occurrence and extent of fires in GAAR where both the boreal forest and tundra ecosystems are subject to periodic fires.

Table 2. Fire and lightning activity in GAAR.
Summary information is presented for; 1) fires that occurred only within the park boundary (designated "In Park") and 2) fires that have burned in the park, but were not limited to the area within the park boundary (designated "Affecting Park"). Most fire activity data is based on NPS fire records from 1950 - 2010 fires (Fire-NPS Alaska 2010, AKRO GIS permanent data set). Lightning strike data is from AICC ARCIMS web page (AICC 2011).

Statistic	GAAR
Number of Fires Affecting Park 1950-2010 (Fire-NPS Alaska 2010)	160
Number of Fires Started in Park 1950-2010 (Fire-NPS Alaska 2010)	147
Total Acres Burned - Affecting Park 1950-2010 (Fire-NPS Alaska 2010)	626,595
Total NPS Acres Burned 1956-2010 *	228703

Statistic	GAAR
Average Area Burned/Year Affecting Park (1956-2010)	11393
Average Area Burned/Year NPS acres in Parks* (1956-2010)	4315
Average Fire Size Affecting Park 1950-2010	3916
Fire Cycle (years)* - number of years estimated to burn entire park area (1956-2010)	1963
Average number of lightning strikes/year (1986-2010)	1727
Park Acreage	8,472,199

* Data based on acres from fire perimeter data set 1956-2010 clipped to park boundaries.

In Gates of the Arctic NPPr thunderstorm activity, accompanied by high temperatures and low precipitation, is common during June and July. This combination of weather factors is conducive to both fire starts and continued fire activity. It follows that the vast majority of fire starts and fire activity in this region occur in June and July (Figure 4).

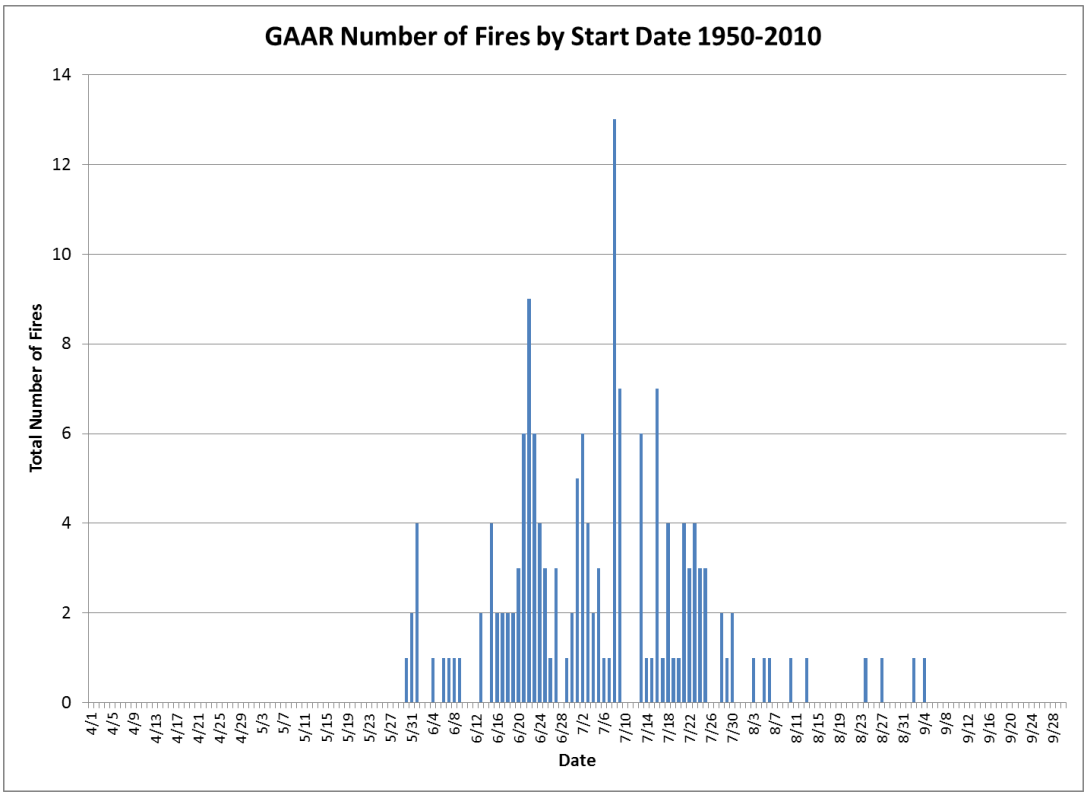


Figure 4: Number of fire starts per day summed across years (1950-2010) in GAAR. Data presented based on 2010 WFMI fire records.

The most frequent and largest fires on record have occurred in the forested portions of Gates of the Arctic; a large proportion of these are located in the Kobuk Preserve of GAAR (also referred to as the southwestern 'boot' of the park) (Fire History Map, Appendix S.2). The 'boot' is situated at the northernmost belt of interior Alaska, just

south of the Arctic Circle. The primary vegetation types in this area are black and white spruce forests; two of the more fire prone vegetation types in interior Alaska. Highly flammable spruce lichen woodlands and spruce feathermoss forest types are particularly common in the 'boot' area. Although fires are most frequent in the forested 'boot' of GAAR they also occur less frequently in alpine and lowland tundra (Fire History Map, AppendixS.2).

The southern foothills of the Brooks Range, including the Kobuk Preserve, have been continuously dominated by black spruce boreal forest for the last ~5000 years (Higuerra et al 2009). A recent study based on lake sediment core records from this area suggests a mean fire return interval of 145 years (range 130-160) (Higuerra et al 2009). The results from this study indicate that vegetation has been the primary control over fire return interval; exerting more influence over fire activity than climate. This result of vegetation exerting more influence on fire regime than climate is counter to what would have been predicted by the model ALFRESCO since the contemporary version of the model places more weight on climate controls than vegetation controls.

Brubaker et al (2009) used the model ALFRESCO to evaluate the relative roles of vegetation community and direct climate effect effects in controlling fire regime in the same study area as that evaluated by Higuerra et al (2009). They similarly found that vegetation, in particular the Mid-Holocene expansion of black spruce lead to altered landscape flammability, was the primary control over fire regime in this region although climatic conditions at the time were not conducive to high fire activity. In short, the ALFRESCO model would have predicted much less fire activity since the Mid-Holocene based on climate records than was actually empirically observed based on lake core records. Because of this disparity, ALFRESCO modelers are working to improve model realism by incorporating information from the mid-Holocene black spruce expansion into the ALFRESCO model.

Gates of the Arctic NPPr includes a substantial amount of altitudinal and latitudinal boreal forest to tundra transition zone, commonly referred to as treeline. In the park, and in the Brooks Range in general, highly flammable black spruce are largely absent from treeline communities, which are rather dominated by white spruce. This is a different pattern than is observed at treeline in Canada where black spruce is often the dominant species. Lloyd et al (2005) investigated the possible reasons for lack of black spruce dominance at treeline near GAAR. Their results suggest that interactions between climate and fire return interval limits black spruce dominance in treeline communities in the Central Brooks Range. They suggest that the prevalent cool and wet conditions in the region limit fire activity and therefore establishment of black spruce since this species depends to a large degree on fire activity for reproduction (Lloyd 2005). Furthermore, climate models suggest that even under significantly warmer conditions treeline expansion from south to north of the Brooks Range is unlikely precluding a temperature increase of 9 degrees C. Even with a drastic increase in temperature, treeline expansion to the north of the Brooks Range would likely require a 2000 year time lag (Rupp 2001).

Fires are infrequent in the northernmost two-thirds of GAAR due to the lack of fuels associated with the barren or sparse alpine tundra on the Brooks Range and the increased precipitation from the arctic coastal influence of the North Slope. Regardless of where they occur, fires can exert landscape-scale controls on vegetation structure and composition, permafrost dynamics, nutrient cycling, carbon loss/gain, primary productivity, and biodiversity (Racine et al 2004).

1.3 Environmental Compliance

The Fire Management Plan for Gates of the Arctic National Park and Preserve complies fully with these directives. An Environmental Assessment was completed for the GAAR Fire Management Plan in 2003with a FONSI in 2004 (Appendix D.3.a). An additional Programmatic Fire Hazardous Fuels Management Plan Environmental Assessment was completed in 2013.

The actions described within this plan also meet the requirements of the National Environmental Policy Act (NEPA), Section 106 of the National Historic Preservation Act (NHPA), Section 7 of the Endangered Species Act (ESA) and the Alaska National Interest Lands Conservation Act (ANILCA). Compliance with these acts will be demonstrated as follows:

- The GAAR Fire Management Plan will be accompanied by an Environmental Assessment a substantive discussion of the effects upon GAAR natural and cultural resources by several alternative actions, including the proposed course of action that is explained throughout the FMP.
- The Environmental Assessment, in turn, will be accompanied by an ANILCA 810(a) Summary Evaluation and Findings document (Appendix D.3.b), an assessment of the impacts of the proposed actions upon subsistence activities within GAAR.
- The Fire Management Plan, Environmental Assessment, and 810(a) Summary Evaluation and Findings will be submitted to National Park Service staff members at The Gates of the Arctic National Park and Preserve and to the Alaska Regional Support Office for review of operational soundness and compliance with federal policy.
- The Fire Management Plan, Environmental Assessment, and 810(a) Summary Evaluation and Findings will be submitted for review to local communities, local native corporations, and to all state and federal agencies holding or administering lands adjacent to or in the proximity of GAAR.
- The State Historic Preservation Officer (SHPO) will review the Fire Management Plan and Environmental Assessment; in addition the SHPO will review all individual prescribed fire burn plans prior to their approval by the Superintendent.
- Notice of availability of the FMP and accompanying Environmental Assessment and 810(a) Summary will be made locally, with public comments accepted by the NPS for a period of thirty days thereafter.

2.0 POLICY, LAND MANAGEMENT PLANNING & PARTNERSHIPS

2.1 Fire Policy

Federal Fire Policy

On May 2, 2008, the Wildland Fire Leadership Council issued a memorandum entitled *Modification of Federal Wildland Fire Policy Guidance.* This memorandum directed federal agencies to test and implement new guidelines for wildland fire management. The modifications are clearly described in the document and were field tested in a number of units in the 2008 fire season.

In 2009 the National Wildfire Coordinating Group (NWCG) issued a memorandum to the NWCG executive board (NWCG#001-2009, January 7, 2009) that;

1. Affirms the soundness of the *Review and Update of the 1995 Federal Wildland Fire Management Policy (January 2001),*
2. Reiterates the policy changes stated in the May 2, 2008 WFLC memorandum entitled *Modification of Federal Wildland Fire Policy Guidance*,
3. States that the Wildland Fire Decision Support System (WFDSS) will replace existing analysis and decision processes, and
4. Confirms that the *Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy (June 20, 2003)* will be replaced in 2009. This document, *Guidance for Implementation of Federal Wildland Fire Management Policy (February, 2009),* is that replacement.

The current policy clearly states that wildland fire analysis will carefully consider the long-term benefits in relation to risks both in the short and long term:

"Fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, and across agency boundaries. Response to wildland fire is based on ecological, social, and legal consequences of fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected dictate the appropriate management response to fire." (1995/2001 Federal Wildland Fire Management Policy)

NPS Policy

National Park Service *Management Policies 2006 section 4.5 gives guidance regarding wildland fire management in National Park administered lands. Detailed NPS guidance in particular to fire management can be obtained from* Reference Manual 18 (Note: RM-18 current version is 2014, plan was written based on RM-18 2008/2010) and Director's Orders 18 . The Management Policies 2006 also proclaim that Fire management or suppression activities conducted within wilderness, including the categories of designated, recommended, potential, proposed, and eligible areas, will be consistent with the "minimum requirement" concept identified in chapter 6 and Director's Orders #41: Wilderness Preservation and Management.

Reference Manual 18: Wildland Fire Management (RM-18) provides NPS field employees legal references, operating policies, standards, procedures, general information,

recommendations, and examples to assist them in carrying out Fire Management Policies and Director's Orders.

Director's Order # 18: Wildland Fire Management (DO-18) recognizes the need of the NPS to foster healthy and natural fire ecology within individual parks, through the development of fire management programs designed around resource management objectives. Tailoring the FMP to park resource management objectives while still following national guidelines is central to the development of individual fire management plans for each park unit. To this end, each unit of the NPS is directed to prepare a fire management plan that supports cultural and natural resource management objectives while emphasizing safety for park visitors, employees, and developed facilities.

Director's Order #41: Wilderness Stewardship (DO-41) states that all fire management activities conducted in Wilderness will conform to the basic purposes of wilderness and that ideally, "natural fire should be considered as a fundamental component of the wilderness environment." Emphasis is placed on the methods used to suppress all wildland fires should be those that minimize the impacts of the suppression action (MIST) and the fire itself, commensurate with effective control and the preservation of wilderness values. Additionally, Fire management plans must address the effects of fire management decisions on wilderness resources and character, air quality, smoke management, water quality, and other pertinent natural and cultural resource management objectives.

Alaska Policy

Alaska Wildland Fire Coordinating Group (AWFCG)

The mission of the Alaska Wildland Fire Coordinating Group, AWFCG, is to provide a forum that fosters cooperation, coordination, collaboration and communication for wildland fire management and related-activities in the State of Alaska. The AWFCG is the leadership focus for planning and implementing interagency fire management statewide. A comprehensive website contains all current AWFCG documents and educational materials through the Alaska Interagency Coordination Center (AICC).

Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement

The Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement, herein referred to as the Master Agreement, documents the commitment of all Parties (BIA, BLM, USFWS, NPS, USFS and the State of Alaska) involved and improves efficiency by facilitating coordination and exchange of personnel, equipment, supplies, services and funds among the parties to this agreement in sustaining wildland fire management activities. This includes prevention, preparedness, communication and education, fuels treatment and hazard mitigation, fire planning, response strategies, tactics and alternatives, suppression and post-fire rehabilitation and restoration.

Alaska Interagency Wildland Fire Management Plan

In Alaska, primary responsibility for wildland fire suppression is divided between the Alaska Department of Natural Resources (DNR), the US Forest Service (USFS), and the Bureau of Land Management Alaska Fire Service (BLM-AFS). The BLM-AFS carries the primary responsibility for suppression actions on lands within Gates of the Arctic National Park and Preserve. Although BLM-AFS has primary responsibility for suppression, 620 Departmental Manual 2.4 states that "nothing herein relieves agency administrators in the Interior bureaus of the management responsibility and accountability of activities occurring on their respective

lands." Section 2.4 goes on to state that "each bureau will continue to use its delegated authority for applications of wildland fire management activities such as planning, education, and prevention, use of prescribed fire, establishing emergency suppression strategies, and setting emergency suppression priorities for the wildland fire suppression organization on respective bureau lands."

The NPS, as well as the US Fish and Wildlife Service (USFWS), the Bureau of Indian Affairs (BIA), and Alaska Native regional corporations and villages participate in wildland fire management training and provide suppression resources during periods of increased fire activity in GAAR, Alaska and the contiguous United States. Although the use of NPS personnel for initial attack and structure protection is not common, qualified NPS personnel may provide initial attack if they are the closest resources or if no other initial attack resources are available.

In 1984, the NPS cooperated with the Alaska Department of Fish and Game (ADF&G), BLM, DNR, USFS, USFWS, BIA, and Regional and Village Native Corporations to produce an Interagency Fire Management Plan for the Kobuk Planning Area. This plan provided direction for fire management activity for GAAR until 1998, when a variety of documents, including 13 local planning area FMPs, were consolidated and approved as the Alaska Interagency Wildland Fire Management Plan (AIWFMP). Copies of these plans can be found at GAAR headquarters in Fairbanks, Alaska. Under the AIWFMP, fire protection needs are determined through annual land manager/owner reviews, at which time lands are placed under Critical, Full, Modified, or Limited protection categories, with categorization based on values to be protected, as well as the managing agency's resource management objectives, policies and mandates. These categories are discussed in detail in the AIWFMP.

Prior to 1980 the policy for fire in Alaska required the immediate suppression of all wildfires. This policy was costly, of questionable effectiveness, and had a negative effect on the diversity and productivity of the fire-dependent ecosystems in some regions of Alaska. In addition, during periods of high fire activity it was not possible to provide immediate or effective suppression on many fires because of the shortage of personnel, equipment, supplies or aircraft. It was soon recognized by all land agencies that an improved system was needed for establishing response priorities. Several progressions of fire management planning documents evolved over the years until finally, in 1998, the Alaska Interagency Wildland Fire Management Plan (AIWFMP) was signed into action as the official response plan.

In 2010, necessary updates were made to respond to public requests for more information regarding Alaskan fire management practices, clarify interagency guidelines, polices and operational directions for responses to wildland fires and to modernize terminology. "This plan affirms that fire firefighter and public safety is the first priority on all fire management activities for all agencies. It also reaffirms the concepts presented in the 1998 plan and previous Alaskan interagency fire planning efforts for a consistent, cost-effective, interagency approach to wildland fire management" (AIWFMP 2010). The updated 2010 AIWFMP is the interagency reference for wildfire operational information. It specifies direction for the response to a wildfire that is based on the management option designation and provides guidelines to Jurisdictional and protection agencies for decision support direction as the complexity of a wildfire increases.

This Fire Management Plan integrates the policies set forth in both DO-18 and the AIWFMP. Specifically, it is a detailed program of action to implement the fire management policies and objectives of the National Park Service. Additionally, this FMP will help to meet the

objectives set forth in the GAAR General Management Plan and the GAAR Resource Management Plan. These objectives include maintaining the wilderness character of GAAR, and allowing wildland fire to continue in its natural role within the Park/Preserve's ecosystem.

Multi-Agency Coordinating Group
The Alaska Multi-Agency Coordinating (MAC) Group provides a forum to discuss actions to be taken to ensure that an adequate number of resources are available to meet anticipated needs and to allocate those resources most efficiently during periods of shortage. The Alaska MAC Group forum ensures coordinated: - Incident prioritization - Resource allocation and acquisition - State and federal disaster response or coordination - Political interfaces - Information provided to media and agencies involved - Anticipation of future needs - Identification and resolution of issues common to all parties. The MAC group convenes on an "as needed" basis or when reaching Preparedness Level 4+.

2.2 Park/Resource Management Planning

General Management
The GAAR General Management Plan (GMP) was approved in 1986, and contains management actions intended to address potential issues and problems within GAAR. The overarching direction of the plan, following ANILCA, is to maintain the area as it was when established so that the significant wilderness quality of the Park/Preserve is not diminished.

Wildfire management is treated only cursorily in the GMP, which states "wildfire has been recognized as a natural phenomenon that must be permitted if natural systems are to be perpetuated" (GMP 1986:104). However, wildfire was also recognized as a threat to private property. Consequently, the National Park Service adopted a policy of limited fire suppression, in which only fires that threaten human life or property are to be suppressed to the degree necessary. This policy followed the interagency fire plan (see below), and complied with provisions in the Alaska Native Claims Settlement Act (ANCSA) that afford native lands wildland fire protection services from the United States. Additionally, the GMP allows the use of prescribed burns to protect property.

Specific GMP management objectives that relate to fire management include:

- Maintain natural features, environmental integrity, and the dynamics of natural processes operating within the park.
- Allow wildfire as a natural process while protecting private property, significant historic resources, water quality, and air quality.
- Maintain clean air and unimpaired view sheds.
- Protect significant cultural resources on park land with methods that are compatible with the wilderness purposes of the area.

Alaska National Interest Lands Conservation Act (ANILCA) - Often called the most significant land conservation measure in the history of our nation, the statute protected over 100 million acres of federal lands in Alaska, doubling the size of the nation's National Park and refuge system and tripling the amount of land designated as wilderness. With this acquisition also came a responsibility of preservation of various Alaskan ways of life, traditional use, natural processes, wildlife habitat, and unique natural character of vast undeveloped expanses.

In 1980 the passage of the Alaska National Interest Lands Conservation Act (ANILCA), added the GAAR to the NPS system in Alaska. Among the purposes for the establishment of the GAAR includes:

> "To maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural features; to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and other wilderness recreational activities, and to protect habitat for and the populations of, fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds." (ANILCA 201:4(a))

2.3 Partnerships

The National Park Service, Alaska Region, is a participant in all of the Interagency planning efforts that take place with regard to the management of wildland fire in Alaska. The AWFCG, the AIWFMP, Master Agreement and the interagency MAC group are all products of a cohesive interagency working group of which the NPS is cooperator. The effect of such interagency organizations is a professional, efficient and responsible way to manage fire over large landscapes.

3.0 PARK-WIDE & FIRE MANAGEMENT UNIT CHARCTERISTICS

3.1 Park-wide Fire Management Considerations

Under the AIWFMP, the NPS, other land management agencies, and private landowners are given the opportunity to evaluate their lands based on values to be protected and resource management objectives. Once fire protection needs are determined, the lands or properties are placed in Critical, Full, Modified, or Limited management option units. The fire management strategies selected varies from initial attack and sustained suppression efforts in the Critical and Full management areas to Surveillance in the limited management areas. Annual revalidation of these selections is required by the AIWFMP to ensure selected strategies remain consistent with changing values at risk and land management objectives.

Site designations were added as a management tool to the 2010 AIWFMP. Site designation provides the land manager the opportunity to acknowledge significance of a particular point within the landscape scale management option designation. Critical, Full, Avoid, and Non-sensitive were the categories created for assignment to these particular sites. Critical and full sites are afforded the same protection priority of their landscape scale counterparts. Avoid designation applies to sites where fire suppression activities should be avoided. At these sites the effects of suppression actions may likely be more detrimental than the effects of the naturally occurring fire. Non-sensitive sites are those acknowledged by the NPS; yet no protection, action, or consideration is warranted for the site.

The utilization and implementation of the AIWFMP management options in GAAR provides the most efficient use of resources throughout the state. Areas of critical concern are prioritized to receive resources first while simultaneously allowing fire to fulfill its natural role in large undeveloped regions. By using this management strategy the NPS succeeds at its dual mission to protect life, property and valuable resources while simultaneously allowing natural ecological process to complete their natural cycles.

Fire Management Units – Common Elements

In accordance with DO-18, the Park/Preserve has been sub-divided into four Fire Management Units (FMUs), each indexed to an appropriate AIWFMP category. Maps in Appendix S.2 show the general location of the FMU boundaries within the park as well as the AIWFMP protection categories for adjacent lands.

FMU Common Management Constraints and Guidance

Management Constraints

The majority of Gates of the Arctic National Park/Preserve is designated or suitable wilderness and sensitive resources that could be adversely affected by fire suppression activities exist throughout the Park/Preserve. Only the Agency Administrator or delegated official can approve deviation from the restrictions described below.

- Firefighter and public safety will be the number one concern in all fire management activities.

- Heavy equipment (including bulldozers) will not be used without the approval of the Superintendent (or delegate), except in life-threatening situations.

- Retardant will not be used without the approval of the Superintendent (or delegate), except when fire imminently threatens life or values to be protected. Any use of retardant will comply with standards identified in the Interagency Standard for Fire and Fire Aviation Operations (published annually). The use of water rather than retardant if preferable except under the most extreme circumstances. If used, retardant will not be applied within a 1 mile radius of waterways. Waterways are defined in the Interagency Redbook as "Any body of water including lakes, rivers, streams and ponds whether or not they contain aquatic life." As is specified in the 2010 AIWFMP, retardant use in Park/Preserve will only be used upon authorization of Agency Administrator or designee.

- Prior to the set-up of any remote extended fire camp in the Park/Preserve, fire managers will make every attempt to notify cultural resource staff. Fire staff will actively work with Cultural and Natural Resource staff to select an appropriate camp location. This consultation will ensure campsite locations are chosen in order to minimize impacts to resources at risk. The establishment of extended fire camps is essential and immediate responses to an emergency and/or immediate threat to life or property by wildland fire.

- Gates of the Arctic employees involved in fire management activities will make every effort to understand wilderness policy, identify sensitive over flight areas, and coordinate with the Agency Administrator, Chief of Operations or delegate prior to flying when fire incidents take place in GAAR.

- The GAAR fire staff will make every reasonable effort to communicate to the public and NPS employees ongoing fire management efforts, fire situation, and socio-political and economic impacts of any fire management activities conducted within this FMU

Special Concerns

- Gates of the Arctic fire staff involved in fire management activities in GAAR will make every effort to understand current sensitive issues in each of the four management areas. This includes but is not limited to; current political issues, subsistence seasons/areas; critical migration paths/timing, reindeer grazing allotment susceptibility, wilderness policy, private land issues and susceptible cultural resources. Park managers will reciprocate by providing timely and accurate information that will aid fire managers in determining appropriate responses to current fire situations without jeopardizing valuable park resources and park/community relations.

- The use of motorized equipment or mechanized transport that is generally prohibited by the Wilderness Act (helicopter landings, use of chainsaws, use of bulldozers, etc.) will not be permitted on lands that are designated as Wilderness or suitable for Wilderness prior to the preparation of a Minimum Requirement/Minimum Tool Analysis. Actions taken to suppress wildfires will use the minimum requirement concept, and will be conducted in such a way as to protect natural and cultural resources and to minimize the lasting impacts of the suppression actions.

Safety Considerations

Fire management unit boundaries have no effect on safety considerations in Gates of the Arctic National Park/Preserve and therefore will be discussed in Section 4.1 of this Plan.

Operational Information

Specific operational information can be obtained from the Alaska Statewide Annual Operating Plan, which is located in Exhibit C of the Master Cooperative Wildland Fire Management and Stafford Act Response Agreement. The Annual Operating Plan (AOP) will be updated annually to reflect changes in organizational structure, policy, and legal mandates as it relates to all interagency cooperators. The AIWFMP 2010 is the reigning response plan for all lands in Alaska regardless of ownership. FMU options are delineated and topics of intent, priority, objectives, operational guidance and general fire occurrence are defined and discussed.

Non-Federal Land Ownership

Certain lands contained within Gates of the Arctic National Park and Preserve were made available for selection under the Alaska Native Claims Settlement Act (1981), through the establishment of regional and village corporations and their designation of small tract allotments. The majority of the corporate lands and small-tract allotments that were selected within the boundaries of GAAR have been conveyed, providing fee title to the selecting entities. Most conveyed lands are located in the northern portion of the Park/Preserve, near Anaktuvuk Pass and the surrounding area. Other non-federal holdings within the Park/Preserve include small mining claims, state-owned submerged lands, and small private tracks.

Ownership of Adjacent Lands

Lands adjacent to GAAR fall under the following ownership/management categories:

- Trans-Alaska Utility Corridor (BLM)
- State of Alaska (owned and selected lands)
- Noatak National Preserve (NPS)
- Alaska National Petroleum Reserve
- Arctic Slope Regional Corporation
- Doyon Limited Regional Corporation
- Nunamiut Village Corporation
- Other Native-owned land
- Other Native-selected land

Primary suppression efforts in all of these areas are the responsibility of the BLM - Alaska Fire Service.

Historic Fire, Weather, Fire Season, Fuels and Fire Behavior

1. Historic Role of Fire in GAAR

Fires are infrequent in the northernmost two thirds of Gates of the Arctic Park and Preserve; largely due to the presence of the Brooks Range which is mostly covered by non-fire prone vegetation communities (e.g. alpine and subalpine tundra, and partially vegetated to barren scree slopes). However the southern third of GAAR lies within the

northernmost subarctic boreal forest zone of Interior Alaska, where fire has occurred much more frequently. Periodic fires in the boreal forests of Gates of the Arctic have shaped the ecosystem so that many plants and animals exhibit fire-adapted traits. For instance, white spruce colonizes mineral soil seedbeds after intense ground fires which remove organic soil layers and black spruce is partially dependent upon fire activity for sexual reproduction since seeds, which ripen at the peak of the Alaskan fire season. Aspen and birch trees also respond rapidly to fire; burned areas are often colonized by dense stands of these species which provide good habitat for some wildlife species.

Fires can have a landscape-level influence on vegetation structure and composition, permafrost dynamics, water quality, air quality, nutrient cycling, primary productivity for herbivores, and biodiversity. In the absence of fire in boreal forests, organic matter accumulates and insulates the ground, causing the permafrost table to rise. Fires usually remove portions of the accumulated organic layer which can warm the soils and increase the active layer (Van Cleve and Viereck 1981). These changes in soil temperature can influence nutrient availability (Smithwick et. al. 2005) and permafrost depths which can relate to ecosystem productivity (Van Cleve and Viereck 1981). Changes from fire regime cause nutrient cycling, trophic dynamics, and species regeneration that may be completely different from the original system (Johnstone and Chapin 2006).

In Alaska's boreal forest and tundra ecosystems, burn severity strongly impacts post-fire vegetation patterns and succession (Sorbel and Allen 2005). If burn severity is low or moderate, the aboveground plant materials may be singed or burned, but much of the vegetation will be able to regenerate quickly from roots and stems. However, severe fires burn deeper into the organic soils which may kill off the underground root structure of some shrubs and herbaceous plants. Therefore plant reproduction may be more dependent on seed establishment or deep rooted plants, which may slow or alter the successional changes after a fire (Bernhardt e al. 2011, Johnstone and Chapin 2006b, Sorbel and Allen 2005). Changes in vegetation due to fires, in turn, affect wildlife distribution and habitat use. Patchy fires create a mosaic of habitats frequently used by snowshoe hares and martens, while moose often browse on resprouting willow and other shrubs (Sorbel and Allen 2005). Small mammals such as voles often thrive in recently burned areas, creating large colonies in the remaining duff and feeding on new vegetation. In the winter, caribou often avoid recently burned areas for they lack sufficient amount of lichen for winter forage (Joly et al. 2010).

The known fire history (1956-2010) of GAAR is depicted in Figure 5. Fire activity ranges from non-existent in some years to substantial in others. No fire activity was detected in Gates of the Arctic during 33 of the past 53 years however during years such as 1959, 1969, and 1991 fire activity has been substantial. Therefore fire is currently a significant ecological process with the potential to impact large tracts of the park.

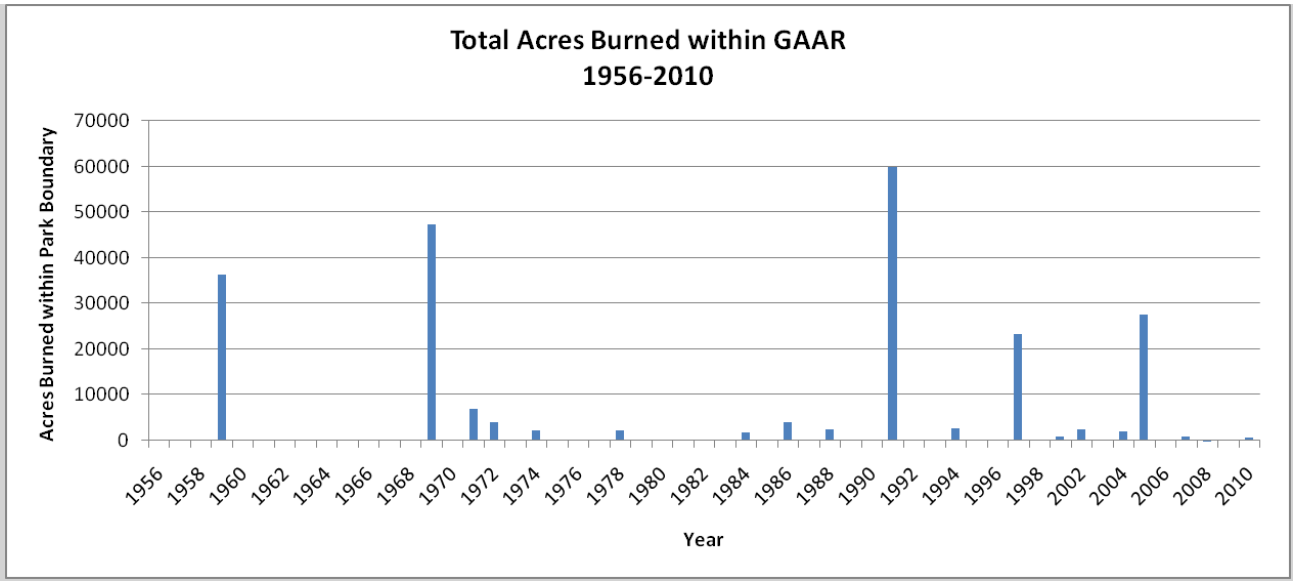


Figure 5: Acres burned per year in Gates of the Arctic National Park and Preserve between 1956-2010.
Data presented based on 2010 WFMI fire records.

2. Weather Analysis

Weather in Northern Alaska is characterized as extreme, and Gates of the Arctic National Park and Preserve is no exception. The Park/Preserve weather patterns are determined by the Brooks Range. The weather south of the Brooks Range below 2,500 feet in elevation mimics that of Interior Alaska. Precipitation is low, averaging 12-18 inches in the west and 8-12 inches in the east. Snow falls approximately nine months out of the year, averaging 60-80 inches. The average maximum and minimum July temperatures are 65 to 70° F and 42 to 47° F, respectively. Average maximum and minimum temperatures in January are 0 to –10° F and –20 to –30° F. Thunderstorm activity is common during June and July, with the period of most rain occurring between June and September. Prevailing winds are usually from the north.

In contrast, the north side of the Brooks Range has an arctic climate. The influences of the Arctic Ocean and North Slope weather patterns are more significant, especially during the summer months. Mean annual temperatures are colder than on the south side. Average maximum and minimum February temperatures are –5 to –10° F. July is the warmest month, with 55 to 65° F the maximum and 35 to 45° F the minimum. Precipitation is extremely low, averaging 5-10 inches annually, resulting in arctic desert conditions. Snow has been recorded in every month of the year, and the annual average snowfall is 35-50 inches. Prevailing winds occur from the east during the summer and the west in winter, but are greatly modified by local terrain.

The NPS, FWS, and BLM maintain Remote Automated Weather Stations (RAWS) at various sites near the southern boundary of GAAR, including Bettles (PABT), Ambler (PAFM), Hogatza River (HOG), Kanuti NWR (KAN), and Norutak Lake (NRU). Data from all RAWS sites are available on the Internet through the Alaska Fire Service homepage (go to **fire.ak.blm.gov**; next click **weather**, then **AFS Fire Weather Database**). Information collected from the RAWS sites contributes to interagency efforts

to monitor weather and generate fire weather indices. All RAWS records are archived at the Eastern Region Climatological Center.

The NPS Arctic Network Inventory and Monitoring Program (ARCN) have installed four climate monitoring stations in GAAR. The stations provide critical data on high elevation sites in the park that will help characterize the climate gradients and patterns of the central Brooks Range. The objective of the ARCN climate monitoring program is to monitor and record weather conditions at representative locations in order to identify long and short-term trends, provide reliable climate data to other researchers, and to participate in large-scale climate monitoring and modeling efforts beyond park boundaries. The sites are named after nearby geographic land marks: Chimney Lake (3,700 ft.) in the eastern area of the park; Pamichtuk Lake (3,135 ft.) in the central region of the park; Ram Creek (4,100 ft.) a tributary of the Alatna drainage; and Killik Pass (4,360 ft.) in the northwest area of the park. These new NPS sites complement existing RAWS and National Weather Service stations along the Koyukuk and Kobuk Rivers.

3. Fire Season

The seasonal fire cycle in the Alaskan interior consists of four micro-seasons or phases, each varying with the changing weather pattern and the stage of vegetation development for the growing season.

The first begins in late May with the loss of snow cover and ends in early June when green-up (the budding of trees and shrubs) begins. During the transition from 100% winter-cured fuels to green-up, human-caused fires may occur; these fires are usually relatively easy to suppress due to high relative humidity recovery at night, cool day and night temperatures, and typical close proximity to roads, airstrips, and/or navigable water. Spring fires that are not suppressed, however, often grow later in the season as fuels become dryer.

The second and third fire-cycle phases are primarily lightning driven. Suppression of such fires is harder, because of their occurrence in remote areas where detection and access are more difficult and because more time typically passes between detection and initial attack. Fires occurring in June, the second period, usually do not develop the intensity of later summer fires. However, during hot, dry, and windy conditions, June wildland ignitions can result in extreme fire behavior.

The third period of fire activity begins in mid-July and runs through the first part of August. This is the period of maximum fire activity. The usual problems of accessibility and detection are compounded by increased rates of spread and higher fire intensities due to lower fuel moisture levels. Even with prompt initial attack, fires are often beyond immediate control by the time firefighting forces arrive, and indirect attack is often the only viable suppression strategy.

The final micro-season occurs from mid-August into early September. Ignitions during this period are usually caused by hunters and fishermen. These fires are generally easy to control, except during particularly dry autumn weather.

4. Fuel Characteristics and Fire Behavior

Fire behavior is essentially a function of fuel type, fuel loading, fuel moisture content, topography, and local weather conditions. GAAR exhibits four major fire behavior systems of vegetation that can be described under three vegetation types: grass/tundra, mixed woods, and conifers. Two separate systems occur in conifer, spruce-lichen woodland and boreal spruce. The four systems are described below.

a. Dwarf and Low Shrub Tundra

Continuous graminoid cover with or without low ericaceous shrubs, occasional trees or tall shrubs occur but do not appreciably affect fire behavior characterizes this fuel type. Four subtypes are found in this system: matted grass, common after snowmelt in the spring; standing dead grass, common in late summer to early fall; tussock/tundra and shrub tundra. The live to dead ratio and wind speed in grasslands has a pronounced effect on fire spread.

Matted/Standing Dead Grass: Fire behavior in these two grass subtypes is relatively easy to suppress. These fuel type burns during the spring and fall. The burning period is shorter due to less solar radiation and high humidity recovery at night; a condition referred to as diurnal effect. The rate of spread can be high in this fuel type but there is limited smoldering and mop-up (post-suppression maintenance accomplished to ensure that all ground fire is extinguished) is relatively easy.

Tussock Tundra: Fire behavior in the tussock/tundra type is substantially different than other grass models. Tussocks form an extensive layer of dead leaves at the base of the plant creating grassy knobs. The dense thatches of dead leaves that make up the tussock mound are small in diameter and loosely compacted. The fuel wets and dries very rapidly, burns quickly, and, because there is typically a substantial amount of fuel, the fires can be remarkably intense when burning under dry, windy conditions. This fuel situation presents a set of control problems unique to the fuel type, as extinguishing can be extremely difficult due to thick mats of dry mosses, lichens and other organic matter. Travel on the ground is also difficult in tussock tundra. Elevations above 3,000 feet form effective barriers to fire spread since they generally do not support enough vegetation to carry fire.

Birch/Ericaceous Shrub Tundra: Dwarf birch and ericaceous genera comprise this fuel type. These shrub species grow in mosaic like patterns with all varieties of tundra communities. The shrub layer forms a continuous fuel bed that often burns early to mid-summer with green leaves intact unlike the pure deciduous forest fuel type below. Dwarf birch particularly has an elevated resin content that leads to an increase in fire behavior intensity. Although common throughout Alaska, this fuel type is not clearly defined nor its fire behavior well-documented in literature currently available.

b. Shrublands

Tall Shrub

Alder/Willow Shrublands: This fuel type is represented by pure stands of deciduous shrub of alder and willow, but also includes deciduous forest types of balsam poplar, aspen or paper birch. Stages in leaf development (leafless, green-up, leaf fall) drastically effect fire behavior and fuels present in this system. Fires in this type usually occur in spring before leaf-out or in fall after leaves have fallen. During this time, leaf litter is the primary carrier of the fire and usually results in low to moderate

fire intensities except under the most severe weather conditions. Fires can burn in this fuel type post green-up (leaf-on) but fire behavior is greatly reduced due to shading of fuel by the canopy cover thus increasing relative humidity and decreasing fuel temperatures. Fires that do occur during the leaf-on stage carry in grasses, dry herbaceous, and various understory shrubs.

c. Deciduous Forest

Pure Deciduous Forest: This fuel type is represented by pure stands of deciduous forest species including but not limited to alder, willow, aspen and birch. Stages in leaf development (leafless, green-up, leaf fall) drastically effect fire behavior and fuels present in this system. Fires in this type usually occur in spring before leaf-out or in fall after leaves have fallen. During this time, leaf litter is the primary carrier of the fire and usually results in low to moderate fire intensities except under the most severe weather conditions. Fires can burn in this fuel type post green-up (leaf-on) but fire behavior is greatly reduced due to shading of fuel by the forest canopy thus increasing relative humidity, decreasing fuel temperatures and reducing surface wind speeds. Fires that do occur during the leaf-on stage carry in grasses, dry herbaceous, and various understory shrubs.

d. Needleleaf Forest

Spruce-Lichen Woodland

This fuel type is characterized by open, white spruce. Stands occupy well-drained upland sites. Forest cover occurs as widely spaced individuals and dense clumps. Tree heights vary considerably, but bole branches that emanate from the trunk of the tree (both live and dead) uniformly extend to the forest floor and layer development is extensive. Woody surface fuel accumulation is usually very light and scattered, and shrub cover is exceedingly sparse. The ground surface is fully exposed to the sun and commonly covered by a nearly continuous mat of reindeer lichens, averaging 3-4 cm in depth.

The spruce-lichen woodland fuel type may support a high rate of spread, but may or may not support a continuous crown fire. Mop-up may be difficult if the organic mat is deep and dry. For the most part, fires occurring in this fuel type are relatively easy to control because they are primarily surface fires, which can be extinguished by firefighters on the ground.

Boreal Spruce

This fuel type is characterized by pure, moderately well stocked black spruce stands on poorly drained sites. Tree crowns occur near the ground and dead branches are typically draped with bearded lichens. The flaky nature of the bark on the lower portion of the trunk is pronounced. Low to moderate volumes of woody material is present on the ground. Labrador tea is often the major shrub component, and a carpet of feather mosses and/or ground-dwelling lichens dominates the forest floor. Sphagnum mosses may occasionally be present. A compacted organic layer commonly exceeds a depth of 20-30 cm below ground surface.

Stand replacement and crown fires dominate the fire behavior of this fuel type. A crown fire may commence when the fire reaches a rate of spread of 10 chains (660 feet) per hour or flame height over 1 ft. Typically crowning occurs just behind the flaming front. Independent crown fires are rare. It is also common to have spotting by aerial firebrands in a crowning spruce fire. Wind is the crucial factor, with spotting

frequently occurring between ½ to two miles ahead of the fire. The carrier fuel consists of the organic mat, which has a tremendous surface-to-volume ratio with immediate responses to changes in relative humidity, solar radiation, and wind. Rate of spread is relatively slow and predictable, while intensity is high in surface fuels. Mop-up may be difficult if the organic mat is dry.

Mixed forests

Aspen, willow, cottonwood, birch, black and white spruce characterize the mixed forests fuel type. On any specific site, individual species can be present or absent from the mixture, however spruce must be present in order for the fuel to fall into this classification. Stand mixtures exhibit wide variability in age and stand structure. Two phases associated with the seasonal variation in the flammability of the hardwoods are recognized—the leafless stage occurring during the spring and fall, and the green stage during summer. Rate of spread in both fuel types is weighted according to the proportion of softwood and hardwood components. In areas where the proportion of hardwoods is greater than softwoods and when the deciduous overstory and understory are in leaf, fire spread is greatly reduced with maximum spread rates only 1/5 that of spring or fall fires under similar burning conditions. During spring and fall when the deciduous overstory and understory are leafless, the leaf litter can burn similar to the grass models because the diurnal effect shortens the burning period and there is little smoldering. In areas where the proportion of softwoods is greater than hardwoods, the dryness of the organic mat will dictate the difficulty of extinguishing fire. The rate of spread will be relatively slow in these areas unless there is a very large grass component and conditions are extremely dry.

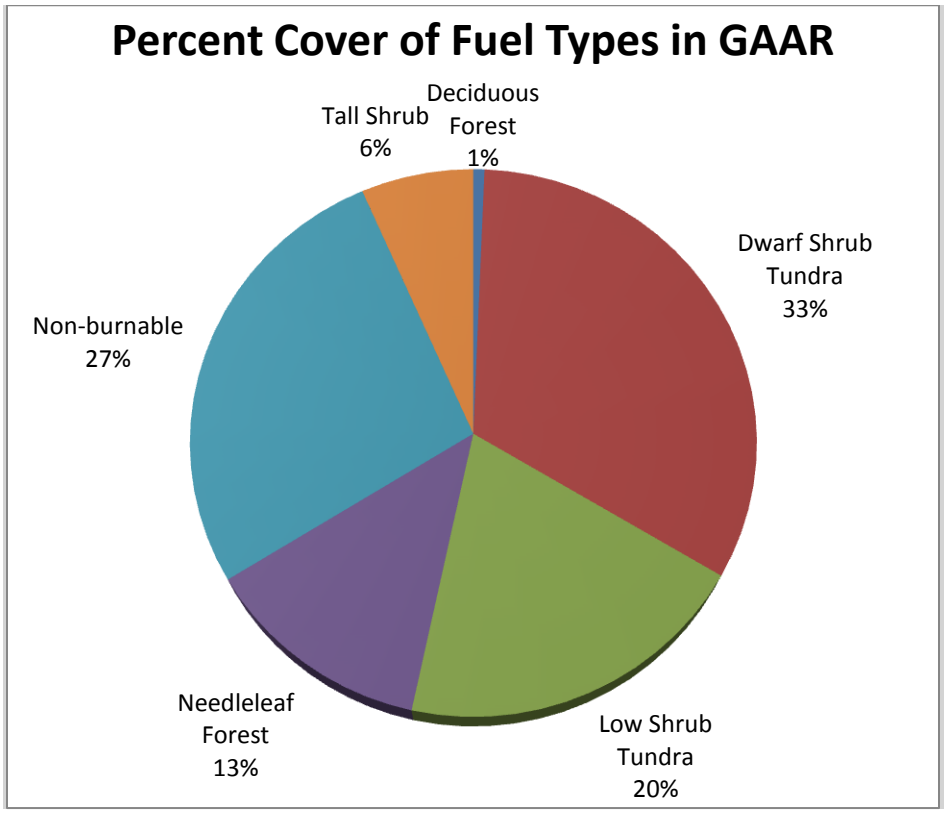


Figure 6: Generalized landcover for Gates of the Arctic National Park and Preserve.

The proportion of different fuels types within GAAR is summarized in Figure 6. The values presented are based on a compilation of the vegetation classes (NPS ARCN 2009 Landcover Map) presented in Table 1 into broader fuels types; Deciduous Forest, Dwarf Shrub Tundra, Low Shrub Tundra, Needleleaf Forest, Non-burnable and Tall Shrub communities. Deciduous forest includes paper birch and balsam poplar forests. Dwarf shrub tundra includes dwarf shrub and Dryas dominated vegetation communities. Low shrub tundra includes low ericaceous shrub, dwarf birch and mixed low shrub and tussock communities. Needleleaf forest is both pure spruce dominated forests and mixed stands of spruce and deciduous trees. Willow or alder dominated shrublands. Non-burnable areas are water, vegetated areas with significant standing water, snow, barren, or partially vegetated areas. Tall shrub communities are dominated by either alder or tall willow species.

5. Historical Alterations of Fuel Regimes

Organized suppression has occurred in Alaska since 1939, when the Alaska Fire Control Service (predecessor to the AFS) was established. The effects of this activity are not clear, however, the reduction of total fire acreage has been unmistakable in some areas. For example, a study of the Tanana/Minchumina Planning Area has shown that annual burned acreage hovered around 900,000 acres between 1957 and 1981, down from the estimated 1.5 to 2.5 million acres prior to 1940. It is worth noting however that the Tanana/Minchumina Planning Area received greater fire suppression emphasis than the area encompassed by GAAR.

The impact of aggressive suppression in interior Alaska and GAAR is difficult to assess but for the most part, wildfires have been allowed to burn with little suppression activity in GAAR. Few records of actual fire suppression in the park exist. Therefore, any large-scale alterations to fuel regime in GAAR as a result of fire activity is most likely a natural part of this ecosystem. Minimal alterations, such as resource use by humans, have occurred on a very small scale throughout the area.

To date, detection of fires in interior Alaska is difficult, especially during periods of high fire activity and associated smoke obscuration. However, Alaska fire management personnel postulate that the fire ecology of Gates of the Arctic has remained relatively unchanged from what it was prior to the development of organized suppression efforts. This belief is based on the observation that large fires have occurred throughout the known fire history of the area. Furthermore, the span of time during which suppression activity might have been taken in GAAR is less than the predicted fire return interval in the region.

Control Problems

Control and suppression problems are dependent on fuel type, fuel loading, weather, and time of year. Alaska has four distinct periods of fire activity with different control and suppression problems associated with each.

1. Spring Green-up

Ignitions during spring green-up are usually wind-driven, surface fires that are relatively easy to control and extinguish. High winds can cause high rates of spread and control may be more difficult. These fires are mostly limited to fine fuels (i.e. grass) that are

directly exposed to solar radiation, humidity, wind, and precipitation. This period is typically from early to mid-June.

2. Transitional
Ignitions that occur during the transitional time are typically more difficult to control, as hand-constructed firebreaks are less effective. Water under pressure from fire pumps with hose lays and aerial support, such as a medium helicopter and bucket, may be required for effective action at the fire's head. This period is typically mid-June to early July.

3. Cumulative Drought
Initial ignitions during the time of cumulative drought, as well as carryover fires from the previous period, are the most difficult types to control and extinguish, and may require indirect attack, aerial back firing, and/or the use of natural barriers. Direct attack is rarely possible because of the fire's intensity, and should only be attempted with the utmost caution. Suppression actions must be restricted to the flanks and back of the fire. Indirect attack in the form of aerial ignition, if available, may be effective depending on the fire's forward rate of spread. Fire extinguishing may be particularly difficult in the conifers and mixed forests due to the deep, dry organic matte present. This period is typically from early July to early August.

4. Diurnal Effect
This period is typically from early to late August when the days become shorter. Ignitions during this period of diurnal effect are easier to suppress because the reduced amount of daylight allows for the relative humidity to recover, resulting in increased moisture content in fuels. These fires are limited to fine fuels, such as grass, that are directly exposed to the drying effects of solar radiation. Smoldering and creeping fires from the previous periods may still be evident.

3.1.1 Fire Management Goals and Objectives

AIWFMP (State and Park-Wide Fire Management Options/Units)
Goals and objectives differ depending on the fire management option selected for each management area. Goals and Objectives in the AIWFMP are both broadly defined solely because all agencies across the State of Alaska needed to find common ground from which to operate. These goals, listed below are taken directly from the 2010 AIWFMP and provide a basis for which the protecting agency can operate.

Goals
- Emphasizing firefighter and public safety as the single, overriding priority.
- Defining criteria for prioritizing the allocation of resources in response to a wildland fire.
- Using ecologically, operationally and fiscally sound principles.
- Integrating fire management, mission objectives, land use, and natural resource goals.
- Maintaining a flexibility that allows agencies to adhere to their policies and respond to changes in objectives, fire conditions, land use patterns, resource information and technologies.
- Promoting cooperation, collaboration and partnerships for fire management between federal, state, and local governments, Alaska Native groups and other organizations

Objectives

- Protect human life.
- Prioritize areas for protection actions and allocation of available firefighting resources without compromising firefighter safety.
- Use a full range of fire management activities to achieve ecosystem sustainability including its interrelated ecological, economic, and social components. (fire suppression, monitoring, prescribed fire, thinning and other vegetation treatment projects, prevention and education programs, scientific studies, etc.)
- Use wildland fire to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, enable fire to function in its ecological role and maintain the natural fire regime.
- Manage vegetation through various fuels treatment techniques to reduce and mitigate risks of damage from wildland fire.
- Balance the cost of suppression actions against the value of the resource warranting protection and consider firefighter and public safety, benefits, and resource objectives.
- Consider short and long-term cost effectiveness and efficiencies while maintaining responsiveness to jurisdictional agency objectives and within the scope of existing legal mandates, policies and regulations.
- Minimize adverse environmental impact of fire suppression activities.
- Maintain each jurisdictional agency's responsibility and authority for the selection and annual review of fire management options for the lands that they administer.
- Adhere to state and federal laws and regulations

NPS –Gates of the Arctic National Park and Preserve –Goals

Whenever safely possible, Gates of the Arctic National Park and Preserve will utilize the role of fire in the natural environment in the fulfillment of NPS natural resource management directives. Accordingly, the Park/Preserve will direct all fire management activities toward the accomplishment of the following goals:

- The protection of human life, property, and irreplaceable natural and cultural resources.
- The preservation of fire in its natural role and as a natural process to the fullest extent possible.
- The maintenance of dynamic natural processes occurring within the Park/Preserve.
- The use of selected wildland fires for the accomplishment of resource management objectives and for the reduction of hazardous fuels.
- The minimization of adverse effects of fire and/or fire suppression activities.
- The coordination and scientific management of wildland fire on the basis of the best natural resource management program goals and objectives.
- The education of employees and public about the scope and effect of wildland fire management.

- The management of wildland fire incidents in accordance with accepted interagency standards and the achievement of maximum efficiency through interagency coordination and cooperation.

- The development of on-site protection capabilities at the Park/Preserve through the training of GAAR personnel and acquisition of wildland firefighting equipment.

- The provision of fire situation, fire behavior and fire effects information to the Park/Preserve Superintendent and to appropriate Alaska Fire Service personnel.

Objectives

Wildfire

- Maintain natural features, environmental integrity, and the dynamics of natural processes operating within the park.
- Allow wildfire as a natural process while protecting private property, significant historic resources, water quality, and air quality.
- Maintain clean air and unimpaired viewsheds.
- Protect significant cultural resources on park land with methods that are compatible with the wilderness purposes of the area.
- Maintain Condition Class 1 within GAAR.

Fuels Management

- Maintain Condition Class 1 within GAAR to protect structures and private property at risk.
- Provide cost-effective maintenance of fuel loads within the natural range of variation for the fire regimes.

In managing and restoring the ecological benefits of fire on the landscape, managers must understand the differences between current conditions and desired conditions. Managers must also understand the practices and environmental factors that contributed to the current conditions. Information used to develop the desired conditions includes research data (where available), historic photos and written documents, and expert opinion. Desired conditions must be periodically evaluated to determine whether they are still realistic and wanted in light of a changing environment. It is important to recognize that further work is needed at GAAR to better understand the interrelationships within natural systems.

Desired Conditions/Goals

In managing and restoring the ecological benefits of fire on the landscape, managers must understand the differences between current conditions and desired conditions. Managers must also understand the practices and environmental factors that contributed to the current conditions. Information used to develop the desired conditions includes research data (where available), historic photos and written documents, and expert opinion. Desired conditions must be periodically evaluated to determine whether they are still realistic and wanted in light of a changing environment. For example, desired conditions may be based on our knowledge of past long-term climate conditions; however, future climate changes may preclude achieving these targets.

It is important to recognize that further work is needed in GAAR to better understand the interrelationships within natural systems. As this occurs, we may be able to refine these desired conditions – as part of adaptive management. This could be accomplished at the landscaped or vegetation community scale and could be useful in developing ecological models and refining ecosystem priorities. Currently no Desired Conditions are developed for GAAR. The following interim fire and vegetation Desired Conditions are provided here as suggestions for GAAR:

- Fire processes in fire dependent/adapted vegetation communities will be managed to promote healthy and functional ecosystems. Vegetation succession reflects the natural range of variability under conditions that would occur under historical fire regimes.
- The number of acres burned per year is within the range of natural variability (1950-2013).
- The number of natural fire starts per year is within the range of natural variability (1950-2013).
- Total duration (days) of fire incidents annually are within the range of natural variability (1950-2013). The count of days from the first fire discovered to the final fire declared out date.

- Wildfire is recognized as a natural process, wildfires continue to occur in the park with minimal amount of suppression action. Natural fire regimes are maintained or restored.
- Fires are suppressed only if they pose a threat to human lives or private property, or that will enter another suppression zone. The level of fire suppression is determined by the interagency fire management plan, GAAR Fire Management Plan, and Agency Administrator.
- All wildland fires are effectively managed, considering resource values to be protected and firefighter and public safety, using the full range of strategic and tactical operations as described in an approved fire management plan.
- The best available technology and scientific information are used to manage fire within the park, to conduct routine monitoring to determine if objectives are met, and to evaluate and improve the fire management program.
- Fire processes in fire dependent/adapted vegetation communities are managed to promote healthy, functional ecosystems. Vegetation succession reflects the natural range of variability.

3.1.2 Wildland Fire Management Actions

Following March 31, 2010 the new guidance for the Implementation of Federal Wildland Fire Policy is in effect for future fire seasons. Decision support processes and analysis that help determine and document decisions regarding the management of individual ignitions will follow national direction. The policy for the National Park Service is to use the Wildland Fire Decision Support System (WFDSS) and analysis tools such as FARSITE, FlamMap, and FSPro.

Further regional guidance is located in the 2010 Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement and the 2010 Alaska Statewide Annual Operating Plan.

The fire management program at Gates of the Arctic National Park and Preserve complies with the policies resulting from the Federal Wildland Fire Management Policy Review of 1995, as well as those established by the Alaska Interagency Wildland Fire Management Plan. All human-caused fires will receive a suppression response using the appropriate operational suppression response delineated in the AIWFMP and based on the values at risk.

Allowing for use of varied management applications regarding wildland fire and its associated fuels will provide managers with every opportunity to obtain desirable results post treatment. Regarding unplanned ignitions, the practice of allowing fires to burn within predetermined areas will be both emphasized and heavily utilized in GAAR, particularly in the Limited Fire Management Option lands as directed in the GMP and DO 41. This management practice will also be considered in the other management options on a case by case basis at the discretion of the Agency Administrator (see the Alaska Statewide Annual Operating Plan for updated direction).

Planned fuel treatment projects will take a less significant role by utilizing both mechanical and prescribed fire, often in tandem to protect valuable park resources. These tools can be implemented to provide increased protection to park resources regardless of the fire management option selection surrounding the resource. Additional prescribed fires may be utilized in the context of the objectives set within their respective General Management Plans. Suppression actions will be used as a tool predominantly where Critical and Full management options prevail as directed and agreed upon in the 2010 AIWFMP and where appropriate to protect sensitive resources in the Limited management option.

No matter the tools selected to manage wildland fire and protect park resources, continual evaluation will be implemented to ensure fire and resource management goals and objectives are being met and wilderness values upheld. Monitoring and research findings will be reviewed and incorporated into future management decisions as outlined in Section 5.0 Adaptive Management Strategy as well as RM-18, Chapter 7-Fuels Management.

Fire Management Units

According to the AIWFMP, each FMU has specific, predetermined management strategies (or combinations thereof) that consist of the various management options described below (Table 3). For example, wildfire with resource benefit objectives will be the pre-planned response for ignitions detected within the GAAR Limited Protection FMU and in the Modified Protection FMU after the conversion date. These management strategies are summarized by FMU in Table 4.

Table 3: DO-18 Fire Management Strategies

Management Option	Intent	Policy
Prescribed Fire Prescribed Fire Plan → management-implemented ignition	• Ecosystem sustainability • Achieve Resource Management goals and objectives	• May only be implemented within FMUs designated for such use. • Context and circumstances of

Wildfire (Use of Wildland Fire) Natural ignition → managed based on resource management objectives	• Long-term protection of life, property, and/or fire sensitive resources. • Restoration of historic conditions. • Cost effectiveness.	the fire dictate the appropriate response, based on the approved FMP. • Management strategy or prescribed fire plan should be based on resource management objectives.
Wildfire(Suppression) **Any ignition where there are no alternative appropriate responses→ suppression response**	• Immediate protection of life, property, and/or fire-sensitive resources. • Cost effectiveness.	• Suppression actions triggered automatically in certain FMUs. • Agency Administrator may select suppression actions in any FMU. • Context and circumstances of the fire dictate the appropriate response, based on the approved FMP • Suppression actions should comply with resource management objectives whenever possible. • Minimum Impact Suppression Tactics (MIST) will be used

Table 4: AIWFMP Management Options

PROTECTION CATEGORY	POLICY/RESPONSE	INTENT
CRITICAL	• Aggressive suppression of fires within or threatening designated areas. • Highest priority for available resources.	• Prioritization of suppression actions for wildland fires threatening human life, inhabited property, and/or other designated structures. • Complete protection of designated sites
FULL	• Aggressive suppression of fires within or threatening designated areas, depending upon availability of resources.	• Protection of uninhabited cultural and historical sites, private property, and high-value natural resources.
MODIFIED	• Fires in designated areas receive initial attack depending on availability of resources, unless land manager chooses otherwise and documents with WFDSS. • After designated **conversion date**, operational response to Modified protection zones is identical to that of Limited zones.	• Greater flexibility in selection of suppression strategies when chance of spread is high (e.g., indirect attack). • Reduced commitment of resources when risk is low. • Balancing of acres burned with suppression costs and with accomplishment of resource management objectives.
LIMITED	• Wildfires allowed to burn within predetermined areas. • Continued protection of human life and site-specific values. • Surveillance/Monitor.	• Reduction of long-term costs and risks through reduced frequency of large fires. • Reduction of immediate suppression costs. • Facilitation of bio-diversity and ecological health

Determination of GAAR Fire Management Units and their respective management strategies is based on the proximity of values at risk, the role of fire within the GAAR vegetative communities, and overall management objectives, as specified in DO-18. Variables such as fuel type, loading, and moisture level will be considered in the decision-making process for specific incidents, as well as in the writing of individual prescribed fire plans. Table 5 below summarizes the GAAR FMUs and rationale for FMU determination.

A statewide Multi-Agency Coordination (MAC) group will be convened when the Alaska Preparedness Level reaches Level 4 to establish priorities for suppression resource allocation and to determine if the need exists for a temporary change in the selected fire management option identified in the AIWFMP for a specific geographic area(s). Such temporary changes may be implemented during periods of unusual fire conditions (e.g., numerous or unusually large fires, predicted drying trends, problematic smoke dispersal, shortages of suppression resources, etc.). The duration and geographical extent of any such changes will be determined by the MAC group and will be reflected in GAAR FMUs, which will be managed accordingly. The regional FMO represents the NPS on the MAC group.

Table 5: Integration of AIWFMP and DO-18 Policy at GAAR

GAAR Fire Management Units (Derived from AIWFMP Protection Categories)	**POSSIBLE RATIONALES for FMU Determination** *Approved Strategic Direction*	**APPLICABLE Management Strategies**
Critical	• Presence of permanent residences and valuable cultural resources, including National Historical Landmarks. *Protect human life and high-value resources by making this designation the highest priority for firefighting resource allocation.*	• Suppression Objectives • Prescribed Fire Use • Mechanical
Full	• Presence of private structures and of structures included on the National Register of Historical Places. • Proximity to Critical FMU. *Minimize damage to resources without compromising human safety. Contain fires with initial action forces. Manage fire for multiple objectives.*	• Suppression and/or Resource Benefit Objectives • Prescribed Fire Use • Mechanical
Modified	• Proximity to Critical and Full FMUs. • Presence of fire-dependent ecosystems. • Appropriate balance of cost and control. *Maintain flexibility to respond to fire conditions and tailor the initial action to those conditions. Allows for accomplishment of NPS objectives under suitable conditions while providing protection to identified sites.*	• Suppression and/or Resource Benefit Objectives • Prescribed Fire Use • Mechanical
Limited	• Presence of fire-dependent ecosystems. • Relative lack of significant fire-sensitive resources. *Allow fire to fulfill its natural ecological role. Environmental impacts from fire suppression activities may exceed damages incurred from fire effects or suppression costs may exceed value of resources to be protected.*	• Suppression and/or Resource Benefit Objectives • Prescribed Fire Use • Mechanical

Note: Gates of the Arctic National Park and Preserve will manage fire for resource benefits whenever possible. Under the new National Fire Policy direction, increased opportunities for allowing fires to burn for resource benefit may become more available in GAAR. The Area FMO and Agency Administrator will assess every opportunity for managing fire for the benefit of the resources within GAAR.

3.2 Fire Management Unit Specific Characteristics

Determination of Fire Management Units within Gates of the Arctic National Park/Preserve is a result of interagency agreements based on NPS management directives outlined in the GMP, RMP, foundation statement and NPS RM-18. These land management option selections are also in agreement with the broader AIWFMP. Predetermined responses are clearly defined by the AIWFMP and understood by all participating agencies within Alaska.

NPS selections were based upon laws, enabling legislation, mandates, and policies applicable to fire management within the NPS. Values and resources to be protected, fire behavior and ecology, and human use patterns were critical components to the selection process. If adjacent land manager/owners selected different options for their lands, attempts were made to negotiate an agreement on the selected option or determine reasonable boundaries if options differed. Every effort was made not to use administrative boundaries but to select option area boundaries that were identifiable from the air and were feasible considering operational and fire behavior concerns (AIWFMP, 2010). These selections are revisited annually and updated when changes to land management objectives or values at risk dictate the necessity. Due to the aforementioned selective factors, 99% of the 8.3 million acres lands managed by GAAR fall in the Limited Fire Management Option (default wildfire with resource benefit objectives on NPS lands) [8,258,508 acres]. The balance of management option acreage is delineated as Full [14,159acres] and Modified [34,306acres], 0% is identified as Critical [78 acres]. Most classified Full and Modified Options areas within NPS unit boundaries are the result of inholdings and other land owners' selections.

FMU Description

Due to the vast acreage covered by this fire management plan coupled with the geographically large and politically complex boundaries that define each management option, detailed written descriptions of each fire management option are not included. Instead a general description of where the fire management option occurs within the unit boundary will follow accompanied by a detailed map (see Appendix S.2: Map 2).

CRITICAL

Intent: In accordance with the AIWFMP, the highest priority for the aggressive suppression of ignitions occurs within Critical Protection zones and/or sites. To give the highest priority to suppression action on wildland fires that threaten human life, inhabited property, designated physical developments and to structural resources designated as National Historic Landmarks.

Goals:

1. Protect human life.
2. Prioritize areas for protection actions and allocation of available firefighting resources without compromising firefighter safety.
3. Protect area from wildland fire.
4. Provide for protection actions on fires that threaten human life, qualifying properties, or high-value resources with available firefighting resources and without compromising firefighter safety.

Prescribed fire and/or mechanical fuel reduction is appropriate in critical protection FMUs based upon land manager/owner's land and fire management objectives.

Physical Description: There is one Critical Protection FMU on NPS land within GAAR. The village of Anaktuvuk Pass is the single critical protection fire management unit within the boundaries of Gates of the Arctic, consisting of a 78 acre block located near the northern boundary of the Park/Preserve. Anaktuvuk Pass is the sole population center within the boundary of the Park/Preserve, with a population of 256 as of July, 2009. The rectangular protection unit encompasses the entire village, beginning just northwest of the landing strip and extending to the west and south.

FULL

Intent: The primary objective in the Full Protection FMU is to protect valued resources by minimizing the presence of uncontrolled fire. AFS and/or the NPS will respond whenever possible to ignitions within this FMU with an appropriate suppression response, unless the GAAR Agency Administrator requests otherwise. may occur within this FMU with the Agency Administrator's concurrence with the AFS (Galena or Tanana Zone) FMO on a Decision Criteria record (see AIWFMP). Prescribed fire may also be implemented in this FMU, with the Superintendent's approval of a formal prescribed fire plan, for the purpose of preserving and/or restoring fire in its natural role, reducing hazardous fuel accumulations, or restoring historic conditions. Mechanical fuel reduction is appropriate based on land manager/owner's land and fire management objectives.

Goals:

1. Prioritize areas for protection actions and allocation of available firefighting resources without compromising firefighter safety.
2. Minimize damage to the identified sites and areas from wildland fire.
3. Control all wildland fires at the smallest acreage reasonably possible with initial action forces.

Physical Description:

The majority of the Full Protection FMU (14,159 acres) within the boundaries of GAAR consists of a large section of land that surrounds the Anaktuvuk Pass Critical Protection FMU, and acts as a buffer between the Critical and Limited FMUs. The Full Protection FMU is located in the Anaktuvuk Valley, between the Anaktuvuk River to the east, the 3000-foot contour level in the mountains to the south and west, and a designated boundary roughly ¾ of a mile north of Kongumavik Creek. This land is owned by the Arctic Slope Regional Corporation and the Nunamiut Village Corporation. Over fifty native allotments parcels located within the Park/Preserve have also been designated as full protection sites.

Management Constraints:

- The Park/Preserve will make every reasonable effort to communicate to the public and NPS employees' ongoing fire management efforts, fire situation, and socio-political and economic impacts of any fire management activities conducted within this FMU.
- Firefighter and public safety will be the number one concern in all fire management activities.
- Retardant and heavy equipment (including bulldozers) will not be used without the permission of the Superintendent (or delegate), except in life-threatening situations.

- Helicopter flight time will be minimized in all possible situations to ensure wilderness concerns are addressed and will make every reasonable effort to communicate to the public and NPS employees ongoing fire management efforts, fire situation, and socio-political and economic impacts of any fire management activities conducted within this FMU.

MODIFIED

Intent: Provides an adaptable option management level between Full and Limited that allows the NPS to consider environmental conditions into their decision making process. The primary objective in the Modified Protection FMU is to achieve an appropriate balance between protection of life and property and cost effectiveness through the implementation of alternative suppression strategies. AFS will provide operational control of initial attack for ignitions detected within the Modified Protection FMU, if adequate firefighting resources are available and conversion has not occurred. However, minimizing acreage burned is less of a priority in Modified FMUs than it is in Critical or Full FMUs. Accordingly, Incident Managers will consider a wide range of suppression strategies within the Modified FMU, including containment by natural barrier or indirect use of retardant or handline. Within this FMU if circumstances preclude initial attack within 24 hours of discovery or suppression response is not feasible, the wildfire will be allowed to burn within predetermined areas. This option of allowing a fire to burn may be implemented with Agency Administrator's approval with consultation from the NPS Area FMO and appropriate AFS (Galena or Tanana Zone) FMO. The decision to manage wildfire with resource benefit objectives will be documented through the Wildland Fire Decision Support System strategic planning process. Once the Modified Protection FMU has converted, the Limited Protection FMU becomes the default management action.

Goals:

1. Use a range of fire management responses:
   Before the conversion date: Contain fires with initial action forces.
   After the conversion date: Use wildland fire to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, allow fire to function in its ecological role and maintain the natural fire regime.
2. Weigh costs and associated environmental impacts of the suppression actions against the values to be protected.
3. Realize short and long-term cost effectiveness and efficiencies.
4. Moderate the adverse effects of fire suppression efforts.

Prescribed fire may be implemented in this FMU for the purpose of reducing hazardous fuel accumulations or restoring historical conditions, with the Superintendent's approval of a formal prescribed fire plan. Mechanical fuel reduction is appropriate based upon land manager/owner's land and fire management objectives.

Physical Description:
The Modified Protection FMU (approximately 34,306 acres) consists of two areas located in the southeast and southwest corners of the Park/Preserve. The area in the southeast corner is partially owned by Doyon Limited Regional Corporation.

Management Constraints:

- The Park/Preserve will make every reasonable effort to communicate to the public and NPS employees' ongoing fire management efforts, fire situation, and socio-political and economic impacts of any fire management activities conducted within this FMU.
- Retardant and heavy equipment (including bulldozers) will not be used without the permission of the Superintendent (or delegate), except in life-threatening situations.
- Firefighter and public safety will be the number one concern in all fire management activities.
- Helicopter flight time will be minimized in all possible situations to ensure wilderness concerns are addressed.

LIMITED

Intent: To recognize areas where the exclusion of fire may be detrimental to the fire dependent ecosystem, the environmental impacts of fire suppression activities may have more negative impacts on the resources than the effects of the fire, or the cost of suppression may exceed the value of the resources to be protected. Due to the near absence of values at risk within this unit, most ignitions occurring within the Limited Protection FMU will be managed for the purpose of preserving fire in its natural role within the ecosystem and accomplishing fire and land management objectives. Allowing fires to burn within predetermined area is the default management action for wildfires in the Limited Protection FMU. The decision to manage wildfire with resource benefit objectives will be documented through the Wildland Fire Decision Support System strategic planning process.

Goals:

1. Use wildland fire to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, enable fire to function in its ecological role and maintain the natural fire regime.
2. Weigh the costs and associated environmental impacts of the suppression actions against the values to be protected and consider firefighter and public safety, benefits and resource objectives.
3. Realize short and long term cost effectiveness and efficiencies.
4. Minimize the adverse effects of fire suppression efforts

Prescribed fire may also be implemented in this FMU, with the Superintendent's approval of a formal prescribed fire plan, for the purpose of preserving and/or restoring fire in its natural role, reducing hazardous fuel accumulations, or restoring historic conditions. Mechanical fuel reduction is appropriate based upon land manager/owner's land and fire management objectives.

Physical Description:
The Limited Protection FMU (approximately 8,258,508 acres) includes all GAAR holdings (lands under NPS management) not contained within the Full or Modified FMUs.

Management Constraints:

- The Park/Preserve will make every reasonable effort to communicate to the public and NPS employees' ongoing fire management efforts, fire situation, and socio-political and economic impacts of any fire management activities conducted within this FMU.

- Retardant and heavy equipment (including bulldozers) will not be used without the permission of the Superintendent (or delegate), except in life-threatening situations.
- Firefighter and public safety will be the number one concern in all fire management activities.
- Helicopter flight time will be minimized in all possible situations to ensure wilderness concerns are addressed.

Special Concerns within all FMUs

Gates of the Arctic was established primarily for its wilderness values. Employees involved in fire management activities will make every effort to understand wilderness policy, identify sensitive overflight areas, and coordinate with the Agency Administrator, Chief of Operations or delegate prior to flying, while fire incidents take place in Gates of the Arctic National Park and Preserve. The use of motorized equipment or mechanized transport that is generally prohibited by the Wilderness Act (helicopter landings, use of chainsaws, use of bulldozers, etc.) will not be permitted on lands that are designated as Wilderness or suitable for Wilderness prior to the preparation of a Minimum Requirement/Minimum Tool Analysis unless they are emergency actions.

Fire Management Site Designations

AIWFMP

Critical, Full, Avoid and **Non-sensitive** site designations have been established to identify the appropriate actions to be taken within the landscape-scale management option areas. These site designations give protection agencies specific guidance for structures, cultural and paleontological sites, small areas of high resource value and threatened and endangered species nesting areas.

- ***Critical*** sites are to be protected from fire and receive the same priority as Critical Management Option areas.
- ***Full*** sites are to be protected from fire and receive the same priority as Full Management Option areas.
- ***Avoid*** sites are areas where fire suppression activities should be avoided and effects from suppression efforts minimized. Aircraft should be restricted from these areas.
- ***Non-sensitive*** sites have been located and identified by the jurisdictional agency and do not require any type of protection, suppression actions, or considerations (*see additional guidance below*)

When a structure is located during fire management activities and no designation has been recorded, the jurisdictional agency will be notified immediately and they will determine actions to be taken. (2010 AIWFMP)

NPS

Because the protection of every known site within GAAR unit boundaries is not feasible, criteria have been established to provide cultural resource specialists and park management with a consistent methodology for determining which key sites will be afforded special protections from wildland fire. Additional to the AIWFMP site designation criteria, cultural resource managers for NPS have defined criteria for each of the categories and added a fifth. Non-Sensitive/Defensible Space was added to the management strategy for site specific considerations within the Park Units. This

designation provides managers with a more flexible option when considering the protection of potentially valuable resources. Within the designation, defensible space will be created either through a fuels management project ideally preceding the fire start, or during an incident before fire impacts the area, this may decrease the likelihood of damage from wildfire but firefighters will not be required to stay and perform suppression actions at the site. Fuels mitigation work will follow project standards and may be implemented by either NPS fire personnel from neighboring programs or GAAR maintenance personnel. These sites will receive the lowest priority for suppression resources from the protection agency.

The criteria, listed in the following sections and may be updated or improved upon should new information come to light. Please note that although this section focuses on cultural resources that are not currently occupied, the following protection categories apply to all buildings and structures located within the park boundary. It is for this reason that "year-round residence" or "trespass structures" are listed as criteria.

Archeological/Cultural/Historic Resources

If historic fire activity is any indication, one may presume that wildland fire has, at some point, affected many of the prehistoric sites within the Park/Preserve, and perhaps even some of the historic sites. Wildland fire effects on the types of materials commonly found in prehistoric sites will tend to be minimal. Thus, the Fire Management Plan will have no immediate impact on the majority of archeological and non-structural historical resources within the Park/Preserve.

Known historic and prehistoric sites that have the potential to be impacted by wildland fire will be identified and assessed by qualified cultural resource personnel. Each threatened site will be assigned a fire protection category (see below) so that the FMO will be able to identify those cultural resources that may warrant special attention in the event of a wildland fire. Each site will be assigned to one of the four fire protection categories using a variety of criteria, including National Register of Historic Places status and eligibility, GAAR management objectives, and site or structure integrity, among others. Assigning protection categories will expedite the planning of, and subsequent response to, wildland fire incidents. The cultural resource staff will continue to update the FMO on changes to integrity and condition of these resources that may change their protection status.

In addition, where wildland fire activity threatens cultural sites that have been designated Full or Critical protection status, the FMO will immediately contact the park Cultural Resource Specialist for consultation, particularly if ground disturbing activities are required for protection or fire suppression. The FMO will also contact the Cultural Resource Specialist if fire suppression activities for the protection of inholdings/allotments might affect sites on surrounding park land.

Fire Protection Categories

CRITICAL:

Definition: Fires immediately threatening this designation will receive highest priority for protection from wildland fires by immediate and continuing aggressive actions dependent upon the availability of suppression resources.

Objectives: Protect human life, inhabited property and designated physical developments without compromising fire fighter safety. Protection of the aforementioned elements is the primary objective, not control of the wildland fire.
Recommended criteria:

1. Any historic property designated as a National Historic Landmark.
2. Any cabin or building that has been specified as actively occupied on a resident use permit granted to the user by the NPS.
3. Any property that is essential to the GAAR management and resource operations; examples include: ranger stations, remote base camps, etc.

FULL:
Definition: Fires immediately threatening this designation will receive aggressive initial attack dependent upon the availability of suppression resources.
Objectives: Protect sites designated as Full management from the spread of wildland fires burning in a lower priority fire management option. Minimize damage from wildland fires to the resources identified for protection commensurate with values at risk.
Recommended criteria:

1. Any historic property designated, or determined eligible for, inclusion on the National Register that retains structural integrity (i.e., standing with a roof).
2. Any property that has received NPS funds for stabilization or rehabilitation, or is designated to receive funds in the future.
3. Administrative sites (i.e., public use cabins, actively used airstrips, etc.).
4. Cultural resources that are representative of historical themes established by the park unit and retain a high degree of structural integrity.

NON-SENSITIVE:
Definition: Fires immediately threatening this designation will be allowed to burn under the influence of natural forces within predetermined areas while continuing protection of human life.
Objectives: Within land manager policy constraints, accomplish land and resource management objectives through the option of allowing wildfires to burn within predetermined areas. Reduce overall suppression costs through minimum resource commitment without compromising firefighter safety. Typical suppression response is a confinement strategy.
Recommended criteria:

1. Trespass structures that do not meet any of the criteria listed above.
2. Cultural resources that are not eligible for the National Register.
3. Historic properties that lack significant structural integrity:
   a. Stand-alone log buildings/structures that consist of four courses of logs or less
   b. Stand-alone frame buildings with one or more collapsed wall(s)
   c. Stand-alone tent frames and other camp features (meat racks, fish wheels, etc.) that are less than 50% intact
   d. Stand-alone mining features (adit, penstock, flume, dam, etc.) that are less than 50% intact
   e. Multi-component properties in which the majority of the contributing structures are less than 50% intact
   f. Bridges, trestles, aerial tramways, or other transportation-related features that are less than 50% intact
   g. Machinery, vehicles, or other equipment that has degraded to the extent that function and/or interpretive value has been compromised

NON-SENSITIVE/DEFENSIBLE SPACE:

Definition: Fires immediately threatening this designation will be allowed to burn under the influence of natural forces within predetermined areas while continuing protection of human life. Defensible space will be built prior to any fire starts.

Objectives: Within land manager policy constraints, accomplish land and resource management objectives through the option of allowing wildfires to burn within predetermined areas. Allow protection of structural resources using minimum tool and ensuring firefighter safety.

Recommended criteria:

1. Cultural resources that are not eligible for the National Register, but that are representative of historical themes established by the park unit and have a decrease in structural integrity.
2. Cultural resources that are in the process of assessment for the National Register.
3. Historic properties that have a decrease in structural integrity:
   a. Stand-alone log buildings/structures with a collapsed roof
   b. Stand-alone frame buildings with a collapsed roof
   c. Stand-alone tent frames and other camp features (meat racks, fish wheels, sheds, outhouses, etc.) that are less than 75% intact
   d. Stand-alone mining features (adit, penstock, flume, dam, etc.) that are less than 75% intact
   e. Multi-component properties in which the majority of the contributing structures are less than 75% intact
   f. Bridges, trestles, aerial tramways, or other transportation-related features that are less than 75% intact

Note: See the 2005 "Alaska NPS Structure Protection Procedures" for the latest Guidance.

4.0 WILDLAND FIRE OPERATIONAL GUIDANCE

4.1 Safety

The foremost guiding principle of *Federal Wildland Fire Management Policy, January 2001* is that firefighter and public safety is the first priority in every fire management activity. The AIWFMP and this Fire Management Plan and the activities defined within reflect this commitment. The commitment to and accountability for safety is a joint responsibility of all firefighters, managers, and administrators. Individuals must be responsible for their own performance and accountability. Every supervisor, employee, and volunteer is responsible for following safe work practices and procedures, as well as identifying and reporting unsafe conditions. All firefighters, fireline supervisors, fire managers, and agency administrators have the responsibility to ensure compliance with established safe firefighting practices.

All actions defined in the Fire Management Plan will conform to safety policies defined in agency and departmental policy, including, but not limited to:

a. Interagency Standards for Fire and Fire Aviation Operations (Redbook)
b. NPS Director's Order 18 Wildland Fire
c. NPS Reference Manual 18, Chapter 3 - Standards for Operations and Safety"
d. DOI Departmental Manual 485 (appropriate sections)

4.1.1 Firefighter Safety

Fire management safety concerns at Gates of the Arctic National Park/Preserve include threats posed by fire and smoke to visitors, local residents, employees and wildland firefighters. Due to the remote nature of the Park/Preserve, transportation of fire personnel by fixed and rotor-winged aircraft and boats represent additional safety concerns. Risks are reduced by following existing policies and procedures established for aircraft and boat travels and following firefighting operational safety procedures described below.

Transportation safety

Aviation Safety **-** As is the case in most of Alaska, air travel is the predominate mode of transportation in and around GAAR. Inherent risks are reduced by following existing Federal Aviation Administration safety policies and procedures and more specific Interagency Standards for Fire and Fire Aviation Operations as referenced in NPS Reference Manual 18.

The inherent remoteness of Gates of the Arctic National Park/Preserve demands that safety be a priority to all personnel involved in fire operations and associated project work. Aviation operations become routine in Alaska and it is not unusual for personnel to become complacent. Access to most field camps and facilities within the Park/Preserve is by airplane and/or helicopter only and therefore routine low level fixed wing and helicopter aircraft are to be expected during the busy summer months.

Watercraft and ATV Safety **-** Watercraft and ATV's also provide routine transportation. Operation of any watercraft will be done by a qualified operator who has passed the agency Motorboat Operator Certification Course (MOCC) as outlined in DOI DM 485 Safety and Occupational Health Chapter 22: Watercraft Safety. Additionally any personnel operating ATV's on NPS land will adhere to regulations clarified in NPS

Reference Manual 50B Section 6: Motor vehicle Safety, specifically section 6.1 which addresses ATV safety in particular.

Weather - Weather patterns in this region of Alaska are exceptionally inhospitable and inclement weather should be expected. This includes fog and winds for days at a time and low ceilings among other things and special attention should be given to weather forecasts for the fire area. Grounding of aircraft is common and therefore additional clothing, supplies and food should be the standard for operations being conducted within Gates of the Arctic National Park and Preserve.

Requirements for Fire Personnel

All personnel participating in fire management activities within GAAR will be required to comply with all National Firefighting standards and complete the following before an NWCG Red Card will be issued:

- Pass routine physical examination as required.
- Participate in Annual Firefighter refresher and safety training
- Succeed at completing the Work Capacity Test requirements
- Participate in routine physical fitness training (Primary FFT = Mandatory, Secondary FFT = highly encouraged) when appropriate.

After the completing of the aforementioned requirements, a Red Card will be issued providing current NWCG qualifications and training needs where appropriate. Annual participation is required in order to keep Red Card currencies. Additionally, qualified fire personnel operating on assignments in Alaska and nationally, will adhere at all times to the following safety guidelines

- Know and Follow the 10 Standard Fire Orders
- LCES (effectively use Lookouts, Communication, Escape routes, and Safety zones)
- Recognize the 18 Watch Out Situations
- Recognize the Common denominators of Tragedy Fires
- Follow the WORK/REST GUIDELINES as outlined in Chapter 7-*Safety* of the Interagency Redbook
- Follow the Risk Management Process (Incident Response Pocket Guide, page 1)

Refusing an Assignment

At no time will any employee be asked to perform duties outside of their current qualification status unless the task is being used for training purposes, in which case, a qualified trainer will oversee the operation. All firefighters have the right to a safe assignment. All employees have the right to turn down unsafe assignments; they also have the responsibility to identify alternative methods of accomplishing the mission. For more information on proper protocols, refer to the *Incident Response Pocket Guide* (IRPG) (NFES1077, PMS 461) under "How to Properly Refuse Risk." All personnel are authorized and obligated to exercise emergency authority to stop and prevent unsafe acts.

Standard Operating Procedures

Job Hazard Analysis (JHA): Requirements for completed Job Hazard Analysis are outlined in Chapter 7- *Safety and Risk Management* of the Interagency Standards for Fire and Fire Aviation Operations. It is the responsibly of the supervisor or line manager to ensure JHA's are reviewed and signed prior to any non-routine task or at the beginning of the fire season. (See Appendix G: Preparedness plan for further information pertaining to JHA's)

After Action Review (AAR): An AAR is a learning tool intended for the evaluation of an incident or project in order to improve performance by sustaining strengths and correcting weaknesses. An AAR is performed as immediately after the event as possible by the personnel involved. An AAR should encourage input from participants that is focused on (1) what was planned, (2) what actually happened, (3) why it happened, and (4) what can be done next time. It is a tool a supervisor can use to get maximum benefit from the experience gained on any incident or project.

Serious Accident/Incident Review/CISM: Certain situations warrant investigations and review processes according to both National and NPS policy. Detailed guidance for the review and investigation requirements and protocols are outlined in NPS RM-18 Chapter 3, *Standards for Operations and Safety* and the 2010 Interagency Standards for Fire and Fire Aviation Operations Chapter 18, *Reviews, Investigations & Analysis.* In conjunction with serious accident/incident occurrences, Critical Incident Stress Management (CISM) may be appropriate. Responsibilities and protocols regarding the initiation of a CISM team is outlined in the Interagency Redbook.

4.1.2 Public Safety

Public safety concerns at Gates of the Arctic include threats posed by fire and smoke to visitors, local residents, employees. Due to the remote nature of the Park/Preserve, fixed and rotor-winged aircraft and watercraft represent additional safety concerns, especially under conditions of heavy smoke.

Visitor use will not be allowed near fire perimeters. An attempt will be made to inform all visitors of any known wildland fire activity within the Park/Preserve, and signs will be posted on nearby roads, villages and departure points if smoke produced during wildland and prescribed fire creates a safety concern. The Superintendent may initiate a temporary closure of the hazardous area if large or erratic fire behavior endangers visitor and employee safety to a significant degree. Closures may also apply to airspace.

Emergency Evacuation procedures

The Alaska Division of Emergency Services has developed standard procedures for the evacuation of personnel and/or public due to risks posed by fire and/or smoke. Either the GAAR Superintendent or the GAAR Agency Administrator may request the Alaska Division of Emergency Services (ADES) to implement evacuation procedures for the Park/Preserve or for adjacent communities. This could range from the evacuation of an individual adversely affected by smoke to community evacuation due to the threat of fire. Any fire related evacuation effort will be coordinated with the protection organization FMO or Incident Commander. A Fire Incident Draft Evacuation Operation Plan is available for viewing online.

Burn Restrictions and Bans

The Code of Federal Regulations, Title 36 – Parks, Forests and Public Property Chapter 1 (7-1-02), Section 2.13 (c) states; "During periods of high fire danger, the superintendent may close all or a portion of a park to the lighting or maintaining of a fire." Section (d) states: "The regulations contained in this section apply, regardless of land ownership, on all lands and waters within the park area that are under the legislative jurisdiction of the United States."

The Alaska Wildland Fire Coordinating Group (AWFCG) established procedures for implementing statewide or regional burn restrictions/bans at Preparedness Levels IV and V. Either fire protection organizations or land managers can recommend a burn restriction/ban based upon fire indices, risk factors, air quality, forecasted weather and the regional or statewide fire situation. If the AWFCG concurs, the recommendation is forwarded to the Deputy Director of Fire and Aviation (DNR) for implementation by the State Forester. The areas affected by the burn restriction/ban will be delineated using Alaska Department of Fish & Game (ADF&G) management units along with a text description of the area. If the NPS units or a portion of NPS units are included in the burn restriction/ban area the Superintendent has the option to implement a burn restriction/ban using the legislated authority described above. The NPS will support the regional or statewide burn restriction/ban, unless extenuating circumstances exist. Public Orders and new releases will announce the burn restriction/ban and will be posted on the AICC (http://fire.ak.blm.gov/) and DNR-DOF (http://www.dnr.state.ak.us/forestry/fire/) Internet websites. The NPS will prepare press releases as needed and will use NPS communication systems to inform NPS employees of the burn restriction/ban. A copy of the State of Alaska Burning Restrictions and Burn Ban Procedure, 1997 are on file in the Eastern Area and Regional Wildland Fire Management offices.

If burn ban proposals extend beyond NPS administered lands, at Preparedness Levels I, II, and III, local protection agency FMO after contacting local land managers or local land managers may recommend to the local protection agency FMO a burn restriction/ban. Follow Region-wide agreements for approval authority. Public Orders and press releases will be prepared by the protection organization. The Superintendent of affected NPS units will determine if the burn restriction/ban is appropriate. If it is appropriate, the Superintendent will implement the burn restriction/ban using his legislative authority.

Burn restrictions/bans will be rescinded after sufficient recovery of fire indices, improvement of air quality, reduction of risk factors and the regional/statewide fire situation. The burn restriction/ban may be rescinded for a portion of the affected geographic areas, if the exempted area can be clearly delineated and articulated to the general public. Press releases will be prepared by the protection agencies to announce the rescission of burn restrictions/bans. The Superintendent will rescind the NPS burn restriction/ban and announce the rescission through press releases if necessary and NPS communication channels.

4.2 Preparedness

Preparedness activities provide detailed procedures and standards for wildland fire operations, including pre-season and ongoing activities throughout the fire season. It also includes pre-planned procedures for initial response and incident management procedures.

Protection Planning

The NPS will review management option selections for Gates of the Arctic National Park and Preserve annually as defined in the AIWFMP. Changes are submitted through the AWFCG procedures found at http://fire.ak.blm.gov/administration/awfcg.php. The NPS is responsible for setting the strategic fire direction for the park/preserve and completing and/or reviewing other WFDSS pre-season entries.

Protection Area Boundaries

Each winter the GAAR FMO meets with Park/Preserve staff members to re-evaluate the categorization and boundary locations of these units. Other land manager/owners will be consulted and concurrence will be sought for unit location or categorization changes that affect their lands. Final authority for the adjustment of FMUs and/or fire protection categories within the Park/Preserve rests with the GAAR Superintendent. Clear direction for the process and proper documentation procedures for these changes are given in the Alaska Statewide AOP.

Fire Protection and Suppression

The BLM Alaska Fire Service – Galena and Tanana Zones will provide fire detection coverage for GAAR based on lighting activity levels, human use or at the request of the NPS. Upon discovery the Zone will verify and document fire location, management option and cause of fire. Initial response will be implemented according to AIWFMP and the Jurisdictional FMO or designated NPS Duty Officer will be notified. The Alaska Fire Service will initiate a WFDSS entry as part of the notification process.

Prevention

A Step-Up Communications Plan has been developed by the NPS Alaska Regional Fire Education and Communications Specialist in collaboration with other agencies, regarding fire prevention. This plan provides access to detailed information on the current fire situation and emphasizes the likelihood of unwanted wildfires due to careless human acts. Details of this plan are described in detail in Appendix H.

Public Use Restrictions

See section 4.1.2 - *Public Safety* of this FMP regarding Burn Bans and fire area closures.

Prescribed Fire and Fuels Management

Mechanical fuels treatment and prescribed burning, or a combination of the two, may be used in the Park/Preserve to achieve resource management goals. The protection of National Historic Landmarks and classified structures listed on the National Register of Historic Places, or eligible for listing, could warrant these preventative measures. Fuel reduction measures may also be used to protect other Critical and Full protection points that exist in the park that may not fall under the above categories. (i.e., NPS administrative buildings) Mechanical fuel reduction projects will strictly adhere to Fuels Management Plan Guidelines (Section 4.5- *Management of Planned Fuels Treatment*) and any plans for prescribed burning will constitute the development and approval of an official Prescribed Fire Burn Plan. (See Section 4.5.3- *Prescribed Fire Treatments*)

4.2.1 Coordination and Dispatching

The AIWFMP is the operational reference document for fire on all lands throughout Alaska, regardless of ownership. The AIWFMP works in unison with the Statewide AOP, the Master Cooperative Wildland Fire Management Agreement, local area AOP's and this Fire Management Plan for managing wildland fire in Gates of the Arctic National Park/Preserve. The purpose of the AIWFMP is to "Promote cooperative, consistent, cost-effective, interagency approach to wildland fire management" (Alaska Statewide AOP). The Alaska Wildland Fire Coordinating Group (AWFCG) is the interagency team that reviews and updates these governing documents regarding Wildland Fire Management in Alaska. The NPS Regional FMO represents National Park Service interests in the AWFCG.

The Alaska Interagency Coordination Center (AICC) serves as the geographic coordination center for Alaska. AICC provides statewide tactical resource coordination, logistics support, and predictive services for all state and federal agencies involved in wildland fire management in Alaska.

BLM Alaska Fire Service – Galena and Tanana Zones provide fire dispatching services to the Gate of the Arctic National Park/Preserve. The Alaska Fire Service Zone FMO determines appropriate staffing levels in accordance with current and forecast fire weather, fire danger rating indices and/or current and expected wildfire workload.

4.2.2 Preparedness Activities

Alaska wildland fire preparedness activities include a wide range of readiness activities and program elements that are essential to dealing with unplanned ignitions and fuels treatments. AK preparedness levels are determined independently from the National Preparedness scale. Alaska preparedness levels are posted daily on the AICC website at the top of the Wildland Fire Situation Report. Definitions of each preparedness level are given and correlated with the appropriate management action and the assignment of responsibility.

A preparedness plan commonly requires annual updating and for that purpose will be attached in the Appendix G.

4.3 Management of Unplanned Ignitions

A. Preparing for Unplanned Ignitions.

Operational control of wildfire incidents within Gates of the Arctic National Park/Preserve is the responsibility of BLM Alaska Fire Service – Galena or Tanana Zone. The Alaska Statewide AOP contains all specifics regarding the response to, and management of, unplanned ignitions throughout Alaska. This includes initial response direction, WFDSS initiation, cooperation and requirements, FEMA reimbursable expenditures guidance, surveillance and monitoring protocols, and post fire activities (i.e., BAER). Relevant operational guidance regarding unplanned ignitions is also found in the Statewide Master Agreement (clauses 24-33) regarding fire notification, closest forces concept, NPS independent actions, response to a wildfire, "special management considerations", delegations of authority, incident priorities and the preservation of evidence.

1. Objectives – Established goals and objectives for each management option guide pre-planned responses in each of the four management options within the Gates of the Arctic National Park/Preserve. Rooted in founding documents for park purpose and

management, these objectives are clearly described in section 3.1.1 of this plan as well as the 2010 AIWFMP.

2. Risk Assessment – A primary factor used to select the appropriate fire management option for a given areas within the Park/Preserve. Risks evaluated include nearby communities, private residences, private property, valuable natural and cultural fire- sensitive resources, and proximity to critical management units. The modified management option allows managers flexibility to incorporate Fire Weather Seasonal Tracking (FWST) information into their decision making process when choosing the appropriate conversion date and management response.

3. Implementation – The option of allowing fires to burn for resource benefits at GAAR is the preplanned initial action in Limited and Modified (after conversion) protection categories identified in the AIWFMP. This option may be utilized in Modified (prior to conversion) and Full protection categories if suppression actions have not been initiated and the criteria for managing have been met (AIWFMP). The extent fires may be allowed to burn in GAAR may be altered based upon adjustments of the appropriate boundaries and management options for FMUs.

The FMU descriptions contained within this plan specify preplanned management actions, to be enacted automatically by AFS Zone dispatch in the absence of further guidance by the jurisdictional agency. The Superintendent with consultation from the GAAR FMO and the AFS Zone FMO may select a reduced or increased suppression response as determined by current fuel, weather, and fire management conditions and as dictated by NPS policy and the GAAR FMP. See Statewide AOP (Clause 29- Response to Wildfire).

The Wildland Fire Decision Support System (WFDSS) process will be used to document decisions for all unplanned wildland fires. The option of allowing fires to burn in predetermined areas will be initiated through the Wildland Fire Decision Support Process (WFDSS) through consultation with the GAAR FMO and AFS Zone FMO.

Regional guidance for the responsibility for completion of the WFDSS components is located in the 2010 Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement and the 2010 Alaska Statewide Annual Operating Plan.

The initial WFDSS record documents the current and predicted situation, documents all appropriate administrative information, and aids managers by providing them with decision criteria to make the initial decision whether to manage the fire primarily for resource benefits or take aggressive suppression action to limit spread.

4. Staffing

A. Operations – AFS Zone FMO in consultation with GAAR management and Eastern Area FMO will determine staffing and/ or monitoring requirements for wildfire incidents. All personnel involved with fire management activities will be appropriately qualified to meet National Wildfire Coordinating Group (NWCG) standards. Because of the remote nature, relative scarcity of structures or other

sensitive values within portions of GAAR, wildfires with resource benefit objectives incidents may often be adequately managed through aerial surveillance every few days. Other incidents may demand the continuous presence of monitors or fire behavior analysts. Based upon the needs of the fire organization, GAAR needs and personal interest, the Superintendent and Eastern Area FMO will determine what GAAR staff will be available to assist with wildfire incidents. See Statewide AOP for further information (Clause 11-Interagency Dispatch, Clause 12-AICC, Clause 13-Interagency Resources)

B. Fire Effects Monitoring Staff – Following the monitoring procedures at GAAR established by the Regional Fire Ecologist, the Eastern Area Fire Management FMO with consultation from the Protection Agency FMO will determine staffing needs.

5. Information- The information and interpretation component of the fire management program is specifically addressed in Section 4.9. The following objectives, however, pertain directly to wildfires managed for resource objectives:

- When extended wildfire incidents are likely to be visible to visitors, NPS personnel will prepare and distribute handouts explaining the GAAR fire management program, the nature of the specific incident, and the desirability of preserving the area's natural fire regime.

- An attempt will be made to educate all GAAR employees about local fire ecology, the Park/Preserve's fire management objectives, and fire-use incidents that are in progress.

- When fire use incidents occur near frequently used locations, interpreters or other NPS employees will make periodic visits to answer questions.

Communication and education regarding wildfire in and around Gates of the Arctic National Park/Preserve will follow protocols outlined in the Gates of the Arctic Communication and Education Plan (Appendix H) and developed by the Regional Fire Communication and Education specialist.

6. Record Keeping- The following contents will be kept in a permanent file for each incident occurring within Gates of the Arctic National Park/Preserve.

- WFDSS Report
- ICS 209
- WFMI Report
- Monitoring data, reports, and findings
- Revalidation and certification documents (if applicable)
- Funding codes and cost accounting
- Project Maps- generated by aerial surveillance and given to NPS to include in their GIS database, if NPS fire management staff is not present on fire.
- Aerial Photographs
- Any other pertinent information relating to the incident

B. Expected Fire Behavior

Fire behavior in GAAR can range from creeping subterranean fire in tundra to fast moving ground or canopy fire in surface fuels or spruce stands. For more detailed discussion refer to Fuel Characteristics and Fire Behavior (Section 3.1: Historic Fire, Weather, Fire Season, Fuels and Fire Behavior).

CFFDRS - The Canadian Forest Fire Danger Rating System (CFFDRS) is utilized to track fire danger throughout the state. Specific analysis regarding CFFDRS and large fire occurrence has not been thoroughly analyzed for Gates of the Arctic National Park/Preserve. The CFFDRS moisture components and indices commonly monitored further in the interior of the state are the Fine Fuel Moisture Code (FFMC), Duff Moisture Code (DMC), Drought Code (DC), Initial Spread Index (ISI) and the Buildup Index (BUI). The following Table illustrates the thresholds that can elicit extreme fire behavior or a high potential for growth.

Table 6: Canadian Forest Fire Danger Rating System

	FFMC	DMC	DC	ISI	BUI	FWI
Low	<80	0-38	0-150	0-2	0-38	0-9
Moderate	80-86	38-60	151-350	2-5	38-60	9-18
High	87-90	61-80	351-400	5-8	61-90	18-28
Very High	91-93	81-98	401-450	8-11	91-110	28-35
Extreme	>93	>98	>450	>11	>110	>35

C. Initial Response Procedure.

The FMU parameters described within this plan (and adjusted annually) comprise the only predetermined implementation procedures for unplanned ignitions at GAAR.

Initial responses to wildfires throughout Alaska are predetermined and clearly defined in the AIWFMP and statewide AOP. Fires can be categorized as Critical, Full, Modified, or Limited depending on the Fire Management Option selection given to the area the fire is burning in. Responses to these ignitions are predetermined and range from aggressive initial attack (Critical) to periodic aerial surveillance (Limited).

Critical - Fires occurring in or immediately threatening this designation will receive highest priority for protection from wildland fires by immediate and continuing aggressive actions dependent upon the availability of suppression resources.

Full- Fires occurring within or immediately threatening this designation will receive aggressive initial attack dependent upon the availability of suppression resources.

Modified –Before the conversion date, fires will receive initial attack, dependent upon availability of suppression resources, unless otherwise directed by the land manager/owner(s) and documented in WFDSS. After the conversion date, the default action for all fires occurring within the Modified management option areas will be routine surveillance to ensure that identified values are protected and that adjacent higher priority management areas are not compromised. Critical and Full management areas are higher priorities for suppression resources than Modified management areas.

Limited - Wildland fires occurring within this designation will be allowed to burn under the influence of natural forces within predetermined areas while continuing protection of human life and site-specific values within the management option. Generally this designation

receives the lowest priority for allocations of initial attack resources; however, surveillance may be a high priority.

The initial response on all human-caused fires will be to apply the appropriate operational suppression response delineated in the AIWFMP. Therefore, in most cases, response to fires within a given fire management option is the same whether the ignition is natural or anthropogenic. The Agency Administrator, or delegate, may request a non-standard response to fires within Gates of the Arctic National Park/Preserve. The Protection Agency FMO will be consulted on any non-standard response requests. All non-standard responses will be reviewed at the Interagency Fall Fire Review.

1. Information Needed To Set Initial Response Priorities.

Wildland fire management options selections are the basis for the selection of initial response priorities. The fire management option selections were based upon an evaluation of legal mandates, policies, regulations, resource management objectives, and local conditions. Local conditions include but are not limited to fire history, fire occurrence, environmental factors, and identified values to be protected. The following item should be consulted prior to refining the initial response priorities.

a. Fire management unit the incident is located within.
b. Location/distance of the incident is other fire management units.
c. Location/distance of the incident in relation to values at risk (Fire Protection Points/Known Sites Database, Communities, adjacent landownership, Allotment, Archeological Database, proximity to sensitive water sources, etc.
d. Availability of resources.

2. Incident Documentation and Reporting-

The Protection agency is responsible for all fire reporting commensurate with national standards and more specifically, as specified in the Alaska Interagency Mobilization Guide (AIMG) Chapter 20 Section 25.1.01.

Wildfire notifications will follow the procedures within the Alaska Statewide AOP. If NPS personnel, visitors, or local residents detect a new ignition they should notify the appropriate AFS Dispatch as soon as possible. Information needed is: an accurate location of the fire (lat/long), approximate size, resources threatened, and any other pertinent information (nearby lakes or rivers, cardinal direction from these features, color of smoke, fuels (vegetation) present, size of column, etc.). Once AFS Dispatch has this information, they will contact the GAAR FMO. If the GAAR FMO is not available, the next contact is the Regional FMO. If the Regional FMO is not available, then contact the Duty Officer identified on the duty officer schedule distributed to Zone FMOs and dispatch offices in late April. The GAAR FMO or Regional FMO will contact the Superintendent if he has not been informed about the fire.

The Protection Agency and Jurisdictional Agency FMOs will work collaboratively to develop WFDSS documentation as required by National Fire Policy (Redbook) and the Alaska Statewide AOP.

The NPS is also responsible for completing and submitting a Wildland Fire Report Form and any additional fire reporting as required by RM-18, Chapter 11-Wildland Fire Reporting. The GAAR FMO will ensure accuracy of the report and will follow NPS

Alaska Regional Fire Management procedures to have the WFMI Fire Reporting Module entered. A permanent hardcopy of the fire report is filed at the Alaska Eastern Area Fire Management Office in the Fairbanks Administrative Office.

3. Criteria for Selecting the Initial Response

Primarily the initial response will follow the preplanned response as defined in the AIWFMP. The NPS has selected wildland fire management options based upon an evaluation of legal mandates, policies, regulations, resource management objectives, values at risk and local conditions. Local conditions include but are not limited to fire history, fire occurrence, and environmental factors. The NPS should revisit fire management option selections as part of their fire management program. Adaptive Management Strategy procedures to ensure their selections remain consistent with current park management goals and objectives.

Additional criteria that could be evaluated for selecting the initial response for either validating the preplanned initial response, or selecting a non-standard response.

- Current and expected weather,
- Proximity to sensitive resources,
- Current and expected mid to long term availability of suppression resources,
- Current and expected fire business load
- Air Quality advisories,

4. Response Times

Response times for fires occurring within Gates of the Arctic National Park/Preserve will vary depending on the Fire Management Option selected for the area, availability of suppression resources, as appropriate, and with the current fire preparedness level across the state of Alaska. When Alaska Preparedness reaches Level 4 or 5, the Alaska Multi-Agency Coordinating group is assembled. The MAC group ensures:

- Incident prioritization
- Resource allocation and acquisition
- State and federal disaster response or coordination
- Political interfaces
- Information provided to media and agencies involved
- Anticipation of future needs
- Identification and resolution of issues common to all parties
  Response times will be greatly determined by the MAC group and fire activity across the entire state of Alaska.

NPS fire resources response times will vary based on location of the incident and the location and prioritization of NPS aviation resources. The NPS EAFM Fire Exclusive Use Helicopter Contract module will be available seven days a week through the duration of the fire season. The NPS EAFM Fire Exclusive Use Helicopter Contract module is typically located in Yukon-Charley Rivers or Wrangell St. Elias National Park and Preserve. Response times to GAAR are, for EAFM resources, typically between 12 and 36 hours to mobilize. Direct flight time from Ft. Wainwright to GAAR is approximately 2 hours.

5. Management Requirements and Restrictions

See Section 3.1 Park-wide Fire Management Considerations and 3.2 Fire Management Unit Specific Characteristics.

6. Non-Standard Response

The four fire management options address a high percentage of wildland fire situations that occur in Alaska. On rare occasions, however, situations arise where non-standard responses to the selected management options are prudent and justifiable. Non-standard responses procedures will follow those as described in the Alaska Statewide Master Agreement and AOP. Approvals of non-standard responses reside with the Agency Administrator with consultation with the Protection Agency FMO prior to implementation. Examples of Non-Standard Responses are discussed in detail on pages 34-35 of the AIWFMP. All non-standard responses that occur will be reviewed at the annual fall fire review. See Section 3. Criteria for Selecting the Initial Response above for suggested factors to be evaluated prior to making a non-standard response decision.

D. Transition to Extended Response and Large Fire

1. Criteria for Transition

Wildfire incidents in Alaska range from small to large non-complex fires and complex urban interface fires. The vast majorities of the fires within the Gates of the Arctic National Park/Preserve are in the Type 4 complexity category or are only monitored. As incidents escalate, continual reassessment of the complexity level should be competed to validate that the organization remains appropriate, or the need exists for a higher level Incident Management Team. The Interagency Redbook, Chapter 11 contains guidance for the selection of the appropriate team organization determined through the completion of a complexity analysis and an Organizational Needs analysis if the fire reaches a Type 1, 2 or 3 complexity. See the Alaska Statewide Master Agreement and AOP for further guidance.

2. Implementation Plan Requirements and Responsibilities

WFDSS will be used to develop and document decisions and support extended response needs within Gates of the Arctic National Park/Preserve. In the event higher complexity fires occur within the jurisdictional boundary of the NPS, the Jurisdictional Agency may utilize the virtual Decision Support Center and/or assemble a team of advisors (i.e., Superintendent, Chief of Resources, Chief Ranger, etc.) who will assist in the development and review of the WFDSS process. See the Alaska Statewide Master Agreement and AOP for further guidance.

3. Delegation of Authority

Delegations of Authority will be cooperatively developed by the NPS and the BLM Alaska Fire Service – Galena and Tanana Zones and will document procedures and criteria that specify direction, authority, and financial management guidelines to Incident Commanders of fires within GAAR for fires Type 3 and above (Redbook 2013, Annual Operating Plan 2013, Master Agreement 2010). Only after written authority is received

may the Incident Management Team assume authority to manage suppression actions of the incident (AIWFMP, 2010).

Communications throughout Gates of the Arctic National Park/Preserve are a continual challenge. Recognizing this, the Incident Commander, through the Alaska Fire Service – Galena or Tanana Zone, to the best of their ability, will notify the Agency Administrator or delegate of progress and activities occurring on the incident. Then, the NPS can disseminate correct and current information to local community members affected by the fire.

The Resource Advisor is responsible for anticipating the impacts of fire operations on natural and cultural resources and for communicating protection requirements for those resources to the Incident Commander.

The Park should fill this position with a knowledgeable and qualified staff member to ensure the best possible protection of irreplaceable park resources. This position additionally ensures the IMTs compliance with the Resource and Fire Management Plans for Gates of the Arctic National Park/Preserve, and provides counsel to the IC regarding sensitive issues within the Park/Preserve. A complete list of position responsibilities and issues to be considered is available in the Resource Advisor's Guide for Wildland Fire (NWCG PMS 313, NFES 1831, Jan 2004) and the Interagency Redbook, Chapter 11, Page 15.

4.4 Burned Area Emergency Response

4.4.1 Minimum Impact Suppression Tactics (MIST)

It is the policy of the National Park Service that all fire management activities will be executed using minimum impact suppression guidelines. Accordingly, the following constraints apply to all fire management activity in GAAR. These guidelines have been developed collectively by the jurisdictional land management agencies and recently updated in the Guidelines and Constraints section of the 2010 AIWFMP. Further direction specific to Gates of the Arctic National Park/Preserve and its associated resources is described in the NPS section below.

AIWFMP MIST- To the extent possible, minimum impact suppression tactics should be used.

- Firelines will be constructed in a manner that minimizes erosion and will follow natural contours wherever possible. Indirect attack will be used to the extent practical. A fireline rehabilitation plan for wildfire suppression activity damage, as approved by the jurisdictional agency(s), must be completed before the final demobilization occurs.

- The use of tracked or off-road vehicles (for example, bulldozers or all-terrain vehicles) requires written authorization by the jurisdictional agency(s) on a case-by case basis prior to use.

- Application of aerial fire retardant near lakes, wetlands, streams, rivers, and sources of human water consumption or areas adjacent to water sources should be avoided. A minimum of 300 feet is identified in the *Red Book*. Individual jurisdictional agencies may have more restricted retardant guidelines.

- Base camps, spike camps, helispots and other support areas should be located in natural clearings if possible. The construction of helispots should be minimized. Any opening created for support areas will be cut with an irregular perimeter. Such areas will be kept clean so as not to attract animals and will be cleaned up before departure of the last suppression personnel.

- Support areas such as camps, staging areas, and helibases will not be located on Native allotments. No resources will be removed from a Native allotment (e.g., firewood) without an approved agreement. The BIA or the local BIA service provider may prepare the agreement.

- Flight patterns and suppression activities will be restricted around areas designated Avoid. Examples include peregrine falcon nesting areas, threatened or endangered species, or sensitive sites identified by the jurisdictional agency.

- Suppression activities on or near non-structural cultural sites must be coordinated with the jurisdictional agency per the 2010 AIWFMP.

- Jurisdictional agencies should be consulted concerning any operational restrictions in designated wilderness areas as directed in Guidelines and Constraints section of the 2010 AIWFMP.

NPS MIST

- Use water rather than retardant whenever possible. Retardant will not be used unless authorized by the Park Superintendent.

- Use cold-trailing or wet-lining techniques when feasible.

- Utilize weeping hoses or foggers in mop-up; avoid "boring" or other scarring hydraulic actions.

- Dozers and other heavy equipment will be used only with the approval of the Superintendent (or delegate), except in life-threatening circumstances.

- Minimize the falling of trees and the cutting of shrubs; limb vegetation adjacent to fireline only as needed to prevent additional fire spread.

- Minimize the use of helispots/helibases that require clearing.

- Emphasize appropriate Leave No Trace practices by personnel on the fireline and/or in spike camps, particularly with regard to human waste disposal, selection of durable campsites, and food storage in bear country.

Minimum impact suppression tactics and Leave No Trace ethics will be identified as an objective on all wildfire incidents occurring in GAAR.

4.4.2 Burned Area Emergency Response

Because the majority of land within Gates of the Arctic National Park/Preserve is categorized within the Limited Fire Management Option, relatively limited suppression actions will be necessary and thus minimal adverse effects to the management area can be expected. In the event wildfires start in or threaten Full or Critical management areas, more aggressive suppression actions can be expected. In the event where suppression actions are required, MIST will be strongly emphasized. The need for emergency response for the stabilization and prevention of unacceptable degradation of natural and cultural resources resulting from the effects of the fire will be promptly determined by the Management Staff at GAAR and communicated by the agency administrator, or delegate, to the IC. Rehabilitation standards will be developed on a case by case basis in accordance to specific needs on incidents occurring within the Park/Preserve. Additionally see Section 3.1 Park-wide Fire Management Considerations and 3.2 FMU Specific Characteristics provide guidance regarding management constraints by FMU. These constraints will assist NPS in their mission to protect invaluable resources within the Park/Preserve.

4.4.3 Emergency Stabilization

Suppression activity damage repairs are the responsibility of the Incident Commander and are funded using the suppression account. Firelines may require rehabilitation in order to stabilize the burn area and to mitigate the effects of suppression activities. The Agency Administrator will ensure that the Incident Commander consults with natural resource managers as needed, regarding any specific rehabilitation needs. When possible, burned areas will be allowed to regenerate naturally. Due to the magnitude of NPS management units that could potentially be adversely affected by fire, rehabilitation needs will be determined on a case by case basis by park resource management staff within an appropriate time frame for the necessary stabilization work to be completed. For Emergency Stabilization and Rehabilitation timeframes, priorities, policies and procedures to mitigate fire effects on federal lands, reference 620 DM 3, the *Interagency Burned Area Emergency Response Guidebook (Feb 2006)* and the *Interagency Burned Area Rehabilitation Guidebook (Oct 2006.)*

4.4.4 Burned Area Rehabilitation

Burned Area Rehabilitation (BAR) is a continuation of Emergency Stabilization efforts that occur immediately post fire. BAR efforts focus on repair or replacement of minor facilities as well as damage incurred to natural and cultural resources as a result of the fire. The BAR phase usually occurs within one to three years after the fire is extinguished. It is the responsibility of the Agency Administrator to ensure that BAR efforts are completed to the satisfaction. A Burned Area Emergency Response Plan (BAER Plan) may be appropriate if significant damages are incurred during a wildfire incident within Gates of the Arctic National Park/Preserve. At the request of the Agency Administrator, an interdisciplinary team (BAER Team) of specialists may be ordered to prepare a plan with specific rehabilitation guidelines to be carried out during or immediately following the containment of a wildfire.

Appropriate use of funding is described in detail for BAR activities on federal and native lands are outlined in the Interagency Burned Area Rehabilitation Guidebook (and the Interagency Fire Business Management Handbook.

4.5 Management of Planned Fuels Treatments

Though Gates of the Arctic presently has no plans to use broadcast prescribed fire, it may be implemented in the future for the accomplishment of specific resource management goals. Because of the relatively undisturbed nature of the Park/Preserve's fire ecology, the FMO does not anticipate implementing landscape-scale burning for the purpose of restoring or preserving the area's ecosystems. The Park/Preserve may, however, use prescribed fire for the purposes of restoring historical conditions at selected sites or for reducing hazard fuel loads in the vicinity of valued resources. These uses would facilitate the accomplishment of goals identified in the GAAR Resource Management Plan.

4.5.1 Fuels Planning and Documentation

The fuels management program will implement fire management policies and help achieve resource management and fire management goals as defined in:

- Federal Wildland Fire Management Policy and Program Review
- Managing Impacts of Wildfires on Communities and the Environment (USDA, Sept 8, 2000)
- Protecting People and Sustaining Resources in Fire Adapted Ecosystems – A Cohesive Strategy (USDOI/USDA)
- A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan

a. Identify Participants

Any implementation of prescribed fire within GAAR will be predicated by a planning session attended by the Eastern Area FMO, the Chief of Resources, Superintendent or delegate and any other key players or interested parties. Topics covered in this meeting may include the determination of prescribed burn units, the establishment of prescribed fire objectives, the presence and protection of sensitive resources, the mitigation of smoke management problems, determination of prescriptions and/or burning windows, fire effects monitoring protocols and the impact of the proposed action on the full spectrum of GAAR uses, including wilderness values, and subsistence hunting and trapping.

Typical key members for fuels project decisions for Gates of the Arctic include:

- Superintendent(s)
- Eastern Area FMO or delegate
- Eastern Area AFMO
- Archeologists
- Chief of Resources
- Chief of Cultural Resources

b. Identify Candidate Projects

The Five Year Treatment Plan (2014-2019) identifies the following candidate projects for hazardous fuels reduction: Squaw Rapids Cabin (NOR003B), Kutuk River Cabin (ARRI-002), Narvak Lake (KOBU-0032), and Classen Cabin (WALK-003).

This plan is updated annually and future candidate projects will be identified at that time (Appendix E). No fuel treatment projects were completed in GAAR in the 2012 fiscal year.

c. Project Prioritization Criteria

Consistent with the objective of maintaining natural processes to the greatest extent possible within the context of other Natural, Cultural, Subsistence and Adjacent Landowner Objective a current fuels treatment projects are focused on sensitive cultural and administrative sites. The Eastern Area Fire Management Staff, Local Park Fire Coordinator and Chief of Cultural Resources annually review and identify the site specific fire protection status for each site. If fire protection category changes are made to a site, the list of changes will be submitted to the Superintendents for approval. The sites that receive a Critical or Full Protection Category constitute the list of sites that may need fuel management treatments, based on natural fuel hazards at the site. As natural fuels conditions change at a site, periodic visits to the site will be necessary to determine future fuels treatment needs.

TOP PRIORITY (CRITICAL FIRE MANAGEMENT OPTION IN THE ALASKA INTERAGENCY WILDLAND FIRE MANAGEMENT PLAN, AIWFMP)

1. The structure(s) is a primary domicile.
2. The structure(s) is designated as a National Historic Landmark.

SECOND PRIORITY (FULL FIRE MANAGEMENT OPTION IN THE AIWFMP)

1. The structure has been determined eligible for or is on the National Register of Historic Places, has structural integrity (e.g., intact roof and walls, a reasonable probability for defense), is at potential risk from wildland fire and has been identified for or undergoing routine maintenance/restoration.
2. NPS administrative (e.g., patrol cabin) or public use structures – public funds expended to construct or maintain.
3. The use of the structure is provided for under NPS permit or an approved Mining Plan of Operations.

The following types of structures would not receive treatment under this Fuel Plan:

1. Trespass structures
2. Abandoned structures that are not eligible for inclusion on the National Register of Historic Places.
3. Structures without structural integrity or they have not been identified for or are undergoing routine maintenance/restoration. (It is difficult to put a sprinkler system on a structure without a roof.)

Additional criteria, in order of priority but are not limited to, may be utilized to prioritize projects:

- Agency Administrator Priority
- Degree of Hazard (i.e., quantity of fuel adjacent to the site)
- Proximity to Values at Risk (i.e., Fire frequency and extent in the area of the site)

- Logical Project Sequence
- Fire Management Option selection
- Maintenance Cycle
- Logistical Feasibility
- Implementation requirements

d. Updating the Fuels Treatment Plan

Annual review of any fuels treatment plan will be incorporated with the review of this FMP and addressed at the Annual Fire Management Pre- and Post-Fire Season Adaptive Management Strategy Meetings. Any adjustments to Fuels Treatment plans will follow policy guidance as stated in Chapter 7-Fuels Management of the RM-18 and use the NPS Environmental Screening Form (ESF) to ensure new or updated projects remain in compliance with previously approved compliance documentation. If current projects specifications fall outside of previously approved compliance, a new compliance process will be initiated. Guidance for the appropriate action required may be obtained from park or regional compliance specialists and found in Director's Orders 12 .

4.5.2 General Fuels Management Implementation Procedures

See Appendix E – Multi-Year Fuels Treatment Plan for addition information.

a. Guidance

Prescribed fire planning and implementation will be in accordance with RM-18, Chapter 7 - Fuels Management.

b. Annual Actions

Spring

- Update the Five Year Treatment Plan to reflect fuels treatment accomplishments from previous fiscal year.
- Fuels Treatment Plan, including Five Year Treatment Plan, reviewed, updated and approved by Superintendent.
- Final submission National Fire Plan Operations & Reporting System (NFPORS) projects for next fiscal year.
- Compliance Review (PEPC) for current fiscal year projects.
- As appropriate, Prescribed Fire Burn Plans reviewed and completed.

Spring/Summer/Fall

- Implement approved/scheduled thinning, piling and/or pile burning projects.
- As necessary, field visits to potential future treatment sites, including cultural resources consultation.

Fall

- Fuel Treatment project reports completed.
- Submit into NFPORS projects for the next *three* fiscal years.
- After Action Review with Eastern Area Fire Staff, Park Unit Fire Coordinators and Superintendents regarding fuels treatment projects. (Note: This AAR is typically completed with the Post Fire Season Conference Call.)

- Notification of the coming fiscal year planned projects.

Winter

- Receive notification of receipt of NFPORS project funds and reprioritization of projects based on the receipt of funding.
- Update fire protection point status.
- Complete WFMI Fire Reports for completed Prescribed Fire Projects.

c. Implementation Standards

Activities proposed in the Fire Management Plan will be planned and implemented in accordance with Reference Manual 18, Chapter 7-Fuels Management, the Interagency Standards for Fire and Fire Aviation Operations and any applicable sections of the Alaska Statewide Master Agreement.

d. Planning & Reporting Requirements

Fuels **-** The GAAR FMO or delegate will be responsible for inputting proposed and completed projects for Gates of the Arctic National Park/Preserve into NFPORS. Project funds will be requested via NFPORS Treatments and Activities Module. NFPORS project requests will be uploaded into PDS by the FMPC by the date set in the current business rules of each year. The GAAR FMO will recommend and prioritize activities and treatments for funding based upon justification, effectiveness, collaboration, and probability of completion within the fiscal year.

Activity or treatment approval, along with line items, will be entered into the PDS Treatment Approval module by the FMO or delegate, no later than the date given in the current business rules. The RFMO will activate funding for treatment when funding is needed to initiate work and the probability of project completing is acceptable.

Rx Fire **-** The GAAR FMO will report the intent to conduct a prescribed fire by phone to the Regional Fire Management Office by 3:00 p.m. at least one day before a prescribed fire (notifications procedures are identified in the Burn Plan). The FMO or delegate will also notify the Tanana and /or Galena zone dispatch, specific individuals/ organizations/agencies identified in the burn plan, and the appropriate reporting dispatch office following the notifications procedures as identified in the Burn Plan prior to the burn and again upon its completion. The appropriate reporting dispatch office will submit the information to the daily situation report.

The GAAR Fire Management Officer will ensure that each prescribed fire is documented with the following items:

- Approved prescribed fire plan.
- Compliance and planning documents.
- Map of project and surrounding area.
- Monitoring data (including weather, fire behavior, and fire effects observations).
- Smoke dispersal information.
- DI-1202

Escaped prescribed fires within the Park/Preserve will follow protocols outlined in the Statewide AOP, Clause 28- Escaped Prescribed Fires. A WFDSS report will be initiated and the fire will be declared a wildfire and treated as such.

Monitoring reports and documentation will follow protocols defined in the Regional NPS Monitoring Protocols (Appendix F).

e. Monitoring

Prescribed fire and non-fire fuels treatment projects should be designed and implemented to meet the stated management objectives. Prescribed fire and non-fire fuels treatment monitoring should be developed based on the treatment objectives. The following guidance for monitoring prescribed fire and non-fire fuels treatment are described in RM-18 and summarized below:

Prescribed Fire Monitoring Required, RM-18, Chapter 8, 4.4.2 (2008)
"Data collected to determine the immediate or short-term effects of a fire or fire management activity, at a level sufficient to evaluate whether stated management objectives were achieved." **Note:** Plots are not required in each specific project, but the monitoring program should include representative data for each key vegetation and fuel complex with specific objectives (monitoring type) in the park prescribed fire program.

Non-fire Treatment Monitoring Required, RM-18, Chapter 8, 4.4.3 (2008)
"Non-fire fuels treatments must be monitored for pre- and post-treatment conditions at a level sufficient to determine whether the objectives of the treatment were met."

Monitoring objectives and methods are required component of the Prescribed Fire Plan and Fuels Plans for all projects. Monitoring should be designed to meet the objectives of each project and therefore the components of monitoring should be developed based on the project objectives. Guidelines for monitoring prescribed fires and mechanical treatments within GAAR are provided in Section 5.2 Monitoring and protocols for monitoring are provided in Appendix F.

f. Historic Treatment Map

There have been no fuel mitigation projects in Gates of the Arctic on record.

4.5.3 Prescribed Fire Treatments

a. Guidance

At present only site specific debris pile projects are planned to be treated using prescribed fire treatments in Gates of the Arctic. Future Prescribed fire use in the Park/Preserve may be considered when paired with mechanical fuel treatments to reduce fuels around critical fire sensitive resources within the boundary of the Park/Preserve. Any prescribed fire projects will adhere to Interagency Standards for Fire and Fire Aviation Operations Chapter 17, and the Interagency Prescribed Fire Implementation Procedures Reference Guide, as well as incorporate guidance from RM-18, Chapter 7-Fuels Treatments. Additionally, fire staff conducting the prescribed fire will adhere to all stipulations as outlined in the 2010 Statewide Master Agreement, Clause 22- Prescribed Fire and Fuels Management

b. Treatment Review

NPS staff involved in fuels treatments will utilize an adaptive management process to plan, implement, and evaluate the fuels management program. See RM-18, Chapter 7-Fuels Management for specific guidance.

4.5.4 Non-Fire Fuel Treatments

Currently non-fire fuels treatments projects for Gates of the Arctic are in the planning stage. The use of mechanical fuel treatments is a viable option for concerns regarding fire-sensitive resources in the Park/Preserve.

a. Guidance

The planning and implementation of non-fire fuels management projects will be in accordance with Reference Manual 18, Chapter 7- Fuels Management and Chapter 8- Fire Ecology and Monitoring.

b. Planning

Planning efforts for Non-Fire fuels treatments will be in accordance with requirements described in RM-18, Chapter 7 Section 6 - Non-Fire Fuels Treatment. A non-fire treatment plan template is available in RM-18.

c. Treatment Review

Post treatment reviews will be an integral part of the continuation of fuels treatments. An AAR style approach will be taken regarding each project receiving treatment during the field season. Fire staff will provide monitoring data and analysis, digital photographs, and appropriate maps to Park Management and Regional Fire staff to aid in the evaluation process. Chapter 5.0 – Adaptive Management of this plan describes in detail the adaptive management process. See Section 4.5.2 Annual Action for Post Fire Season Review.

4.6 Prevention, Mitigation & Education

The effectiveness of prevention and mitigation efforts is highly dependent on the education of the appropriate audience. The NPS will make every effort to inform the public on all issues pertaining to wildland fires in Alaska and specifically, Gates of the Arctic National Park/Preserve. Emphasis will be placed on the responsible use of fire to minimize unwanted human ignitions and the acceptance of lighting ignitions and their role in the ecosystem in which people live. Interagency cooperation will be used, to the greatest reasonable extent, to ensure a unified message is being sent to all Alaskan's. See Appendix H for the communication and education plan.

4.6.1 Prevention/Mitigation

Historically, the number of fire starts and acres burned has varied in Gates of the Arctic National Park/Preserve. Fire starts in this region of the state are an annual occurrence. When significant drying conditions exist and burning conditions are optimal for large fire growth, the Eastern Area Fire Management officer will notify the Agency Administrator, or delegate, of the wildfire conditions. Management staff at Gates of the Arctic will utilize the fire communication and education plan to educate local residents, visitors and park employees of the dangers of the present fuel conditions. See Appendix H for the communication and education plan. See Appendix S.1 for fire history graphs.

4.6.2 Communications/Education

Mission: To proactively support the Alaska NPS Wildland Fire Management Program through a comprehensive communication and education program that emphasizes wildland fire management and the role of fire in ecosystems.

A. Program Capabilities

Gates of the Arctic is committed to providing high-quality, proactive and coordinated fire communication and education to internal and external audiences. Park staff, Eastern Area Fire Management Program and the regional fire communication and education specialist (RFC&E) in concert will work together to provide effective information and education. The RFC&E provides leadership in and coordinates internal and external fire communication and education programs to present a proactive, integrated, interdisciplinary fire program. The RFC&E coordinates and collaborates with the parks.

1. Contact List

Contact the Gates of the Arctic National Park/Preserve (GAAR) Fire Management Officer (FMO) for a list of the current fire staff. For current information about agency leadership, local emergency responders, clinics, neighbors, local, regional, tribal officials, local schools, researchers and community members, contact the GAAR headquarters or the chief of interpretation based in Fairbanks, AK. An Alaska media contact list is located at http://inside.nps.gov/regions/region.cfm?rgn=1822&lv=3. GAAR specific target audiences are also listed in the GAAR fire communication plan located in Appendix H.

2. Materials

Eastern Area Fire Management Program maintains a cache of NPS and interagency fire brochures such as Wildland Fire in National Parks, Firewise Alaska, Smoke and Fire in Alaska, Safe Burn Barrels and Safe Campfires. Contact the GAAR FMO for materials. Download Alaska interagency brochures at http://www.nps.gov/akso/nature/fire/LearningCnt.cfm . General fire management print-on-demand documents are located at http://fire.ak.blm.gov/administration/awfcg.php. Information about wildland fire key messages and non-personal communication methods is in the GAAR fire communication plan, located in the appendix. Contact the chief of interpretation for information about the GAAR wildland fire education trunk that contains curriculum, books and videos.

3. Press kit

This package is put together for the media, generally for a specific event/incident. It should include, at a minimum, a news release about the incident, fact sheets, incident maps, the park brochure or park newspaper, wildland fire brochures and additional information reporters might need (a map with telephone and power outlets highlighted, for instance, if they are actually at headquarters). Since having a reporter at the park to cover an incident is a good chance to tell a broader story, a press kit is also a good vehicle to include recent park news releases, story tips, materials on other park events and partnerships.

4. Online Resources

Visit the communicator's toolbox on InsideNPS http://inside.nps.gov/regions/region.cfm?rgn=1822&lv=3 for wildland fire communication tools and templates. Valuable resources are grouped under the following topics:

- Wildfire Ignites in Park
- Fuels Project in Park
- Best Practices

- Communicating the Message
- Fire Displays Available for Loan
- PIO Resources
- Templates

Gates of the Arctic has a "current fire information" webpage that is part of the park website. Within 24 hours of a fire igniting at a unit, the park web manager will activate the current fire information page and the public will access it from the park's homepage. Fire staff or a PIO will write consistent and timely content for the page, and send the information to the park web manager for posting. Fire staff or a PIO will also upload current fire information, photos, and maps to InciWeb, an online portal for fire information. A link to InciWeb is located on the park current fire information webpage. Current fire information webpage standard operating procedures are located at http://classicinside.nps.gov/documents/20130411_Incident_WEB-SOP.pdf.

GAAR will share fire information via the park Twitter and Facebook pages. The region will share the same fire information via Alaska national parks Facebook and Twitter accounts. The region also maintains a Flickr account where fire photos will be posted. A link to Flickr is located on the park current fire information webpage. A link to GAAR's current fire information will be at http://www.nps.gov/akso/nature/fire/fires.cfm. Finally, the RFC&E coordinates with the wildland fire interagency community to ensure fire information is shared on fire.ak.blm.gov.

Other important online resources include:

- http://www.nps.gov/gaar
- http://www.nps.gov/akso/nature/fire
- http://fire.ak.blm.gov

B. Information Officer Step-Up Plan

In many Alaskan towns and villages, residents are more familiar with wildland fire than with NPS employees. Some AK NPS employees are not familiar with wildland fire and park staffs may not have experienced wildland fire events during their tenure in Alaska. Furthermore, Public Information Officers (PIO) may be unfamiliar with Alaska wildland fire behavior and management and may require some assistance from AK NPS fire management staff. It is of utmost importance to keep these factors in mind while assessing the need for a PIO.

A wildland fire ignites on National Park Service land and AK NPS fire management and protection organizations initiate the appropriate response based upon the Alaska Interagency Wildland Fire Management Plan and NPS policy. During this process, AK NPS fire management and park staff must anticipate fire and smoke events and distribute information to internal and external audiences before the events impact them. Consider PIO assistance when:

Sizing Up the Fire

- Fire threatens life, property and/or cultural resources
- Many large or small fires throughout the area

- Fire or smoke visible from town
- Fire moves towards a town or village
- Smoke impacts health or transportation in town, village or throughout the area
- Fire triggers media interest

Evaluating AK NPS Fire Management

- Fire management staff anticipates not being able to, or cannot accomplish fire related outreach needs.
- Internal and external communication methods such as news releases and the park current fire information web page no longer fulfill the needs of the incident.
- NPS fire management staff receives more calls or comments of concern regarding the management of the fire than they can sufficiently handle.

Evaluating AK NPS Employees

- NPS staff anticipates not being able to, or cannot accomplish fire related outreach needs.
- Internal and external communication methods such as news releases and the NPS Fire News website (http://www.nps.gov/fire) no longer fulfill the needs of the incident.
- NPS staff receives more calls or comments of concern regarding management of the fire than they can sufficiently handle.
- NPS staff cannot adequately respond to the number of information requests from residents, visitors and other park staff.
- NPS staff voice concern about wildland fire management.
- NPS employees or in particular, key staff members, are unfamiliar with the AK wildland fire management program and wildfire in the boreal forest or tundra.

Evaluating the Community

- Community vocalizes concern about the management of the fire.
- An incident of this nature has not recently occurred in this area.
- Community (at large) is unfamiliar with wildland fire and smoke thus reacts to it in either a negative or positive manner.
- Fire management activities or smoke impacts the community for more than a few days.
- Incident affects the economic viability of the community.
- Community has negative opinions about the NPS or government.
- Similar incidents occurred in the area and community members were affected in a negative way and still harbor and vocalize those emotions.
- Health impacts occur and/or evacuations are planned for or initiated.
- Incident directly affects the community. Such as:
  - Threat or perceived threat to personal property or welfare
  - Impacts planned events
  - Creates resource management issues
  - Their quality of life
  - Effects on their value systems
- Incident will impact the common thread that holds the community together. Such as:
  - Hunting grounds, berry picking opportunities, recreational areas, natural beauty of the surrounding areas

During a fire incident that warrants a PIO, things AK NPS fire management, PIO and park must do in order to be successful:

- Listen, listen, listen to internal and external audiences.
- Make personnel available to answer questions.
- Actively seek out leaders in the community such as Village Councils, Tribal Council and Community Elders to communicate with.
- Ensure the community hears it from NPS or involved agency first.
- Evaluate the most effective means of communicating to residents, for example, local radio station, newspaper, Alaska Rural Communication System Involve community members when giving out information.
- Continually assess community information needs.
- Work closely with all affected agencies (other land managers and protection organizations).

A PIO can be informally requested or resource ordered. Situations that may warrant an informal request include:

- NPS employee where incident occurs is available and the workload does not warrant a full-time PIO.
- AK NPS Regional Fire Communications Specialist is available because this person is considered a local NPS resource.

Situations that may warrant a resource order include:

- FMO must look for assistance outside of park/preserve experiencing fire incident
- Workload demands a full time PIO.
- Size or complexity of the incident exceeds the experience, training or capabilities of the local NPS employee/PIO.
- Size of the information staff needed exceeds the capabilities of the local PIO.
- When local conditions (political or social) indicate that a non-local PIO may have more success in delivering pertinent fire related messages.

If and when it is determined that an Information Officer is needed, there are several potential candidates to choose from. A suggested prioritization of available Information Officers is listed here:

1. AK NPS employee where incident occurs
2. AK NPS employees
3. AK NPS Regional Fire Communications Specialist
4. AK agency employees and/or residents
5. NPS or other agency employees

The AK NPS fire management officer has the discretion to select a PIO1, PIO2, PIOF, or trainee for the fire incident. The size and complexity of the fire incident often foretells what type of PIO is needed.

Once the PIO arrives, encourage him/her to seek out support from local NPS employees, agency employees, community members and the AK NPS regional fire communication and education specialist. AK NPS fire management staff should continue to provide information about the fire to the best of their ability and as needed by the PIO in order to fulfill the information needs of the community, visitors, news media, partners and park

staff. AK NPS employees should be strongly encouraged to participate in information activities as they are initiated by the PIO.

- GAAR leadership and staff, fire management officer and staff, and regional fire communications and education specialist will work together to effectively inform and educate NPS employees and the public about the fire management program, the role of fire in the environment, fuels management and the Firewise program..

During ongoing fires, park staff and the RFC&E will share fire information dissemination responsibilities. Read the wildfire information plan at http://inside.nps.gov/regions/region.cfm?rgn=1822&lv=3 for more information. If an Incident Management Team is deployed to manage a fire that affects GAAR, NPS information personnel will interact with and support the team's Public Information Officer.

4.7 Air Quality/Smoke Management

4.7.1 Air quality issues

All fire management actions at Gates of the Arctic National Park and Preserve will be conducted in full compliance with local, state, and interstate air pollution control regulations as required by the Clean Air Act, 42 U.S.C. 7418. The Alaska Department of Environmental Conservation issues open burning permits. The National Park Service has been an active participant with the Alaska Department of Environmental Conservation in the development of the Alaska Smoke Management Plan. The optimal goal of a smoke management plan and program is to protect public health and the environment while allowing for reasonable resource management (e.g., fires in the Limited Fire Management Option and prescribed fires). Addressing smoke management concerns is a critical component of a Prescribed Burn Plan and the Wildland Fire Decision Support System.

Wildfire smoke could impact local towns and villages in the surrounding area. Appropriate air quality advisories will be issued to effected communities in accordance with the interagency Smoke Education Communication Strategy policy.

Regional Haze Program

No class one airsheds exist in Gates of the Arctic National Park and Preserve or this portion of the state.

It is recognized that fire and its associated smoke is a part of the natural condition in Alaska and complexities such as differentiating transport of smoke and dust from Russia, China, Canada and other Northern European countries need to be quantified. A copy of the current Regional Haze Program is available from the DEC.

EPA Tile 18, Chapter 50: Air Quality Control Section 50.030 (State Air quality Control Plan) is the current compliance document in effect in the state of Alaska.

4.7.2 Smoke Management Program

Smoke assessments are the responsibility of both the Jurisdictional and Protecting agencies. The need for air resources advisors is increasing and additional technical expertise for addressing air quality and health related issues may be available through the Alaska Department Environmental Conservation (ADEC). The ADEC is the regulatory agency responsible for air quality and smoke management in Alaska and is represented on the AWFCG.

The AWFCG approved Smoke Effects Mitigation and Public Health Protection Protocols strive to explain the inevitable presence of smoke during the Alaska fire season. The protocols give detailed guidance to the agencies relevant to information dissemination to the public and other agencies about forecast and current smoke management concerns.

Current smoke information and forecast, regulations, advisories, and educational materials are available at the ADEC website. The ADEC also issues open burning permits. These permits are required prior to the use of any pre-planned ignitions

The Alaska Enhanced Smoke Management Plan for Planned Fire (ESMP) was developed by ADEC in coordination with the AWFCG Air Quality and Smoke Management Committee of which the NPS is an active participant. The optimal goal of a smoke management plan and program is to protect public health and the environment while allowing for reasonable resource management (e.g., fires in the Limited Fire Management Option and prescribed fires). Addressing smoke management concerns is a critical component of a Prescribed Burn Plan and wildland fire planning efforts and decision support systems (WFDSS). The ESMP and its appendices are available online.

All fire management actions at Gates of the Arctic National Park and Preserve will be conducted in full compliance with local, state, and interstate air pollution control regulations as required by the Clean Air Act, 42 U.S.C. 7418.

4.8 Data & Records Management

Immense investments of time, effort and finances go into obtaining fire information needed for federal reporting purposes, thus it is imperative that the data be preserved, safeguarded and permanently archived accordingly. NPS reference manual 18 clearly states the data's many purposes in the dialogue below.

"Information collected is important data used in long-range wildland fire planning, operational decisions, general information reporting, and programmatic performance analysis. It is imperative that the park collect, record, and input wildland fire data accurately and promptly and store permanent records accordingly. The data contained in the wildland fire reporting system is frequently requested and used to fulfill a number of queries from interested members of the public, lawmakers, and researchers – all who rely on the accuracy of the reports." (NPS, RM-18)

All reporting will be annually established by NPS Fire Business Rules. Further guidance pertaining to fire reporting and associated details is available in Chapter 11 of RM-18. Copies will be provided to Gates of the Arctic National Park and Preserve NPS managers as requested.

Fire/Fuels/Budget Submission and Reporting

WFMI Fire Reports

The NPS Wildland Fire Report is the standard format for submission of fire data into the Department of Interior Wildland Fire Management System (WFMI). The AFS Protection Zone Fire Management Officer will take the initial information, verify all information contained in the report is correct, and complete a hardcopy Wildland Fire Report. An electronic Fire Report is provided to the Regional Fire GIS Specialist for review and inclusion into the nationally DOI maintained WFMI Database. The Alaska Eastern Area FMO will ensure prescribed fires, false alarms and support actions are entered into the WFMI Database through the process described above. BLM Alaska Fire Service will maintain the original Protection Agency fire reports in their office in Fairbanks, Alaska. Final NPS Fire reports reside at the offices of The Alaska Fire Service in Ft. Wainwright, Alaska.

WFDSS Decision Document

Following the national direction, the Wildland Fires Decision Support System (WFDSS) is utilized to document decisions regarding the management of individual ignitions. The current national policy for the National Park Service as well as all agencies in the State of Alaska is to use the Wildland Fire Decision Support System (WFDSS) and analysis tools such as FARSITE, FlamMap, and FSPro. A hardcopy fire report will be filed at the Gates of the Arctic Fire Management office in Fairbanks, Alaska.

NFPORS Reporting

Fires with resource benefit objectives, prescribed fire, fuels treatments and fuels activities will be entered in the National Fire Plan Operations and Reporting System (NFPORS).A hardcopy fire report will also be filed at the Gates of the Arctic Fire Management office in Fairbanks, Alaska. Reporting timeliness will remain in compliance with standards specified in Chapter 11 of RM-18 and NPS Fire Business Rules.

Fuels Project Planning and Report

The GAAR Assistant Fire Management Officer will ensure fuels project planning and final report preparation, content and format will follow RM-18, Chapter 7 specifications.

Readiness Review Documentation

Complete Readiness Reviews (Checklists) annually. This documentation is internally completed by Area program overhead with oversight by GAAR FMO. Area completed checklists (with annotations/findings that Regional Office can work from support-wise) will be posted on the AK Regional shared network "Wanshare" for given year. Alaska Regional FMO will archive locally at ARO. Gates of the Arctic will archive documentation at FAC, Fairbanks, Alaska. Readiness reviews should be completed before June 15, preferably sooner.

Program Review Documentation

Area Program Reviews are to be completed every 3 years. The Program Review is intended to be completed by the Alaska Regional Office, Gates of the Arctic Fire Management Program, and potential interagency personnel. Program review documentation, findings and recommendations will be posted on the AK Regional shared network "Wanshare". Alaska Regional FMO will archive locally at ARO. GAAR will archive documentation at FAC, Fairbanks, Alaska.

Budget Submission/Reporting

Line item requests (additional staffing, fire facilities, construction/improvements, etc.) are identified by the Park Unit and Alaska Eastern Area Fire Management Officer and submitted to the AK Regional Fire Management Officer. Fuels Management related project funding is primarily identified in the five year fuels plan and requested through the NFPORS planning process annually. See annually established NPS Fire Business Rules (NPS Wildland Fire and Aviation Financial Management Guide).

Compliance Submission/Reporting

Alaska Eastern Area Fire Management Officer or delegate annually submits project compliance documentation through the Gates of the Arctic People Environment Public Comment (PEPC) system. Timelines are established annually by the GAAR compliance specialist. Typically PEPC submission must be complete by April 15.

Research Permit and Reporting System

When research permits are required, the Alaska Eastern Area Fire Management Officer will be the lead to ensure that the electronic Research Permit and Reporting System procedures and reporting requirements are submitted.

Geographic Information Systems

Point locations of fires affecting Gates of the Arctic National Park and Preserve will be available as a GIS dataset stored in the NPS Alaska Region's GIS Permanent Data Set. The Regional Fire GIS Specialist is responsible for updating this layer on an annual basis. Final fire perimeter polygons will be housed in the interagency statewide polygon fire history layer (maintained by the BLM Alaska Fire Service) as well as any NPS agency specific polygon fire history datasets. The Regional Fire GIS Specialist is responsible for insuring that final fire perimeters are incorporated into these datasets and for insuring that current versions of these datasets are available through the Alaska Region's GIS Permanent Data Set.

NPS/USGS Burn Severity

For fires greater than 500 acres in size, a burn severity assessment will be completed following the protocols of the NPS/USGS Burn Severity Mapping Project and/or the Monitoring Trends in Burn Severity Project. These projects map the burn severity of wildland fires using pre- and post-fire Landsat satellite imagery. In general either an Initial Assessment (immediately post fire) or an Extended Assessment (1 year post fire) will be completed for each fire. Once the assessments are completed, burn severity data will be available for download from the Monitoring Trends in Burn Severity Project website (http://www.mtbs.gov/). The Regional Fire GIS Specialist is responsible for requesting burn severity assessments for Alaska NPS fires and for incorporating burn severity GIS data deliverables into the NPS Alaska Region GIS Permanent Data Set.

Table 7: Reporting Requirements and Responsibility

Action	Responsible Party	Annual Deadline
Annual FMP Review	Area FMO or Delegate	June 1
Incident Reporting (Final Final Report)	Area FMO and BLM AFS- Galena or Tanana Zone (Protection Agency)	October 31
WFMI Reporting	Area FMO or Delegate and AK	October 31

	Regional GIS Specialist	
WFDSS Decision Document	Superintendent or Delegate	Redbook
NFPORS	Area FMO or Delegate and FPMA	NPS Fire Business Rules
Fuels Treatment Plans	Area AFMO or Delegate	RM-18, Chapter 7
Readiness Review	Area AFMO or Delegate	June 15
Program Review	AK Regional FMO	Tri-Annually
Budget Submissions	AK Regional FMO	NPS Fire Business Rules
Compliance Submission	Area AFMO or Delegate	Approx. March
Research Permit and Reporting System	Area FMO or Delegate and Principle Investigator	TBA
Annual Report	Area Fire Program Management Assistant (FPMA)	TBA
Program Accomplishments	Area FMO or Delegate	NPS Fall Fire Review (October)

4.9 Organizational & Budgetary Parameters

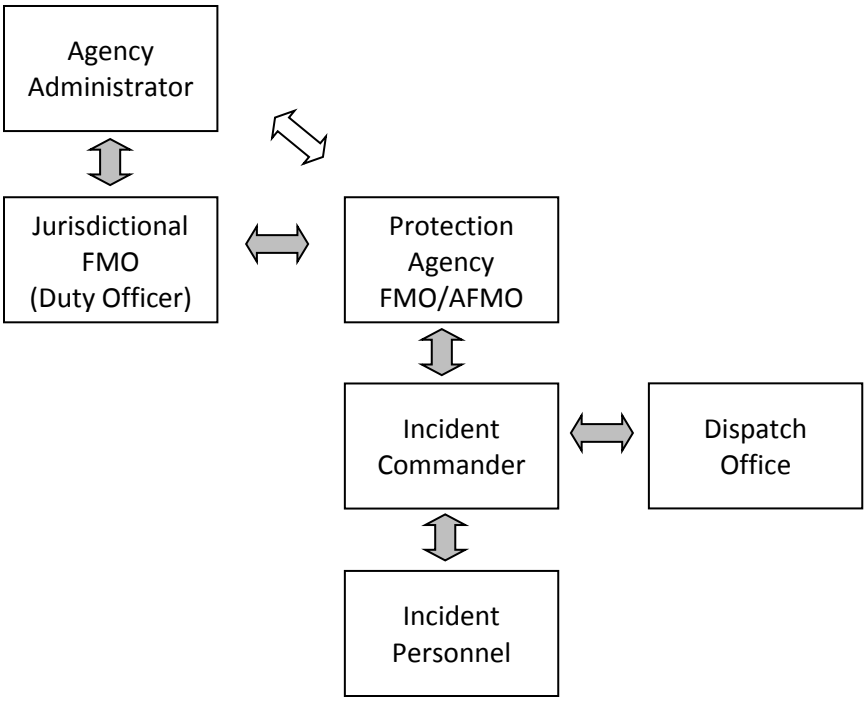
Alaska Interagency Cooperation and Organizational Structure

To ensure safe and efficient operations, a basic understanding of the cooperative relationship between the NPS fire management program and the other land management agencies in Alaska is imperative for all personnel. Departmental Manual 620 Chapter 2 describes the consolidation of wildfire suppression services for all Department of Interior Lands in Alaska under the Bureau of Land Management. The 2010 AIWFMP, 2011 Alaska Statewide Master Agreement and its associated AOP as well as the 2011 Alaska Interagency Mobilization Guide work together to describe the consolidation and coordination of wildfire suppression services for all lands in Alaska.

According to aforementioned documents, the BLM Alaska Fire Service -- Galena and/or Tanana Zone provides suppression services and maintains operational control for implementing wildfire suppression tactics on Gates of the Arctic National Park/Preserve administered lands. It is the duty of the GAAR staff together with the NPS GAAR Fire Management Officer to ensure that all suppression services contribute to the achievement of the management goals of the Park/Preserve as well as that of the National Park Service. See Figure 7 below regarding Gates of the Arctic National Park and Preserve Fire Management and the Protection Agency for coordination on Incidents.

Figure 7: Gates of the Arctic National Park/Preserve and BLM AFS Galena or Tanana Zone Coordination

Communication Flowchart



NPS General Organizational Structure

The GAAR Fire Management Program is coordinated by a co-lateral duty FMO based in Fairbanks. The FMO administers fire programs in Yukon-Charley Rivers National Preserve, Wrangell St. Elias National Park and Preserve and Gates of the Arctic National Park and Preserve. In all fire management related activities with the GAAR, the GAAR FMO reports to the Superintendent.

The NPS develops the strategic objectives and direction on how a wildfire will be managed and communicates the objectives and direction to the Protection Agency. The AEAFM Duty Officer, typically the Fire Management Officer, serves as the liaison for wildfire suppression services between the Superintendent and the Protection Agency Fire Management Officer.

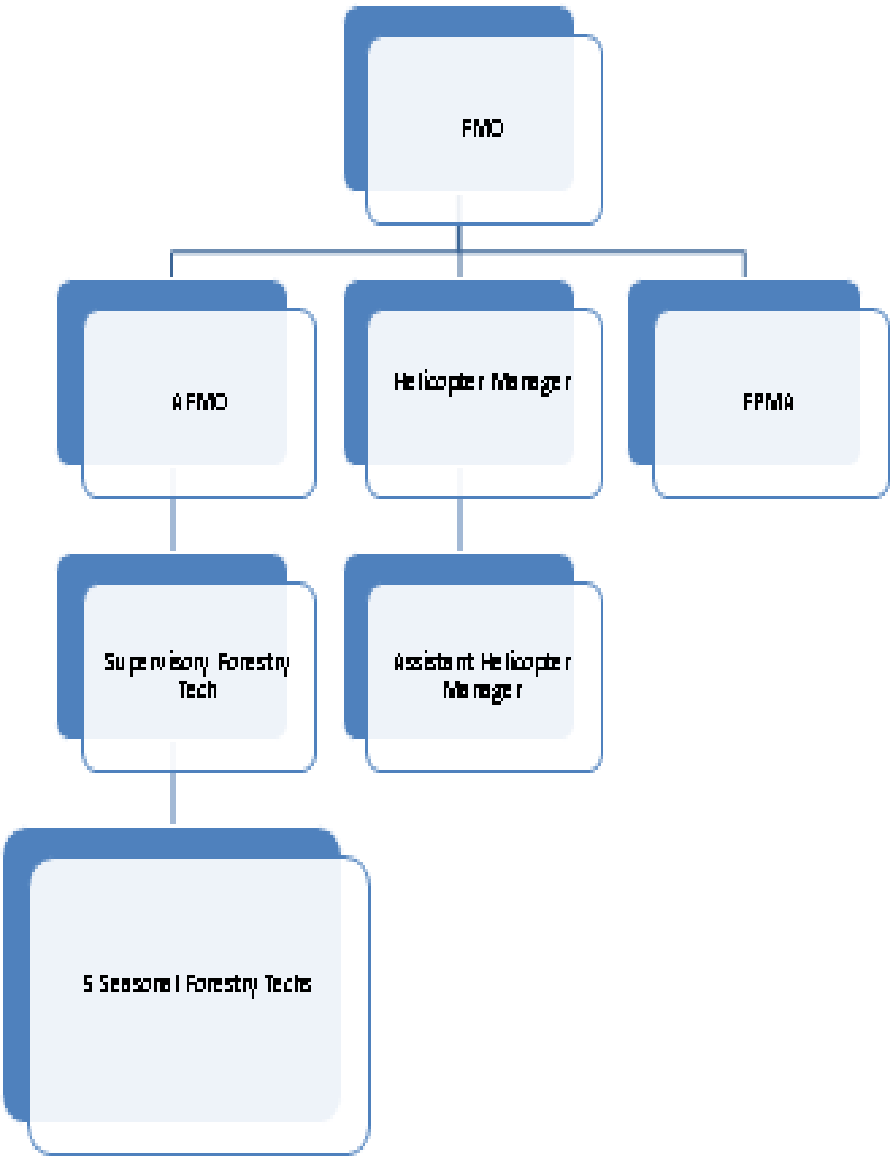
Necessary fire related project work, fire research and additional monitoring mandated by NPS policy will be coordinated from the NPS Gates of the Arctic Fire Management Office as warranted.

An Agency Administrator will be designated for each incident at Gates of the Arctic. The Agency Administrator will function as the direct representative of the Park/Preserves' Superintendent and as such will be responsible for the identification and accomplishment of GAAR and NPS resource management goals. The Agency Administrator will prepare, in consultation with the NPS Area FMO and suppression FMO, and sign key decision-making and validation documents (e.g., WFDSS). The Agency Administrator may also request that additional personnel be ordered to assist specifically with the accomplishment of GAAR and/or NPS goals (e.g., resource advisors, monitors, fire behavior analysts, etc.).

Figure 8: Alaska Eastern Area Fire Management Organization

ALASKA NPS EASTERN AREA FIRE MANAGEMENT

Gates of the Arctic National Park and Preserve
Yukon-Charley National Preserve
Wrangell St. Elias National Park and Preserve



Duty Officer

An NPS duty officer is assigned at all times during the summer season when fire potential exists. The duty officer for Gates of the Arctic National Park and Preserve is routinely the GAAR FMO. When the FMO cannot fulfill the role of the duty officer, the Assistant FMO or previously established, with an approved delegation of authority, GAAR lead fire management staff will be assigned in the order listed below.

1. Assistant Fire Management Officer
2. Helicopter Manager
3. AK NPS Regional FMO
4. Assistant Helicopter Manager
5. Supervisory Forestry Technician

The order of contact is communicated to the Protection Agency dispatch offices annually and updated with current contact information. The Fire Program Management Assistant is included in the contact list to assist as necessary, though not in the duty officer role.

The FMO may assign the duty officer position to any fire management position, including detailed support positions, as necessary in his/her absence to balance meeting the needs of the each park unit's fire program without compromising safety provided an approved delegation of authority exists from the Superintendent. The Duty Officer serves as the liaison between the Gates of the Arctic National Park and Preserve Superintendent and the appropriate Protection Agency Officer (i.e., BLM Alaska Fire Service, Galena or Tanana Zone) on all wildland fires in the GAAR.

The duty officer oversees and documents fire operations in the Park/Preserve and does not function in any ICS role during their role as duty officer. The primary role of the NPS duty officer is to ensure compliance of NPS policy on incidents within the Park/Preserve. They also serve as a vital communication link between park management and the Protecting Agency. See Section 4.3 Management of Unplanned Ignitions for specific procedures/activities the Duty officer will follow once notified of a fire within the Gates of the Arctic National Park/Preserve.

Similarly, the protecting agency will also have a duty officer assigned. More duty officer functions can be found in Ch. 3 of the *Interagency Redbook*. Primary responsibilities of the BLM Alaska Fire Service – Galena and Tanana Zones are to coordinate and prioritize suppression actions and resource allocation to meet the strategic objectives as identified by the Jurisdictional Agencies.

Cooperation with Alaska Fire Service

In order to ensure safe and efficient operations, a basic understanding of the cooperative relationship between the GAAR fire management program and the BLM-Alaska Fire Service (AFS) is imperative for all personnel. As specified in the Alaska Interagency Wildland Fire Management Plan, the 2010 Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement and the 2010 Alaska Statewide Annual Operating Plan, the Alaska Fire Service is responsible for providing fire suppression services on all wildland fires occurring within GAAR. The management and staff of Gates of the Arctic National Park and Preserve, in turn, will ensure that all suppression services contribute to the achievement of the management goals of the

Park/Preserve and the National Park Service, and to the greatest extent possible support suppression efforts as required.

Additional Resources

Gates of the Arctic National Park and Preserve may use personnel to assist in information collection above and beyond the information provided by AFS. These personnel may work directly for the NPS Fire Management Officer or, when an Incident Commander is assigned, directly for the IC. The NPS Fire Management Officer and the suppression agency FMO will work together to determine the chain of command for these individuals.

Agency Administrator

An Agency Administrator will be designated for each incident at Gates of the Arctic. The Agency Administrator will function as the direct representative of the Park/Preserve's Superintendent and as such will be responsible for the identification and accomplishment of GAAR and NPS resource management goals. The Agency Administrator will prepare, in consultation with the NPS Area FMO and suppression FMO, and sign key decision-making and validation documents (e.g., Wildland Fire Implementation Plan and Wildland Fire Situation Analysis components). The Agency Administrator may also request that additional personnel be ordered to assist specifically with the accomplishment of GAAR and/or NPS goals (e.g., resource advisors, monitors, fire behavior analysts, etc.).

Incident Command Structure

For incidents at Gates of the Arctic, resource advisors will report to the Planning Section Chief as per NWCG specifications for Incident Command structure. Other personnel requested specifically to assist with the accomplishment of agency or Park/Preserve resource management goals (e.g., monitors, fire behavior analysts, fire-use module personnel, etc.) will normally report to the NPS Fire Management Officer. Affected personnel will be briefed on contingent procedures and alternative chain of command for situations in which the FMO departs the incident or falls out of regular contact.

In summary, NPS personnel may participate in fire management operations within the Park/Preserve in two distinct ways:

1. NPS employees may work to help ensure the achievement of Park/Preserve management goals under the supervision of the Fire Management Officer (or the Planning Section Chief, in the case of NPS personnel serving as resource advisors). For example, an NPS employee working as a monitor in support of the fire use validation process would typically report to the Park/Preserve FMO; a GAAR staff member advising an incident command team on the presence of sensitive resources would report to the Planning Section Chief.

2. NPS employees may serve directly with operational forces (or other branches of command) assigned by the Alaska Interagency Coordination Center, under supervisors provided by the AFS or ordered through the interagency mobilization system. For instance, a GAAR employee assigned to assist smokejumpers during line construction on a small wildland fire might report directly to a jumper-in-charge dispatched from Fairbanks.

GAAR employees dispatched directly by the Park/Preserve may occasionally serve as interim Incident Commanders, as qualified, on GAAR incidents. These rare instances will be in consultation with the suppression FMO. In most cases, however, operations will be conducted from the outset by the AFS, with GAAR managers focusing on the identification and achievement of resource management goals and the conduction of monitoring efforts when necessary.

Fire Management Responsibilities for GAAR Personnel

In light of the interagency nature of fire management actions at GAAR as well as the co-lateral nature of the Park/Preserve's assigned FMO and fire crew, fire management responsibilities for individual employees are best explained in two steps. All personnel at GAAR have predetermined responsibilities within the Park/Preserve's fire management program; these fixed responsibilities are shown in Table 8 below. For specific incidents, however, specific functions will be filled by any one of several appropriate personnel. These incident specific functions, their organizational structure, and lists of personnel who may perform them are shown in Figure 9.

Relation of Fire Management Program to GAAR Organization

The GAAR Fire Management Program is coordinated by a co-lateral duty FMO based in Fairbanks. The FMO administers fire programs in Yukon-Charley Rivers National Preserve, Wrangell St. Elias National Park and Preserve, and Gates of the Arctic National Park and Preserve.

Area Fire Management Officer – Oversight of all aspects of the fire programs for the Eastern Area Parks including; coordination of fire management strategies between the Eastern Area Park Superintendents and the Protection Agencies, coordination and preparation of wildland fire decision documents, and keeping Eastern Area Park Superintendents informed and engaged in the fire organization.

Assistant Fire Management Officer (Wildland Fire Operations Specialist) – Supervises the daily operations of the area fire program. Assists the Area FMO in oversight and coordination responsibilities. In the absence of the Area FMO, the Assistant FMO will assume all responsibilities of the Area FMO in an acting capacity. Assists as directed in all aspects of the area fire program.

Fire Program Management Assistant – Provide administrative and budgetary expertise to the fire program. Assists in the administrative duties in planning and reporting for the program and works to minimize the administrative burden on the rest of the area fire program staff.

Helicopter Manager – Provides leadership to the aviation portion of the area fire program. Leads, manages and administers the Fire Exclusive Use helicopter contract for the area fire program. Assists in the staffing of the NPS Southeast Region Contract Helicopter, based at Great Smokey National Park, between January through May. The helicopter manager will assume the AFMO responsibilities in the absence of the AFMO. Assists as directed in all aspects of the area fire program.

Assistant Helicopter Manager – Assists the Helicopter Manager is all duties as stated above. Assists the Supervisory Forestry Technician with hazard fuels projects. In the

absence of the Helicopter Manager assumes the Helicopter Managers responsibilities. In the absence of the Supervisory Forestry Technician assumes the supervision of the five person fuels/helitack crew. Assists as directed in all aspects of the area fire program.

Supervisory Forestry Technician – Hires and supervises the five person fuels/helitack crew. Responsible for hazard fuels project planning and implementation. Assists as directed in all aspects of the area fire program.

Table 8: Predetermined Fire Management Responsibilities

Position:	**Superintendent**
Fire management role:	The Superintendent of Gates of the Arctic National Park and Preserve is responsible for the planning and direction of all Park/Preserve activities and programs and as such is ultimately responsible for any wildland fire operation at GAAR. The Superintendent may, however, choose to delegate any or all fire management responsibilities to appropriate personnel (e.g., Fire Management Officer, Chief of Operations, etc.).
Specific responsibilities:	• Approves Limited Delegation of Authority and provides briefing and evaluation of Incident Management Teams. • Serves as Agency Administrator unless delegated. • Approves management of fires to meet resource objectives. • Approves prescribed fire plans. • Approves mechanical hazard fuel reduction plans. • Approves use of retardant and/or heavy equipment in non-life-threatening wildland fire situations. • Participates in all official fire reviews. • Participates in NWCG functions as qualified.
Position:	**Chief of Operations**
Fire management role:	The Chief of Operations is the on-scene supervisor for all Park/Preserve operations.
Specific responsibilities:	• Provides guidance to the FMO in fire management issues pertaining to GAAR. • Participates in all official fire reviews. • Participates in NWCG functions as qualified.
Position:	**Fire Management Officer**
Fire management role:	The FMO oversees and coordinates the Park/Preserve's fire management program. The Park/Preserve's FMO is currently based in Fairbanks and administers two other Fire Management Programs. Responsibilities listed below may be delegated to appropriate personnel (including, typically, the Chief of Operations, fire staff, and AFMO).
Specific responsibilities:	• Works with Incident Commander, Zone FMOs, and suppression organization personnel. • May serve as Agency Administrator for GAAR incidents when feasible. • Ensures that GAAR Superintendent/staff and key AFS personnel are informed of pertinent conditions and/or situations. • Works with GAAR staff and AFS zone managers to determine and adjust boundaries and strategies for GAAR FMUs. • Prepares Prescribed Fire Plans. • Prepares Mechanical Fuel Reduction Plans. • Represents Region and Park/Preserve on taskforces and in agency and interagency training. • Ensures the education of Park/Preserve staff on fire management issues.

- Participates in all official fire reviews.
- Prepares and maintains fire records and reports.
- Prepares funding proposals and manages the Park/Preserve's fire accounts.
- Manages the Park/Preserve's fire cache and coordinates acquisition of supplies.
- Ensures qualifications of staff.
- Serves as liaison with regional office staff.
- Ensures Federal Fire Policy is followed.
- Participates in NWCG functions as qualified.

Position	**Chief of Resource Management**
Fire management role:	The GAAR Chief of Resource Management functions as the primary resource advisor for all fire management activities at the Park/Preserve.
Specific responsibilities:	• Advises GAAR Superintendent on approval of prescribed fire and mechanical reduction plans. • Advises Agency Administrator on managing fire for resource benefit. • Advises Agency Administrator and Incident Commander/overhead team of location and sensitivity of significant resources during wildland fire incidents. • Participates in all official fire reviews. • Assists with the development of fire management objectives. • Participates in NWCG functions as qualified.

Position	**Regional Communication/Information/Prevention Specialist**
Fire management role:	The Regional Fire Communication/Information/Prevention Specialist is responsible for informing and educating media, visitors, and residents within and around the Park/Preserve about all fire management goals, objectives, and actions.
Specific responsibilities:	• Develops and coordinates on-going programs for educating the public about the area's fire ecology and the Park/Preserve's fire management program. • Develops and coordinates a "step-up staffing plan" for disseminating information during large or complex incidents. • Informs public of current fire situation. • Participates in NWCG functions as qualified. • Coordinates with AFS on prevention efforts. • Coordinates with AFS on information distribution.

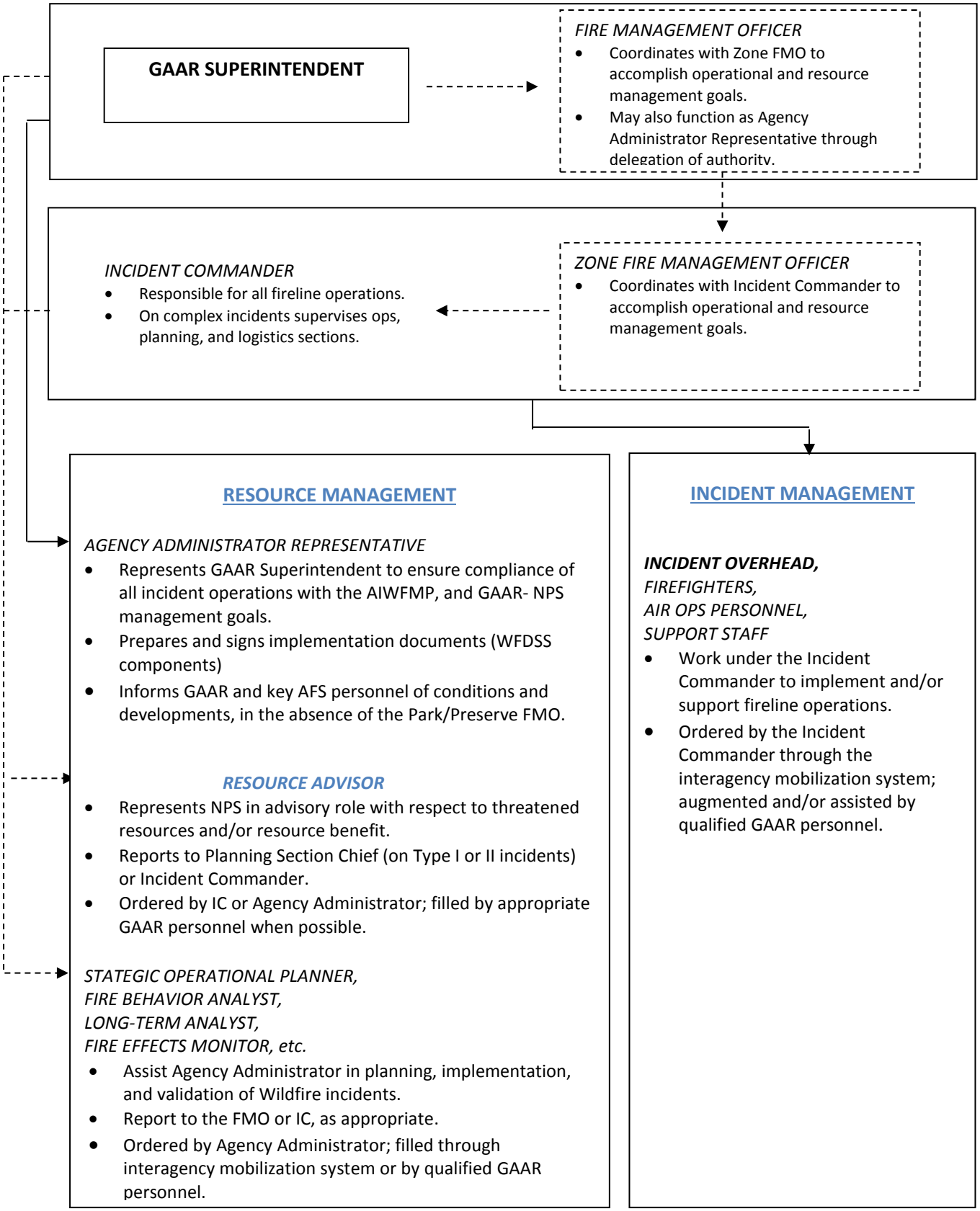
Position	**Regional Fire Ecologist**
Fire management role:	The Regional Fire Ecologist is responsible for coordinating fire effects monitoring and research within Gates of the Arctic and with other agencies.
Specific responsibilities:	• Coordinates all fire monitoring activities. • Develops fire research program for the Park/Preserve. • Coordinates with other agencies on research/monitoring. • Member of the AWFCG Fire Research Development and Application Committee

- Provides ecological expertise on vegetation communities and fire effects.

Position	**Fire Staff**
Fire management role:	Fire staff is based at Fairbanks and work at GAAR to help plan and implement fire management activities within the Park/Preserve.
Specific responsibilities:	• May serve as Agency Administrator or Acting FMO in the absence of the FMO, as qualified. • Serves as helicopter manager and/or crewmember during fire management and other resource management activities. • Serves as crew boss, etc. as qualified. • Supervises and assists with gathering and processing of data for use in long-term and incident-specific fire management planning. • Plans and implements hazard fuel reduction projects. • Assists with planning and supervision of prescribed fires. • Supervises and/or performs various resource management projects throughout the Park/Preserve. • Participates in NWCG functions as qualified.

Position	**Other GAAR Employees**
Fire management role:	Any GAAR employee may be assigned to assist with fire management activities as environmental and/or cultural specialists, logistical advisors, firefighters, support personnel, law enforcement officers, etc., depending on qualifications, skills, and regular duties.
Specific responsibilities:	• Advising FMO or Agency Administrator during planning of fire management activities. • Gathering and processing of data for use in long-term and incident-specific fire management planning • Reports ignitions in the Park/Preserve. • Law enforcement. • Participate in NWCG functions as qualified.

Figure 9: Incident-Specific Fire Management Functions at GAAR



General Budget Process

Suppression
Suppression costs for operations occurring within the Park/Preserve are the responsibility of the Alaska Fire Service as explained in Exhibit D of the Master Agreement. Further, the Alaska Statewide Master Agreement explains use and reimbursement of fire interagency resources within Alaska under clauses 34-37 and in Exhibit D: Reimbursable Billings and Payment.

Fuels Management
All requests for national fuels funding must be made by deadline established in the applicable version of the NPS Fire and Aviation Financial Management Guide (Fire Business Rules). Typically the deadline is approximately February 1st of the preceding year in order to be considered. Requests for fuels base funding will be submitted through the Regional FMO and requires a brief justification. Separate requests must be submitted for individual activities/projects in NFPORS. All requests must follow the procedures and deadlines as established NPS Fire and Aviation Financial Management Guide. Sporadically there is year-end funding available between August and September, but competition for these funds are high.

Cost Accountability and Budget Tracking
All fire management activities occurring within Gates of the Arctic National Park and Preserve will meet fiscal accountability and tracking requirements as outlined in the, Interagency Fire Business Management Handbook Standards and Alaska Statewide Master Agreement. The recently implemented Wildland Fire Decision Support System (WFDSS) uses the USFS fire cost estimation model, Stratified Cost Index (SCI) to help predict incident costs. This tool assists fire managers by ensuring decisions made on the incident will meet strategic objectives.

Interagency Agreements

1. Alaska Interagency Wildland Fire Management Plan
2. 2010 Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement
    a. 2010 Alaska Statewide Annual Operating Plan

5.0 ADAPTIVE MANAGEMENT STRATEGY

Adaptive management has been embraced by the Department of the Interior and is being mandated throughout NPS Fire Management programs. Adaptive management ensures projects are well thought out, professionally planned, skillfully implemented, and appropriately monitored. The project data is then analyzed and ***communicated*** to all stakeholders involved in the project. Annual evaluations will ensure information learned from the project including data analysis, will be used to modify plans and objectives for the betterment of future projects in the Park/Preserve.

Gates of the Arctic managers will collaborate with fire staff to ensure adaptive management strategies are implemented on all fires and fire related projects throughout the Park/Preserve. This process begins with policy direction and incorporates the most current information to make knowledge-based management decisions about how best to maintain fire-related natural resource components and processes. These decisions are periodically evaluated against monitoring results, new research and other relevant information. Recommendations and changes are integrated into the planning and execution phases to help guide the fire management program.

Fire management program goals and objectives are described in sections 3.1.1. and 5.1 of the Fire Management Plan. Cumulatively, these goals and objectives emphasize the desire to understand the effects of fire management actions by monitoring and evaluating the effects of fire and fuels management activities on park natural and cultural resources. To accomplish this task, specific, measurable objectives are needed as a point of reference to determine if the resource conditions resulting from fire management actions are meeting park goals for maintaining natural conditions. To answer the question, "What would the resource look like if we achieve our goals?" desired conditions are needed to describe resource goals more specifically and to serve as a standard by which to measure fire management program success.

As the monitoring results become available, they are used to determine if management objectives are achieved and to determine if management activities need to be adjusted. Also at this time, an assessment of whether the management objectives are still desired is warranted in light of ongoing monitoring results and any new information made available. In this adaptive way, we can be sure that the monitoring program will adequately assess the success of the fire management program.

Annual planning and evaluation meetings will be coordinated by the GAAR Fire Management Officer for fires or projects implemented during the summer season. The complexity of the incident or project that occurred or is planned will determine the required level of adaptive management necessary. Appropriate adaptive management may range from an organized conference call for small simple fires, to a face-to-face meeting for larger more complex fires or projects. As complexity warrants, regional staff members may be called upon to participate and provide valuable input regarding fires or fire related projects in the applicable park units. These positions include but are not limited to; Fire Ecologist, Communication and Education Specialist, GIS Specialist.

The need for FMP updates may be initiated by the FMO or park management and will be addressed at the Adaptive Management Strategy Meeting.

For details regarding all aspects of adaptive management, please visit the DOI Adaptive Management Initiative Website and RM-18, Chapter 7, Section 3.4 and Chapter 8-Fire Ecology & Monitoring Section 3.1.

5.1 Fire Management Objectives

Wildfire

- Maintain natural features, environmental integrity, and the dynamics of natural processes operating within the park.
- Allow wildfire as a natural process while protecting private property, significant historic resources, water quality, and air quality.
- Maintain clean air and unimpaired viewsheds.
- Protect significant cultural resources on park land with methods that are compatible with the wilderness purposes of the area.
- Maintain Condition Class 1 within GAAR.

Fuels Management

- Maintain Condition Class 1 within GAAR to protect structures and private property at risk.
- Provide cost-effective maintenance of fuel loads within the natural range of variation for the fire regimes.

Fire management objectives and draft fire Desired Conditions are provided in Section 3.1.1. Currently draft Desired Conditions have been developed for Gates of the Arctic in the draft General Management Plan. Section 3.1.1 of this fire management plan provides suggested Desired Conditions. True DC's are difficult to formulate due to the lack of knowledge of the fire ecosystem in GAAR and also the potential impacts of climate change. However the recommendation to consider the natural range of variability of fires over the 60 year documented record of fire for GAAR should be developed to assess past and future changes in fire regimes. **Future Needs –** Analysis of the natural range of variability from the historical records per park unit has yet to be completed. Once the analysis is completed a baseline will be established to measure success in meeting Gates of the Arctic fire management objectives.

Due to the accelerated climate effects in the Arctic Region and the potential impact warming temperatures may have on natural fire regimes future development or refinement of fire management objectives is anticipated.

5.2 Monitoring

The NPS Wildland Fire Management Reference Manual 18 states that "Fuels management activities and treatments must be monitored in order to assess treatment effectiveness and to determine whether management objectives were met. Moreover, monitoring is the basis of a successful adaptive management program" (RM-18, Ch. 7, section 3.4, USDI NPS 2008). The Alaska NPS fire ecology program is designed to determine whether fire and resource management objectives are being met, as well as to document any unexpected consequences of fire management activities. Fire and non-fire fuels treatment monitoring is an important part of adaptive management for fire management activities.

Guidelines for monitoring wildland fires, prescribed fires and mechanical treatments within GAAR were developed in consultation with the Interagency Alaska Fire Effects Task Group (FETG), reference the NPS Fire Monitoring Handbook (FMH, 2001), and modified by the NPS Alaska Regional Fire Ecologist. These guidelines provide recommendations for minimum variables to monitor fire or treatment effects within a framework of three monitoring intensities (Level 1 – 3) and are shown in Table 9. Brief descriptions of the three monitoring levels are provided below.

Level 1, Surveillance Monitoring – This level provides a basic overview of the baseline data that is required to be collected for all wildland or prescribed fires along with some variables that are required for mechanical treatments. Information at this level includes items such as RAWS weather data, general description of the fire environment (i.e., topography and fuel types), and fire location or perimeter. Information collected at this level precludes the necessity for on the ground measurements and can be done from remote sensing or an aerial platform. This data is necessary to satisfactorily complete a Wildland Fire Report.

Level 2, Moderate Intensity Monitoring – This level of monitoring documents fire behavior observations (not addressed in this document), fuels, and general effects of wildland fires, prescribed fires or mechanical treatments on vegetation. Information at this level includes characteristics of the fire, such as rate of spread, fire behavior, and burn severity, as well as current weather conditions. Fuel conditions would be assessed by determining the fuels array, composition, and dominant vegetation within the burn area, in addition to using vegetation and fuels maps to predict potential fire spread. Information to assess pre and post fire or treatment effects would include duff depth and moisture measurements, photo points, vegetation cover, and tree parameters. This level of monitoring is recommended for fire managed for resource benefits and prescribed fires, but is dependent on the objectives of the burn and the resources of concern. Some of the variables monitored at this level would require on the ground measurements of specific sites.

Level 3, Comprehensive Monitoring (Short or Long-term Fire Effects) – This level would be used to monitor the effects of prescribed or wildland fires in greater depth, it may also be used for mechanical treatments. Level 3 monitoring requires collecting information on fuel reduction, vegetative changes, and soil parameter changes. This level of monitoring may also include wildlife utilization techniques. The number of variables monitored increases and the techniques are more rigorous. Information collected at this level is based upon management objectives and the resources of concern. Variables monitored at this level would require the establishment of ground based plots.

Table 9: Monitoring Level Requirements and Recommendations for Fire Management Activities

Management Activity	***Minimum Required* Monitoring Levels**	***Recommend* Monitoring Levels**
Wildfire	Level 1 *Burn Severity	Levels 1, 2, 3, *Burn Severity
Prescribed Fire	Levels 1, 2, 3, *Burn Severity	Levels 1, 2, 3, *Burn Severity
Non-Fire Treatments	Level 1	Levels 1, 2, 3

*Burn Severity should be requested for all fires > 500 acres on NPS lands (RM-18, Chapter 8, 4.3).

Fire and mechanical treatment monitoring should be designed to meet the objectives of each project and therefore the components of monitoring should be developed based on the project objectives. Suggested monitoring variables for Level 1 through 3 are provided in Table 10 below. Measurement of Level 1 variables is the recommended minimum for all wildland fires. The implementation of variables at Level 2 and Level 3 would depend on the objectives of the fire/treatment and the resources of concern, and would remain up to the discretion of the FMO, resource management staff, and fire ecologist. The difference between Level 2 and Level 3 monitoring will often be the nature of data gathered for the same variable (qualitative vs. quantitative) or the number of plots, which may determine the statistical significance of findings.

Table 10: Recommended Monitoring Variables for the Three Major Fire Management Activities

R = Required, O = Optional, and N/A = Not Applicable

Monitoring Level	Monitoring Variable	Wildland Fire	Prescribed Fire	Mechanical Treatment
1	Perimeter (> 100 acre fire) or Point Location	R	R	R
1	Fuel types	R	R	R
1	Site description	R	R	R
1	Weather (RAWS)	R	R	O
1	Fire Danger Indices	R	R	N/A
1	FRCC	R	R	R
1	Burn severity maps (> 500 acres)	R	R	N/A
2	Photos of burn or treatment area	O	O	O
2	Photo Points	O	R	O
2	Fire behavior	O	R	N/A
2	Smoke	O	R	N/A
2	Duff/fuel bed depths	O	O	O
2	Duff moisture	O	O	O
3	Duff consumption (pins)	O	O	N/A
2	Burn severity assessment	O	O	N/A
2	Vegetation class (pre & post)	O	O	O
2	Vegetation cover/ composition (Level 2 - quantitative)	O	O	O
2	Tree density by species and size class	O	O	O
2	Tree canopy cover	O	O	O
3	Tree heights, diameters	O	O	O
3	Tree damage (insect and disease)	O	O	O
3	Ladder fuel heights	O	O	O
3	Active layer depth	O	O	O
3	Soil parameters	O	O	O
3	Tree ring disks/cores	O	O	O
3	Shrub or species specific densities	O	O	O
3	Coarse woody debris (Brown's transects)	O	O	O
3	Herbivory	O	O	O

Wildfire Monitoring

The minimum required monitoring for wildfires on AK NPS lands includes the data necessary to fill out DOI required Wildland Fire Management Information (WFMI) fire reporting documentation (https://www.nifc.blm.gov/fire_reporting/NPS/doc/index.html).

This includes documentation of information such as the fire origin, fire start and end dates, fuels, weather, final fire size (acres), and suppression actions. Currently, remotely sensed burn severity data using dNBR is required for all wildfires and prescribed fires exceeding 500 acres on National Park Service lands (RM-18, USDI NPS 2008 Chapter 8). A description of burn severity mapping and monitoring is provided in the Fire & Fuels Monitoring Plan in Appendix F. Fire effects plots may be established if Fire Management, Resource Management or other needs are identified for specific fires. The AK Regional NPS Fire and Fuels Monitoring Protocol is recommended for monitoring wildfire effects (Appendix F).

Prescribed Fire Monitoring

All prescribed fires that are implemented in GAAR are required to have a monitoring plan that addresses the objectives of the prescribed fire. Not all prescribed fires need to be monitored, if representative fuel types are being monitored with similar prescription and fuels. All prescribed fires >500 acres are required to have a burn severity assessment map. The AK Regional NPS Fire and Fuels Monitoring Protocol is recommended for monitoring prescribed fire effects (Appendix F).

Non-Fire Fuels Treatment Monitoring

Mechanically treating fuels has recently become an important part of reducing fuel densities and reducing overall threats associated with wildland fires. A fuels treatment plan should be prepared for each project and include the following components. This plan includes a description or purpose of the project in an executive summary. A detailed description of the fuels to be treated is discussed. The area is identified with a project map listing the goals and objectives of the project. Project costs are calculated and summarized in the plan. The plan addresses the protection of sensitive features, safety of the personnel and the public, interagency coordination, public involvement, a monitoring plan, and post project rehabilitation issues. The main body of the plan addresses the statement of work to be done and specifications for treatments. These specifications address plant species by diameter and percent of stand for treatment. The monitoring section of the plan contains information on documenting and collecting photo point information and addresses other techniques or methods used to monitor the effectiveness of mechanically treating the vegetation.

Minimum Recommendations for Non-Fire Treatment Monitoring

- Describe treatment objectives and methods
- Document location, size, and data of treatment
- Photo points or video documentation

5.3 Evaluation

After each fire season an interagency review of fire plan implementation and fire suppression operations is attended by both Protection Agency personnel and Jurisdictional Agency personnel. All involved parties are given the opportunity to identify plan implementation problems and operational concerns. The NPS evaluates how the Protection Agencies responded to fires in different fire management option areas. Special considerations will be given to non-standard responses and opportunities will be available for each agency to comment. Consideration of fire management option selection is reevaluated annually and if deemed appropriate will follow the revision process and timeline specified in the AIWFMP. At minimum the Regional FMO and the Regional Fire Ecologist will be present to give voice to park units not already represented by and NPS Area FMOs.

All wildland fires occurring within GAAR will be reviewed in accordance with Reference Manual 18, Chapter 17- Wildland Fire and Program Reviews and the Interagency Redbook-Chapter 18-Reviews and Investigations. If fires occur and the complexity necessitates a specific incident review, the Eastern Area FMO, GAAR Fire Coordinator and the Regional FMO will coordinate with the GAAR management personnel to schedule a review for the specific incident.

Park specific standards and procedures for the evaluation of monitoring and research data from wildfire, prescribed fire and non-fire fuels treatments is discussed in Section 5.0 Adaptive Management Strategy of this FMP.

5.4 Fire Research

Implementation of this fire management plan is not contingent upon the completion of research. A limited body of scientific information about the fire effects and fire regimes in the Gates of the Arctic National Park/Preserve is available and information regarding primary and secondary fire effects in most ecosystems of GAAR is incomplete. A more detailed summary of fire research and monitoring is provided in the Fire and Fuels Monitoring Plan (Appendix F). Research topics pertaining to fire, vegetation and climate and corresponding references are listed here:

Climate, fire and vegetation regime history

Brubaker, L.B., P.E. Higuera, T.S. Rupp, M.A. Olson, P.M. Anderson and F.S. Hu. 2009. Linking sediment-charcoal records and ecological modeling to understand causes of fire-regime change in boreal forests. Ecology 90(7):1788–1801

Clegg, B.F. and F.S. Hu (2010) An oxygen-isotope record of Holocene climate change in the south-central Brooks Range, Alaska. Quaternary Science Reviews 29:828-839

Higuera, P.E., L.B. Brubaker, P.M. Anderson, F.S. Hu and T.A. Brown. 2009. Vegetation mediated the impacts of postglacial climate change on fire regimes in the south-central Brooks Range, Alaska. Ecological Monographs, 79(2): 201–219

Hu, F.S., Higuera, P., Barnes, J.L., Rupp, T.S., Chipman, M., and Duffy, P.A. 2010. Reconstructing fire regimes in tundra ecosystems to inform a management-oriented ecosystem model. Final Report, JFSP Project Number 06-3-1-23, CESU Agreement J979106K153/001, April 2010. https://www.firescience.gov/projects/06-3-1-23/project/06-3-1-23_hu_et_al_finalreport_jfsp_06-3-1-23.pdf

Springsteen, A, and Rupp, T.S. 2009. Summary report for Alaska National Parks: Projected vegetation and fire regime response to future climate change in Alaska. CESU Final Report, NPS.

Treeline dynamics in GAAR

Lloyd, A.H., A.E. Wilson, C.L. Fastie, and R.M. Landis. 2005. Population dynamics of black spruce and white spruce near the arctic tree line in the southern Brooks Range, Alaska. Canadian Journal of Forest Research 35: 2073–2081.

Rupp, T.S., F.S. Chapin, and A.M. Starfield. 2001. Modeling the influence of topographic barriers on treeline advance at the forest-tundra ecotone in Northwestern Alaska. Climatic Change 48:399–416

Fire and Permafrost

Swanson, D.K. 1996. Susceptibility of permafrost soils to deep thaw after forest fires in Interior Alaska, U.S.A., and some ecologic implications. Arctic and Alpine Research, Vol. 28(2):217-227

Fire and Small Mammals

Swanson, S.A. 1996. Small mammal populations in post-fire black spruce seral communities in the Upper Kobuk River Valley, Alaska. Technical Report NPS/AFA RNR/NRTR-96/30.

Fire, Caribou and Lichen

Several research studies have been completed to assess the impacts of fire on lichen and caribou winter grazing habitat in northwest Alaska, and specifically in Gates of the Arctic. Recent publications on this topic include:

Joly, K., F.S. Chapin, and D.R. Klein. 2010. Winter habitat selection by caribou in relation to lichen abundance, wildfires, grazing, and landscape characteristics in northwest Alaska. Ecoscience 17 (3): 321-333.

Joly, K., T.S. Rupp, R.R. Jandt, and F.S. Chapin. 2010. Fire in the range of the Western Arctic Caribou Herd. Alaska Park Science 8 (2): 85-91.

Swanson, D.K. 1996. Fruticose lichen distribution in the Kobuk Preserve Unit, Gates of the Arctic National Park, Alaska. Technical Report NPS/AFA RNR/NRTR-96/28.

Assessing Remote Sensed Burn Severity Maps

Allen, J.L. and Sorbel, B. 2008. Assessing the differenced Normalized Burn Ratio's ability to map burn severity in the boreal forest and tundra ecosystems of Alaska's national parks. International Journal of Wildland Fire 17: 463-475.

Fire Research Needs

Opportunities will be taken to identify and encourage fire related research within the park and funding and implementation will be coordinated between NPS resources, NPS fire management, and Arctic Network Inventory and Monitoring Program personnel. As research needs are identified, funding will be sought for implementation of corresponding studies. Fire research has limited funding within the NPS. But if fire ecology information is deemed necessary NPS personnel may submit proposals through the NPS Fire Research Funding call as well as through the Joint Fire Science Program. Other funding is available through the Cooperative Ecosystem Study Units (CESU 2004) and through National Park Service requests (Fee Demonstration Program, Project Management Information System (PMIS) and Natural Resource Challenge). The fire research and monitoring needs currently identified for Gates of the Arctic NPPr include:

- Determine fire effects in GAAR through the establishment plots for short or long-term post-fire monitoring. Results from monitoring in areas affected by fires will allow for information on the:
  - Effects of fire on wildlife habitat.
  - Effects of fire on permafrost and erosion.

- Assess changes to fire risk and fire behavior in relation to climate change.

- More accurately determine the historic fire regime in GAAR (especially in tundra communities). Fire history beyond the last 60 years.

- Assess the natural range in variability of fires in GAAR over the past 60 years.

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Appendix B: Definitions

Agency Administrator: An incident-specific position filled by any qualified GAAR staff member as designated by the Superintendent. The Agency Administrator represents the GAAR Superintendent and works with the incident command team to ensure the compliance of wildland fire operations with GAAR and NPS resource management policy and AIWFMP.

Appropriate Management Response (AMR): Any wildland fire action selected and developed through either the implementation of the AIWFMP, initial decision-making process (i.e. WFIP stage I) or a WFSA. AMRs may be directed toward suppression or resource benefit, depending on predetermined parameters and incident-specific conditions.

BEHAVE: A system of interactive computer programs used for formulating fuel models based and predicting fire behavior.

Condition Class 1: Fire regimes are within an historical range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within an historical range.

Director's Order 18 (DO-18): A comprehensive statement of National Park Service wildland fire management policy.

Extended Attack: Any wildland fire suppression action lasting beyond one operational period.

Fire Management Officer (FMO): A permanent position with responsibility for the planning and coordination of fire management programs on NPS lands in Eastern Alaska. The GAAR FMO is based out of Fairbanks, AK and provides fire management direction for the Gates of the Arctic National Park and Preserve.

Fuel Loading: Amount of live and dead organic matter present at a particular site.

Fuel Model: A mathematically simulated fuel complex based on representative descriptors; used to estimate rate of spread and other fire behavior indices.

Initial Action: The actions taken by the first resources to arrive at a wildfire. Initial Action may include the full spectrum of responses from monitoring to aggressive containment.

Initial Attack: Initial action focused on aggressive containment of the fire perimeter.

Maximum Manageable Area (MMA): A geographical parameter established during the WFIP process and indicating the size that a fire use incident may grow to before triggering a WFSA.

Operational Period: The period of time scheduled for execution of a given set of tactical actions as specified in the Incident Action Plan. Operational Periods can be of various lengths, although usually not over 24 hours.

Prescribed Fire: Planned implementation of fire within a predetermined area and under predetermined conditions, for the accomplishment of resource management objectives and/or hazard fuel mitigation.

Reference Manual 18 (RM-18): A detailed set of guidelines for the operational implementation of the wildland fire management policies specified in DO-18. RM-18 consists of a continuously evolving on-line document.

Response to Wildland Fire: The mobilization of the necessary services and responders to a fire based on ecological, social, and legal consequences, the circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected.

Suppression: All the work of extinguishing a fire or confining fire spread.

Unplanned Ignition: The initiation of a wildland fire by lightning, volcanoes, unauthorized human-caused fires and escaped prescribed fires where the objective is to protect values at risk while meeting resource objectives specified in Land/Resource Management Plan

Unwanted Ignition: An ignition from any source that is unplanned and unwanted.

Wildfire: Unplanned ignition of a wildland fire or escaped prescribed fire where the objective is to protect values at risk while meeting resource objectives specified in the Land/Resource Management Plan

Wildland Fire: Any non-structure fire that occurs in the wildland. Two distinct types of wildland fire have been defined and include wildfire (unplanned ignition) and prescribed fire (planned ignition).

Wildland Fire Decision Support System (WFDSS): A decision support system, utilized Nation-wide for the federal agencies after March 31, 2010.

Wildland Fire Implementation Process (WFIP): A multi-stage decision-making process triggered by the detection of a wildland fire. Initial WFIP components help managers determine initial strategies (e.g. fire use or suppression) for areas without preplanned responses; subsequent components document continued viability of fire use.

Wildland Fire Situation Analysis (WFSA): A standardized decision-making process triggered when a fire renders present management actions inadequate. WFSA components provide a means of evaluating alternative strategies and serve to document decisions, actions, and results.

Wildland Fire Suppression: Any management action based on protection goals rather than resource management concerns.

ACRONYMS

AICC	Alaska Interagency Coordination Center
AIWFMP	Alaska Interagency Wildland Fire Management Plan
ANILCA	Alaska National Interest Lands Conservation Act
AKSO	Alaska Support Office
AWFCG	Alaska Wildland Fire Coordination Group
BLM-AFS	Bureau of Land Management – Alaska Fire Service
DENA	Denali National Park
DNR	State of Alaska, Department of Natural Resources
DO-18	Director's Orders 18 – Wildland Fire Management
DOF	State of Alaska, DNR, Division of Forestry
FFMC	Fine Fuel Moisture Content
FMO	Fire Management Officer
FMP	Fire Management Plan
FMU	Fire Management Units
GAAR	Gates of the Arctic National Park and Preserve
GMP	General Management Plan
IC	Incident Commander
LCES	Lookouts, Communication, Escape Routes, Safety Zones
LCS	List of Classified Structures
MAC	Multi-Agency Coordination Group
NEPA	National Environmental Planning Act
NHPA	National historical Preservation Act
NPS	National Park Service
NWCG	National Wildfire Coordinating Group
RAWS	Remote Automated Weather Station
RM-18	Reference Manual 18 – Wildland Fire Management
RMP	Resource Management Plan
SACS	Shared Applications Computing System
SHPO	State Historic Preservation Officer
USFS	United States Forest Service
WFDSS	Wildland Fire Decision Support System
WFSA	Wildland Fire Situation Analysis
WFIP	Wildland Fire Implementation Plan

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Appendix C: Current Species of Concern

Avian Species

Under Consideration for Listing as Federal Threatened and Endangered Species:
Gavia adamsii (Yellow-billed Loon)*

*Yellow-billed loons have been documented within GAAR. However, their habitat is generally restricted to aquatic areas which are not generally impacted by fire activity.

Listed as Species of Concern for the State of Alaska
Harlequin Duck
Long-tailed Duck
Short-eared Owl
Bluethroat
Golden-crowned Sparrow
Gray-cheeked Thrush
Northern Shrike
Northern Wheatear
Rusty Blackbird
Smith's Longspur
Yellow Wagtail

Mammal Species

No mammal species known to reside in GAAR are currently of concern.

Plant Species

Species in Gates of the Arctic National Park and Preserve listed on the National Heritage Program AK Rare Plant List S1- Critically Imperiled within the State (S1)*
Draba pauciflora (G4S1)
Festuca edlundiae (G3G4S1)

* Also documented in GAAR and listed on the Rare Plant List for the State of Alaska are an additional 9 species listed as S2 (imperiled in the state) and sixteen species listed as S3 (vulnerable in the state).

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Appendix D: Compliance for FMP

1. *Consultation and Coordination of the Original 2003 Fire Management Plan.*
The following individuals were consulted in the preparation of this plan:

Fred Anderson, Fisheries Biologist/Subsistence Manager, National Park Service, Gates of the Arctic National Park and Preserve

Brad Cella, Fire Management Officer, National Park Service, Alaska Region

Ken Coe, Fire Management Officer, Alaska Fire Service, Galena Zone

Joan Darnell, Chief of Environmental Quality, National Park Service, Alaska Region

Eileen Devinney, Cultural Resource Specialist, National Park Service, Gates of the Arctic National Park and Preserve

Roger Semler, Chief of Operations, National Park Service, Gates of the Arctic National Park and Preserve

Bruce Greenwood, Environmental Protection Specialist, National Park Service, Alaska Support Office

Kato Howard, Fuels Management Specialist, Alaska Fire Service, Upper Yukon Zone

Dave Jandt, Assistant Fire Management Officer, Alaska Fire Service, Tanana Zone

Marsha Henderson, Fire Management Officer, National Park Service, Gates of the Arctic National Park and Preserve, Yukon-Charley Rivers National Preserve

Dave Mills, Superintendent, National Park Service, Gates of the Arctic National Park and Preserve

Debbie Nigro, Biological Technician, National Park Service, Gates of the Arctic National Park and Preserve

Sarah Robertson, Interagency Fire Planner, National Park Service/USDA Forest Service, National Interagency Fire Center

Shelli Swanson, Biologist, National Park Service, Gates of the Arctic National Park and Preserve

Steve Ulvi, Management Assistant, National Park Service, Gates of the Arctic National Park and Preserve

Tom Zimmerman, Fire Science/Ecology Manager, National Park Service, National Interagency Fire Center

2. *Contributors and Reviewers of the updated 2014 Fire Management Plan.*

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b. Reviewers

Jennifer Northway, Assistant Regional Ecologist, National Park Service, Alaska Region

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Lois Dalle-Malle, Wilderness Specialist YUGA

Jeff Rasic, Chief of Resource Management

Marcy Okada, Subsistence Coordinator

3. *NEPA (EA), ANILCA 810, FONSI*

Appendix D.3.a: Environmental Assessment

The following is the Environmental Assessment from the 2003 Gated of the Arctic National Park and Preserve Fire Management Plan. There will be no significant change to the environment with the updated GAAR Fire Management Plan.

ENVIRONMENTAL ASSESSMENT

FIRE MANAGEMENT PLAN

FOR

GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE

PREPARED BY

NATIONAL PARK SERVICE

GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE

April 21, 2003

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ENVIRONMENTAL ASSESSMENT

Fire Management Plan for Gates of the Arctic National Park and Preserve

I. INTRODUCTION

A. Purpose and Need

The National Park Service proposes implementing National Park Service Director's Order 18 (DO-18) (2002) by establishing a fire management plan for Gates of the Arctic National Park and Preserve (GAAR). This fire management plan is a comprehensive document that outlines GAARs fire management goals and describes the policies and actions by which these goals will be realized. The plan will formalize the fire management decision making process and the procedures that have been in place for over 15 years, redefine fire management strategies, establish the park's fire management organization and responsibilities, and relate resource management goals to fire management strategies. With the implementation of the proposed action, fire management within GAAR will remain status quo and the application of fire management strategies will continue as in the past.

The Fire Management Plan is necessary to comply with DO-18, and codifies the way fire will be managed within GAAR. Although fire protection needs may arise and remain our first priority, managers need to consider that fire has long been an integral component of the area's ecosystems and is critical for the maintenance of virtually all indigenous conditions, from plant and animal populations to soil and permafrost layers. Accordingly, the scope of the preferred alternative and other considered alternatives entail the planning and implementation of policies and practices flexible enough to allow the simultaneous pursuit of protection and resource management goals.

This Environmental Assessment (EA) has been prepared in accordance with the National Environmental Policy Act of 1969 and the regulations of the Council of Environmental Quality (40 CFR 1508.9). It evaluates the potential impacts to cultural and natural resource values that could result from implementing the Gates of the Arctic National Park and Preserve Fire Management Plan. The environmental assessment is intended to facilitate decision-making, based on an understanding of the environmental consequences of the proposal, and to determine whether preparation of an environmental impact statement is required.

B. Background

Two federal legislative acts, the Organic Act and the General Authorities Act, prohibit impairment of park resources and values. NPS Management Policies and Director's Order 12 use the terms "resources and values" to mean the full spectrum and intangible attributes for which the park is established and are managed, including the Organic Act's fundamental purpose and any additional purposes as stated in the park's establishing legislation. The impairment of park resources and values are not allowed unless directly and specifically provided by statute. The primary responsibility of the National Park Service is to ensure that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunity for enjoyment of them. The evaluation of whether impacts of a proposed action would lead to an impairment of park resources and values is included in this environmental assessment. Impairment may occur when there are potential impacts to 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.

In 1980, Congress created the Gates of the Arctic National Park and Preserve through the passing of the Alaska National Interest Lands Conservation Act (ANILCA), a comprehensive statement of purpose for several Alaskan Park and Preserve areas. Section 201[4] of ANILCA specifically establishes Gates of the Arctic National Park and Preserve and ascribes to it the following mission, among others: to "maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural features; to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and to other wilderness recreation activities; and to protect habitat for and the populations of fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds."

The Gates of the Arctic National Park and Preserve Resource Management Plan (1994) specifies three objectives directly relevant to GAAR's fire management program: 1) To protect significant cultural resources on park land with methods that are compatible with the wilderness purposes of the area; 2) To maintain natural features, environmental integrity and the dynamics of natural processes operating within the park; and 3) To allow fire to fulfill its role as a natural process to the fullest extent possible while protecting human life, private property and cultural and natural resources that warrant protection.

In 1984 the National Park Service cooperated with Bureau of Land Management, Alaska Department of Natural Resources, Alaska Department of Fish and Game, US Fish and Wildlife Service, Bureau of Indian Affairs, and Alaska Native regional and local village corporations to produce an Interagency Fire Management Plan for the Kobuk Planning Area. This plan provided direction for fire management activity in Gates of the Arctic National Park and Preserve until 1998, when a variety of documents were consolidated and approved as the Alaska Interagency Wildland Fire Management Plan (AIWFMP). Under the AIWFMP, fire protection needs are determined through annual land owner/manager reviews and lands are then placed under critical, full, modified or limited protection categories, with categorization based on presence and/or proximity of values to be protected, as well as the resource management objectives of the pertinent land management agency (see Table 1 for description of categories). Each reported wildland fire is managed in accordance with the categorization of the sub-unit in which it occurs, with responses ranging from rapid and aggressive attack by all available forces in the case of fires detected in Critical Protection areas, to periodic surveillance for certain fires detected in Limited Protection areas (see Figure 1 for map of Park/Preserve units).

Table 1: Alaska Interagency Wildland Fire Management Plan Options

Protection Category	Policy	Intent
Critical	• Aggressive suppression of fires within or threatening designated areas. • Highest priority for available resources.	• Prioritization of suppression actions for wildland fires threatening human life, inhabited property, and/or other designated structures. • Complete protection of designated sites.
Full	• Aggressive suppression of fires within or threatening designated areas, depending upon availability of resources.	• Protection of uninhabited cultural and historical sites, private property, and high-value natural resources.
Modified	• Fires in designated areas receive initial attack depending on availability of resources, unless land manager chooses otherwise and documents with WFSA. • After designated **conversion date**, operational response to Modified protection zones is identical to that of Limited zones.	• Greater flexibility in selection of suppression strategies when chance of spread is high (e.g., indirect attack). • Reduced commitment of resources when risk is low. • Balancing of acres burned with suppression costs and with accomplishment of resource management objectives.
Limited	• Wildland fires allowed to burn within predetermined areas. • Continued protection of human life and site-specific values. • Surveillance.	• Reduction of long-term costs and risks through reduced frequency of large fires. • Reduction of immediate suppression costs. • Facilitation of bio-diversity and ecological health

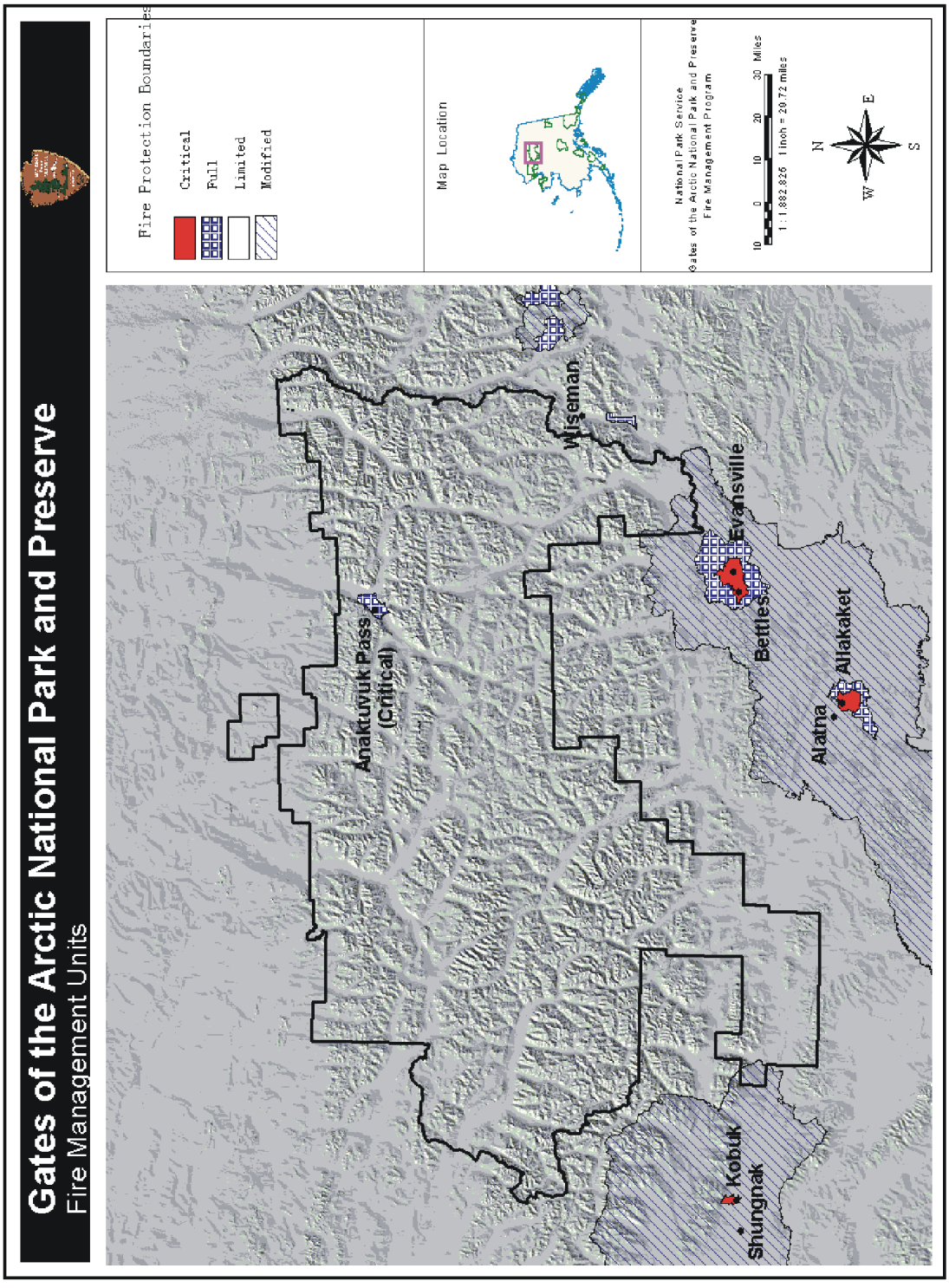

Figure 2: Fire Protection Boundaries

This EA presents two alternatives for the application and use of wildland fire as a management tool for resource benefits. All of the alternatives discussed here, including the preferred alternative described throughout the proposed GAAR fire management plan, would entail continued compliance with the AIWFMP, while at the same time bringing the Park/Preserve's fire management program into compliance with recently developed National Park Service directives. **NPS Director's Order 18** (2002) mandates a distinction between **prescribed fire**, defined as any fire planned and implemented by management, and **wildland fire**, defined as any unplanned ignition, whether human or natural. Wildland fire incidents, in turn, fall into two categories: **Wildland fire use** entails the management of certain unplanned ignitions for the achievement of management goals, including the reduction of dangerous and unnatural accumulations of burnable vegetation and the preservation of fire in its natural role; **wildland fire suppression** entails a broad spectrum of actions aimed at protecting life, property, and sensitive resources while also ensuring firefighter safety, cost effectiveness, and minimal disturbance from suppression activities.

Each of the alternatives presented in this Environmental Assessment comprise a particular combination of the various management strategies permitted under NPS Director's Order 18. These alternatives have been evaluated for their ability to contribute to the accomplishment of the resource management objectives described above.

C. Impact Topics Addressed and Analyzed

Impact topics were identified to focus the analysis of alternatives on the most relevant subject matter and resources of concern. A brief rationale for each impact topic follows, as well as the reasons for dismissing specific topics from further analysis.

Vegetation and Biodiversity

The National Environmental Policy Act (1969) requires analysis of impacts on all affected components of the ecosystem, including biotic communities of plants and animals. NPS Management Policies (2001) requires maintenance of these communities, including their natural abundance, diversity and ecological integrity. Fire plays an important role in changes to vegetative cover, which in turn affects habitat and overall ecological health; therefore, effects on vegetation and bio-diversity are analyzed as an impact topic.

Cultural Resources

The National Historic Preservation Act, as amended in 1992 (16 USC 470 *et seq.*); the National Environmental Policy Act; and NPS Cultural Resource Management Guidelines (1994) and Management Policies (2001) require the consideration of impacts to cultural resources listed on or eligible for listing on the National Register of Historic Places. The undertakings described in this document are also subject to section 106 of the national Historic Preservation Act, under the terms of the 1995 Programmatic Agreement among the NPS, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers. Impacts to cultural resources (archeological, historic, and paleontological) are therefore analyzed in this environmental assessment.

Aesthetics and Recreation

The mission of the NPS, as stated in the Organic Act of 1916, is to "conserve the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same." Gates of the Arctic National Park and Preserve was established to "maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, …and scenic beauty…to provide reasonable access, for mountain climbing, mountaineering, and other wilderness recreational activities." Scenic

values, recreational activities, and general visitation within and around fire-treated areas may be temporarily impacted, thus visitor use will be considered as an impact topic.

Local Economy
The National Environmental Policy Act (NEPA) regards impacts to the human environment to include any effects of federal actions on the social and economic well-being of communities and individuals. Impacts to the local economy are therefore analyzed in this environmental assessment.

Wetlands and Floodplains
NPS guidelines and policies require the consideration of impacts to floodplains and wetlands (Executive Orders 11988 and 1190). Impacts to wetlands and floodplains are therefore analyzed in this environmental assessment.

Subsistence Use and Wildlife Habitat
Title VIII, Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) states "in determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands…the head of the federal agency…over such lands…shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs." Subsistence use may be temporarily impacted, thus subsistence use will be considered as an impact topic.

Air Quality
The 1963 federal Clean Air Act (42 U.S.C. 7401 *et seq.* as amended) stipulates that federal land managers have an affirmative responsibility to protect a park's air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse air pollution impacts. Specifically one objective of the GAAR RMP is to maintain clean air and unimpaired viewsheds. Air quality would potentially be affected in the short-term during any type of ignition event; therefore, it is analyzed as a relevant impact topic.

Water Quality and Fisheries
National Park Service policies require the protection of water resources consistent with the Clean Water Act. Increased erosion following a fire may affect water quality and is, therefore, considered a relevant impact topic.

Wilderness Character
National Park Service Director's Orders 41, Wilderness Preservation and Management (DO-41) states that "Fire management activities conducted in wilderness areas will conform to the basic purposes of wilderness". Gates of the Arctic is predominately designated wilderness and therefore will be analyzed as a relevant topic.

D. Impact Topics Considered and Dismissed

Threatened and/or Endangered Species
The Endangered Species Act (1973) requires disclosure of impacts on all federally threatened or endangered species. NPS policy also requires the analysis of effects on federal species, as well as state-listed threatened, endangered, candidate, rare, declining and sensitive species. Two subspecies of Peregrine falcon, *Falco peregrinus* subs. *anatum*, and *Falco peregrinus* subs. *tundrius*, were recently delisted, however, the park maintains responsibility for monitoring their populations. GAAR is also within the range of a species of Aster (*Aster yukonensis*) that has recently been removed from the rare plant list but remains a species of concern for Park/Preserve managers. This plant occupies a specific microsite along rivers and streams in sandy soils that occur within the gravel bar/shrub interface. Because of the proximity of this plant's habitat to rivers and moist fuels, it is unlikely that a fire would negatively

affect this species except under the most severe drought circumstances, when fire behavior supercedes normal fire behavioral patterns.

Environmental Justice. Executive Order 12898, "Environmental Justice"
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, requires all federal agencies identify and address disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. This project would not be expected to result in significant changes in the socioeconomic environment of the project area, and, therefore, would not be expected to have any direct or indirect impacts to minority or low-income populations or communities.

II. RANGE OF ALTERNATIVES

A. Introduction.

Each alternative consists of a different combination of the fire management strategies as mandated by NPS Director's Order 18 (DO-18), with each alternative representing a different application of fire as a management tool. The considered alternatives differ in their respective approaches to the management of wildland ignitions and in their allowance or preclusion of prescribed fire.

B. Actions Common to all Alternatives

Under each alternative, mechanical fuel reduction may be used to mitigate hazard fuel buildup or recreate historical landscapes/conditions in areas where prescribed fire or wildland fire would pose an unreasonable threat to the property or resources.

All fire management actions at Gates of the Arctic National Park and Preserve will be conducted in full compliance with local, state, and interstate air pollution control regulations as required by the Clean Air Act, 42 U.S.C. 7418. Currently, no local or interstate air pollution control regulations exist in Alaska.

The Park/Preserve will employ three primary strategies in order to protect archeological, cultural, and historic sites from damage by fire or fire suppression activities. First, culturally significant structures will be assigned Critical or Full Protection status, as dictated by the recommended criteria for fire protection of structural resources within GAAR. Second, personnel conducting detection and/or reconnaissance flights within the Park/Preserve will be directed to remain alert for the presence of any undiscovered cultural sites or structures and to report their presence to the Park/Preserve FMO. Third, designated Incident Commanders will consult with appropriate resource advisors regarding the identification and sensitivity of previously unknown sites, and will cooperate with the Agency Advisor to mitigate any damage to such sites.

Certain fire suppression activities could pose a threat to fragile soil layers and to other ecosystem components. This type of risk will be mitigated through the use of minimum impact suppression tactics as specified by NPS policy.

C. Alternatives

Alternative 1: Combination of Wildland Fire Use and Wildland Fire Suppression

Natural ignitions occurring in certain areas and under predetermined conditions would be managed for the accomplishment of resource management goals, including the preservation of fire in its natural role and

the reduction of hazardous accumulations of burnable vegetation. Any fire posing a threat to life or property would be immediately suppressed. Prescribed fires would not be implemented.

Alternative 2: Combination of Prescribed Fire Use, Wildland Fire Use, and Wildland Fire Suppression (NPS Preferred Alternative)

All three of the major management actions described under DO-18 would be allowed, as determined by a combination of pre-established and incident-specific decision making criteria. Wildland fires that do not pose a threat to life, property, or significant resources would be managed for the accomplishment of resource management goals, including the preservation of fire in its natural role and the reduction of hazardous accumulations of burnable vegetation. Prescribed fire would be implemented, in certain cases, under the direction of National Park Service personnel for the purpose of reducing hazardous fuel loads. Suppression would continue in or near developed areas, near Park/Preserve boundaries with administrative units having different fire management objectives, in areas known to contain sensitive cultural and/or archeological resources, or whenever insufficient resources are available to ensure the effective, long-term management of wildland fire to meet resource management objectives. This action would be a continuation of the fire management strategies that have occurred in GAAR for the past 15 years.

D. Alternatives Considered but Rejected.

Full Wildland Fire Suppression
All ignitions, including those of natural origin, would be suppressed and no prescribed fire would be implemented. Reduction of flammable vegetation would be accomplished strictly by mechanical means (e.g., through the use of chain saws, cross cut saws or other tools). Mechanical reduction would be limited primarily to the protection of historic and/or archeological sites and Park/Preserve boundary areas. In some cases, however, mechanical reduction could be used to restore selected landscapes to historic conditions.

This alternative is rejected for the following reasons: 1) the increased risk of catastrophic wildland fire which would result from the exclusion of the area's natural burn cycle; 2) the prohibitively high cost of large-scale mechanical fuel reduction; 3) non-conformance with the existing interagency management scheme and a potential to cause an impairment of park resources and values.

Full Wildland Fire Suppression and Prescribed Fire
All ignitions, including those of natural origin, would be suppressed. The effects of natural wildland fire would be simulated through the use of planned ignitions conducted by park personnel in defined zones. Such fires would be ignited under predetermined fuel and weather conditions; control problems would thereby be minimal.

This alternative is rejected for the following reasons: 1) the inability to maintain a natural burn cycle through only prescribed burns; 2) the increased risk of catastrophic wildland fire which would result from the exclusion of the area's natural burn cycle; 3) the prohibitively high cost of large-scale mechanical fuel reduction and prescribed burns; 4) non-conformance with the existing interagency management scheme and a potential to cause an impairment of park resources and values.

III. AFFECTED ENVIRONMENT

A. Introduction.

Gates of the Arctic National Park and Preserve encompasses 8,307,051 acres, of which the federal government manages 97%. Much of the remaining land belongs to Arctic Slope Regional Corporation and Doyon, Ltd. Other ownership categories include local village corporation tracts, allotments, and patented/unpatented mining claims. Located north of the Arctic Circle, this remote Park/Preserve lies within the central Brooks Range, and is one of the Nation's largest wilderness parks. The village of Anaktuvuk Pass is located in the mountains near the Park/Preserve's northern border and is the only established community within the boundary of GAAR. The community of Bettles/Evansville is the field operations center for GAAR, located south of the Park/Preserve. Other nearby communities include Coldfoot and Wiseman, located to the east of the Park/Preserve on the Dalton Highway. Access is mainly by commercial air services or private plan, however, some visitors access the Park/Preserve by foot from Anaktuvuk Pass, Coldfoot or Wiseman.

B. Natural Environment

Gates of the Arctic National Park and Preserve contains examples of a variety of ecotypes including taiga forest, alpine tundra, and boreal forest communities. The rugged peaks of the Brooks Range rise to over 8,000 feet in the park and are separated by small valleys created by creeks flowing from the summits and by broad glacial valleys that are the products of four major glaciations. GAAR's climate consists of four distinct seasons with relatively short cool summers and long severe winters. Spring and autumn come and go rapidly with the quick increase and decrease in sunlight and temperature. The park receives continuous sunlight during the summer for at least 30 days.

The southern portion of Gates of the Arctic lies within a greater ecological zone known as the taiga, an area extending from the Alaskan Interior north to the Brooks Range that is dominated by black spruce. In the Park/Preserve, as elsewhere in the taiga, lowlands and drainages are often heavily forested. Uplands become more thinly forested with increasing elevation, with most areas above 2,000 feet consisting of treeless shrub tundra. The mountainous regions and northern foothills represent the tundra community, dominated by tussocks and sedges at lower elevations where poor drainage precludes the presence of black spruce stands. Much of the Park/Preserve is underlain by permafrost that can average several hundred feet thick, with the top of the permafrost layer often occurring as little as 2 to 3 feet below the ground surface at the peak of summer. Permafrost hinders subsurface drainage, causing unstable soil conditions on sloping surfaces. Consequently, when surfaces are disturbed and permafrost is allowed to melt, soils often collapse.

Numerous species of large and small mammals occur within GAAR. Large mammals include Dall sheep, moose, muskoxen, caribou, black and brown bear, and wolves. Smaller mammals, such as arctic hare, wolverine, porcupine, weasel, land otter, ground squirrel, muskrat, vole, lemming, and many others are abundant throughout the park area. In addition, over 20 species of fish and 140 species of bird are also present in GAAR on a seasonal basis.

C. Cultural Environment

Gates of the Arctic contains a wealth of prehistoric, protohistoric, and historic archeological sites. Humans have continuously explored and lived in the region and used its resources for more than 10,000 years. Approximately 5% of the total area of GAAR has been surveyed by archeologists, and over 800 sites have been recorded to date. Of these, only 34 contain some manner of combustible structural

components, such as cabins, caches, outhouses, caribou drivelines, corrals, campsites, etc. The remaining 566 sites are prehistoric and historic, containing largely lithic and organic materials and little to no combustible components.

Currently, GAAR is home to the last remaining group of the Nunamiut, or inland Iñupiat, who live in the village of Anaktuvuk Pass. The Nunamiut practice a mixed economy, consisting of both wage labor and traditional hunting and gathering practices (commonly referred to as subsistence in Alaska).

D. Historical Role of Fire

Historically, the northernmost two thirds of GAAR are less susceptible to fire due to the presence of the Brooks Ranges and the Arctic coastal influence of the North Slope. However, the southern third of the Park/Preserve lies within the northernmost belt of Interior Alaska, characterized by boreal forest. In Interior Alaska, fire has played a critical role in ecosystem sustainability. For thousands of years, periodic fires have resulted in plants and animals that are adapted to fire-caused change. For example, both black and white spruce depend on intense ground fire to clear organic layers and thereby expose the fertile seedbed. Black spruce, moreover, is at least partially dependent upon stand-replacement fire, in that its' seeds become ready for germination at the peak of the Alaskan interior fire season and are released when its semi-serotinous cones are opened by canopy fire. Even more fundamentally, fire plays a key role in the regulation of the permafrost table throughout all of the ecosystems of the Alaskan interior. Without fire, organic matter accumulates, the permafrost table rises, and ecosystem productivity declines. Vegetation communities become much less diverse, and wildlife habitat decreases. Fire rejuvenates these systems. It removes some of the insulating organic matter and elicits a warming of the soil. Nutrients are added both as a result of combustion and by increased decomposition rates.

The impact of aggressive suppression on the Alaskan interior at large and GAAR in particular is, difficult to assess. Organized suppression has occurred on a large scale in Alaska since 1939; however, effects of suppression efforts are not clear. Alaska fire management personnel postulate that the fire ecology of the area may be relatively unchanged from its condition prior to the development of organized suppression efforts.

E. Wildland Fire Management Situation

The seasonal fire cycle in the Alaskan interior consists of four "micro" seasons or phases, each varying with the changing weather patterns and the stages of vegetation development for the growing season. The first begins in mid-May with the loss of snow cover, and ends in late May or early June when greenup begins. During the transition from 100% winter-cured fuels to greenup, human-caused fires occur frequently. These fires are usually relatively easy to suppress. Spring fires that are not suppressed, however, often grow later in the season as fuels become dryer. The second and third fire-cycle phases are primarily lightening driven. Suppression of such fires is harder. Fires occurring in June, the second period, usually do not develop the intensity of later summer fires; during hot, dry, and windy conditions, however, June wildland ignitions can result in extreme fire behavior. The third period of fire activity begins in mid-July and runs through the first part of August. This is the period of maximum fire activity. The final micro-season runs from late August into early September. These fires are generally easy to control except during particularly dry autumn weather.

IV. ENVIRONMENTAL CONSEQUENCES

A. Impacts of Alternatives

Alternative 1. Wildland Fire Use and Wildland Fire Suppression

Vegetation and Biodiversity
Certain wildland fires would be managed for the accomplishment of resource management goals, including the preservation of fire in its natural role and the reduction of burnable vegetation therefore maintaining a naturally functioning ecosystem. However, in the Full Protection Units the exclusion of prescribed fire may result in an unacceptable increase in vegetation thereby increasing the threat to the resources found within these units.

A purpose of the park is to "maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural feature." Fire is an inextricable component of the fire dependant ecosystem of this area and is known to maintain a balanced, naturally functioning ecosystem. This alternative would manage ignitions within established resource objectives to maintain the natural function of the ecosystem in the Park/Preserve.

Conclusion: Minimal impacts are expected with the use of this alternative due to an increase in vegetation resulting from no prescribed fire. The level of impacts to vegetation and biodiversity anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Cultural Resources
The prohibition of prescribed fire could hamper both the protection of historic and/or archeological resources and the restoration and/or protection of historic landscapes and conditions. Mechanical techniques employed in place of prescribed fire would tend to be more expensive and in some cases might not sufficiently mimic the effects of fire. However, certain wildland fires would be managed for the accomplishment of resource management goals including the reduction of burnable vegetation thereby better protecting the cultural resources from catastrophic fire.

Cultural resources are not specifically stated as a purpose of the Park/Preserve.

Conclusion: Minimal impact would occur due to an increase in vegetation resulting from no prescribed fire. The level of impacts to cultural resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Aesthetics and Recreation
Under this alternative the only impact would be the occasional closure of specific areas due to fire activity for the safety of visitors resulting in an inconvenience for the visitors or cause them to alter their plans.

A purpose of the Park/Preserve is "to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and to other wilderness recreation activities." Selection of Alternative 1 would not result in a change in vegetative composition and it would support a naturally functioning ecosystem. Sight lines and access would be maintained.

Conclusion: This may result in a minimal impact by closing certain areas and more vegetation may be burned decreasing aesthetics. The level of impacts to aesthetics and recreation anticipated from this

alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Local Economy
There would be a slight influx of revenue for businesses in communities near the incident from occasional suppression operations.

Conclusion: The increase in revenue would result in a minimal beneficial impact. The level of impacts to the local economy would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Wetlands and Floodplains
There would be a minimal risk of disruption to these communities due to fire suppression operations. There may be impacts due to erosion after fire has burned through a wetlands or floodplain. Once vegetation in these areas re-establishes erosion is expected to diminish.

A purpose of the Park/Preserve is to "maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural feature." Fire is an inextricable component of the fire dependent ecosystem of this area and is known to maintain a balanced, naturally functioning ecosystem. Managing wildland fire within established resource objectives would encourage the natural function of the ecosystem in the Park/Preserve.

Conclusion: There would be temporary minimal impacts due to a loss of vegetation. The level of impacts to wetlands and floodplains anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Subsistence Use and Wildlife Habitat
A short-term impact on game species and plants in specific areas could occur due to the decrease of vegetation within burned areas. However, this alternative would more adequately facilitate the long-term preservation of the area's natural processes by allowing fire to play its role in the ecosystem.

A purpose of the Park/Preserve is to "protect habitat for and the populations of fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds" and "subsistence uses by local residents shall be permitted in the park, where such uses are traditional, in accordance with the provisions of title VIII." Fire is an inextricable component of the fire dependent ecosystem of this area and is known to contribute toward the maintenance of a balanced, naturally functioning ecosystem.

Conclusion: This would not disrupt the natural function of the ecosystem in the Park/Preserve, therefore maintaining wildlife habitat and subsistence use within the Park/Preserve. There would be a negligible short-term impact resulting from a displacement of wildlife in the burned area. This, however, would replicate a naturally functioning ecosystem and subsistence regime. The level of impacts to subsistence and wildlife habitat anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Air Quality
Under this alternative, smoke would be monitored for trajectory, mixing height, and impact to overall air quality. Certain wildland fires would be managed for the accomplishment of resource management goals,

including the preservation of fire in its natural role and the reduction of burnable vegetation. This would reduce the possibility of catastrophic fire thereby reducing long-term, intense reduction of air quality.

Air quality is not specifically stated as a purpose of the Park/Preserve, though a degradation of air quality by fire could affect visitor use and recreation purposes. Fire naturally occurs in the Park/Preserve ecosystem and degradation in air quality at the levels expected would also be similar to a natural occurrence.

Conclusion: No long term impacts to air quality are expected. The level of impacts to air quality anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Water Quality and Fisheries

Under this alternative certain wildland fires would be managed for the accomplishment of resource management goals including the preservation of fire in its natural role and the reduction of burnable vegetation. This would result in a greater number of low-intensity wildland fires thereby reducing the potential for erosion along streams.

A purpose of the Park/Preserve is "to protect habitat for and the populations of fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds." Fire is an inextricable component of the environment of this area and is necessary to maintain a balanced, naturally functioning ecosystem. Selection of this alternative would not disrupt the natural function of the ecosystem in the Park/Preserve. A fire is a common occurrence in this ecosystem and does result in some erosion, affecting water quality and fisheries habitat. Under this alternative, the amount of erosion is expected to continue at the same natural level and will not result in an impairment of the stated park purpose, or any resources or values.

Conclusion: Long term impacts to water quality and fisheries are not expected. Short-term negligible impacts of increased sedimentation may occur initially after the fire and prior to reestablishment of vegetation. The level of impacts to water quality and fisheries anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Wilderness Character

UNDER THIS ALTERNATIVE CERTAIN WILDLAND FIRES WOULD BE MANAGED FOR THE ACCOMPLISHMENT OF RESOURCE MANAGEMENT GOALS INCLUDING THE PRESERVATION OF FIRE IN ITS NATURAL ROLE AND THE REDUCTION OF BURNABLE VEGETATION.

Much of Gates of the Arctic is designated wilderness. The wilderness character of the area reflects natural conditions and a vast undeveloped arctic landscape untrammeled by humans. There are no human caused trails or modern structures on designated wilderness lands. A sense of solitude and distance from modern civilization and its modifications of the natural world dominate the recreational experience. Under this alternative natural fire would be allowed to continue and will not result in an impairment of the stated park purpose or any resources or values.

Conclusion: Long term impacts to wilderness character are not expected. Short-term impacts during fire suppression activities may occur but will be mitigated by using minimum tool/minimum requirement analysis. The level of impacts to wilderness character anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural integrity of the park.

Alternative 1, Cumulative Impacts: The on-going and future activity that would have a cumulative effect on resources of concern within and outside of the Park and Preserve's boundaries analyzed in this Environmental Assessment is the adjacent landowners' fire management plans. All public land management agencies in Alaska are signatories of the Alaska Interagency Fire Management Plan, which allows for fire to burn on the landscape in limited suppression units. Much of the public lands surrounding the Park and Preserve is in a limited suppression unit and may result in multiple large fires, especially with an increase in vegetation due to no prescribed burns. The results of these multiple fires may be greater than fires managed just within the Park and Preserve boundary.

Alternative 2. Prescribed Fire Use, Wildland Fire Use, and Wildland Fire Suppression (NPS Preferred Alternative)

Vegetation and Biodiversity
Alternative 2 would have the least impact on vegetation with the maximum potential for maintaining diversity, by way of careful implementation of prescribed fire in areas ill-suited to wildland fire use. Wildland fire that poses a potential threat to life, property, or sensitive resources would be suppressed, while continued implementation of wildland fire use in remote portions of the Park/Preserve would ensure the cost-effective preservation of the area's natural fire ecology as well as the reduction of potentially dangerous fuel loads.

A purpose of the park is to "maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural features." Fire is an inextricable component of the environment of this area and is necessary to maintain a balanced, naturally functioning ecosystem. Selection of this alternative to use prescribed fire; wildland fire use within established resource objectives, and wildland fire suppression would result in a natural functioning ecosystem within the Park/Preserve.

Conclusion: A balanced and naturally functioning ecosystem would be maintained with the use of this alternative. The level of impacts to vegetation and biodiversity anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Cultural Resources
There would be improved long-term protection of registered and unregistered cultural resources with the use of fire near and surrounding cultural resources. The occasional use of prescribed fire would allow a relatively cost-effective means of reducing fuel loads and preserving historic landscapes and conditions where the presence of values to be protected prohibits the implementation of wildland fire use.

Cultural resources are not specifically stated as a purpose of the Park/Preserve.

Conclusion: Long-term protection of registered and unregistered cultural resources would result from this alternative. This is anticipated to not result in an impairment of park resources fulfilling specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Aesthetics and Recreation
The impacts would be similar to Alternative 1 with the addition of the occasional use of prescribed fire that would allow a relatively cost-effective means of reducing fuel loads where the presence of values to be protected prohibits the implementation of wildland fire use.

A purpose of the Park/Preserve is "to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and to other wilderness recreation activities." Selection of Alternative Two would not result in a change in vegetative composition and it would support a naturally functioning ecosystem. Sight lines and access would be maintained.

Conclusion: This may result in a minimal impact by closing certain areas and some vegetation may be burned decreasing aesthetics in limited areas. The level of impacts to aesthetics and recreation anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Local Economy

The impacts would be similar to Alternative 1 with the addition of the occasional use of prescribed fire would allow a relatively cost-effective means of reducing fuel loads where the presence of values to be protected prohibits the implementation of wildland fire use.

Conclusion: The increase in revenue would result in a minimal beneficial impact. The level of impacts to the local economy would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Wetlands and Floodplains

The impacts would be similar to Alternative 1 with the addition of the occasional use of prescribed fire would allow a relatively cost-effective means of reducing fuel loads where the presence of values to be protected prohibits the implementation of wildland fire use.

A purpose of the park is to "maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural features." Fire is an inextricable component of the environment of this area and is necessary to maintain a balanced, naturally functioning ecosystem.

Conclusion: There would be temporary minimal impacts due to a loss of vegetation. The level of impacts to wetlands and floodplains anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Subsistence Use and Wildlife Habitat

The impacts would be similar to Alternative 1 with the addition of the occasional use of prescribed fire would also allow a relatively cost-effective means of reducing fuel loads where the presence of values to be protected prohibits the implementation of wildland fire use.

A purpose of the Park/Preserve are "to protect habitat for and the populations of fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds" and "subsistence uses by local residents shall be permitted in the park, where such uses are traditional, in accordance with the provisions of title VIII." Fire is an inextricable component of the environment of this area and is necessary to maintain a balanced, naturally functioning ecosystem.

Conclusion: The natural function of the ecosystem in the Park/Preserve would not be disturbed, therefore maintaining wildlife habitat and subsistence use within the Park/Preserve. There would be a negligible short-term impact resulting from a displacement of wildlife in the burned area. This, however, would replicate a naturally functioning ecosystem and subsistence regime. The level of impacts to subsistence and wildlife habitat anticipated from this alternative would not result in an impairment of park resources

that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Air Quality

The impacts would be similar to Alternative 1 with the addition of the occasional use of prescribed fire would allow a relatively cost-effective means of reducing fuel loads where the presence of values to be protected prohibits the implementation of wildland fire use.

Air quality is not specifically stated as a purpose of the Park/Preserve, though a degradation of air quality by fire could affect visitor use and recreation purposes. Fire is a naturally occurring event in the Park/Preserve ecosystem. Degradation in air quality at the levels expected would be similar to a natural occurrence.

Conclusion: No long term impacts to air quality are expected. The level of impacts to air quality anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Water Quality and Fisheries

The impacts would be similar to Alternative 1 with the addition of the occasional use of prescribed fire that would allow a relatively cost-effective means of reducing fuel loads where the presence of values to be protected prohibits the implementation of wildland fire use.

A purpose of the Park/Preserve is "to protect habitat for and the populations of fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds." Fire is an inextricable component of the environment of this area and is necessary to maintain a balanced, naturally functioning ecosystem. Selection of this alternative would not disrupt the natural function of the ecosystem in the Park/Preserve. Fire is a common occurrence in this ecosystem and does result in some erosion, affecting water quality and fisheries habitat. The erosion is expected to continue at the same natural levels.

Conclusion: Long term impacts to water quality and fisheries are not expected. Short-term negligible impacts of increased sedimentation may occur initially after the fire and prior to reestablishment of vegetation. The level of impacts to water quality and fisheries anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural or cultural integrity of the park.

Wilderness Character

The impacts would be similar to Alternative 1 with the addition of the occasional use of prescribed fire that would allow a relatively cost-effective means of reducing fuel loads where the presence of values to be protected prohibits the implementation of wildland fire use.

Much of Gates of the Arctic is designated wilderness. The wilderness character of the area reflects natural conditions and a vast undeveloped arctic landscape untrammeled by humans. There are no human caused trails or modern structures on designated wilderness lands. A sense of solitude and distance from modern civilization and its modifications of the natural world dominate the recreational experience. Under this alternative natural fire would be allowed to continue and will not result in an impairment of the stated park purpose or any resources or values.

Conclusion: Long term impacts to wilderness character are not expected. Short-term impacts during fire suppression activities may occur but will be mitigated by using minimum tool/minimum requirement analysis. The level of impacts to wilderness character anticipated from this alternative would not result in

an impairment of park resources that fulfill specific purposes identified in the establishing legislation or are key to the natural integrity of the park.

Alternative 2 Cumulative Impacts: The on-going and future activity that would have a cumulative effect on resources of concern within and outside of the Park and Preserve's boundaries analyzed in this Environmental Assessment is the adjacent landowners' fire management plans. All public land management agencies in Alaska are signatories of the Alaska Interagency Fire Management Plan, which allows for fire to burn on the landscape in limited suppression units. Much of the public lands surrounding the Park and Preserve is in a limited suppression unit and may result in multiple large fires. The results of these multiple fires may be greater than fires managed just within the Park and Preserve boundary.

B. Cumulative Impact Mitigation

Potential cumulative impacts can be mitigated by the convening of a Multi-Agency Coordinating (MAC) group. As directed in the Alaska Interagency Fire Management Plan, "A statewide Multi-Agency Coordinating (MAC) group may be convened to implement a temporary change from the selected management options for a specific geographic area(s) during periods of unusual fire conditions (e.g., numerous fires, predicted drying trends, smoke problems, unusually wet conditions or suppression resource shortages)."

C. IMPACTS OF ALTERNATIVES SUMMARY

	Alternative 1: Wildland Fire Use and Wildland Fire Suppression	Alternative 2 (Preferred): Prescribed Fire Use, Wildland Fire Use, and Wildland Fire Suppression
Vegetation and Bio-diversity	Minimal impact: continued potential for minimal loss of diversity through fire exclusion in or near Critical and Full Protection Units and sites.	Least impact: maximum potential for diversity through careful implementation of prescribed fire in areas ill-suited to wildland fire use.
Cultural Resources	Minimal impact: Increased potential for uncontrolled fire due to increased fuels through fire exclusion in or near Critical and Full Protection Units and sites.	Improved long-term protection of registered and unregistered historic and/or archeological sites; improved maintenance of historical landscapes and conditions.
Aesthetics and Recreation	Minimal impact: occasional closures of specific areas; vegetation burned may decrease aesthetics.	Minimal impact: occasional closures of specific areas; vegetation burned may decrease aesthetics.
Local Economy	Minimal impact	Minimal impact
Wetlands and Floodplains	Minimal impact: may be some erosion until vegetation returns.	Minimal impact; may be some erosion until vegetation returns.
Subsistence Use and Wildlife Habitat	No long-term impact; some potential for short-term displacement of game from specific areas.	No long-term impact; some potential for short-term displacement of game from specific areas.
Water Quality and Fisheries	No long-term impact; some short-term erosion.	No long-term impact; some short-term erosion.
Air Quality	Minimal impact.	Minimal impact.
Wilderness Character	No long-term impact; some short-term impact from fire suppression activities.	No long-term impact; some short-term impact from fire suppression activities.

V. COORDINATION AND CONSULTATION

Brad Cella, Fire Management Officer, Alaska Region, National Park Service

Marsha Henderson, Area Fire Management Officer, Gates of the Arctic National Park and Preserve, Yukon-Charley Rivers National Preserve, and Wrangell-St. Elias National Park and Preserve

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PREPARER

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Appendix D.3.b: ANILCA 810

ANILCA Title VIII Section 810 (a) Summary Evaluation and Findings

INTRODUCTION

This section was prepared to comply with Title VIII, Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA). It summarizes the evaluations of potential restrictions to subsistence activities that could result from the implementation of the proposed fire management plan and the actions described therein.

EVALUATION PROCESS

Section 810(a) of ANILCA states:

> In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands…the head of the federal agency…over such lands…shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes. No such withdrawal, reservation, lease, permit, or other use, occupancy or disposition of such lands which would significantly restrict subsistence uses shall be affected until the head of such Federal agency—
>
> (1) gives notice to the appropriate State agency and the appropriate local committees and regional councils established pursuant to section 805;
>
> (2) gives notice of, and holds, a hearing in the vicinity of the area involved; and
>
> (3) determines that (A) such a significant restriction of subsistence uses is necessary, consistent with sound management principles for the utilization of the public lands, (B) the proposed activity will involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other disposition, and (C) reasonable steps will be taken to minimize adverse impacts upon subsistence uses and resources resulting from such actions.

ANILCA created new units and additions to existing units of the national park system in Alaska. Gates of the Arctic National Park and Preserve was created by ANILCA Section 201[4] in order to "maintain the wild and undeveloped character of the area, including opportunities for visitors to experience solitude, and the natural environmental integrity and scenic beauty of the mountains, forelands, rivers, lakes, and other natural features; to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and to other wilderness recreations activities; and to protect habitat for and the populations of fish and wildlife, including, but not limited to, caribou, grizzly bears, Dall sheep, moose, wolves, and raptorial birds." The act also states "subsistence uses by local residents shall be permitted in the park where such uses are traditional, in accordance with the provisions of title VIII."

The potential for significant restriction to subsistence resources must be evaluated for the proposed action's effect upon subsistence uses and needs, the availability of other lands for the purposes sought to be achieved and other alternatives which would reduce or eliminate them.

PROPOSED ACTION ON FEDERAL LANDS

The National Park Service requires every administrative unit with burnable vegetation to develop a fire management plan—a unit-specific document outlining fire management goals and describing the policies and actions by which these goals will be realized (Director's Order 18). Since 1983, the Park/Preserve's fire management program has operated under the jurisdiction of various statewide interagency documents, including the **Alaska Interagency Wildland Fire Management Plan**, or **AIWFMP** (1998). Under the AIWFMP, fire protection needs at Gates of the Arctic are determined by NPS and Bureau of Land Management (BLM) managers; lands within the Park/Preserve are categorized as **critical**, **full**, **modified**, or **limited** protection, depending on the proximity of values to be protected and on overall resource management objectives.

The proposed action consists of the establishment of a Fire Management Plan for Gates of the Arctic National Park and Preserve. The preferred alternative and the other considered alternatives (see Appendix C1, Environmental Assessment, this document) specify continued adherence to the AIWFMP as well as compliance with recently developed National Park Service directives. Specifically, NPS Director's Order 18 mandates a distinction between **prescribed fire** (planned and implemented by management) and **wildland fire** (unplanned ignitions), with wildland fire incidents further categorized, in turn, as either wildland **fire use** or wildland fire **suppression**. Each of the considered alternatives mandates a specific configuration of DO-18 management options and relates these options to the policies and procedures outlined in the AIWFMP.

The preferred alternative allows for the continued management of wildland fire at Gates of the Arctic National Park and Preserve through a combination of wildland fire suppression, wildland fire use, and prescribed fire use. This statement of Summary Evaluations and Findings addresses the impact of these fire management policies and actions on subsistence activities within the Preserve.

AFFECTED ENVIRONMENT

As mandated by ANILCA section 1313, the "preserve" portion of GAAR will be managed so as to allow for subsistence trapping as well as hunting and fishing for either sport or subsistence under applicable state and federal regulations. "Park" designated lands allow for subsistence trapping and hunting only, available to residents of the resident zone communities around or within Gates of the Arctic (See Subsistence Management Plan, 2000 Appendix B for descriptions of Resident Zone Communities). Subsistence activities occur throughout the year and are usually concentrated in the northern and eastern portions of the park or along river corridors.

Residents from eleven local communities have exclusive use of the park for subsistence use (See Subsistence Management Plan, Appendix B). Winter trapping efforts concentrate on the harvest of lynx, wolverine, wolves, marten and fox. Caribou, moose, sheep and several species of fish make up major portions of the subsistence diet. Hunting, fishing, trapping and gathering in repeated seasonal cycles remains a vital part of the evolving subsistence lifeways of local residents in this region and an unbroken link to the past. Many factors including disruption of the natural fire regime, air or water pollution, mineral development, or an increase in human populations may significantly impact the timing and nature of traditional subsistence activities.

The majority of GAAR lies within the Limited Protection Fire Management Unit. Under the proposed action, wildland fire ignitions occurring within this unit would be managed for the accomplishment of resource management goals, including the preservation of the natural fire regime, and the perpetuation, in turn, of healthy and biologically diverse plant communities and fish and game habitat.

SUBSISTENCE USES AND NEEDS EVALUATION

To determine the potential impact on existing subsistence activities, three evaluation criteria were analyzed relative to existing subsistence resources that could be impacted.

The evaluation criteria are:

- the potential to reduce important subsistence fish and wildlife populations by (a) reductions in numbers, (b) redistribution of subsistence resources, or (c) habitat losses;
- the effect the action might have on subsistence fisherman or hunter access; and
- the potential for the action to increase fisherman or hunter competition for subsistence resources.

Potential to Reduce Populations:
The National Park Service has generally found populations of plants and animals important to subsistence activities to be healthy. Because site-specific information on population, distribution, and harvest is lacking for many of these species, however, recognition of declining populations has been difficult.

The GAAR Resource Management Plan (1994) identifies several potential threats to the continuation of traditional and customary subsistence lifestyles, including, specifically, any activity that impairs the overall health of the ecosystem through the disruption of the natural fire regime. The actions that would be implemented under the preferred alternative would be aimed directly at the safe and cost-effective preservation of the area's natural fire ecology. As such, GAAR enactment of the preferred alternative would have a beneficial effect on the long-term viability of plant and animal populations pertinent to subsistence use within the Park/Preserve. The occasional displacement of plant and animal populations from specific locales by wildland fire is a natural and inevitable occurrence within the fire-dependent ecosystems of the Gates of the Arctic area. Although current populations may experience some adverse effects, usually those effects are greatly offset by the benefits accrued to future generations of populations.

Under the proposed action, potential losses to subsistence users could be mitigated through the consideration of hunting and trapping activities by land managers in the planning and implementation of wildland fire use and prescribed fire incidents. There are a few users who have permits for the use of public structures within the Preserve. These structures are protected under Critical Suppression as noted in the accompanying Fire Management Plan (FMP, Section XVI Protection of Sensitive Resources). In the event of loss of or damage to this structure, the Superintendent of the Preserve may permit reconstruction of this structure. The long-term benefits of fire to the wildlife habitats of GAAR outweigh any short-term losses by subsistence users and, therefore, will not be the sole reason for suppressing a wildland fire. However, subsistence use is an important factor in the determination of prescribed fire within the Park/Preserve.

Restriction of Access:
Occasional restriction of access to local areas by subsistence users because of fire behavior and/or fire management practices is inevitable as a result of public safety issues. Under the proposed action, such restrictions would be minimized in the future through the reduced possibility of widespread, catastrophic fire.

Increase in Competition:
The enactment of the preferred alternative would not significantly increase competition for the use of subsistence resources. Displacement of plant and animal populations from specific sites would be short-term, and, in fact, in most cases the long-term viability of the populations in question depends directly on the natural processes that the proposed plan is intended to safely perpetuate.

AVAILABILITY OF OTHER LANDS

As stated earlier, wildland fire is an inevitable component of the plant and animal communities of the Park/Preserve area. Consequently, the availability of other lands is not a pertinent consideration in this particular case.

With respect to the question of subsistence use, the scope and intensity of wildland fire incidents managed for resource benefit (i.e., fire use incidents) will generally be of small significance when considered within the context of overall available acreage. Prescribed fires will be planned and managed so as to avoid any significant hardship to subsistence users.

ALTERNATIVES CONSIDERED

This section discusses the considered alternatives with respect to their respective reduction or elimination of the need to use public lands necessary for subsistence purposes. Alternative one (a combination of prescribed fire use and wildland fire suppression) would perhaps result in the least short-term disruption of subsistence activities, with suppression responses preventing the spread of many wildland fire ignitions. The long-term impacts of this alternative, however, would be negative, with the exclusion of wildland fire leading to the gradual decline of biodiversity and viable habitat throughout all areas within the Park/Preserve utilized by subsistence hunters and trappers.

Alternative two (a combination of wildland fire use and wildland fire suppression) would not significantly differ from the preferred alternative with respect to the reduction or elimination of the need to use public lands for the accomplishment of fire management goals.

The preferred alternative (a combination of wildland fire use, wildland fire suppression, and prescribed fire use) would yield the same favorable long-term effects on lands used for subsistence activities as alternative two, while allowing more effective protection and restoration of significant fire-sensitive sites and/or landscapes.

FINDINGS

This analysis concludes that the proposed action will not result in a significant restriction of subsistence uses.

Appendix D: Compliance for FMP (continued)

4. *NHPA (Section 106)*
   This will be determined through the park compliance through a case by case basis.

5. *ESA (Section 7)*
   Comments are imbedded in the Environmental Assessment.

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Appendix E: Multi-Year Fuels Treatment Plan

Fuels Treatment Plan
Gates of the Arctic

Introduction

The purpose of the Gates of the Arctic's Fuels Plan is to provide firefighter/public safety and to increase the probability of protecting the built environment and private property within the park. By implementing the fuel treatment prescription to reduce or remove vegetation, a defensible space will be created and maintained around the park structures, private structures, and private property. This space allows radiant heat from a wildfire to dissipate, and reduces crown fire potential, thus keeping the sites from igniting. It also prevents structural fires from igniting other structures, and provides a safe area for suppression crews to work. Creation of this space reduces the risk of property damage in the event of a wildland fire, improves security for visitors and residents, and reduces the risks for firefighters. This plan also describes implementation and maintenance schedules for specific sites. All fuels treatments in GAAR are subject to the YUGA compliance review process.

This plan documents how to implement the fuel reduction program in Gates of the Arctic. An Alaska NPS Regional Hazardous Fuels Environmental Assessment was prepared according to the National Environmental Policy Act of 1969 and regulations of the Council on Environmental Quality (40 CFR 1508.9). The Environmental Assessment received a Finding of No Significant Impact (FONSI) December of 2013. In addition, the GAAR FMP had an Environmental Assessment completed and received a Finding of No Significant Impact (FONSI) September, 2004.

The Gates of the Arctic Fuels Plan complies with NPS policies and guidelines and provides guidance for treating vegetative fuels. The Alaska NPS Structure Protection Procedures were approved in 2005 by the Alaska Regional Director and provide direction to the park superintendents concerning structure protection.

The wildland urban interface is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. The vegetation near structures is referred to as fuel. In some areas of Gates of the Arctic this vegetation is particularly thick and may touch or overhang structures. The vegetation significantly complicates the ability of fire fighters to control a wildland fire and protect the structures. Many of the structures in Gates of the Arctic have been built within the forest or close to the forest edge, or the forest has since expanded to the proximity of the structures. Due to the remoteness and difficulty of access, it takes a significant amount of time, effort, and resources to protect cabins and structures during a fire.

General Concept

In support of the FireWise Community Action Program, the National Park Service will remove hazardous vegetative fuel that surrounds structures in the backcountry areas within Gates of the Arctic.

Scope

The proposed areas will be developed through consultation with park staff, typically occurring at isolated historic, private and/or cultural sites located throughout Gates of the Arctic. To continue the benefits of hazardous vegetative fuel reduction, a maintenance program involving periodic repeated removal of vegetation in these same areas is addressed in this plan. Similar treatments will be applied if additional structures are determined to warrant protection.

Treatment Zones

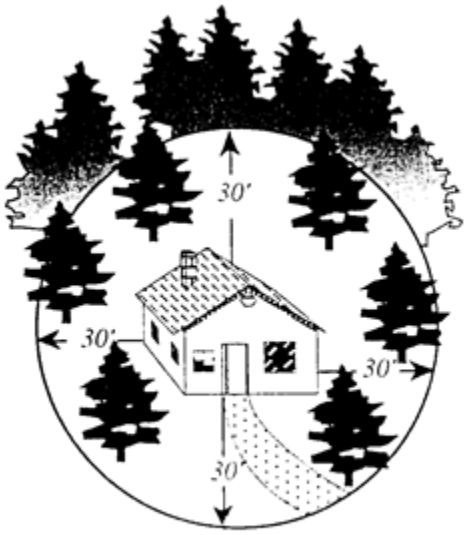

Figure 1-1. Fuel Treatment Zone 1.

Three basic Firewise treatment zones around structures and sites are shown schematically in Figure 1. Zone 1 has a radius of 15 feet around structures and all conifers and dead or dry vegetation would be removed. This zone could contain mowed grass, small native plants, flowers, or gravel. Zone 2 would extend an additional 15 feet to a 30-foot radius around a structure. This zone would include removal or all dry or dead vegetation, removal of shrubs beneath trees, pruning of limbs on mature conifers to 6-8 feet above the ground surface, and thinning of conifers or clumps of small conifers up to about 15 feet between extending branches. Zone 3 would extend an additional 70 feet from zone 2 for a total minimum distance of 100 feet from each structure. On downslope areas this distance would be increased, according to the slope angle over 30% incline. In zone 3 the thinning of trees would be to a spacing of 10-15 feet, depending on the location and flammability of the trees.

Areas around each structure will be individually evaluated to design defensible spaces within the context of that structure's use, location, and cultural significance. It is important to evaluate each structure on its own relative to the proximity of green lawns, driveways, roads or natural fuel breaks. For example, a spruce tree may be left in Zone 1 if lawn and driveway extended the largely vegetation-free area beyond the 30-foot point. Limited numbers of trees may remain as long as they are not leaning toward the structure or do not have branches that extend over the roof. Efforts will be made to work with residents to identify trees that could remain around their house. Should a fire occur and approach a particular structure, residents need to understand that there is a high probability that even those trees that are not removed in advance will have to be removed to protect the structure.

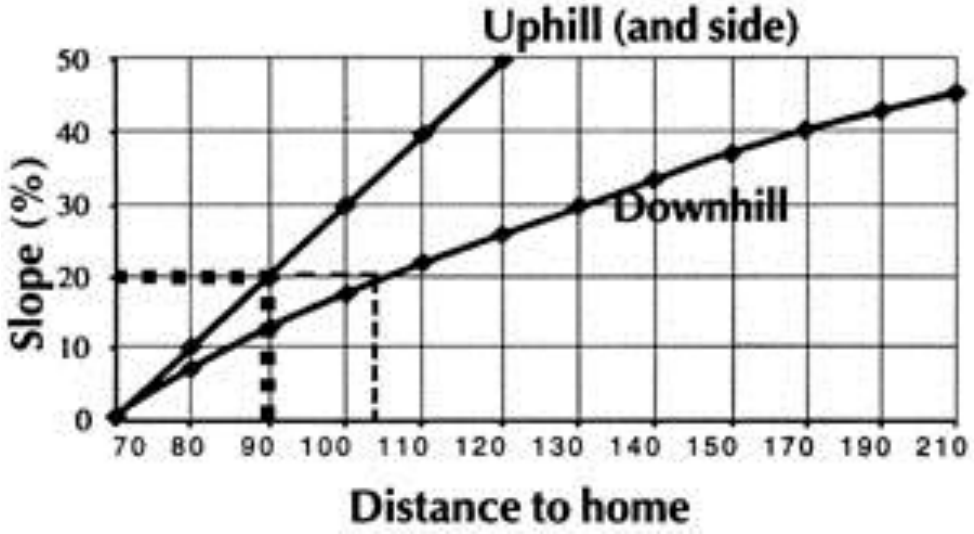

Figure 2-1: Chart showing minimum distances for Zone 2 using percent slope and position of the structure.

Criteria Used to Determine Treatment Priority for Structures

Because the protection of every known structure within the park cannot happen at the same time, criteria have been established to provide managers with sound methodology for determining which structures to treat first. The criteria are as follows and may be updated or improved should new information become available (Appendix G. Alaska NPS Structure Protection Procedures).

TOP PRIORITY (CRITICAL FIRE MANAGEMENT OPTION IN THE ALASKA INTERAGENCY WILDLAND FIRE MANAGEMENT PLAN, AIWFMP)

1. The structure(s) is a primary domicile.
2. The structure(s) is designated as a National Historic Landmark.

SECOND PRIORITY (FULL FIRE MANAGEMENT OPTION IN THE AIWFMP)

1. The structure has been determined eligible for or is on the National Register of Historic Places, has structural integrity (e.g., intact roof and walls, a reasonable probability for defense), is at potential risk from wildland fire and has been identified for or undergoing routine maintenance/restoration.

2. NPS administrative (e.g. patrol cabin) or public use structures – public funds expended to construct or maintain.
3. The use of the structure is provided for under NPS permit or an approved Mining Plan of Operations.

The following types of structures would not receive treatment under this Fuel Plan:

1. Trespass structures
2. Abandoned structures that are not eligible for inclusion on the National Register of Historic Places.
3. Structures without structural integrity or they have not been identified for or are undergoing routine maintenance/restoration. (It is difficult to put a sprinkler system on a structure without a roof.)

On-site Evaluation

Site reconnaissance will be completed to evaluate actual field conditions and determine planned actions. For example, trees selected for removal and areas selected for clearing and thinning will be identified and inspected to confirm planned actions. Representatives from Cultural Resources and Fire Management will review all actions in the field and agree on the designations made for each area or building perimeter. The number of trees removed will vary at each location depending on the type and characteristics of the vegetation, slope and aspect, and degree of significance of the structure. Each site, structure, and situation is unique (for example, fire history, roadside screening, roof material, siding material, continuum of fuel, location of road, privacy, aesthetic considerations) so the treatment of the site will be tailored accordingly. Paramount consideration will be for the safety of personnel protecting the structure should a fire occur.

Specific aspects of removal and clearing to be evaluated include, but are not limited to: resulting vegetative edge conditions, integration of root systems, and canopy constraints.
Resulting vegetative edge conditions should be reviewed to ascertain potential weakness of remaining plant materials that would be exposed to wind, sunlight and a change in precipitation levels. Roots of a number of trees may in fact share a singular root system and may require careful evaluation before removing single specimens. Consideration of canopy form and aesthetic appearance of those trees that remain should be evaluated to determine whether extensive pruning and/or limbing would be required.

Fire Management staff will devise a site protection plan for each backcountry structure at the initial clearing. This plan would estimate the amount of time and resources needed for protection (and maintenance) of the site.

Site Access

Staff and/or contractors involved in the removal/clearing of vegetation will be provided with the locations of all accessible routes into the area. Locations for staging, stockpiling, parking, landing, and administrative functions should also be identified so that activities are restricted from areas that will continue to be used by public/park staff during the removal period or that contain resources that are to remain undisturbed.

The following measures would be taken to mitigate noise intrusion and resource damage by motorized equipment in areas of designated and suitable wilderness:

- Strictly limit work to only necessary sites. The sites where work is proposed constitute the most critical needs. No work is proposed at less important sites.

- Control means of access. Coordinated on a yearly basis.

- Crews may perform long-term maintenance at some backcountry sites during winter. This may include debris pile burning.

- Where feasible, subsistence permit holders will be encouraged to maintain the defensible space around the cabins, in accordance with the standards identified in this plan. This would reduce NPS administrative presence and associated helicopter use. NPS fire management staff is available to consult with permit holders to identify needed treatment and if it benefits the NPS, fire management staff may assist with the treatment.

Use of Tools

Motorized tools such as chainsaws and "weed eaters" will be permitted for the fuel reduction at both designated and suitable wilderness sites. This exception allows motorized use and is based on weighing the need to accomplish the work expeditiously in order to avoid catastrophic harm by fire against the desire to reduce the impacts of motorized noise on wilderness users. Factors considered include labor required to accomplish the work by hand, utility of the buildings and infrequency of visitor presence. The use of mechanized and motorized tools to remove hazard fuels will be subject to the minimum requirement/ minimum tool.

Motorized tools will be permitted for subsequent work at sites outside and inside the designated Wilderness. These tools are commonly used at many of the inholdings and cabin sites by landowners and subsistence users. The projected level of additional use connected with the proposed action would not be significant, and would not diminish the suitability of the portions of the park where these other sites are located from being considered for wilderness designation in the future.

Protection of Resources

Removal of vegetation will be completed in a manner that does not damage or disturb the remaining vegetation, other natural resources, historic and cultural resources, or infrastructure/improvements. If observation by archaeologists, cultural resource specialists, or other park staff is anticipated, they will coordinate with the fuels reduction crew will minimize/facilitate site visits. Park staff will be responsible for properly identifying specific resources that are to be protected and informing the fuels reduction crew.

Fuel reduction crews will be briefed about cultural resources concerns such as the need to use care when removing vegetation growing on, under, or next to structures; the types of artifacts that may

be encountered when working around historic structures; and the requirement that trees and shrubs be cut off at ground level and not uprooted.

The crews will be instructed to not disturb artifacts and to immediately contact the supervisor if artifacts are found. Sensitive areas will be identified to the crew to minimize foot traffic and dragging of brush over these sites. Tree felling will be accomplished in such a way that trees would be dropped in directions away from identified sites. A cultural monitor will be requested if historic properties are discovered or unanticipated effects on historic properties are found.

Removal Techniques

Beyond routine and accepted techniques per arboricultural standards, removal of trees will be accomplished in a manner that minimizes disturbance of administrative and public activities. Removal operations will generally occur during normal business hours. Re-routing traffic and controlling access to removal areas will be the responsibility of the involved contractor/park staff. All necessary safety precautions will be taken to protect the public, staff and contracted workers.

Trees designated for removal will ideally be felled with the stump grubbed or cut flush with the existing grade, hashed with saw cuts, and covered with dirt and forest floor debris. This will facilitate recovery of groundcover and will be consistent with the treatment and appearance of cultural landscape that is to be interpreted. Felling should be accomplished in a manner that minimizes leaving permanent markings or indentations on any surface of the ground. At remote sites logs will be bucked up, allowed to dry, and used as firewood at patrol cabins. Larger tree trunks may be saved for renovation of historic structures. Logs from trees at residences may be bucked up and used as firewood by the residents.

Successional changes at treated sites will continue through the selection of seedlings and saplings that will not be removed from Zones 1 and 2. Identified seedlings/saplings will be permitted to grow and develop naturally to replace trees and shrubs that die off.

Park residents are encouraged to discuss the details of fuel removal with fire management staff to assure that both fire protection and aesthetic concerns are addressed when fuel reduction decisions are made. The Park Superintendent will retain the authority to determine if or extent of fuel management treatments if conflicts occur.

Limb and Branch Pruning

Trees may require pruning of lower limbs, damaged or imbalanced branches, previously cut knobs, and sucker growth. Clean cuts will be kept close to the trunk or connecting branch. Trees that may be retained within the 30-foot clear zone of a building will be limbed up a minimum of 6 feet from the ground. Limbing of trees between 30 and 100 feet away from a building will be evaluated on an individual basis; however, a rule of thumb is the closer to the building, the higher the limbing. Some snags may remain on the outer edges of Zone 2 as long as they do not pose a safety or fire hazard. Snags will not remain in Zone 1 since they are an ideal source of burning embers that pose too great a threat to firefighters and structures.

Burning

Fire prevention measures as identified in a certified burn plan will be taken to assure that a wildland fire is not ignited by burning of shrub and branch debris. The burn plan will address appropriate weather conditions, adequate clearing around debris piles, limiting the number of piles that are burning at one time, and presence of trained personnel with appropriate fire fighting apparatus and personal protective equipment.

Where feasible, shrubs and branches may be scattered rather than burned if the surrounding fuel loading is not adversely affected by additional bio-debris and fire hazard is not increased. Shrubs and branches, if burned, will be piled in locations distant enough from structure areas to prevent damage to the structures. Shrub and branch piles shall be burned during a time that minimizes impact to park users, during a time when visitation is the lowest and fire danger is low. Burning will be done in compliance with National Park Service policies and Alaska Department of Conservation Open Burning regulations.

Clean Up

All tree, limb, and branch debris will be removed from non-paved areas. Additionally, the aforementioned materials plus twigs, leaves, needles, chips, and other organics will be removed from all trails and site furnishings. All refuse generated or brought on site in the form of packaging, equipment parts, or worker supplies will be removed from the park.

Periodic Maintenance

Sites in Gates of the Arctic will be revisited periodically following fuel removal. An evaluation of limb, sapling and shrub re-growth will occur and a determination will be made regarding removal cycles. It is generally anticipated that re-treatment may be necessary roughly every five to 10 years. Reduction in the height and density of herbaceous plants, grasses, and small shrubs may be done annually via mowing in developed areas.

Five Year Treatment Plan (2014-2019)

The following sites have been identified for potential hazardous fuels reduction projects over the next five years: Squaw Rapids Cabin (NOR003B), Kutuk River Cabin (ARRI-002), Narvak Lake (KOBU-0032), and Helmerick's Outcamp/Usibelli Cabin (WALK-005). The Five Year Treatment Plan is updated annually and future candidate projects will be identified at that time. No fuel treatment projects were completed in fiscal year 2012.

Identified Infrastructure within GAAR Boundaries

These sites are separated into two major categories: allotments and structures. All of the sites are indicated in the following tables.

Table 1.1: All allotments within Gates of the Arctic National Park and Preserve.

Tract Number	Land Owner	Latitude (NAD83)	Longitude (NAD83)
GAAR-17-109	HORNER, CHARLIE K, heirs of	66.7469	-155.3286
GAAR-11-102	MERRY, RENEE A, heirs of	68.4055	-149.9002
GAAR-11-103	DARLING, MARY A, heirs of	68.3912	-149.9130
GAAR-07-103	MEKIANA, DAVID O, heirs of	68.3857	-152.8187
GAAR-07-121	RULLAND, JOHNNY	68.3471	-152.3666
GAAR-07-122	MORRY, BILLY, heirs of	68.3166	-152.2414
GAAR-07-115	HUGO, SUSAN A	68.2620	-152.7052
GAAR-07-116	HUGO, JOHN, heirs of	68.2516	-152.7275
GAAR-08-108	NAGEAK, ANNA E	68.2177	-152.7016
GAAR-09-111	HUGO, ZACCHARIUS O	68.1982	-151.5445
GAAR-09-109	MEKIANA, REBECCA, heirs of	68.1938	-151.6391
GAAR-08-130	MEKIANA, JUSTUS, estate of	68.1987	-152.7702
GAAR-09-103	MORRY, MAGGIE HUGO, estate of	68.1726	-151.9155
GAAR-08-107	MEKIANA, ETHEL K, estate of	68.1946	-152.7581
GAAR-09-112	AHGOOK, MOLLY, estate of	68.1902	-151.6056
GAAR-12-101	MERRY, RENEE A, heirs of	68.1570	-150.2393
GAAR-11-105	MERRY, RENEE A, heirs of	68.1591	-150.2384
GAAR-08-111	MORRY, RILEY, estate of	68.1565	-152.1275
GAAR-08-112	MORRY, JOHN, heirs of	68.1368	-152.0981
GAAR-09-137	RILEY, RACHEL S	68.1291	-151.4787
GAAR-09-141	MORRY, MAGGIE, estate of	68.1119	-151.3485
GAAR-09-120	YOUNG, JANE RULLAND, heirs of	68.1020	-151.6895
GAAR-12-102	MERRY, RENEE A, heirs of	68.0745	-150.4735
GAAR-09-124	AHGOOK, RHODA	68.0715	-151.9754
GAAR-08-121	MORRY, BILLY, heirs of	68.0450	-152.2433
GAAR-08-122	NAGEAK, ANNA E	68.0389	-152.2321
GAAR-08-123	RULLAND, LAZARUS, estate of	68.0252	-152.3612
GAAR-08-124	HUGO, CHRIS, SR	68.0180	-152.3660
GAAR-14-106	AHGOOK, BEN, heirs of	67.8836	-152.2635
GAAR-14-107	MEKIANA, ETHEL K, estate of	67.8773	-152.2609
GAAR-14-108	AHGOOK, LELA	67.8690	-152.2826
GAAR-14-103	MEKIANA, JOSEPH, heirs of	67.7956	-152.4513
GAAR-14-110	AHGOOK, MOLLIE K, estate of	67.7792	-152.3717
GAAR-14-111	HUGO, DANNY, JR	67.7742	-152.3847
GAAR-14-115	MERRY, RENEE A, heirs of	67.4498	-150.8470
GAAR-17-105	BERNHARDT, MAY	66.9001	-155.6729
GAAR-17-102	ROSS, IDA	66.8006	-154.7052
GAAR-17-107	HORNER, CHARLIE K, heirs of	66.7596	-155.5048
GAAR-17-108	HORNER, CHARLIE K, heirs of	66.7461	-155.3565
GAAR-07-127	BURRIS, MABEL	68.2833	-152.6562

Table 2.1: Identified structures within Gates of the Arctic National Park and Preserve.

CABIN NUMBER	CABIN NAME	FIRE PROTECTION	FIRE PROTECTION CODE REASON	LAT (NAD 83)	LONG (NAD 83)
ALAL-001	Helmericks Takahula Lake Cabin	FULL	REVIEW YEARLY W/ CHIEF OF RESOURCES	67.3575	-153.6597
ALAM-001	Unakserak River (Hamilton) Cabin	FULL	NATIVE ALLOTMENT	67.5503	-154.1338
ARRI-002	KUTUK RIVER CABIN	FULL	ELIGIBLE FOR NAT'L REGISTER	67.5156	-153.9736
ARRI-002A	KUTUK RIVER CABIN CACHE	FULL	ELIGIBLE FOR NAT'L REGISTER	67.5156	-153.9736
DACR-001	Dahl Creek Compound: Not In GAAR	FULL	PARK SUPPORT FUNCTION	66.9475	-156.9101
HUNT-002	Kevuk Creek (Rulland 2) Cabin	FULL	NATIVE ALLOTMENT	67.8594	-152.6227
HUNT-006	KEVUK- HUNT FORK	FULL	NATIVE ALLOTMENT	67.8595	-152.6384
ITKI-001	Itkillik Lake (Renee Merry) Cabin	FULL	NATIVE ALLOTMENT	68.4062	-149.9047
ITKI-002	Oolah (Merry) Lake Cabin	FULL	NATIVE ALLOTMENT	68.1576	-150.2365
JOHL-004	Hunt Fork (Ahgook/Hugo) Cabin	FULL	NATIVE ALLOTMENT	67.7798	-152.3775
KOBU-001	Kobuk River (Sheldon) Cabin	FULL	NATIVE ALLOTMENT	66.7601	-155.5233
KOBU-002	Narvak Lake (Bernhardt) Cabin	FULL	NATIVE ALLOTMENT	66.9018	-155.6699
KOBU-003	Narvak Lake	FULL	NPS-OWNED AND STRUCTURALLY SOUND	66.9281	-155.6144
KOBU-004	Narvak Lake (Sheldon) Cabin	FULL	REVIEW YEARLY W/ CHIEF OF RESOURCES	66.9587	-155.6077
NOAL-001	Nelson Walker	FULL	PARK SUPPORT FUNCTION	67.7205	-156.1439
NORL-003B	SQUAW RAPIDS CABIN	FULL	ELIGIBLE FOR NAT'L REGISTER	67.3269	-150.7182
NORL-006	Long Lake (Merry) Cabin	FULL	NATIVE ALLOTMENT	67.4475	-150.8498
NORU-001	Summit Lake (Merry) Cabin	FULL	NATIVE ALLOTMENT	68.0725	-150.4738
RAWS-NORUTAK LK	RAWS-NORUTAK LAKE	FULL	PARK SUPPORT FUNCTION	66.8486	-154.3417
RPTR-POPE CREEK	Pope Creek Radio Repeater	FULL	PARK SUPPORT FUNCTION	66.9263	-151.0937
RPTR-WISEMAN	Wiseman Radio Repeater	FULL	PARK SUPPORT FUNCTION	67.3765	-150.0628
WALK-001B	Helmericks Lodge Cabin #1	FULL	NPS-OWNED AND STRUCTURALLY SOUND	67.1021	-154.2795
WALK-002	Helmerick's Swan Island Cabin	FULL	REVIEW YEARLY W/ CHIEF OF RESOURCES	67.1170	-154.3655
WALK-003	Claseen Cabin	FULL	REVIEW YEARLY W/ CHIEF OF RESOURCES	67.1374	-154.4084
WALK-004	Walker Lake (Chase) Cabin	FULL	REVIEW YEARLY W/ CHIEF OF RESOURCES	67.1392	-154.3951
WALK-005	Helmerick's Outcamp/Usibelli Cabin	FULL	REVIEW YEARLY W/ CHIEF OF RESOURCES	67.2143	-154.5722
ALAL-002	Takahula Lake Portage Trail Cabin (Newer)	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	67.3648	-153.6574
ALAL-006	ERNIE LAKE	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	67.3834	-152.9667
ALAL-007	TAKAHULA PORTAGE TRAIL CABIN RUIN	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	67.3637	-153.6592
ALAU-001	PEGEELUK CREEK	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	67.5669	-154.2834
ALLE-001	Swamp Creek Cabin	NONSENSITIVE	INELIGIBLE FOR NAT'L REGISTER	67.6554	-151.6836
ARRI-001	Arrigetch Creek A-Frame Cabin	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	67.5053	-153.9396
ARRI-003	UPPER AWLINYAK CREEK	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	67.3831	-154.3643
ARRI-004	OLD ARRIGETCH CREEK - CABIN GONE	NONSENSITIVE	CABIN GONE	67.5053	-153.9396
GLAC-001	LASALLE CREEK #1	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4024	-150.6392
GLAC-002	LASALLE CREEK #2	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4058	-150.6385
GLAC-003	Middle Glacier River Cabin	NONSENSITIVE	NON-HISTORIC ON FEDERAL LAND	67.4168	-150.6230
GLAC-004	DELAY PASS #2 - DESTROYED	NONSENSITIVE	CABIN GONE	67.4250	-150.6322
GLAC-005	UPPER GLACIER	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4415	-150.5961
GLAC-006	BLUECLOUD CREEK #2	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4484	-150.5730
GLAC-007	BLUECLOUD CREEK #1	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4491	-150.5790
GLAC-011	CONGLOMERATE CREEK RUIN #4 - destroyed	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4510	-150.6486
GLAC-012	MASCOT CREEK CABIN RUIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4541	-150.5608
GLAC-013	DRIFT MINER'S BOILER CABIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5003	-153.9668
GLAC-018	GLACIER PASS WOODCHOPPER'S CABIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4636	-150.3145
GLAC-019	VINCENT KNORR HUNTING CABIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4171	-150.6239
GLAC-025	GLACIER CABIN #3 - did not locate	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4393	-150.6083
GLAC-026	WASHINGTON CREEEK CABIN #3 - did not locate	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5324	-150.3139

GLAC-027	BLUECLOUD CREEK #4 - did not locate	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4476	-150.5666
GLAC-028	CONGLOMERATE CREEK #3	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4831	-150.6857
GLAC-029	Conglomerate (Harp) Creek Cabin	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4906	-150.7090
GLAC-030	Small Log Structure: Glacier River	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4186	-150.6240
HUNT-001	KEVUK CREEK/ RULLAND #1	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.8590	-150.6222
HUNT-003	LOON CREEK	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.9390	-150.6845
HUNT-004A	KEVUK CREEK -TENT FRAME - did not locate	NONSENSITIVE	CABIN GONE	67.7755	-152.9173
HUNT-004B	Kevluk Creek Cabin	NONSENSITIVE	CABIN GONE	67.7755	-152.9173
HUNT-005	AGIAK LAKE/ DORRIS HUGO	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	68.0680	-152.9805
JOHL-001	TANGLEBLUE CREEK	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5702	-152.2075
JOHL-002	WOLVERINE CREEK #2 - NOT LOCATED	NONSENSITIVE	NOT LOCATED	67.6183	-152.2996
JOHL-003	WOLVERINE CREEK #1	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.6153	-152.4869
JOHL-005	KELLUM-IRWIN CABIN RUINS (?)	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.6096	-152.2473
KILL-001	CHRISLER'S CABIN	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	68.1231	-154.0995
KOYU-001	Middle Fork Miner's Cabin Ruin	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.0767	-150.5548
NOAL-002	Joiner/Nigik Creek Noodle Shack Cabin Ruin	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.7042	-155.9003
NORL-003A	SQUAW RAPIDS CABIN RUIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.3269	-150.7182
NORL-004	DELAY PASS #1	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4316	-150.7313
NORL-005	PEGGY HARRY - DESTROYED 2004	NONSENSITIVE	CABIN GONE	67.4407	-150.8018
NORL-007	WHITE BLUFFS	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4618	-150.8694
NORL-008	BONANZA CREEK	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5168	-150.8821
NORL-009	Lower Tinayguk River Cabin	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5771	-151.0320
NORL-009A	LOWER TINAYGUK OLD RUIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5787	-151.0359
NORL-010	CONGLOMERATE CREEK #2	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5393	-150.7948
NORL-011	JOE PUP CABIN RUIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5281	-150.6819
NORL-013	BONANZA CREEK CABIN RUIN #2 - did not locate	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.5059	-150.8903
NORL-014	CONGLOMERATE CREEK #1 - destroyed 6/2004	NONSENSITIVE	CABIN GONE	67.5576	-150.7853
NORL-015	ALDER CREEK CABIN	NONSENSITIVE	POOR CONDITION AND INELIGIBLE FOR NAT'L REGISTER	67.1952	-150.6004
NORL-016	HAMIL BAR CABIN RUIN	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.0767	-150.5550
NORL-017	Ipnek Creek Log Cache	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.4257	-150.8031
NORL-018	Alder Creek Cache	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.1966	-150.6285
OKOK-001	Okokmilaga cabin	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	68.3700	-153.0800
SCHE-001	Reed River Hot Springs Cabin Ruin	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.2669	-155.0582
TINA-001	UPPER TINAYGUK REMAINS - not located	NONSENSITIVE	POOR CONDITION ON FEDERAL LAND	67.9069	-151.5750
TINA-002	UPPER TINAYGUK CABIN - HISTORIC?	NONSENSITIVE	NON-HISTORIC ON FEDERAL LAND	67.9030	-151.5755
WALK-006	Wien Cabin Ruin at Walker Lake	NONSENSITIVE	CABIN GONE	67.0691	-154.3648
ALAL-003	New Gaedeke Cabin	NOT DESIGNATED	PRIVATE LAND: 2010 GIS LAND STATUS LAYER	67.4211	-153.7115
ALAL-004	Gaedeke Cabin	NOT DESIGNATED	PRIVATE LAND: 2010 GIS LAND STATUS LAYER	67.4215	-153.7106
ALAL-005	Gaedeke Cabin	NOT DESIGNATED	PRIVATE LAND: 2010 GIS LAND STATUS LAYER	67.4222	-153.7124
ALAU-002	Gaedeke Headwaters Cabin	NOT DESIGNATED	PRIVATE LAND: 2010 GIS LAND STATUS LAYER	67.8983	-155.0675
GLAC-009	CHARLES "CHARLIE" YALE CABIN - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.4668	-150.4873
GLAC-010	VINCENT KNORR CABIN - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.4913	-150.5332
GLAC-014	UKNOWN-NO CABIN LEFT-DOYON	NOT DESIGNATED	NATIVE CORP LAND	67.4794	-150.5388
GLAC-015	NICK IKOVICH CABIN - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.5036	-150.5461
GLAC-016	GLACIER RIVER CABIN #1 - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.4565	-150.5468
GLAC-017	GLACIER RIVER CABIN #2 - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.4571	-150.5441
GLAC-020	MASCOT CREEK CABIN RUIN #2 - destroyed	NOT DESIGNATED	NATIVE CORP LAND	67.5257	-150.5528
GLAC-021	WASHINGTON CREEK CABIN #1	NOT DESIGNATED	NATIVE CORP LAND	67.5187	-150.3323

GLAC-022	WASHINGTON CREEK CABIN #2 - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.5146	-150.3764
GLAC-023	A.P. NESS CABIN - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.4736	-150.4695
GLAC-024	TRAPPER SHELTER'S CABIN - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.4714	-150.3936
NORL-001	MIDDLE FORK/EVANSVILLE - Doyon	NOT DESIGNATED	NATIVE CORP LAND	67.0663	-151.0509
NORL-012	BONANZA CREEK CABIN RUIN #1 - did not locate	NOT DESIGNATED	NATIVE CORP LAND	67.5187	-150.5472

Appendix F: Wildfire and Prescribed Fire/Fuels Treatment Monitoring Plan

I. INTRODUCTION / EXECUTIVE SUMMARY

1.1 Introduction

Gates of the Arctic National Park and Preserve (GAAR) has established a program of fire management to achieve resource management objectives associated with the protection and stewardship of fire-adapted ecosystems. The purpose of the Alaska NPS Fire Ecology program is to provide effective evaluation of NPS Alaska Fire Program management activities with respect to fuels, vegetation, wildlife habitat or other identified objectives. The program is designed to determine whether fire and resource management objectives are being met, as well as to document any unexpected consequences of fire management activities. The program is also intended to inform the staff about results of management activities so management can adapt to changing conditions using the best available information. In addition, the program strives to obtain baseline data on the natural variability of fire on the landscape and asses impacts of potential climate change on fire and fire effects.

The Alaska NPS Fire Ecology program provides science based information to guide Alaska NPS fire and land management planning, decisions and practices in order to maintain and understand fire adapted ecosystems. The primary focus areas of the program are to:

- Participates in *planning* activities for the Fire Management and Park Land Management Programs and develops strategies to accommodate fire management issues as a result of climate change
- Provide effective evaluation of Alaska NPS fire management program activities and fire on the landscape through *monitoring*
- Coordinate *research* and facilitate the use of scientific data, modeling and technology to enhance the fire management program
- Provide fire ecology *information and outreach* to fire managers, other park staff, and the public
- *Collaborate* with other NPS programs, interagency partners, and other entities.

One of the primary tasks of the Fire Ecology program is to develop and implement a comprehensive Fire and Fuels Monitoring program for Alaska's parks. The Regional Fire Ecologist is responsible for coordinating monitoring efforts and maintaining fire effects data and is assisted by an Assistant Regional Fire Ecologist. Currently the Alaska NPS Fire Ecology program does not have a funded fire effect monitoring crew. The monitoring work in other Alaska parks is usually accomplished by NPS Alaska Area Program Fire/Fuels seasonal technicians and staff, under the guidance of the Regional Fire Ecologists. There has been few recent fire or fuels monitoring projects completed in GAAR by NPS staff.

This fire monitoring plan describes the framework that could be used to collect, manage, and evaluate fire effects information at GAAR. As new information and research results are obtained, relevant changes to the Fire and Fuels Monitoring program will be made. These changes may include new or alternative monitoring techniques, changes in treatment prescriptions, or refinement of management objectives.

1.2 Need for monitoring and study in relation to management

NPS Fire Ecology Program Policy is developed by the NPS Fire Ecology Steering Committee with approval from the NPS Fire Management Leadership Board. The information within the NPS Fire Ecology Program Policy is consistent with guidelines provided in both RM-18 (USDI

NPS 2008 http://www.nps.gov/fire/wildland-fire/resources/documents/reference-manual-18.pdf) and the NPS Fire Monitoring Handbook (USDI NPS 2003 http://www.nps.gov/fire/wildland-fire/resources/documents/fire-effects-monitoring-handbook.pdf).

Every Fire Management Area unit that intends to either manage wildland fire for resource benefit or conduct prescribed fire must have an approved Fire Management Plan. In order to evaluate resource benefit the Fire Management Area units must monitor fire effects. A Fire Monitoring Plan can be prepared independent of the Fire Management Plan and attached as an appendix at a later time. This Fire Monitoring Plan has been prepared for Gates of the Arctic since fire management for this park unit manages wildland fires, implements mechanical fuels reduction projects, and may potentially implement prescribed fire.

1.3 History of Fire & Fuels Monitoring

Prior to the 2002 establishment of the Alaska NPS Fire Ecology Program, only one formal fire effects study has been conducted in Gates of the Arctic NPPr. The full protocol and complete methods are provided in Appendix F1 and an overview of the project is provided below.

Alaska NPS Fire Effects Paired Plots (1982-Present)

Background & Purpose: The only formal NPS fire effects study on Alaska parklands prior to 1999 was the Alaska Region NPS Fire Paired Plot study. The project began in 1981 under the direction of Gary Ahlstrand, NPS Alaska Regional Research Ecologist. The purpose of the project was to assess vegetation change and succession as a result of fire and to determine the fire history of a given area. Fire staff established paired vegetation 15-m x 30-m plots in burned areas and in similar areas which were not burned adjacent to the burned areas. The time since fire at the burned plots varied. Between 1981 and 1988, at least 525 plots were installed across 9 different parks in Alaska. Most of the plot locations were not permanently marked. A complete list of the GAAR paired plots and coordinates is provided in Table 1. Paired plots provide valuable historic data on fires and fire effects in Gates of the Arctic. This information can be used to compare post-fire vegetation succession to vegetation succession in similar but unburned areas. Paired plot data has been applied to develop post-fire succession models which are used to update the fuels and vegetation maps used by fire managers.

Methods: Burned sites were identified and selected for the study based on historic fire reports, 1:63,360 color infrared aerial photography, and aerial reconnaissance. Plot data that was collected included: photographic slides of plot, tree density by species and diameter size class on 15-m x 30-m quadrants, vegetation cover class for 30 Daubenmire frames (20 x 50 cm), tree cores/cookies, fuels and soils data (on some plots), and general plot site descriptions.

Data Management: Up until 2008 most of the data was only available in paper format, except for the vegetation cover data was in a TWINSPAN text format. Between 2003 and 2008, paired plot data for all the parks was entered into a Microsoft Access database, and plot locations were digitized based off of information from topographic maps and aerial photos. In 2008 a SEM contract was used to convert the Access database into a database on the Interagency Fire Ecology MS Sequel Server database, FFI (FEAT-FIREMON Integrated). Original and scanned copies of data and photos are archived at the NPS Alaska Regional Office. Scanned copies are also stored by the Regional Fire Ecologist in Fairbanks, Alaska.

Table 1. Fire Effects Paired Plots in GAAR.

Park	Paired Plot ID	Plot Type	Date	Viereck Classification Pre-Fire	Latitude (NAD-83)	Longitude (NAD-83)
GAAR	GAAR-A-310	Burn	7/22/1987	Open Low Mixed Shrub-Sedge Tussock Tundra	66.7995	-155.5027
GAAR	GAAR-ANA-1	Control	7/22/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	66.8154051	-155.6460252
GAAR	GAAR-ANB-1	Burn	7/21/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	66.8144163	-155.6450078
GAAR	GAAR-ANA-2	Control	7/22/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	66.8395435	-155.5522617
GAAR	GAAR-ANB-2	Burn	7/21/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	66.8395829	-155.5557073
GAAR	GAAR-B-093-A	Control	7/18/1987	Black Spruce Woodland	67.2222288	-150.6999919
GAAR	GAAR-B-093-B	Burn	7/18/1987	Black Spruce Woodland	67.2225603	-150.6974409
GAAR	GAAR-B-093A-A	Control	6/27/1987	Open Low Mesic Shrub Birch-Ericaceous Shrub	67.2265217	-150.6781041
GAAR	GAAR-B-093A-B	Burn	6/27/1987	Open Low Mesic Shrub Birch-Ericaceous Shrub	67.2269382	-150.6758677
GAAR	GAAR-B-173-A	Control	6/26/2009	Black Spruce Woodland	66.8195583	-155.010677
GAAR	GAAR-B-173-B	Burn	6/26/2009	Black Spruce Woodland	66.8199266	-155.0156021
GAAR	GAAR-BSA-1	Control	7/8/1985	White Spruce Woodland	67.1667564	-151.062642
GAAR	GAAR-BSB-1	Burn	7/7/1985	White Spruce Woodland	67.1649173	-151.070499
GAAR	GAAR-FCA-1	Control	7/4/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	67.1640902	-150.8454233
GAAR	GAAR-FCB-1	Burn	7/3/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	67.1665936	-150.8405986
GAAR	GAAR-FCA-2	Control	7/4/1985	Open Low Shrub Birch-Willow Shrub	67.1643301	-150.8395861
GAAR	GAAR-FCB-2	Burn	7/3/1985	Open Low Shrub Birch-Willow Shrub	67.1654664	-150.8392722
GAAR	GAAR-FCL-1-A	Control	7/5/1984	Tussock Tundra	Not Available	Not Available
GAAR	GAAR-FLC-1-A	Control	7/5/1984	Black Spruce Woodland	Not Available	Not Available
GAAR	GAAR-FVA-1	Control	7/6/1985	Open Black Spruce Forest	67.129237	-150.9714446
GAAR	GAAR-FVB-1	Burn	7/6/1985	Open Black Spruce Forest	67.1292259	-150.973815
GAAR	GAAR-FVA-2	Control	7/9/1985	Open Black Spruce Forest	67.1137529	-151.0050457
GAAR	GAAR-FVB-2	Burn	7/9/1985	Open Black Spruce Forest	67.1137087	-151.0033857
GAAR	GAAR-KRA-1	Control	8/20/1985	Open Black Spruce Forest	66.7930316	-154.7311235
GAAR	GAAR-KRB-1	Burn	8/19/1985	Open Black Spruce Forest	66.7955968	-154.7357456
GAAR	GAAR-LOK-A	Control	8/21/1984	Open Black Spruce Forest	66.7206706	-155.3077793
GAAR	GAAR-LOK-B	Burn	8/21/1984	Open Black Spruce Forest	66.7222194	-155.305097
GAAR	GAAR-MLB-1	Burn	8/4/1985	Open Black Spruce Forest	66.8949002	-155.023248
GAAR	GAAR-MLB-2	Burn	8/4/1985	Black Spruce Woodland	66.8945827	-155.0195638
GAAR	GAAR-MLB-3	Burn	8/18/1985	Open White Spruce Forest	66.8638956	-155.0929472
GAAR	GAAR-NBA-1	Control	7/5/1985	Open Black Spruce Forest	67.1598698	-151.1590175
GAAR	GAAR-NBB-1	Burn	7/5/1985	Open Black Spruce Forest	67.161259	-151.1570547
GAAR	GAAR-NFA-1	Control	7/4/1986	White Spruce Woodland	67.3908471	-150.7152445
GAAR	GAAR-NFB-1	Burn	7/5/1986	White Spruce Woodland	67.3909183	-150.7182364

Park	Paired Plot ID	Plot Type	Date	Viereck Classification Pre-Fire	Latitude (NAD-83)	Longitude (NAD-83)
GAAR	GAAR-NHA-1	Control	6/23/1985	Open Black Spruce Forest	66.7622845	-154.5508585
GAAR	GAAR-NHB-1	Burn	6/25/1985	Open Black Spruce Forest	66.7614634	-154.5472309
GAAR	GAAR-NLA-1	Control	6/21/1985	Black Spruce Woodland	67.0374955	-154.7715998
GAAR	GAAR-NLB-1	Burn	6/20/1985	Black Spruce Woodland	67.0439457	-154.7859596
GAAR	GAAR-PBB-1	Burn	6/27/1985	Black Spruce-White Spruce Woodland	67.0281198	-154.4983731
GAAR	GAAR-PCB-1	Burn	6/25/1986	Black Spruce-White Spruce Woodland	67.6119574	-151.131583
GAAR	GAAR-RLA-1	Control	7/23/1985	Open Spruce-Paper Birch Forest	66.7053775	-155.320965
GAAR	GAAR-RLB-1	Burn	7/23/1985	Open Spruce-Paper Birch Forest	66.7050105	-155.3345553
GAAR	GAAR-SCA-1	Control	8/14/1985	Black Spruce Woodland	66.8191419	-155.227823
GAAR	GAAR-SCB-1	Burn	8/14/1985	Black Spruce Woodland	66.8179712	-155.2213238
GAAR	GAAR-SEL-A	Control	8/1/1984	Open Black Spruce Forest	66.8817452	-155.6354601
GAAR	GAAR-SEL-B	Burn	8/1/1984	Open Black Spruce Forest	66.880126	-155.635348
GAAR	GAAR-SLT-A	Control	8/24/1984	Vaccinium Dwarf Shrub Tundra	66.7871333	-155.8026107
GAAR	GAAR-SLT-B	Burn	8/24/1984	Vaccinium Dwarf Shrub Tundra	66.7865634	-155.80845
GAAR	GAAR-WPA-1	Burn	7/18/1985	Open Black Spruce Forest	66.823017	-155.5329636
GAAR	GAAR-WPB-1	Burn	7/18/1985	Open Black Spruce Forest	66.8187241	-155.5251518
GAAR	GAAR-WPB-2	Burn	7/19/1985	Open White Spruce Forest	66.8108411	-155.6983641
GAAR	GAAR-WPA-3	Control	7/17/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	66.7983234	-155.5348183
GAAR	GAAR-WPB-3	Burn	7/17/1985	Open Low Mixed Shrub-Sedge Tussock Tundra	66.7989317	-155.536454

FirePro Ground Truth and Intensive Mapping Areas/Units

NPS fire management personnel collected vegetation and landform data from sites throughout GAAR and other Alaska parks during the late 1980s and early 1990s. Vegetation classification, landform, drainage, slope, aspect, and soils data were collected for two types of sites: Intensive Mapping Areas/Units (IMAs/IMUs) polygons and Ground Truth (GT) sites. Site locations were selected (based on aerial photographs) to provide representative vegetation types. The purpose of the data collection was to compile information that could be used for vegetation mapping purposes. The GT sites were assessed both aerially and on the ground. The IMUs are areas that were assessed only from the air. Photographs were taken of most of the sites. Site locations have been digitized. The dataset exists as an MS Access database and is also available as an ArcView-to-Access Field Data Viewer. The database and associated GIS themes are stored in the Fairbanks Office of the Regional Fire Ecologist. The data collected at these sites was utilized to create the landcover maps for the GIS Thematic Mapper Landcover Mapping Project. The number of sites in GAAR is listed by type in Table 2.

Table 2. Ground Truth and IMA sites in Gates of the Arctic National Park and Preserve*.

Park	Ground Truth Sites (GT)	Intensive Mapping Units/Areas (IMU/IMA)
GAAR	530	703

*Datasource: 2007 compilation of data provided by Beth Koltun (Alaska Regional Office- GIS).

II. FIRE ECOLOGY AND FIRE HISTORY

2.1 Overview of Gates of the Arctic National Park and Preserve Fire Ecology

General Fire Effects

Fires can exert a landscape-level influence on vegetation structure and composition, permafrost dynamics, water and air quality, nutrient cycling, wildlife habitat, and biodiversity. In the absence of fire in boreal forests, organic matter accumulates and insulates the ground, causing the permafrost table to rise. Fires usually remove portions of the accumulated organic layer which can warm the soils, lower the permafrost table and increase active layer depth (Van Cleve and Viereck 1981). Soil temperature directly effects nutrient availability (Smithwick et al. 2005) and therefore ecosystem productivity (Van Cleve and Viereck 1981). Fire related changes to nutrient cycling, cycling, trophic dynamics, and species composition may occur to such an extent that post-fire communities may be completely different from the original pre-fire community (Johnstone and Chapin 2006).

Burn Severity

In Alaska's boreal forest and tundra ecosystems, burn severity strongly impacts post-fire vegetation patterns and succession (Sorbel and Allen 2005). If burn severity is low or moderate, aboveground plant material may be singed or burned, but much of the vegetation will be able to regenerate quickly from roots and stems. In contrast, severe fires burn deeper into organic soils which may kill off the underground root structure of some shrubs and herbaceous plants. Therefore, in severely burned areas, plant reproduction may be more dependent on seed establishment or deep rooted plants than in low or moderately burned areas. This may in turn slow or alter the post-fire vegetation successional trajectory (Bernhardt et al. 2011, Johnstone and Chapin 2006b, Sorbel and Allen 2005).

The ecosystems of Alaska are fire-adapted ecosystems, and are characterized by a mosaic of different aged landscapes that are maintained by fire. Within this system, burn severity strongly influences vegetation patterns and succession after fire. Since many of the plant species are rooted in the organic forest floor mat, the amount of consumption of the organic mat will determine whether vegetation regeneration occurs through seeding or re-sprouting post fire (Viereck 1983). For tree establishment, seed source and seedbed conditions at the micro-site scale in the immediate post-disturbance period are major drivers of recruitment (Zasada et al. 1972, Johnstone and Chapin 2006). If fire severity is low to moderate, above-ground portions of plants may be top-killed, but minimal organic mat or duff is burned and regeneration can occur quickly through re-sprouting from roots and stems for species such as aspen, paper birch, Labrador tea, willow, resin birch, rose, fireweed, tussocks or northern blue joint grass (Viereck and Schandelmeier 1980, Foote 1983, Racine et al 1987). On the other hand, severe burns will consume most of the organic layer and may kill more of the underground root structure of shrubs and herbaceous plants, such that reproduction will occur more often by seed. As a result, severity will influence the plant species composition at a site.

Boreal Forest Fire Effects

Periodic fires in the boreal forests of Gates of the Arctic have shaped the ecosystem so that many plants and animals exhibit fire-adapted traits. For instance, white spruce colonizes mineral soil seedbeds after intense ground fires which remove organic soil layers and black spruce is partially dependent upon fire activity for sexual reproduction. Aspen and birch trees also respond rapidly to fire; burned areas are often colonized by dense stands of these species which provide good habitat for some wildlife species.

Tundra Fire Effects
Relatively few studies have documented the effects of fire and burn severity in tundra ecosystems. Unless fires are severe, most shrub-tussock tundra types re-vegetate rapidly, sometimes within a few weeks after a fire event (Racine et al. 1987, Racine et al. 2004). On the other hand, high severity fires may either decrease or eliminate tussock cottongrass (*Eriophorum vaginatum* L.).

Fire is important in maintaining the long-term growth and survival of tussock cottongrass. In the absence of fire, tussock-shrub tundra undergoes a series of autogenic successional changes. These changes involve the accumulation of peat and burial or submergence of tussocks by dwarf shrubs, mosses, and lichens. This results in raised permafrost levels, reduced frost action, and senescence of tussocks. Frost action prevents such changes by churning soils, incorporating organics, and preventing the buildup of dwarf shrubs, mosses, and lichens. Frost action is renewed when enough organics are burned so that thaw depth reaches into mineral soils.

Tussock cottongrass survives fire because its growing points are insulated by tightly bunched dead and live tillers, stem sheaths, and scales. The elevated position of tussocks increases resistance to ground fire. Fire provides an opportunity for seedling establishment. Since sheathed cotton-sedge has both shallowly and deeply buried seed, some viable seed is available regardless of depth of burn into the peat horizon. Burned peat is an ideal seedbed. In a comparison of sheathed cotton-sedge seedling emergence on different substrates, burned peat showed highest rates of emergence.

Habitat Fire Effects
Changes in vegetation due to fires, in turn, affect wildlife distribution and habitat use. Patchy fires create a mosaic of habitats frequently used by snowshoe hares and martens, while moose often browse on resprouting willow and other shrubs (Sorbel and Allen 2005). Small mammals such as voles often thrive in recently burned areas, creating large colonies in the remaining duff and feeding on new vegetation. In the winter, caribou often avoid recently burned areas for they lack sufficient amount of lichen for winter forage (Joly et al. 2010).

2.2 Historic Role of Fire

An annual average of 4315 acres per year burns in GAAR and a total of roughly 626,525 acres have burned within and immediately around the park unit over the last 55 years (Table 2, GAAR FMP Section 1.2.2.3). Climate, terrain, and vegetation strongly influence the occurrence and extent of fires in GAAR where both the boreal forest and tundra ecosystems are subject to periodic fires.

In Gates of the Arctic NPPr thunderstorm activity, accompanied by high temperatures and low precipitation, is common during June and July. This combination of weather factors is conducive to both fire starts and continued fire activity. It follows that the vast majority of fire starts and fire activity in this region occur in June and July (Figure 4, GAAR FMP Section 1.2.2.3).

The most frequent and largest fires on record have occurred in the forested portions of Gates of the Arctic; a large proportion of these are located in the Kobuk Preserve of GAAR (also referred to as the southwestern ‘boot’ of the park) (Appendix S.2, Fire History Map). The ‘boot’ is situated at the northernmost belt of interior Alaska, just south of the Arctic Circle. The primary vegetation types in this area are black and white spruce forests; two of the more fire prone vegetation types in interior Alaska. Highly flammable spruce lichen woodlands and spruce feathermoss forest types are particularly common in the ‘boot’ area. Although fires are most

frequent in the forested 'boot' of GAAR they also occur less frequently in alpine and lowland tundra in the northernmost two-thirds of GAAR (Appendix S.2, Fire History Map) because of lack of fuels associated with barren or sparse alpine tundra on the Brooks Range and the wetter climate associated with the Arctic coastal influence. However, it is worth noting that large fires do occur in the tundra region north of the Brooks Range as indicated by the large 256,734 acre Anaktuvuk River Fire that occurred in 2007 (Appendix S.2, Fire History Map).

III. MANAGEMENT GOALS, OBJECTIVES, AND DESIRED CONDITIONS

3.1 Monitoring Program Goals and Objectives

The Fire Management program has developed a comprehensive Fire Management Plan for Gates of the Arctic National Park and Preserve. Within RM-18 it is stated that: "Fuels management activities and treatments must be monitored in order to assess treatment effectiveness and to determine whether management objectives were met. Moreover, monitoring is the basis of a successful adaptive management program." Fire ecology program requirements are described in the Fire Ecology and Monitoring section of RM-18 (Ch. 8, USDI NPS 2008).

Fire Management Strategic Objectives

Whenever safely possible, Gates of the Arctic National Park and Preserve (GAAR) will utilize the natural role of fire in the natural environment in order to fulfill NPS natural resource management directives. Accordingly, GAAR will direct all fire management activities toward the accomplishment of the following strategic objectives (FMP Section 3.1.1):

- Protect human life.
- Prioritize areas for protection actions and allocation of available firefighting resources without compromising firefighter safety.
- Use a full range of fire management activities to achieve ecosystem sustainability including its interrelated ecological, economic, and social components (fire suppression, monitoring, prescribed fire, thinning and other vegetation treatment projects, prevention and education programs, scientific studies, etc.)
- Use wildland fire to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, enable fire to function in its ecological role and maintain the natural fire regime.
- Manage vegetation through various fuels treatment techniques to reduce and mitigate risks of damage from wildland fire.
- Balance the cost of suppression actions against the value of the resource warranting protection and consider firefighter and public safety, benefits, and resource objectives.
- Consider short and long-term cost effectiveness and efficiencies while maintaining responsiveness to jurisdictional agency objectives and within the scope of existing legal mandates, policies and regulations.
- Minimize adverse environmental impact of fire suppression activities.
- Maintain each jurisdictional agency's responsibility and authority for the selection and annual review of fire management options for the lands that they administer.
- Adhere to state and federal laws and regulations

Fire and Fuels Monitoring Program Goals

A natural fire regime shapes a significant portion of the landscape in Gates of the Arctic NPPr. Therefore a good understanding of baseline fire effects on landscape-level ecology is necessary for detecting discrepant responses to environmental change and management decisions. Understanding the ways in which fire events effects vegetation ecology; 1) can be used for determination of appropriate fire management decisions, and 2) elucidates ecosystem response to natural- and human-related changes in fire activity. Monitoring helps address questions about which management decisions should be made and how those management decisions should be implemented.

The purpose of the Alaska NPS Fire Ecology program is to provide science based information to guide Alaska NPS fire and land management planning, decisions and practices in order to maintain and understand fire adapted ecosystems. The primary focus areas of the program are to:

- Participates in *planning* activities for the Fire Management and Park Land Management Programs and develops strategies to accommodate fire management issues as a result of climate change
- Provide effective evaluation of Alaska NPS fire management program activities and fire on the landscape through *monitoring*
- Coordinate *research* and facilitate the use of scientific data, modeling and technology to enhance the fire management program
- Provide fire ecology *information and outreach* to fire managers, other park staff, and the public
- *Collaborate* with other NPS programs, interagency partners, and other entities.

Management objectives and desired conditions are continually developed and refined based on new knowledge. Corresponding monitoring methodologies and objectives need to reflect these changes and are therefore periodically updated. Monitoring objectives may also vary as a function of specific project management objectives and ecosystem type.

3.2 Adaptive Management

As monitoring results become available, they are used for determination of whether management objectives have been achieved and/or need to be adjusted. They are analyzed to assess whether the original management objectives are still applicable and/or desirable based on information from monitoring results. Any changes or additions to monitoring protocols based on new monitoring results will be included in future revisions of this Fire Monitoring Plan. The adaptive management approach employed by the NPS Fire Management program is designed to ensure that the Fire Management Program receives adequate assessment of success in implementing management decisions.

3.3 Desired Conditions

In managing and restoring the ecological benefits of fire on the landscape, managers must understand the differences between current conditions and desired conditions. Managers must also understand the practices and environmental factors that contributed to the current conditions. Information used to develop the desired conditions includes research data (where available), historic photos and written documents, and expert opinion. Desired conditions must be periodically evaluated to determine whether they are still realistic and wanted in light of a changing environment. For example, desired conditions may be based on our knowledge of past long-term climate conditions; however, future climate changes may preclude achieving these targets.

It is important to recognize that further work is needed in GAAR to better understand the interrelationships within natural systems. As this occurs, we may be able to refine these desired conditions – as part of adaptive management. This could be accomplished at the landscaped or vegetation

community scale and could be useful in developing ecological models and refining ecosystem priorities. Currently no Desired Conditions are developed for GAAR. The following interim fire and vegetation Desired Conditions are provided here as suggestions for GAAR:

- Fire processes in fire dependent/adapted vegetation communities will be managed to promote healthy and functional ecosystems. Vegetation succession reflects the natural range of variability under conditions that would occur under historical fire regimes.
- The number of acres burned per year are within the range of natural variability (1950-2013).
- The number of natural fire starts per year are within the range of natural variability (1950-2013).
- Total duration (days) of fire incidents annually are within the range of natural variability (1950-2013). The count of days from the first fire discovered to the final fire declared out date.
- Wildfire is recognized as a natural process, wildfires continue to occur in the park with minimal amount of suppression action. Natural fire regimes are maintained or restored.
- Fires are suppressed only if they pose a threat to human lives or private property, or that will enter another suppression zone. The level of fire suppression is according to the interagency fire management plan, GAAR Fire Management Plan, and Agency Administrator.
- All wildland fires are effectively managed, considering resource values to be protected and firefighter and public safety, using the full range of strategic and tactical operations as described in an approved fire management plan.
- The best available technology and scientific information are used to manage fire within the park, to conduct routine monitoring to determine if objectives are met, and to evaluate and improve the fire management program.
- Fire processes in fire dependent/adapted vegetation communities are managed to promote healthy, functional ecosystems. Vegetation succession reflects the natural range of variability.

IV. MONITORING DESIGN AND METHODOLOGY

The Gates of the Arctic Fire Management Plan mandates that fuels treatments and prescribed fires must have measurable objectives. In order to know whether the measurable objectives have been met, fire effects and fuels treatment monitoring is necessary. The minimum required monitoring for wildfires on AK NPS lands includes the requisite data for completion of a DOI-required Wildland Fire Management Information (WFMI) fire reporting document (https://www.nifc.blm.gov/fire_reporting/NPS/doc/index.html). There are no established ongoing monitoring projects currently being conducted in GAAR. In the event that either the park requests monitoring or begins fuels reduction projects for which monitoring is required, the following section describes recommended sampling designs, methods, monitoring visit frequency, and analysis approaches for future monitoring projects.

4.1 Design and Methodology

The National recommended NPS standard for fire effects monitoring is the National Park Service, Fire Monitoring Handbook (USDI NPS 2003). In addition, the Fire Ecology and Monitoring chapter of RM-18 (USDI NPS 2008, Ch. 8) states that alternative monitoring protocols may be used to address local/regional needs and objectives. Furthermore, monitoring protocols can be developed at

the park, community or project levels. All alternative protocols must be reviewed by the Regional Fire Ecologist prior to implementation.

Since 2002, when a Regional Fire Ecologist was hired for the Alaska Region parks, the vast majority of the fire monitoring projects conducted on NPS lands in Alaska has employed some variation on the Alaska NPS Fire and Fuels Monitoring Program Field Method Protocol. A general overview of the framework, timing and data management for monitoring based on the Fire and Fuels Monitoring Program Field method is provided in Sections 4.2 and 4.3. The full protocol recommended for fire and fuels monitoring plots in GAAR is provided in Appendix A.1. Additionally, the Paired Plot monitoring methods which were established in the 1980's are provided in Appendix A.2.

4.2 Fire & Fuels Monitoring Framework

Fire effects and fuels treatment monitoring is an important part of adaptive management. Guidelines for monitoring wildland fires, prescribed fires and mechanical treatments within GAAR were developed based on 1) the collaboration with the Interagency Alaska Fire Effects Task Group (FETG) (Alaska Interagency Fire Effects Task Group 2007), 2) reference to the NPS Fire Monitoring Handbook (USDI NPS 2003), and 3) consultation with the NPS Alaska Regional Fire Ecology program. These guidelines provide recommendations for minimum variables to monitor fire or treatment effects within a framework of three monitoring intensities (Level 1 – 3) and are summarized in Table 3. Brief descriptions of the three monitoring levels are provided below:

Level 1, Surveillance Monitoring - This level provides a basic overview of the baseline data that is required to be collected for all wildland or prescribed fires, some variables are required for mechanical treatments. Information at this level includes such items as RAWS weather data, general description of the fire environment (i.e., topography and fuel types), and fire location or perimeter. Information collected at this level precludes the necessity for on the ground measurements and can be done from remote sensing or an aerial platform. This data is necessary to satisfactorily complete a Wildland Fire Report.

Level 2, Moderate Intensity Monitoring - This level of monitoring documents fire behavior observations (not addressed in this document), fuels, and general effects of wildland fires, prescribed fires or mechanical treatments on vegetation. Information at this level includes characteristics of the fire, such as rate of spread, fire behavior, and burn severity, as well as current weather conditions. Fuel conditions would be assessed by determining the fuels array, composition, and dominant vegetation within the burn area, in addition to using vegetation and fuels maps to predict potential fire spread. Information to assess pre and post fire or treatment effects would include duff depth and moisture measurements, photo points, vegetation cover, and tree parameters. This level of monitoring is recommended for wildfires managed for resource benefits and prescribed fires, but is dependent on the objectives of the burn and the resources of concern. Some of the variables monitored at this level would require on the ground measurements of specific sites.

Level 3, Comprehensive Monitoring (Short or Long-term Fire Effects) – This level would be used to monitor the effects of prescribed or wildland fires in greater depth, it may also be used for mechanical treatments. Level 3 monitoring requires collecting information on fuel reduction, vegetative changes, and soil parameter changes. This level of monitoring may also include wildlife utilization techniques. The number of variables monitored increases and the techniques

are more rigorous. Information collected at this level is based upon management objectives and the resources of concern. Variables monitored at this level would require the establishment of ground based plots.

Table 3: Monitoring level requirements and recommendations for Fire Management Activities

Management Activity	***Minimum Required* Monitoring Levels**	***Recommend* Monitoring Levels**
Wildfire	Levels 1 *Burn Severity	Levels 1, 2, 3, *Burn Severity
Prescribed Fire	Levels 1, 2, 3, *Burn Severity	Levels 1, 2, 3, *Burn Severity
Non-Fire Treatments	Level 1	Levels 1, 2, 3

*Burn Severity should be requested for all fires > 500 acres on NPS lands (RM-18, Chapter 8, 4.3)

Fire and mechanical treatment monitoring should be designed to meet the objectives of each project. Therefore the objectives and implementation of monitoring should be developed based on the project objectives.

Wildfire Monitoring

The minimum required monitoring for wildfires on AK NPS lands includes the data necessary to fill out DOI required Wildland Fire Management Information (WFMI) fire reporting documentation (https://www.nifc.blm.gov/fire_reporting/NPS/doc/index.html). This includes documentation of various parameters such as the fire origin, fire start and end dates, fuels, weather, final fire size (acres), and suppression actions. Currently, remotely sensed burn severity data using dNBR is required for all wildfires and prescribed fires exceeding 500 acres on National Park Service lands (USDI NPS 2008, RM-18, Chapter 8). A description of burn severity mapping and monitoring is provided in the AKR Fire and Fuels Monitoring Protocol (Appendix A.1). Fire effects plots may be established if fire and/or resource management needs are identified for specific fires. The AKR Fire and Fuels Monitoring Protocol is recommended for monitoring wildfire effects at fire effects plots (Appendix A.1).

Prescribed Fire Monitoring

All prescribed fires implemented in GAAR are required to have a monitoring plan that addresses the objectives of the prescribed fire. However, not all prescribed fires must be monitored if similar or representative fuel types are being monitored for projects with similar prescribed fire objectives. All prescribed fires >500 acres are required to have a burn severity assessment map.

Non-Fire Fuels Treatment Monitoring

Mechanically treating fuels has become an important part of reducing fuel densities and thus wildland fire threats to human infrastructure. A fuels treatment plan should be prepared for each mechanical fuels reduction project which should include; 1) statement of the project purpose, goals and objectives, 2) a detailed description of the fuels to be treated, 3) identification of the treatment area on a project map, 4) project cost calculations and summaries, 5) protection plan for sensitive features in the area, and 6) potential post-treatment rehabilitation issues. The fuels treatment should also account for personnel and public safety as well as outline possible interagency coordination and public involvement. Project specifications should address specific fuels parameters that will be affected by the fuels treatment (e.g., % reduction of species by size class, % reduction of given fuel type within given area).

A project monitoring plan should be attached to each fuels treatment project. The monitoring plan should outline how treatment implementation will be documented and include instructions on which monitoring methods should be used for documentation. The minimum recommendations for non-fire treatment monitoring are to:

- Describe treatment objectives and methods
- Document the treatment area location and size
- Record what data was collected in association with the treatment
- Take photographs of specific points within the treatment (or provide video documentation)

4.3 Monitoring Basics – Frequency, Timing, Locations

Established monitoring plots will be re-measured following the protocols documented in Alaska NPS Fire Management Program Fire and Fuels Monitoring Protocol (Appendix A.1). It is recommended that variations on the Fire and Fuels Monitoring Protocol are applied to meet specific project objectives.

Frequency of Monitoring - Plots will be sampled pre-treatment, post-treatment, and in subsequent years on a time schedule determined based on project objectives.

Timing - Monitoring will be conducted sometime between June and August, since peak plant phenology occurs at this time. When possible, monitoring plots will be visited during the same month for each monitoring visit. New plot installations should precede treatment occurrence or application. For the sake of continuity and statistical validity, plot re-measurements should follow the monitoring protocol established prior to the current visit. Plot re-reads should be conducted within one year of treatment application and after that at a time intervals which meets project objectives. For prescribed fires, immediate post fire reads will be done within one month of the completion of the burn or at the earliest possible time thereafter.

Plot Location – A handheld Global Positioning System (GPS) will be used to record the location of all plots. In the event that GPS coordinates cannot be sampled at the initial plot visit date, attempts will be made in later years to obtain this data. Data will be processed and archived by the Fire Ecology program. GPS coordinates will be stored in the Fire Management Office and used for ArcGIS mapping projects. Directions for plot access will be recorded on datasheets. For detailed information on how to record plot location refer to Appendix F.3.

V. PROGRAM MANAGEMENT

5.1 Information Management

Data will be entered into databases, quality checked, and managed by Fire Ecology Program staff and supervised by the Fire Ecologist. Original copies of all data will be maintained at the office of the Regional Fire Ecologist and disseminated as requested.

The NPS Alaska Fire Ecology program uses monitoring data collected for a number of purposes. For example, the information is used as an indicator of program status which is reported at the end of each fiscal year in an annual report. The format of the annual report is flexible and geared towards the needs of the NPS Fire Program. The annual report includes a summary of monitoring activities from the year, results from data analysis, and discussion on objectives.

In addition to annual report documentation of Fire Ecology Program status, oral presentations are regularly made for park staff which allow for open discussions of the program and monitoring information. Furthermore, summary articles may be disseminated in fire ecology and fire management newsletters, scientific journals, and "popular" publications. Communication of fire ecology information should also include intranet and internet web sites. NPS fire ecologists

regularly work with NPS Fire Communication and Education staff to communicate monitoring results, particularly to provide NPS Fire Success Stories for Fire Ecology program representation.

Communication goals of the NPS Fire Ecology Program include:

- Communicating results to park resource staff for the purpose of adaptive management
- Presenting status reports to NPS Regional and National Offices for the purpose of programmatic accountability
- Communicating monitoring results to the scientific community
- Presenting fire ecology information as success stories and other formats to NPS staff, interagency community, NGO's and general public

5.2 Data Management and Analysis

The National Database, FEAT-FIREMON Integrated (FFI), is the computer database tool utilized for fire ecology monitoring data entry and storage. FFI databases containing data collected by the NPS Fire Ecology program are maintained at the Fairbanks Administrative Center.

Data collection will be directed by the NPS fire ecologists and will follow the standard operating procedures outlined Alaska NPS Fire and Fuels Monitoring protocols. Fire Ecology Program data management activities include data entry, quality control and filing of paper copies of data as well as photograph labeling and archiving. Monitoring data is entered into a database, quality checked, and analyzed. Formal data reports are presented at the end of the year. Monitoring data should be archived and copies sent to the NPS Regional Office.

Databases are stored at the office of the fire ecology program on fire ecology computers. Additionally, the data is regularly (either daily or weekly depending on programmatic workload) electronically backed up on the NPS Fairbanks Administrative Center computer network as 'zipped' database files for each Fire Management Unit Area Program. A master copy of data files is maintained in the NPS Regional Fire Management Office. Copies of all data and data summaries will be shared upon request.

Data analysis is conducted using FFI, ARC/INFO GIS mapping software and SPSS Statistical Software. Data analysis should include consultation with a statistician to determine the most appropriate data analysis approach.

5.3 Management Implications of Monitoring Results

Monitoring results will be used to evaluate whether fire management program goals and objectives are met. The fire ecologists, in consultation with the Regional Fire Management Officer and GAAR Resource Management Staff, will determine if the results of fuels treatments or planned fire management activities are on acceptable. Whether results are acceptable is based on whether management objectives stated within the specific prescribed fire, mechanical treatment or monitoring plans have been met. If monitoring results suggest deviation from defined desired conditions for vegetation, or if resource management needs change, the involved parties will determine how future activities should be altered to changes necessary for future activities.

Data collected for fire related studies, presentations or reports will presented to the park and fire management staff to inform the staff of findings. Possible discussion items presented generally include evaluation of whether program objectives were achieved, any observable trends indicated

by the monitoring results, areas of concern, needed assistance to achieve research or monitoring goals or possible topics requiring further study and research. Presentations are made open to all NPS staff, but the focus audience is usually the Fire and Resource Management personnel. Following each presentation a summary of findings and feedback is prepared which includes updates based on staff feedback and an evaluation of which monitoring approaches were successful and applicable. If monitoring results indicate that monitoring objectives are not being met, alternatives to current methodologies will be considered (including modification of prescriptions and objectives or identification of further research potentials).

5.4 Responsible Party – Staffing Roles and Responsibilities

This monitoring plan has been prepared, and will be updated, by the Alaska Region Fire Ecologists who are currently based at the Fairbanks Administrative Center in Fairbanks, Alaska. The Alaska Regional Fire Management Officer and the GAAR Chief of Resource Management will initially review the plan. After these initial reviews the plan will be reviewed by the Gates of the Arctic Superintendent. Following the review process the appropriate NPS Fire and Resource Management personnel will continue with project planning, identification of specific fire and resource objectives, and review of monitoring projects and objectives.

VI. RESEARCH

Implementation of this Fire Management and Fire Monitoring Plan is not contingent upon the completion of research, however the information gleaned from fire-related research may be incorporated into land and fire management objectives for Gates of the Arctic National Park and Preserve. A limited body of information pertaining to fire effects and fire regimes in and near Gates of the Arctic National Park and Preserve is available. Key points about fire ecology related topics in GAAR are summarized briefly in Section 1.2.2.3 of the GAAR Fire Management Plan. A list of references to pertinent fire related research conducted in and around GAAR is provided in Section 5.1 of the GAAR Fire Management Plan. The abstracts and summaries from a subset of fire related research studies conducted in and around GAAR is provided below.

6.1 Fire-related Research

Brubaker, L.B., P.E. Higuera, T.S. Rupp, M.A. Olson, P.M. Anderson and F.S. Hu. 2009. Linking sediment-charcoal records and ecological modeling to understand causes of fire-regime change in boreal forests. Ecology 90(7):1788–1801

Abstract: Interactions between vegetation and fire have the potential to overshadow direct effects of climate change on fire regimes in boreal forests of North America. We develop methods to compare sediment-charcoal records with fire regimes simulated by an ecological model, ALFRESCO (Alaskan Frame-based Ecosystem Code) and apply these methods to evaluate potential causes of a mid-Holocene fire-regime shift in boreal forests of the southcentral Brooks Range, Alaska, USA. Fire-return intervals (FRIs, number of years between fires) are estimated over the past 7000 calibrated 14C years (7–0 k yr BP [before present]) from short-term variations in charcoal accumulation rates (CHARs) at three lakes, and an index of area burned is inferred from long-term CHARs at these sites. ALFRESCO simulations of FRIs and annual area burned are based on prescribed vegetation and climate for 7–5 k yr BP and 5–0 k yr BP, inferred from pollen and stomata records and qualitative paleoclimate proxies. Two sets of experiments examine potential causes of increased burning between 7–5 and 5–0 k yr BP. (1) Static-vegetation scenarios: white spruce dominates with static mean temperature and total precipitation of the growing season for 7–0 k yr BP or with decreased temperature and/or increased precipitation for

5–0 k yr BP. (2) Changed-vegetation scenarios: black spruce dominates 5–0 k yr BP, with static temperature and precipitation or decreased temperature and/or increased precipitation. Median FRIs decreased between 7–5 and 5–0 k yr BP in empirical data and changed-vegetation scenarios but remained relatively constant in static-vegetation scenarios. Median empirical and simulated FRIs are not statistically different for 7–5 k yr BP and for two changed-vegetation scenarios (temperature decrease, precipitation increase) for 5–0 k yr BP. In these scenarios, cooler temperatures or increased precipitation dampened the effect of increased landscape flammability resulting from the increase in black spruce. CHAR records and all changed-vegetation scenarios indicate long-term increases in area burned between 7–5 and 5–0 k yr BP. The similarity of CHAR and ALFRESCO results demonstrates the compatibility of these independent data sets for investigating ecological mechanisms causing past fire-regime changes. The finding that vegetation flammability was a major driver of Holocene fire regimes is consistent with other investigations that suggest that landscape fuel characteristics will mediate the direct effects of future climate change on boreal fire regimes.

Clegg, B.F. and F.S. Hu (2010) An oxygen-isotope record of Holocene climate change in the south-central Brooks Range, Alaska. Quaternary Science Reviews 29:828-839.
Abstract: Understanding the ecological and socio-economic impacts of climatic warming requires knowledge of associated changes in moisture balance. Reconstructions of Holocene moisture-balance variation offer indispensible baseline information against which recent changes can be evaluated. We analyzed Charastem encrustations in the sediments of Takahula Lake, located in the south-central Brooks Range of Alaska, for oxygen and carbon-isotope composition to infer climatic change over the past 8000 years. To help constrain climatic interpretations of the sediment $\delta^{18}O$ record, we also analyzed water samples from Takahula and other lakes in the region for oxygen and hydrogen isotope composition. Results show that winter precipitation dominates the water balance of these lakes and that post-input evaporation is a key control of lake-water isotope composition of Takahula Lake. Stratigraphic patterns in Chara-$\delta^{18}O$, supplemented by those in $\delta^{13}C$ and sediment lithology, reveal distinct changes in effective moisture (precipitation minus evaporation) over the past 8000 years. Effective moisture was relatively high from 8000 to 5000 cal BP, with marked fluctuations between 6800 and 5000 cal BP. It then decreased to reach a minimum around 4000 cal BP and increased with fluctuations from 4000 to w2500 cal BP, followed by a decreasing trend toward the present that was interrupted by a wet Little Ice Age (centered at 400 cal BP). Aridity during the 20th century was among the highest of the entire 8000-year record. At the millennial timescale, the temporal patterns of moisture-balance shifts at Takahula Lake are broadly coherent with those inferred from previous paleoclimate records from the region. The Chara- $\delta^{18}O$ values around 5600 cal BP and during the Little Ice Age are up to 5% lower than at present and 3.6% lower than that of the modern input-water to the lake. These exceptionally low values suggest that factors other than effective moisture must have contributed to the pronounced variations in the Takahula Lake $\delta^{18}O$ record. Increased winter precipitation associated with a westerly Aleutian Low position may account for 1% of the $\delta^{18}O$ decrease. Other factors leading to the ^{18}O -depletion during these periods probably include decreased temperatures, as well as increased lake-ice cover and associated reductions in evaporation**.**

P.E. Higuera, L.B. Brubaker, P.M. Anderson, F.S. Hu and T.A. Brown. 2009. Vegetation mediated the impacts of postglacial climate change on fire regimes in the south-central Brooks Range, Alaska. Ecological Monographs, 79(2): 201–219
Abstract: We examined direct and indirect impacts of millennial-scale climate change on fire regimes in the south-central Brooks Range, Alaska, USA, using four lake sediment records and existing paleoclimate interpretations. New techniques were introduced to identify charcoal peaks semi-objectively and to detect statistical differences between fire regimes. Peaks in charcoal

accumulation rates provided estimates of fire return intervals (FRIs), which were compared among vegetation zones identified by fossil pollen and stomata. Climatic warming between ca. 15 000–9000 yr BP (calendar years before Common Era [CE] 1950) coincided with shifts in vegetation from herb tundra to shrub tundra to deciduous woodlands, all novel species assemblages relative to modern vegetation. Two sites cover this period and show decreased FRIs with the transition from herb to Betula-dominated shrub tundra ca. 13 300– 14 300 yr BP (FRImean ¼ 144 yr; 95% CI ¼ 120–169 yr), when climate warmed but remained cooler than present. Although warming would have favored shorter FRIs in the shrub tundra, the shift to more continuous, flammable fuels relative to herb tundra was probably a more important cause of increased burning. Similarly, a vegetation shift to Populus-dominated deciduous woodlands overrode the influence of warmer- and drier-than-present summers, resulting in lower fire activity from ca. 10 300–8250 yr BP (FRImean ¼ 251 yr; 95% CI ¼ 156–347 yr). Three sites record the mid-to-late Holocene, when climatic cooling and moistening allowed Picea glauca forest–tundra and P. mariana boreal forests to establish ca. 8000 and 5500 yr BP, respectively. FRIs in forest–tundra were either similar to or shorter than those in the deciduous woodlands (FRI mean range ¼ 131–238 yr). The addition of P. mariana ca. 5500 yr BP increased landscape flammability, overrode the effects of climatic cooling and moistening and resulted in lower FRIs (FRImean¼145 yr; 95% CI¼130–163). Overall, shifts in fire regimes were strongly linked to changes in vegetation, which were responding to millennial-scale climate change. We conclude that shifts in vegetation can amplify or override the direct influence of climate change on fire regimes, when vegetation shifts significantly modify landscape flammability. Our findings emphasize the importance of biophysical feedbacks between climate, fire, and vegetation in determining the response of ecosystems to past, and by inference, future climate change.

Hu, F.S., Higuera, P., Barnes, J.L., Rupp, T.S., Chipman, M., and Duffy, P.A. 2010. Reconstructing fire regimes in tundra ecosystems to inform a management-oriented ecosystem model. Final Report, JFSP Project Number 06-3-1-23, CESU Agreement J979106K153/001, April 2010.

Abstract: We reconstructed fire history in one of the most flammable tundra ecosystems in Alaska, the Noatak River watershed, and interpreted records in the context of local vegetation change and regional climate. We also developed models linking monthly weather conditions to annual area burned in Alaskan tundra from 1950-2008. Both objectives served the additional goal of improving the Boreal ALFRESCO model, an ecosystem model representing vegetation change as a function of climate and disturbance by fire. Fossil pollen records indicate that tundra vegetation in the Noatak study area showed subtle shifts over the past 6000 years, likely in response to previously-described millennial-scale variations in relative moisture (precipitation - evaporation). Different patterns between sites suggest that local factors modified the impacts of regional dryness ca. 4000 years ago and subsequent increases in relative moisture. Estimated fire return intervals (FRIs) since 6000 years before present (yr BP) varied from 30 to 720 years, with mean FRIs (summarized over 2000-yr periods) varying from 120 to ca. 500 years. These millennial-scale changes in mean FRIs were significantly linked to changes in vegetation, suggesting that white spruce, shrub birch, and grasses are associated with increased fire risk, whereas alder is associated with decreased fire risk. The taxonomic makeup of future tundra ecosystems, therefore, could have important impacts on fire risk. When characterized over the past 2000 years, estimated FRIs were shorter (average 134 yr [95% CI 109-162]) at warmer sites with greater tussock-shrub tundra abundance than at cooler, up-valley sites with a greater abundance of low shrub-tundra (mean FRI 295 yr [189-415]). Results from modern fire-climate analyses indicate that annual area burned can be largely explained with climate variables representing summer temperature and precipitation (r2> 0.83). Models linking historical climate with tundra area burned in combination with estimated FRIs from the paleo data were used to parameterize tundra regions represented by the Boreal ALFRESCO model. Comparisons between

historical simulation and the paleo record from the Noatak study suggest that the newly-informed Boreal ALFRESCO model provides improved estimates of tundra fire occurrence in the Noatak as compared to previous versions.

Springsteen, A, and T.S. Rupp. 2009. Summary report for Alaska National Parks: Projected vegetation and fire regime response to future climate change in Alaska. CESU Final Report, NPS.
A CESU agreement was developed with Dr. Scott Rupp at the University of Alaska-Fairbanks to assess how different climate scenarios may impact the fire regimes and vegetation within several parks over the next 100 years. The landscape dynamics model, Boreal ALFRESCO, was used to simulate the potential response of vegetation and fire regimes to likely scenarios of future climate change using IPCC models. The following parks were selected for analysis: Denali, Yukon-Charley Rivers, Gates of the Arctic, Noatak, Bering Land Bridge, and Wrangell-St. Elias. Results of this study were presented to Park Service personnel and a final report was prepared in 2009. It was noted in the report that they have less confidence on the results for tundra dominated areas such as Bering Land Bridge and Noatak, and they were in the process of further developing and refining tundra vegetation and fire models.

Treeline dynamics in GAAR and surrounding area

Lloyd, A.H., A.E. Wilson, C.L. Fastie, and R.M. Landis. 2005. Population dynamics of black spruce and white spruce near the arctic tree line in the southern Brooks Range, Alaska. Canadian Journal of Forest Research 35: 2073–2081.
Abstract: Black spruce (*Picea mariana* (Mill.) BSP) is the dominant species in interior Alaska but it is largely absent from the arctic tree line. To evaluate the importance of climate and fire as controls over the species distribution, we reconstructed stand history at three sites near its northern limit in Alaska, where it grows with white spruce (*Picea glauca* (Moench) Voss). We developed a matrix model to explore black spruce population dynamics and response to varying fire intervals. All sites burned in the early 1900s. High recruitment of black spruce occurred for <30 years following the fire, but most current black spruce recruitment is clonal and seed viability is low. White spruce recruitment has been consistently high since the fire, and the majority of seedlings in the stands are white spruce. Despite low recruitment, the matrix model suggests that black spruce populations are nearly stable, largely because of low adult mortality rates. Although black spruce recruitment is stimulated by fire, the model indicates that fire intervals <350 years would destabilize the population, primarily because of slow growth and low seed production. Population dynamics of black spruce at its northern limit in Alaska thus appear to reflect an interaction between fire, which determines the temporal pattern of tree recruitment, and climate, which limits tree growth and, presumably, viable seed production.

Rupp, T.S., F.S. Chapin, and A.M. Starfield. 2001. Modeling the influence of topographic barriers on treeline advance at the forest-tundra ecotone in Northwestern Alaska. Climatic Change 48:399–416
Abstract: The response of terrestrial ecosystems to climate warming has important implications to potential feedbacks to climate. The interactions between topography, climate, and disturbance could alter recruitment patterns to reduce or offset current predicted positive feedbacks to warming at high latitudes. In northern Alaska the Brooks Range poses a complex environmental and ecological barrier to species migration. We use a spatially explicit model (ALFRESCO) to simulate the transient response of subarctic vegetation to climatic warming in the Kobuk/Noatak

River Valley in northwest Alaska. The model simulations showed that a significantly warmer (+6 C) summer climate would cause expansion of forest through the Brooks Range onto the currently treeless North Slope only after a period of 3000–4000 yr. Substantial forest establishment on the North Slope did not occur until temperatures warmed 9 C, and only following a 2000 yr time lag. The long time lags between change in climate and change in vegetation indicate current global change predictions greatly over-estimate the response of vegetation to a warming climate in Alaska. In all the simulations warming caused a steady increase in the proportion of early successional deciduous forest. This would reduce the magnitude of the predicted decrease in regional albedo and the positive feedback to climate warming. Simulation of spruce forest refugia on the North Slope showed forest could survive with only a 4 C warming and would greatly reduce the time lag of forest expansion under warmer climates. Planting of spruce on the North Slope by humans could increase the likelihood of large-scale colonization of currently treeless tundra. Together, the long time lag and deciduous forest dominance would delay the predicted positive regional feedback of vegetation change to climatic warming. These simulated changes indicate the Brooks Range would significantly constrain regional forest expansion under a warming climate, with similar implications for other regions possessing major east-west oriented mountain ranges.

Fire and Permafrost

Swanson, D.K. 1996. Susceptibility of permafrost soils to deep thaw after forest fires in Interior Alaska, U.S.A., and some ecologic implications. Arctic and Alpine Research, Vol. 28(2):217-227

Abstract Some soils with permafrost thaw deeply and become drier after forest fires in interior Alaska, while others change little. Soils with permafrost on the coldest and wettest landscape positions (concave to plane, lower slope positions, and north-facing mid-slopes) usually failed to thaw deeply after fires in the study area. Soils with permafrost on warmer and drier positions (convexities, crests and shoulders, and east-, west-, or south-facing mid-slopes) thawed deeply in some instances and not in others, presumably as a function of fire severity or frequency. The driest soils (those on convex, upper slope positions, usually with sand and gravel at shallow depth) lack permafrost regardless of time since fire. Post-fire vegetation changes on soils that fail to thaw are weaker than on soils that thaw deeply after fire or were dry and originally free of permafrost. Soils with permafrost that fail to thaw show little post-fire increase in cover of the plants browsed by moose. More cover and forage for voles are present on soils with permafrost and soils that thaw deeply after fires than on those that are always dry and permafrost free.

Fire and Small Mammals

Swanson, S.A. 1996. Small mammal populations in post-fire black spruce seral communities in the Upper Kobuk River Valley, Alaska. Technical Report NPS/AFA RNR/NRTR-96/30.

Summary: Seven small mammal species were identified during the study: yellow-cheeked vole, red-backed vole, masked shrew, pygmy shrew, dusky shrew, northern bog lemming, and brown lemming. Red-backed voles were most abundant, followed by yellow-cheeked voles and masked shrews, respectively. Snap traps accounted for 59% of the total captures; however, shrews and lemmings were captured only in pitfall traps. Burned vegetation grids had higher species diversity than their corresponding mature vegetation grids. Small mammal abundance was highest on the burned moss/shrub forest and lowest on the mature lichen woodland. Small mammal abundance was higher on the moss/shrub forest grids than on the lichen woodland grids.

Small mammal populations declined significantly from 1993 to 1994 on all 4 grid habitats. Low small mammal abundance was noted on other small mammal study sites in interior Alaska in 1994. Placental scars and embryos were detected only in red-backed voles and masked shrews. When populations were high in 1993, the mean red-backed vole littersize was 8.0 but when populations were low in 1994, mean litter size was 11.5. Increased natality is often a response to high mortality (when food is not the limiting factor). Small mammal abundance on post-fire seral stages is likely related to food availability, organic mat depth (burrowing/digging substrate), and presence of escape cover. Yellow cheeked voles probably are found in disturbed areas such as burns because of better conditions for colony and runway formation and the presence of forbs and graminoids. Common post-fire plant species such as *Equisetum* spp., *Epilobium* spp., *Carex* spp., and *Calamagrostis canadensis* are primary food sources for these voles. Rhizomes produced by these plants (which often survive fires since they grow in mineral soil) are cached for winter consumption and enable yellow-cheeked voles to establish themselves and overwinter on burned areas prior to other vole species establishing residency. Red-backed voles are found in a wide variety or habitats, but they are probably most abundant in areas with a well-developed organic layer for tunneling, high berry production and sufficient escape cover. Red-backed voles appear to focus on berries while yellow-cheeked voles concentrate on herbaceous vegetation; this potential division of food resources may allow fairly high populations of both species to coexist if adequate supplies of both berries and herbaceous vegetation are available. This situation was encountered in the burned moss/shrub forest habitat. Yellow-cheeked voles were more numerous than red-backed voles in the recently burned lichen woodland grid because berry production was probably insufficient to support a higher population of red-backed voles. Sparse berries would particularly preclude overwintering of red-backed voles in recent burns. Shrews were most abundant on the moss/shrub forest grids, where the organic layer depth, humidity conditions, arthropod abundance, and vole runway/burrow density (for food routes) may have been optimal conditions for shrew habitation. For predators dependent on small mammal food sources, optimal feeding habitat presumably would have a high density small mammal population, coarse woody debris to allow subnivean access to small mammals in the winter, and presence of perching sites and relatively low overstory cover for avian predators. Based on these assumptions, predators in the burned moss/shrub forest habitat would have greater hunting success than on the other sites studies. Mammalian predators may be better suited than avian predators to hunt on the mature moss/shrub forest because tree and canopy cover may deter avian visibility and maneuverability.

Fire, Caribou and Lichen

Joly, K., F.S. Chapin and D.R. Klein. 2010. Winter habitat selection by caribou in relation to lichen abundance, wildfires, grazing, and landscape. Ecoscience 117 (3): 321-333
Abstract: Lichens are important winter forage for large, migratory herds of caribou (*Rangifer tarandus granti*) that can influence population dynamics through effects on body condition and in turn calf recruitment and survival. We investigated the vegetative and physiographic characteristics of winter range of the Western Arctic Herd in northwest Alaska, one of the largest caribou herds in North America. We made 3 broad comparisons: habitats used by caribou versus random locations, burned versus unburned habitats, and habitats within the current winter range versus those in the historic winter range and potential winter ranges. We found that lichen abundance was more than 3 times greater at locations used by caribou than found at random. The current winter range does not appear to be overgrazed as a whole, but continued high grazing pressure and consequences of climate change on plant community structure might degrade its condition. Within the current winter range, lichen abundance was more than 4 times greater at unburned locations than at recently (< 58 y) burned locations. Other than lichen abundance, there were few vegetative differences between burned (mean = 37 ± 1.7 y) and unburned locations. The

historic winter range has low lichen abundance, likely due to sustained grazing pressure exerted by the herd, which suggests that range deterioration can lead to range shifts. Recovery of this range may be slowed by continued grazing and trampling during migration of caribou to and from their current winter range, as well as by high wildfire frequency and other consequences of climate change. The area identified as potential winter range is unlikely to be utilized regularly by large numbers of caribou primarily due to low lichen abundance associated with extensive deciduous stands, large areas of riparian habitat, high moose (*Alces alces*) densities, and greater prevalence of wildfire. Our results suggest that lichens are important in the overwintering ecology of caribou that face the energetic costs of predator avoidance and migration.

Joly, K., T.S. Rupp, R.R. Jandt, and F.S. Chapin. 2010. Fire in the range of the Western Arctic Caribou Herd. Alaska Park Science 8 (2): 85-91.
Abstract: Wildfire is the dominant ecological driver in boreal forest ecosystems. Although much less is known, it also affects tundra ecosystems. Fires effectively consume fruticose lichens, the primary winter forage for caribou, in both boreal and tundra ecosystems. We summarize 1950-2007 fire regime data for northwestern Alaska and subregions. We also identified meteorological factors that help explain the variability in fire extent across this landscape. We review information and inferences from recent studies on tundra fire regimes for managing caribou winter range. Climate warming may increase fire size and frequency in this region, which may substantially impact the vegetation, wildlife, and people of this region.

Swanson, D.K. 1996. Fruticose lichen distribution in the Kobuk Preserve Unit, Gates of the Arctic National Park, Alaska. Technical Report NPS/AFA RNR/NRTR-96/28.
Abstract: The distribution of fruticosa lichens in the upper Kobuk River valley is strongly influenced by soil conditions and disturbance; lichen cover is highest where disturbance is infrequent and poor soils reduce competition by vascular plants. Lichen cover is low on flooded soils as a result of burial by sediment and enhanced competition by deciduous vascular plants on rich floodplain soils. Lichen cover is also low on steep mountain slopes as a result of snow avalanche disturbance or dense vascular vegetation. Lichen cover is high on dry, stable, infertile soils unless there has been a recent burn. These soils occur mainly on bedrock ridges and on Pleistocene glacial deposits in the study area. Lichen cover increases for at least 100 years after fire on dry, un-flooded soils; *Polytrichum* spp. moss and *Cladonia* spp. lichens dominate during the first half-century after fire, while *Cladina rangiferina* and *C. stellaris* lichens dominate thereafter. Wet soils generally have low to moderate lichen cover, probably as a result of competition by mosses and sedges. Exceptions include 1) palsas and peat plateaus, where droughty conditions due to drainage of water into thermokarst pits, and very acid soils allow lichens to dominate; and 2) sloping un-forested areas in the lowland forest-tundra ecotone of the western part of the study area, where moss competition is apparently reduced due to lack of a tree overstory.

Burn Severity

In Alaska the level of burn severity strongly influences post-fire vegetation succession, soil erosion, and wildlife populations in the fire-adapted boreal forest and tundra ecosystems. Methods have been developed to map burn severity for landscape level fires using remote sensing. The NPS–U.S. Geological Survey (USGS) National Burn Severity Mapping Project and the Monitoring Trends in Burn Severity Project (MTBS) sponsored by the Wildland Fire Leadership Council address the need to quantify fire effects on public lands in order to develop an archive of fire history. The goal of both projects is to monitor fire effects using standardized geographic databases employing consistent measures of *burn severity*, which is defined as the magnitude of ecological change caused by fire. The process uses Landsat 30-meter data and a

derived radiometric value called the ***Normalized Burn Ratio (NBR)***. The difference between pre- and post-fire NBR datasets is computed to determine the extent and degree of landscape change resulting from fire.

The NPS Alaska fire program has investigated the accuracy of the remote sensed burn severity maps in various fuel types. To do so satellite-derived estimates of burn severity (differenced Normalized Burn Ratio [dNBR] calculated from pre- and post-fire Landsat TM/ETM+ data) have been compared to ground-based burn severity measures in several of Alaska National Parks. The purpose of this project was to provide ground verification of remotely-sensed burn severity data in Alaskan ecosystems through the installation of burn severity plots - Composite Burn Index (CBI) plots. Ground-based burn severity measures have not been conducted in Gates of the Arctic but a burn severity map has been generated for one fire in the area (Sorbel and Allen 2005). In the future ground-truthing of burn severity maps in GAAR may be generated.

Sorbel B. and J. Allen. 2005. Space-based burn severity mapping in Alaska's National Parks. Alaska Park Science, 4-11.

Allen, J.L. and Sorbel, B. 2008. Assessing the differenced Normalized Burn Ratio's ability to map burn severity in the boreal forest and tundra ecosystems of Alaska's national parks. International Journal of Wildland Fire 17: 463-475.

6.2 Fire Research Needs

Opportunities will be taken to identify and encourage fire related research within the park and funding and implementation will be coordinated between NPS resources, NPS fire management, and Arctic Network Inventory and Monitoring Program personnel. As research needs are identified, funding will be sought for implementation of corresponding studies. Fire research has limited funding within the NPS. But if fire ecology information is deemed necessary NPS personnel may submit proposals through the NPS Fire Research Funding call as well as through the Joint Fire Science Program. Other funding is available through the Cooperative Ecosystem Study Units (CESU 2004) and through National Park Service requests (Fee Demonstration Program, Project Management Information System (PMIS) and Natural Resource Challenge). The fire research and monitoring needs currently identified for Gates of the Arctic NPPr include:

Fire Research Needs

- Determining fire effects in GAAR through the establishment plots for short or long-term post-fire monitoring. Results from monitoring in areas affected by fires will allow for information on the:
  - Effects of fire on fish and wildlife habitat
  - Effects of fire on permafrost and erosion
- Assessing changes to fire risk, fire behavior and insect infestation in relation to climate change.
- More accurately determining the recent historic fire regime in GAAR (especially in tundra communities).
- More accurately determining paleo-historic fire regime in GAAR (especially in tundra communities).

VII. APPENDICES

Appendix A. Applied AK Regional NPS Fire and Fuels Monitoring Protocols

Appendix A.1. Fire and Fuels Circular Plot Monitoring Protocol

Alaska NPS
Fire Management Program
Fire Ecology Program

Fire and Fuels Circular Plot Monitoring Protocol

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(Version June 2012)

Overview

The Alaska NPS Fire and Fuels Monitoring Protocols were developed as a guideline for establishing fire and fuels treatment (i.e. hazard fuels reduction treatments) monitoring projects within Alaska National Park Service lands. The purpose of the Fire and Fuels Monitoring Protocol is to provide a standardized approach to monitor the effects of wildfire and prescribed fire as well as fuels thinning projects implemented by NPS fire management. The overarching purpose of the NPS studies which employ the Fire and Fuels Protocol is to provide scientific based information to guide Alaska NPS fire and land management planning, decisions and practices to maintain and understand fire adapted ecosystems. Monitoring can be used to document changes as a result of fire, implementation of treatments, or effects associated with long-term climate change or fire management activities. This protocol is a NPS specific modification of the field-tested methods created by the Alaska Interagency Fire Effects Task Group (FETG) and compiled in the Fire Effects Monitoring Protocol (Alaska FETG 2007). All or any combination of the protocol methods (i.e. point intercept, tree density, tree measurements etc.) maybe be used, depending on the objectives of the project.

Purpose

This document provides instruction and datasheets for utilizing a circular plot layout. A separate set of instructions have been developed for belt transect plot shape and can be found in the following document: AKR Fire and Fuels Monitoring Protocol Belt Transect 2012 Final.docx. In general the circular plot method works well with larger diameter trees that are less dense, while the belt method works well for small diameter/dense trees (black spruce), shrublands or grasslands. The circular plot method provides a larger tree plot size or variable plot size for smaller diameter, dense trees. The circular plot method covers a total of 16-m, which works better for small treatment areas. Standard methods utilized within

the circular plot protocol are slightly less rigorous (fewer point intercept and points along the transect for soils) unless an additional transect is added.

This protocol may be used in full. Alternatively a subset of individual methods may be selected in order to meet the specific monitoring objectives of a project (see Project-Level Application below). The protocol may be used for the following purposes:

Wildfire effects protocol application: The Fire and Fuels Monitoring Circular Plot Protocol may be utilized to monitor wildfire effects. Project objectives may be met by establishing vegetation/soil plots in front of active fires and evaluating them prior to, during and after fire treatments.

Hazard fuels reduction protocol application: The Fire and Fuels Monitoring Circular Plot Protocol may be utilized to monitor hazard fuels reduction treatment effects. Project objectives may be met by establishing vegetation/soil plots prior to hazard fuels reduction treatments and evaluating them before and after hazard fuels treatments.

Prescribed fire effects protocol application: The Fire and Fuels Monitoring Circular Plot Protocol may be utilized to monitor prescribed fire treatment effects.

Project-Level Application of AKR Fire Ecology Monitoring Protocol

This document provides protocol methods, instructions and data sheets for fuels and vegetation sampling in fire and fuels treatment areas. For specific project level monitoring plans, a Project Monitoring Document should be prepared that provides the following descriptions of the planned project and monitoring:

- Project Description
    - Project Background & Purpose
    - Project Area Description (general vegetation, treatment area)
    - Treatment Goals & Objectives
    - Monitoring Objectives
- Methods Overview
    - Plot Selection and Naming Convention
    - List protocols selected for monitoring, with reference to main AK Protocol document for methodologies. Note any alterations to standard methodologies. (use list from Methods Overview section within this document).
    - Description of any variations to the main protocol.
- Data Management and Sampling Schedule
    - Data entry and data management
    - Sampling Schedule
- Map and/or table of plot location coordinates

Descriptions and recommended methods for the above listed sections for a project level monitoring document are described below. Overview of methods and detailed methodology instructions for individual monitoring protocols are provided in Section 2 and 3 of this document.

Monitoring Goals & Objectives

Studies which utilize the Fire and Fuels Protocol may be implemented to meet one or more of the following goals:

- Verify that fire management objectives are met.
- Document long-term trends and natural level of variation in the frequency, extent, and severity of fires, monitor for impacts of climate change.

- Monitor fire and mechanical fuels treatment effects including:
  - effects of time since fire and burn severity or mechanical treatments on vegetation species composition, vegetation structure, and ground cover in varying vegetation types
  - effects of time since fire and burn severity or mechanical treatment on soil parameters
  - effects of time since fire on wildlife habitat
- Document fuels information for fire behavior modeling
- Monitor fuel moisture of applicable fuel types

Objectives for monitoring or inventories should be clearly defined before sampling and should follow the SMART rule for objectives. They should provide for unbiased, repeatable assessment of fire and fuels treatment effects and provide measures of whether the management goals and objectives were met. Refer to the National Park Service Fire Monitoring Handbook (2003) for more information on developing quantifiable objectives.

Plot Selection/Location

Method of plot selection and locations should be documented for all studies. There are numerous ways and methods for selecting plot locations, dependent on the needs of the study. Please refer to other documents for discussion on statistical needs for number of plots and randomization. Below are a few recommendations on how to select plot locations.

Wildland Fire Plots

Locations of pre- and post-fire plots are usually randomly established but a number of plot selection methods are utilized. Two examples of methods used for wildfire pre- and post-fire plot location selection are:

> *Transect Method* - Using the fire perimeter map draw transects parallel to the head of the fire, flank of the fire, and rear of the fire. Mark 6 points that fit equally along the project transect. For instance, if the transect is 1-mile long, put a point every 1/6th of a mile. Fly or walk the transect and determine if the points are in a vegetation type that should be sampled, if not fly or walk to the next point.
>
> *GIS Method* - In Arc Map use the buffer tool to create a buffer around the current fire perimeter of a distance safe for sampling based on the fire rate of spread. Use the Arc Toolbox random point generator (also available in Alaska Pak tools) to create points within the buffered polygon; select a minimum spacing of 500 m between points.

Hazard Fuels Plots

Monitoring plots will be usually be randomly established within the treatment zones as well as control areas immediately adjacent to the treatment areas in stands representative of the pre-treatment forest. GIS layers of the treatment and control areas are utilized to select plot locations. For the control area, a 200-m buffer around the thinning unit is created using ArcGIS. A GIS random point generator and manual manipulation to spread plot distribution is used to establish plots in the treated areas and control area. Plots that fall within parking areas or other built features are not utilized.

Plot Naming Convention:

The plot names should follow this naming convention: PARK- PPP-LOCATION-###, where the first four letters (PARK) is the park identifier (i.e., DENA, YUCH), the next letters (PPP) are the project identifier, and the third letters (LOCATION) are the location of the plots, such as the fire number or treatment site (e.g., A503 or Headquarters HQ), and the last three are plot identifiers. For wildland fire plots the project could be: WF (wildfire) or a project identifier such as VDM (video-moose). For hazard fuels treatment

plots the project identifier will be: HZF (hazard fuels). For prescribed fires the project type should be RX. The plot identifiers are numerical as established. Examples of plot identifiers: DENA-WF-A503-003 and WRST-HZF-HQ-C-03.

Methods Overview

The following section is a quick reference of methods for each protocol. Full methods are described in the following sections. A complete plot with all protocols can be laid out and read by an experienced crew in less than 3 hours. All or any combination of the protocol methods (i.e. point intercept, tree density, tree measurements etc.) maybe be used, depending on the objectives of the monitoring project.

For simplicity, the myriad of options for modifying and customizing monitoring protocols or plot sizes, levels of monitoring intensity, deciding on the number of plots to use, placement of plots, other variables to include, etc. are not discussed here. It is recommended the user consult many other excellent references on setting up a monitoring study, including Measuring and Monitoring Plant Populations (Elzinga et al. 1998) or the NPS Fire Monitoring Handbook (NPS 2003). Data can be entered into the National Fire Effects Database program FFI (FEAT FIREMON Integrated). Refer to the "FFI Data Entry Instructions for NPS Alaska Manual" (Mitchell and Barnes 2011) for specific data entry protocols.

The following section provides an overview of the AK Fire and Fuels Monitoring Program Method Protocol.

1. PLOT LAYOUT (See Figure 1.)
    - Set up an 8-m radius (16-m diameter) circular plot based on a center-point coordinate.
    - Plot azimuth will North-up so 16-m end of transect is due north of plot center and 0-m end of transect is due south of center-point.
    - Lay out a 16-m transect (for point intercept and location of seedling and shrub density subplots). Pull the 0-m end of measuring tape due south 8-m, the center point should be at 8-m on the tape. Then pull the end of the tape in a 16-m straight line to the North (record declination used) and use a chaining pin to stake the 16-m end of the transect. Keep the tape as low to the ground as possible.
    - If a permanent plot, mark the center-point of the circular plot with non-burnable marker (e.g. rebar, conduit, metal monument). If re-visits planned then recommend staking both the 0-m and 16-m transect ends and the 8-m center point of the transect with wooden lathe.
    - Mark each end with flagging and GPS a point at the plot center-point.

2. SITE DESCRIPTION (*SITE DESCRIPTION* datasheet)
    - General plot description, direction to plots
    - Lat/Long, datum, error
    - General vegetation class for 8-m radius area
    - Take horizontal and vertical photographs of each cardinal direction (N, S, E, W) from the circular plot center-point or from each end of the transects.

3. GENERAL VEGETATION (*GENERAL VEGETATION* datasheet)
    - Record estimates of vegetation and substrate % cover for 8-m radius plot area (regardless of tree density circular plot size).
    - Record height estimates for tree, tall shrub and low shrub species.

4. VEGETATION COVER (*VEGETATION POINT INTERCEPT* Datasheet)
   - Point intercept along 16-m transects (32 points, every 0.5-m along 16-m baseline). Use a bike flag or other narrow pole for recording point intercepts "hits". Take points on right side of tape while walking on the left side of tape.
   - Record all trees, shrubs, herbaceous species, include substrate or groundcover that are located at each point along the transect ("hits").
5. TREE DENSITIES (*TREE DENSITY TALLY* Datasheet)
   - In less densely forested stands, tally all trees > 4.5' (1.37 m) tall located within 8-m radius plot area if there are <15 trees within a 4-m radius subplot area. In more dense forested stands (if there are >15 trees in the 4-m radius subplot area) tally all trees located within a 4-m radius subplot.
   - Within 8-m or 4-m radius circular plots tally trees >4.5' (1.37 m) tall by species and diameter size class: (< 5 cm, 5.1-10 cm, 10.1-15 cm, 15.1-23 cm, >23 cm), status (Live/Dead).
   - Tally small trees (<4.5' tall) in 3 1-m radius subplots centered at 4-m, 8-m and 12-m marks along center-line (total "seedling" area of 9.42 m^2 or .0048 ac).

6. TREE MEASUREMENTS (*TREE MEASUREMENT* Datasheet)
   - For two trees of each species and diameter size class record diameter (DBH), height, crown base height (CBH), ladder fuel heights, and crown radius.
   - Choose trees located closest to plot center-point and within 4- or 8-m radius plot.
   - For needleleaf trees record all tree measurements. For deciduous trees record *only* DBH and height measurements.

7. ACTIVE LAYER & SOILS (*ACTIVE LAYER/SOILS* Datasheet)
   - Every 2-m beginning at 2-m mark (8 total points) record:
     - Active layer depth to active layer boundary (rock, ice or seasonal frost).
     - Surface fuel code for the top layer of ground cover (live moss, dead moss, upper duff, lower duff, mineral soil)
   - Record soil moisture (%), soil temperature (°C) and pH of soils at the 4-m, 8-m and 12-m points along transect.

8. BURN SEVERITY & DUFF CONSUMPTION (*BURN SEVERITY/DUFF CONSUMPTION* Datasheet)
   - Post-burn: Record micro-site (point) burn severity, using the FMH method which identifies 5 levels of severity provides corresponding codes for substrate and vegetation. Record severity every 2-m beginning at 2-m mark, for 8 total points.
   - If plots are established pre-fire, duff consumption pins (pre-burn) can be placed every 2-m, for a total of 8 points (co-located with FMH burn severity index points).
   - Assess CBI (Composite Burn Index) for overall burn severity score of plots, and for comparison to remote-sensed burn severity (dNBR differenced normalized burn ratio) using methodology described in FIREMON (Key and Benson 2006).

9. DUFF THICKNESS & FUEL MOISTURE (*DOWN WOODY DEBRIS & DUFF THICKNESS* and *FUEL MOISTURE* Datasheets*)*
   - Record forest floor surface material (live moss, dead moss, upper and lower duff layers) depths at two places offset ~1-m from the transect in locations representative of the forest floor along the transect.
   - Collect duff plugs for determination of fuel moisture.

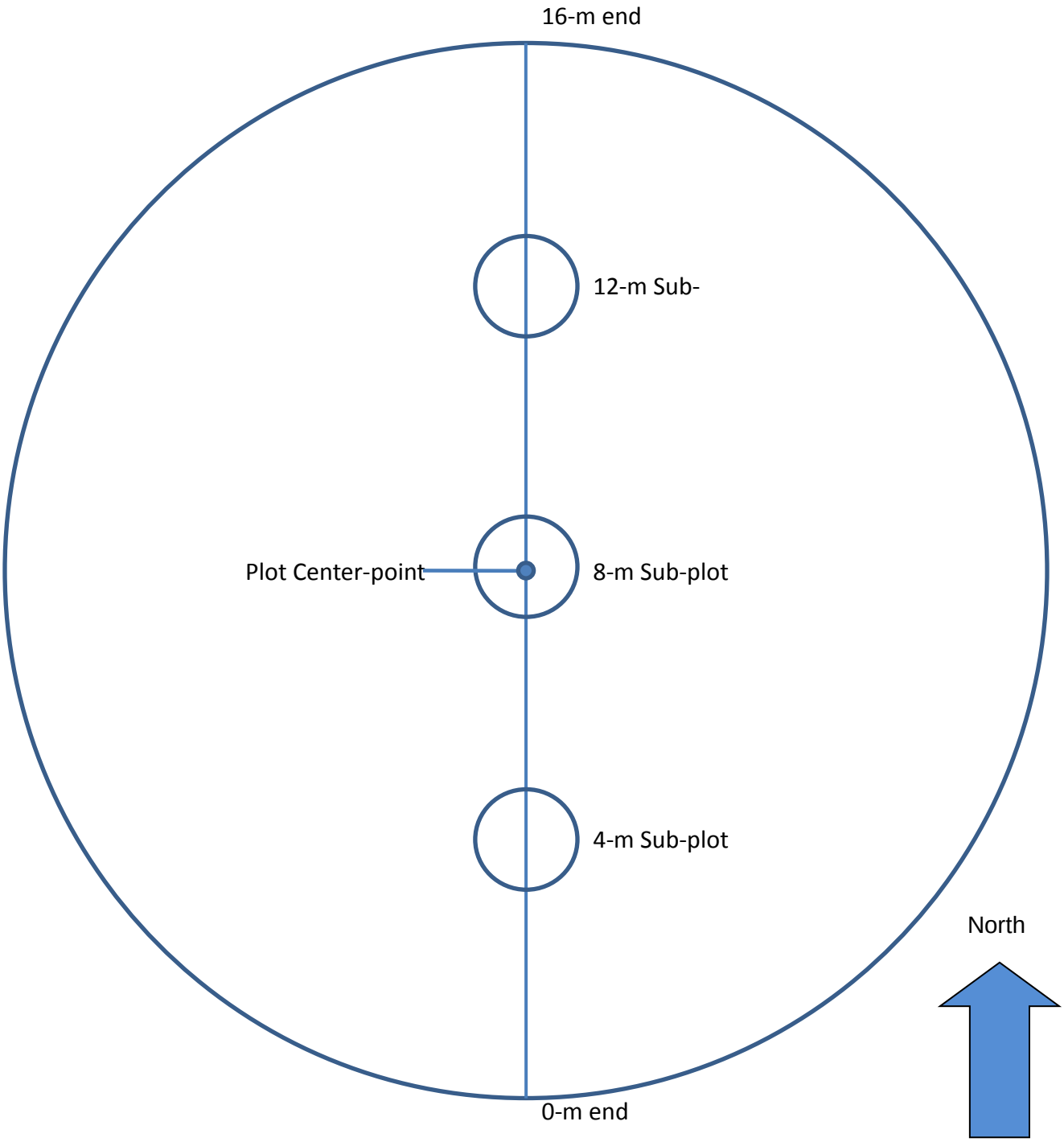
10. DOWN WOODY FUEL LOADING (*DOWN WOODY DEBRIS & DUFF THICKNESS* Datasheet)
    - Brown's transect extends length of 16-m transect: 0-ft to 6-ft for 1-hr and 10-hr fuels; 0-ft to 12-ft for 100-hr fuels, and 0-ft to 52.5-ft for 1000-hr fuels (1.8-m, 3.66-m, and 16-m).
    - Record litter and duff layer thickness at each end of the 16-m transect (off-set 1-m)
    - If quantitative fuel loading is needed, place additional Brown's transects at 120° and 240° from origin and mark ends with pin flag.

11. SHRUBS (*SHRUB DENSITY)*
    - Measure shrub density by tallying all shrubs within 8-m radius circular plot. If shrub density is greater than 15 individuals (defined as clusters of stems within 10-cm of one another) then tally shrubs within a 4-m radius circular plot. Record individuals by species and life status. Record average height by species.

12. MOOSE BROWSE AND HERBIVORY (*MOOSE BROWSE ARCHITECTURE* or MOOSE BROWSE DENSITY Datasheets)
    - Record evidence and degree of moose browse for two shrub individuals of each browse species located within the 8-radius circular plot. Select individuals located closest to the circular plot center-point.
    - Measure the density preferred moose browse species by tallying all preferred species of shrubs or trees within 8-m radius circular plot. If density is greater than 15 individuals (defined as clusters of stems within 10-cm of one another) then tally shrubs within a 4-m radius circular plot. Record individuals by species, height class and browse architecture.

13. INVASIVE PLANTS *(ALASKA EXOTIC PLANT MANAGEMENT TEAM [EPMT]* Datasheet)
    - Record observations of invasive plants in monitoring project areas to get a rough idea of presence, location, cover, phenology, and how long it would take to remove invasive plant species from given area.
    - Copies of datasheets should be brought on monitoring projects so that any observed invasive species can be recorded and reported to the NPS Alaska EPMT team.

Figure 1. 8-m radius circular plot layout



Methods Detailed

Plot Layout

Standard plot configuration is depicted in Figure 1. An 8-m radius circular plot will be laid out based on a center-point coordinate. If any of the following methodologies (shrub density, seedling density, point intercept, fuel loading, active layer depth, or soil measurements) are utilized in the monitoring project then lay out a 16-m transect. Lay out transect by staking the center point of the plot. Setup a 16-m transect by pulling the 0-m end of a 30-m measuring tape with a chaining pin due south 8-m, the center point should be at 8-m on the tape. Then pull the end of the tape in a 16-m straight line to the North (record declination used) and use a chaining pin to stake the 16-m end of the transect. For permanent plots, drive markers (e.g. spray-painted 2.5-ft conduit or rebar, metal monuments) into the ground at the plot center-point. If re-visits are planned then it is recommended that both the 0-m and 16-m transect ends and the 8-m center point of the transect are staked with wooden lathe for easy re-location. Mark plots with flagging for easy spotting in aerial photo or where needed. When laying out plot avoid walking or trampling on the right side of the transect where vegetation data is collected. For all plots record the coordinates of the transect center-point. Set the GPS to take an average of 20 or more points and record the accuracy in the "Error" field on the SITE DESCRIPTION datasheet. Also record waypoint numbers or names. NAD-83 Datum will be used in the GPS receivers (standard for DOI agencies).

Photographs

A minimum of nine photos are taken for each plot. Two photos (one horizontal and one vertical) in each cardinal direction (N, E, S, W) are taken from the center-point of the circular plot. An additional photo is taken of the ground at the circular plot center-point. The ground photo should include the plot marker but does not require a photo board. *Alternatively photos may be taken at each end of the transect facing towards the center point.* For all photos except ground photos, label a dry-erase board with the park-project-location-plot ID (i.e. YUCH-PPF-A324-02), sample date, transect azimuth (direction facing) and designate as CP (center point) to N, CP to S, etc. Hold the board to the edge of the photo view within the 1.5 - 2 m of the photographer. Hold the camera at a fixed height of 5 ft above the ground. Record photo times on the Plot Description datasheet. Aerial photos should be taken of the plot where possible and applicable.

Site Description

General site information is recorded for each plot on the *SITE DESCRIPTION* Datasheet. Additional plot location descriptions, diagrams of plots, and additional notes are written on the back of the *SITE DESCRIPTION* datasheet. More detailed information on the datasheet fields is provided below:

Section: General Site Description

- **Unit** – land unit identifier (NPS - four letter park acronym, e.g., Yukon-Charley Rivers National Preserve is YUCH) or land unit name (i.e., Steese White Mountains)
- **Project** – description of project: WF (wildfire), PPF (pre/post fire), CBI (burn severity), HZF (for hazard fuels), PP (paired plots). Also include an identifier for the area, such as a fire name or cabin name.
- **Plot ID** – identifier for the plot within the project. Best to name plot with descriptor which includes park unit, project name, plot unique identifier. For pre/post wildfire monitoring plots, use the park unit name, fire number and sequential numbering 01 through x.
- **Date** – sample date
- **Field Crew** – names of all crew members
- **Plot Markers** – type of marker used to mark plot (wooden lathe, metal monument, flagging etc)
- **Transect Azimuth** – record the azimuth of the transect facing from the zero end to the 16-m end, recorded in True North (declination set).

- **Transect slope –** record slope from the 0 to 30m direction, looking down the transect
- **Plot dimensions-** plot radius, record units
- **Slope** –% slope of the site, use clinometer
- **Aspect** – slope aspect (facing downhill). Record azimuth (degrees) based on true north compass setting.
- **Declination used** – record declination setting (degrees) on your compass. For initial plot visit, base declination on declination information provided in GPS. For future reading use the declination used in previous visits.
- **Elevation** – record elevation at center-point of circular plot (in feet or meters, record units) from GPS.
- **Soil** – record estimate of soil drainage (wet, moist, or dry). Wet soils must have some visible evidence of water, dry soils must be without moisture entirely (e.g. dry sand). The vast majority of soils will be categorized as moist.
- **Disturbance** – general note of disturbance to plot and general area (provide more detail including estimated disturbance date in notes where applicable).
- **Fire Indicators** – record visible evidence of fire (provide more detail in notes where applicable).
- **Estimated time since fire** – where fire indicators are noted provide rough estimate of years since plot area burned.

Section: Treatment/Fire Description

- **Plot Type** – indicate whether a plot is a wildfire, hazard fuels (thinning), prescribed fire (RX) or control plot.
- **Thinning Treatment Phase** – pre-thinning, post-thinning and time since thinning date. Maintenance thinning if second thinning treatment has been implemented.
- **Treatment Year** – record the year of the thinning or hazard fuels reduction occurred
- **Treatment Type** – brief description of type of fuels treatment (optional). (e.g. 5 ft bole spacing, limb to 5 ft)
- **Fire Number and Fire Name** – prescribed or wildfire fire name and number
- **Fire Year -** date of prescribed or wildfire fire (year)
- **Pre or Post yrs** – time since wildfire or prescribed fire (years or months). Indicate if pre-fire.

Section: Latitude/Longitude & Photos

- **GPS Type** – type of GPS used to collect location information (e.g. Garmin 76CSx Map)
- **GPS Identification** –GPS unit identifier (person's name or unit number)
- **GPS Datum** – GPS datum used; NAD-83 (essentially same as WGS-84).
- **Description** – description of where coordinates recorded (e.g. center-point of circular plot, LZ for the plot or other pertinent coordinates).
- **Waypoint number/name**– waypoint identifier recorded in GPS. Best to re-name the points to indicate plot and where recorded (usually transect centerpoint). Example of waypoint name: 362-03-CP (*fire number*: 362, *plot number*: 03, *location:* CP (center-point) taken at the circular plot center-point).
- **Latitude/Longitude** – use GPS (recommended: Garmin 76CSx Map or Trimble) to record coordinates in decimal degrees (e.g. Latitude: N65.634891°, Longitude: W142.982340°)
- **GPS Error** – before saving the coordinate allow the GPS to average for a minimum of 20 points. Record the error and units (m or ft).
- **Photo number, time and camera** – description of photos taken, photo time (from camera) and camera used.

Section: Vegetation Class

- **Vegetation Class -** for the 8-m radius circular plot area use the Alaska Vegetation Classification (Viereck 1992), determine the current vegetation class and pre-disturbance vegetation class (if possible). Describe to Viereck Level IV of V (where possible).
- **Vegetation Dominant Species** - record the dominant species in the 8-m radius circular plot area (particularly if not using the Point Intercept or General Vegetation datasheets). Skip if General Vegetation datasheet used at plot.
- **Plot Layout and General Notes** – use back of page to describe how to get to site, landing zones, disturbance, habitat use and any other pertinent observations. Draw maps, diagrams and sketches where applicable.

Vegetation and Ground Cover

Ocular Vegetation Cover Estimation

On the *GENERAL VEGETATION* datasheet record ocular estimates of vegetation and substrate % cover for vegetation and ground cover within the 8-m radius plot area (regardless of tree density circular plot size). The cover classes are defined in 10% increments (e.g. 1-10%, 10-20%....90-100%). Estimate the cover of each species or substrate and check the appropriate box on the datasheet. Due to overlapping components of the canopy cover, total cover can equal more than 100%. Use species scientific names where possible, use first two letters of the genus and the species (see *Species Codes* section below) (USDA NRCS 2011, http://plants.usda.gov/). Additional species can be added on the second page or by crossing out pre-written species. Estimate average plant heights in meters for all trees, tall shrubs and low shrubs. On the datasheet, species are listed by forest canopy layer as described below:

- *Tree Layer* – estimate the percent cover of each tree species. At all plots indicate average tree height (m). If Tree Density and Tree Measurement datasheets not used then also estimate average tree diameter and ladder fuel height. If a single species forms two or more distinct sub-layers, list it on separate rows (e.g. PIGL-sapling, PIGL-overstory, PIGL-dead). Shrubs, such as willows or alders of tree size, are not considered trees.
- *Shrub Layer* - shrubs are defined as woody plants with multiple stems. Estimate the % cover of tall (e.g. alder), low (e.g. dwarf birch) and dwarf (e.g. low-bush cranberry) shrubs. Provide estimates of tall and low shrub heights (in centimeters). If there are newly established shrubs, identify if plants are new seedlings or re-sprouts, if not leave the column blank to indicate mature plant.
- *Herb and Graminoid Layer* – this layer is inclusive of all non-woody species observed including graminoids (grasses, sedges, and rushes), herbs/forbs, ferns, horsetails, and club mosses. Estimate the % cover of non-woody species. If there are newly established shrubs or herbs, identify if plants are new seedlings or re-sprouts, otherwise leave the column blank.
- *Non-vascular Layer* - estimate the percent ground cover of mosses, lichens and liverworts.
- *Ground Cover Layer* - estimate the percent ground cover of litter, down woody fuels, bare ground, water or duff.

Point-Intercept Vegetation Cover Measurement

Use the VEGETATION POINT INTERCEPT datasheet. Along the 16-m transect, the point intercept method will be used to determine plant and ground cover. Every 50 cm along the 16-m transect, record all plant species and types of surface cover (e.g. mosses, lichens, substrate) intercepted at that point. Start at the 0.5 m mark and record along the right-hand side of the transect. NOTE: An additional transect can be added to increase the number of points for point intercept. Establish the second transect perpendicular to the first transect (forming a cross across the plot).

Using a ¼" diameter pole (6 ft fiberglass bike flag), gently lower the pole so that the rod is plumb to the ground (on slopes this will not be perpendicular to the ground). At each point intercept record the species that touch one side of the pole from top to bottom, for example if black spruce was the tallest vegetation "hit" (touching the pole) at that point black spruce would be recorded first. Similarly, ground cover will always be recorded last.

- *Species Codes:* Record species "hit" using the NRCS four letter plant species codes. Generally, the NRCS codes are the first two letters are the genus (i.e. *Salix*) and the last two are the species (i.e. *glauca*); for *Salix glauca* the NRCS code is SAGL. Refer to the USDA plants database for the most current species codes (USDA NRCS 2011, http://plants.usda.gov/). Also, numbers are frequently used to differentiate species with alphabetical similar codes (e.g. *Calamagrostis canadensis* code is CACA**4**), but if exact code is not known then write the species' full name and the code used on the datasheet.
- *Unknown Species:* If common but unknown species are encountered, then collect for later identification, record on the datasheet as an identifiable acronym, note a description of the species, and whether it was collected.
- *Dead trees:* For dead standing trees, record species and indicate that it is dead by adding a D after the species code as a superscript. For dead branches on a live tree, record the as live.

Tree Density and Measurements

Tree Density

On the TREE DENSITY TALLY datasheet record the total number of trees taller than 1.37-m (4.5 ft) that occur within an the 8-m radius circular plot by species and diameter size class (< 5 cm, 5.1 - 10 cm, 10.1 - 15 cm, 15.1 – 23 cm, > 22.5 cm DBH). *In dense stands of trees* with greater than 15 trees in a 4-m radius subplot, tally only trees within the 4-m radius subplot and indicate on datasheet which plot dimensions used (e.g. 4-m radius plot). Use a Hagloff DME to determine if trees are rooted within the 8-m or 4-m radius circular plot. Tree density data can also be collected to identify disease or insect damaged trees if desired. Record the damage type on the data sheet and record as live or dead. Utilize the damage codes provided in the Appendix of this document.

For seedling density counts all live "seedling" trees (less than 4.5 ft tall) will be tallied by species in three 1-m radius circular subplots located at the 4-m, 8-m, and 12-m marks along the transect (total "seedling" area of 9.42 m^2 or .0048 ac).

Tree Measurements

On the TREE MEASUREMENT Datasheet record detailed tree measurements for two live trees (> 4.5 feet tall) of each species and each size class located. Select trees for measurement which are located; 1) within the 8-m or 4-m radius circular tree density plot and 2) closest to the center point of the plot. If re-visiting the plot is planned then mark the trees with metal tags and unique identifiers. For each tree the following measurements are recorded: DBH (diameter at breast height), tree height, height to live crown, height to live and dead ladder fuels, and crown radius. This information will be used to calculate tree density, tree basal area, crown bulk density, and stand height. For deciduous trees record tree height and DBH only. Diagrams illustrating how to record tree measurements are provided in the QUICK REFERENCE section of this document. Definitions of the parameters measured are as follows:

- **Tree Number** – assign a number to the tree. If it is the first visit to the plot and the tree needs to be marked for plot revisits, then record the designated number on the tree marker or the unique identifier

provided on the tree marker as the tree number. If revisiting a plot with marked trees record the unique identifier on the tree marker.

- **Species** - record the species of the tree using the NRCS species codes (see *Species Code* section above) (USDA NRCS 2011, http://plants.usda.gov/). Shrubs, such as willows or alders of tree size, are not considered trees.
- **Diameter at Breast Height (DBH)** - measure the diameter of the tree trunk in centimeters at 4.5 ft (1.37 m) from the ground using the metric diameter tape measure.
- **Tree height** - measure the tree height in meters using a clinometer. Record measurement from 10 to 30 m away from the tree; the taller the tree the further from the tree the measurement is taken. Use the percent side of the clinometers to calculate tree height. Tree Height (meters)= (distance from tree in meters) x (% to top of tree - % to base of tree). Note: if the base % is negative this will be added to the total height (math: minus a negative is positive).
- **Crown radius** -measure the crown radius in centimeters to the average widest branch or drip-line of the crown.
- **Crown base height** (main live crown) – measure the height in centimeters from the forest floor to the obvious main live crown. Use a clinometer to measure from a distance or measure directly with a tape measure or ruler.
- **Height to live ladder fuel** – measure the height in centimeters from the forest floor to the lowest point of a live branch with a tape measure or ruler.
- **Height to dead ladder fuel** – measure the height in centimeters from the forest floor to the lowest point of a dead branch**.**
- **Comments –** use this field to describe notable aspects of the tree including location along transect and damage (use damage codes where possible).

Permafrost & Soils

On the *ACTIVE LAYER/SOILS* datasheet record active layer depth at 8 points located at 2-m intervals along the transect (except the last point is placed at 15-m) (Figure 1). At each point measure the depth of the active layer by inserting the bike flag rod or permafrost probe into the ground. Record the depth (cm) to resistance (active layer boundary). If possible record whether active layer depth is limited by rock, permafrost, or seasonal frost and note on datasheet. Record the surface fuel codes for each point: LC = lichen, FM = feather moss, SM = sphagnum moss, DM = dead moss, UD = upper duff, LD = lower duff, MIN = mineral, LTRH = Litter (leaf or herbaceous), LTRNDL = Litter (needle). Record soil moisture (%), soil temperature (°C) and pH at 4-m, 8-m and 12-m points on transect.

Burn Severity & Duff Consumption

Burn Severity (Point) & Duff Consumption

On the BURN SEVERITY/DUFF CONSUMPTION datasheet (located on the same datasheet as the ACTIVE LAYER/SOILS data) record assessments of burn severity using the burn severity codes (BSC) for both substrate and vegetation. The BSC used are described in Table 1. Burn severity is assessed at points located every 2-m along the 16-m transect (except for last point is located at 15-m mark on transect).

Table 1. Burn severity code matrix (modified from NPS Fire Monitoring Handbook [2003])

Burn Severity Code (SBS)	**Forest and Shrub Types**	
	Substrate (S)	**Vegetation (V)**
(5) Unburned	Not burned	Not burned
(4) Scorched	Litter/moss partially blackened; duff nearly unchanged; wood/leaf structures unchanged	Foliage scorched and attached to supporting twigs
(3) Lightly Burned	Litter/moss charred to partially consumed; upper duff layer may be charred but the duff layer is not altered over the entire depth; surface appears black; small woody debris is partially burned.	Foliage and smaller twigs partially to completely consumed; branches mostly intact; less than 40% of the shrub canopy is commonly consumed
(2) Moderately Burned	Litter entirely consumed, leaving coarse, light colored ash; duff deeply charred to lower duff or upper /lower duff interface, but underlying mineral soil is not exposed; woody debris is mostly consumed; logs are deeply charred, burned-out stump holes are common	Foliage, twigs, and small stems consumed; some branches (>0.5 – 2.5 cm) still present. 40-80% of the shrub canopy is commonly consumed
(1) Heavily Burned	Litter and duff completely consumed, or within 1 cm of mineral soil; mineral soil may be visibly altered, sometimes reddish; if present, sound logs are deeply charred, and rotten logs are completely consumed. *Marcantia* and fire mosses may be present.	All plant parts less than 2.5 cm in diameter are consumed, leaving some or no major stems or trunks; any left are deeply charred
(NA) Not applicable	Inorganic pre-burn	None present pre-burn

To quantify duff consumption by fire use the following methodology. First, prior to the fire, insert 8 non-flammable burn pins (recommend 15-30" long welding rods) firmly in the ground at 2-m intervals along the transect. Ensure that the burn pins are pushed into the ground so that the top of the burn pin is flush with the ground surface. If it is not possible to fully insert the burn pin, then either; 1) cut the burn pin so that is flush with the ground using small bolt cutters or 2) record the length (cm) of the segment which remains above the ground on the *BURN SEVERITY/DUFF CONSUMPTION* datasheet. Revisit burned plots to record duff consumption as soon as possible or within 1 year of the fire event. Record the length of burn pin segment exposed as a result of the fire.

Composite Burn Index- Full Plot Burn Severity Assessment

The *COMPOSITE BURN INDEX (CBI)* datasheet is used to assess full plot burn severity. Composite Burn Index (CBI) is a ground-based plot methodology utilized to field-verify remotely-sensed burn severity measures such as the differenced Normalized Burn Ratio (dNBR). CBI plots are used throughout the National Park Service as a tool for validating the satellite-derived estimates of burn severity delivered by the U.S. Geological Survey. CBI ratings can be taken to assess the overall plot burn severity.

Plots are usually 20-m (non-forested sites) or 30-m (forested sites) diameter circular areas. Plot locations are usually pre-determined prior to field-visits to insure that the full range of likely burn severity levels and vegetation types within the fire perimeter are represented in the final dataset. Usually plots are clustered in groups of 8-10 plots within hiking distance of one another and a single group of 8-10 plots may be assessed in a day. CBI plots are usually not permanent and plot markers are usually not installed (unless desired by the park for future monitoring).

The Composite Burn Index is based on ocular (visual) estimates of the degree of environmental change caused by fire to surface features and vegetation layers (strata). The most current data sheet and

instruction are provided and more recent versions can be obtained from: http://www.frames.gov/documents/ffi/docs/Composite_Burn_Index.pdf and a brief overview of major components is provided here. Strata are based on height above ground and include:

- **Substrates** - inert surface materials (soil, duff, litter, and downed woody fuels)
- **Herbs, low shrubs and trees < 3 ft (1m) -** grasses and forbs, as well as shrubs and small trees <3 ft (<1m) tall.
- **Tall shrubs and trees 3-16 ft (1-5 m)-** tall shrubs and trees
- **Intermediate trees (subcanopy and pole-sized trees)** - trees canopy layer situated between "tall shrubs and trees" and "big trees" layers, ~ 4–10 inches (10–25 cm) DBH. Trees may be of stratified heights and extend to upper canopy, but crowns receive little direct sunlight.
- **Big trees (upper canopy, dominant, and codominant trees)** - Tree layer taller than intermediate canopy layer which occupies the upper canopy and receives direct sunlight.
- **Total Plot, or Overall** - All strata of the plot combined for assessment of total burn severity.

Within each stratum, there are 5 or more burn severity variables assessed; each is scored from 0-3 (0 = unburned, 3 = high severity). An overall CBI score is calculated for each plot by averaging the individual severity scores from each of the individual measures. This overall CBI score is then cross-referenced with the satellite measure of severity to determine the degree of correlation.

Alaska Specific Modifications to CBI ranking: The CBI datasheet includes optional fields which provide an opportunity to score additional fields to more accurately represent a specific region. These optional fields are provided for each strata and are called "CBI_1". For Alaska it is recommended to add the following user-defined fields to the "CBI_1" fields on the datasheet:

Medium Fuel, 3-8": If medium down woody fuel **(**3-8" diameter [7.6-20.3 cm]) are present in plot then rate the consumption of down woody fuel as usual. If medium woody fuels are not present and tussocks are present; rate consumption of tussock (*Eriophorum vaginatum)* basal stock. Do not score if no medium fuels or tussocks pre-fire.

Substrate CBI_1: For the user-defined substrate CBI_1, score the consumption of moss and/or lichen species. The scale is the same as used for "Duff" (see below example).

CBI_1: Moss/Lichen Cover	Unchanged	--	Light Char	--	50% Loss deep char	-	Consumed

Forest Floor Duff Thickness and Fuel Moisture

Measurement of litter and duff layer thicknesses is standard for many fire ecology monitoring projects. In some cases duff moisture measurements may also be needed for a project. Both "duff and litter thickness" and "duff moisture" measurements are conducted using duff plugs (removable sections of forest floor).

When removing duff plugs do not disturb the forest floor or the vegetation along the transect within the 8-m radius circular plot area. If permafrost or other obstructions limit the depth of the duff plug then measure the layers available and indicate the type and depth of obstruction. To extract a duff plug carefully cut down through the forest floor (using a compass saw, trowel and/or shovel) to either mineral soil or permafrost. For duff thickness measurements plug size is not crucial, but for fuel moisture measurements extract ~ 4-inch-square plugs.

Duff layer thickness

Duff layer thicknesses are recorded on the *DOWN WOODY DEBRIS & DUFF THICKNESS* datasheet or if measured in combination with fuel moisture measurements on the *FUEL MOISTURE DATA SHEET*

datasheet. Remove duff plugs from at least two sites located at least 1-m away from the belt transect. Choose duff plug collection sites that appear to be representative of the forest floor in the larger plot area. Examine the duff plugs removed and record the thickness of forest floor layers (live moss, dead moss, upper and lower duff layers). Measure the thickness of each layer down to mineral soil (live moss, lichen, dead moss, upper duff and lower duff) with a ruler to the nearest 0.5 cm. Refer to Wilmore (2001) for detailed duff moisture methods.

Fuel moisture measurements

Duff or live fuel moisture measurements are recorded on the *FUEL MOISTURE DATA SHEET* datasheet. If measuring duff moisture, then first record the duff thicknesses as described above and then remove duff samples from each layer. Place the samples in nalgene plastic sampling bottles, and record the number on the bottle selected in the Bottle # field. More detailed information on distinguishing between duff layer, duff moisture sampling and specialized data sheets for data entry see the Alaska Fire Science Consortium web page (http://www.frames.gov/files/9713/6865/6760/Duff_Sampling_Cheat_Sheet__2013.pdf) and reference Wilmore (2000) and Jandt et al (2005).

Live fuel moisture may also be collected. Please see the following references for standard methods in Alaska: http://www.frames.gov/files/3213/6865/6880/Live_Fuel_Moisture_Sampling_Cheat_Sheet_2013_v1.2.pdf (July 3, 2012) or refer to Norum and Miller (1984) for additional information.

Down Woody Fuels

Use the *DOWN WOODY DEBRIS & DUFF THICKNESS* datasheet to tally the number of woody debris particles along the 16-m transect using the planar intersect method outlined by Brown (1974) and the National Park Service Fire Monitoring Handbook (National Park Service 2003). Down woody fuel loads are measured in standard units. Table 2 is a summary of the woody debris size classes and the sample distance segments along the transect. By size class tally the number of times down woody debris intercepts (crosses) the transect line. Size classes are summarized in Table 2. 1-hour and 10-hour fuels are tallied along the first 6 feet of the transect. 100 hour fuels are tallied along the first 12 feet of the transect. 1000 hour fuels are tallied along the whole 52.49 ft (16-m) transect. *For 1000 hr fuels, measure and record the diameter of the 1000 hr fuels (at the line crossing) and record as solid or rotten and also record tree species.* A go-no-go gauge with openings 0.25, 1 and 3 inches is useful for determining size classes. Tally dead and down woody materials only; do not include 1) cones, needle litter, leaf litter, and bark, or 2) stems and branches that are attached to standing trees or shrubs. **Record as "NONE" if there are no woody fuels intersecting the transect.**

Table 2. Woody fuel types, diameter size classes, and distance segment in which each fuel type is tallied along 16-m transect.

Diameter size	Fuel Type	Distance to tally along transect
0 to 0.25 inch	1 hour fuels	From 0 to 6 foot (1.82 m)
0.25 to 1 inch	10 hour fuels	From 0 to 6 foot (1.82 m)
1 to 3 inches	100 hour fuels	From 0 to 12 foot (3.66 m)
> 3 inches	1000 hour fuels Record species, diameter and solid/rotten	From 0 to 52.49 foot (16 m)

Shrub Density

Shrub density is recorded on the *SHRUB DENSITY* datasheet. To quantify tall shrub (alder and tall willow species) density, tally the number of individual shrubs greater than 1-m tall located in the 4-m radius circular plot. Individuals are defined by clusters of stems separated by >10 cm. Where not possible to

distinguish between individual shrubs, record the number of *stems above* ground counted at the ground surface level. Tally shrubs by species and life stage (resprout, mature, decadent and dead). *Mature* shrubs have <50% of the shrub biomass dead compared to *decadent* shrubs which have >50% of the shrub biomass dead. Dead shrubs must have no sign of living material on the plant. Record the average height of each shrub species found within the 8-m circular plot (skip height record if GENERAL VEGETATION datasheet is used).

Moose Browse Architecture & Herbivory

Moose Browse & Herbivory Data

Evidence of browse by moose is recorded on the MOOSE BROWSE ARCHITECTURE datasheet. Moose select certain shrub and tree species for consumption; these species are referred to as preferred species. Preferred browse species includes all common Alaskan deciduous tree species (paper birch, aspen, and balsam poplar) as well as tall (and some low) willow species. Other tall and low shrub species including alder, rose, soapberry, and dwarf birch are *not* preferred browse species. To measure habitat-use based on browse evidence employ the following modification of the general methodology outlined by Seaton (2002).

Select 2 individuals of <u>each</u> preferred species located closest to the circular plot center point and within the 8-m radius plot. For each individual identify the species and record the estimated plant height. Also record the mature class (whether more or less than 50% of the individual is taller than 3-m), the dead class (whether more or less than 50% of the individual is dead) and assign one of the following architectural classifications:

a. **Broomed** – has been extensively affected by browsing activity:
    i. sapling type plants- the main apical stem has been broken by moose. It is important to look at the history of the plant to ensure that; this may have happened 2–10 years before you measured it;
    ii. (bushy type plants) more than half of the current annual growth (CAG) stems arise from lateral stems that were produced as a result of browsing. Look back through stems that are many years old.
b. **Browsed** - has been browsed some in the past, but browsing has not significantly affected its growth. Less than half of CAG twigs between 0.0 and 3.0 m arise from lateral stems that were produced from browsing.
c. **Unbrowsed** - There is no visible evidence that moose have ever browsed this plant.

Additionally, record whether browsing activity by moose has resulted in one or more broken stems; moose often break taller stems to reach new growth and leaves. Record whether there is evidence of hare browsing. Hare browse evidence can be distinguished from moose browse in the following ways: hare browse is usually located lower on the plant than moose browse (at the level of winter snow depth or below) and is indicated by a clean diagonal cut in the stem. Moose browse usually has a more horizontal and jagged appearance. Use comments to note evidence of bark stripping by moose and porcupine, lichen utilization by caribou, and any other evidence of habitat utilization by wildlife (ptarmigan, small mammal, squirrel etc.)

Moose Browse Density

Moose browse architecture may also be collected utilizing a density form. Record on the MOOSE BROWSE ARCHITECTURE DENSITY datasheet the number of individual of plants by species and height class and moose browse architecture as described above. Individual for tall shrubs such as willow are defined as stems that are rooted greater than 10 cm apart. Height classes are defined as: 0-0.5m, 0.5-1m, 1-3m, 3-5m, > 5m. Plants taller than 5 m should not be recorded.

Invasive Plant Infestation

To record observations of invasive plants during monitoring projects use the *ALASKA EXOTIC PLANT MANAGEMENT TEAM (EPMT)* Datasheet (modified for the NPS Alaska Fire Ecology program). Invasive plant infestation is often associated with disturbed areas, including burned and thinned areas. In order to get an idea of what's coming back in areas affected by fire management decisions carry several copies of the Alaska Exotic Plant Management Team (EPMT) datasheets for the purpose of recording observations of invasive species. Where invasive species are observed record a rough estimate of the area infested (buffer), the % cover of the species in the buffer, the current life cycle stage (phenology), the amount of time it would take to remove all individuals from the buffer area, the GPS co-ordinates indicating where to find the infestation and any comments which might lend insight to infestation (e.g. type of disturbance(s), health of species individuals). Recommend carrying copy of Invasive Plants of Alaska (AKEPIC 2005) and/or list of probable invasive species in area visited and reviewing probable invasive species in a given area prior to field visits.

Protocol References

Alaska Exotic Plant Information Clearinghouse (AKEPIC). 2005. Invasive Plants of Alaska. Alaska Association of Conservation Districts Publication. Anchorage, Alaska. http://www.fs.fed.us/r10/spf/fhp/pubs/invasive_plants.pdf

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Field Gear List

General	Item	Per Plot
Plot	30 meter tape	1
Plot	Bike flag	1
Plot	Hagloff DME	1
Plot	Chaining pins	2
Plot	Clinometer	1
Plot	Clipboard	2
Plot	Compass	2
Plot	Diameter calipers	1
Plot	Diameter logger's tape, metric	1
Plot	Diameter tape (small), metric	2
Plot	Fuel Diameter measure (go-nogo)	1
Plot	Field vest	1/person
Plot	Folding ruler 1 meter	2
Plot	Handlens	2
Plot	Paintsticks	2
Plot	Rebar, wooden lathe, other plot markers	2 per plot
Plot	Steel tags w/wire	2 per plot
Plot	Welding rods (duff consumption)	10 per plot
Plot	White board/dry erase pen	1
Duff	4" quilting square	1
Duff	Compass saw	1
Duff	Duff containers	40
Duff	Green duff mat	1
Duff	Pruners	1
Duff	Ruler, centimeter	1
Duff	Special duff plug shovel	1
Tech	Digital Camera	1
Tech	GPS w/appropriate map coverage downloaded	1
Logistic	BK Radio w/appropriate frequencies	1
Logistic	Copies of original Datasheets for each paired plot.	1 set for each year
Logistic	Datasheet organizer for plot project w/ data sheets	1
Logistic	Maps of plot locations	1
Logistic	Satellite Phone	1
Logistic	Shotgun w/ammo	1
Personal	Food, Clothing, Shelter	Yes

Datasheets and Quick Reference

Plot Data Collection Check List

Unit: _____ Project: _____ Plot ID: _____ Date (M/D/Y): ___/___/_____

Protocol/Data Sheet	**Check if Data Form Used**	**Modifications/Comments**
Site Description		
General Vegetation Information		
Vegetation Point Intercept		
Tree Density Tally		
Tree Measurement		
Active Layer/Soils		
Burn Severity/Duff Consumption		
Down Woody Debris & Duff Thickness		
Burn Severity- Composite Burn Index		
Fuel Moisture Data Sheet/Duff Plug		
Shrub Density by Life Status		
Moose Browse Architecture - Density		
Moose Browse Architecture - Estimate		
Invasive Plant Survey		

Site Description

General Site Information:

Unit: _____ **Project:** _____ **Plot ID:** _____ **Date (M/D/Y):** ___/___/____

Field Crew: _____ **Plot Markers:** _____

Transect Azimuth: _____ (0m to 16m) Transect Slope: ____% **Plot Dimensions:**_____

Slope: _____% **Aspect:** _____Deg **Declination used:** _____ **Elevation:** _____ ft/m

Soil (circle): Wet Moist Dry **Disturbance** (circle): Fire Wind Insect Other: _____

Fire Indicators (circle): Burn Snags Burned Stumps Fire Scars Burned Plants Charcoal

Est. Time Since Fire (circle): 0-9 yrs 10-20 yrs 21-50 yrs 51-100 yrs > 100 yrs UNK

Same Site and Lat-Long information as recorded on: ____/____/_____

Treatment/Fire Description:

Plot Type (circle): Wildfire Hazard Fuels RX Control

Treatment phase (circle): Pre-thinning Post-thinning Maintenance thinning

Treatment Year: _____ **Pre or Post:** _____(yrs) Type Treatment: _____

OR

Fire Number: _____ **Fire Name**:_____ **Fire Year**: _____ Pre or Post: _____ yrs

Latitude/Longitude: GPS Type: _____ GPS Identification: _____ GPS Datum:_____

Description	Waypoint	Latitude (DD.DDDD)	Longitude(DD.DDDD)	GPS Error
		N	W	m/ft
		N	W	m/ft
		N	W	m/ft

Photos Camera used: _____

Description	Azimuth	Photo Time (military)

Vegetation Class: *List two or more dominant species of each lifeform and their % cover within the plot area.*
Current Viereck class: _____
Pre-Disturbance Viereck Class: _____
Plot area described: _____

Lifeform	Species 1	% Cover	Species 2	% Cover	Species 3	% Cover	Species 4	% Cover
Tree Sp. (list all spp)								
Tall Shrub Sp.								
Low Shrub Sp.								
Dwarf Shrub Sp.								
Graminoid/Herbaceous Sp.								
Moss/Lichen/Ground Cover								

Notes on Back of Page

Plot Layout and General Notes: Provide notes and map on relocating or LZ, burn information and other plot notes as needed below.

General Vegetation Information

Park Unit: _____ Project: _____ Plot ID: _____ Pre or Post ____ yrs
Field Date: _____ Field Crew: _____ Plot Dimensions: 8 m radius

Record plant status (superscript): **D** (dead), **C** (charred), **S** (scorched). Also record if collected (***** next to spp. code) or trace (**t** = trace) <1% cover. If tree density and tree measurements not recorded at plot, then record average ladder fuel height and DBH for tree species. If a single species forms two or more distinct sub-layers or a substantial proportion of species is burned or damaged then, list on separate rows (e.g. PIGL-sapling, PIGL-overstory, PIGL-scorched).

Species	**Common Name**			**Cover Class**											
Tree Layer		**Avg. DBH (cm)**	**Avg. Ladder Fuel Hgt (cm)**	**1-10%**	**10-20%**	**20-30%**	**30-40%**	**40-50%**	**50-60%**	**60-70%**	**70-80%**	**80-90%**	**90-100%**	**Dead?**	**Avg. Height (m)**
PIGL	White spruce														
PIMA	Black spruce														
POTR5	Aspen														
BEPA	Paper birch														
POBA2	Balsam poplar														
LALA	Larch														
Shrub Layer	**Common Name**	**Seedling**	**Resprout**	**1-10%**	**10-20%**	**20-30%**	**30-40%**	**40-50%**	**50-60%**	**60-70%**	**70-80%**	**80-90%**	**90-100%**	**Dead?**	**Avg. Height (m)**
ALVIC	Green alder														
SALIX	Unknown willow														
SAGL	Glaucous willow														
SAPU15	Diamond Leaf willow														
SABE2	Bebb willow														
BENA	Dwarf birch														
BEGL	Tall shrub birch														
DAFL3	Shrubby cinquefoil														
LEPA11	Labrador tea														
CHCA2	Leatherleaf														
SHCA	Soapberry														
ROAC	Prickly Rose														
VAUL	Blueberry														
VAVI	Lowbush cranberry														
EMNI	Crowberry														
ARRU	Bearberry														
RUCH	Cloudberry														
COCA13	Dwarf dogwood														
LIBO3	Twinflower														

Plot ID:_____ Date:_____

Herbs & Graminoids	Common Name	Seedling	Resprout	1-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Dead?	
EQUIS	Unknown Horsetail														
EPAN2	Fireweed														
GELI2	Pumpkinberry														
CABI5	Bigelow's sedge														
CAREX	Unknown carex														
CACA4	Bluejoint grass														
GRASS	Unknown Grass														
ERVA4	Tussock grass														

Non-vascular	Common Name	1-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Dead?	
MOSS*	Unidentified moss												
SPHAG2	Sphagnum moss												
FMOSS	Unknown feather moss												
HYSP70	Stair-step moss												
PLSC70	Big red stem moss												
CEPU12	Ceratadon moss												
POJU70	Common juniper moss												
AULAC2	Unk. Aulacomnium moss												
MAPO12	Marchantia liverwort												
CLADI3	Cladina unknown												
CLADO3	Cladonia unknown												
LICHEN*	Unknown lichen												
PEAP60	Freckle pelt lichen												

Ground Cover	Common Name	1-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Dead?	
LTRNDL	Needle Litter												
LTRH	Leaf Litter												
DUFF	Duff												
1Hr	0 to 0.25 inch												
10Hr	0.25 to 1 inch												
100Hr	1 to 3 inches												
1000Hr	> 3 inches												
DM	Dead Moss												
UD	Upper Duff												
LD	Lower Duff												
MIN	Mineral Soil												
W	Water												
ROCK	Rocks												

Vegetation Point Intercept

Park Unit: _____ Project: _____ Plot ID: _____ Pre or Post _____ yrs
Field Date: _____ Field Crew: _____

Record substrate and species codes of trees, shrubs, forbs and groundcover intercepted at each 50 cm interval, record plants tallest to lowest. **Record status** (superscript): **D** (dead), **C** (charred), **S** (scorched). ***=**collected

PNT	Meters	*Tallest* SPP 1	SPP 2	SPP 3	SPP 4	SPP 5	SPP 6	SPP 7
1	0.5							
2	1							
3	1.5							
4	2							
5	2.5							
6	3							
7	3.5							
8	4							
9	4.5							
10	5							
11	5.5							
12	6							
13	6.5							
14	7							
15	7.5							
16	8							
17	8.5							
18	9							
19	9.5							
20	10							
21	10.5							
22	11							
23	11.5							
24	12							
25	12.5							
26	13							
27	13.5							
28	14							
29	14.5							
30	15							
31	15.5							
32	16							

Tree Density Tally

Park Unit: _____ Project: _____ Plot ID: _____ Field Date: _____Field Crew: _____ Plot Dimensions: _____

Tally the number of trees taller than 4.5' (1.37-m) by diameter size class, species and status within the 8-m circular plot area. In densely forested stands (with > 15 trees in 4-m radius circular subplot) tally only trees in 4-m radius subplot. Tally trees by live, dead, or if disease or insects are prevalent (record damage code). Dead trees with < 45° angle to ground are not tallied. For small "layering" trees, pull trees upright to determine if height is > 4.5'. Tally seedlings"/saplings (*live* trees less than 4.5' tall) by species and life status in three 1-m radius circular plots at 4-m, 8-m and 12-m on transect. **Resprouts:** new growth from older root stock, **Seedlings:** new plants from seeds < 10cm high, **Mature** >10cm.

		Tree Counts by DBH (cm)					Seedling <4.5ft 4 M	Seedling <4.5ft 8M	Seedling <4.5ft 12M
Tree Species	**Status**	**< 5cm**	**5.1-10 cm**	**10.1-15 cm**	**15.1-23 cm**	**>23 cm**			
Black Spruce (*Picea mariana*)	LIVE						R	R	R
	Dmg____						S	S	S
	DEAD								
	Dmg____						M	M	M
White spruce *(Picea glauca)*	LIVE						R	R	R
	Dmg____						S	S	S
	DEAD								
	Dmg____						M	M	M
Aspen *(Populus tremuloides)*	LIVE						R	R	R
	Dmg____						S	S	S
	DEAD								
	Dmg____						M	M	M
Paper birch *(Betula papyrifera)*	LIVE						R	R	R
	Dmg____						S	S	S
	DEAD								
	Dmg____						M	M	M
Balsam poplar *(Populus balsamifera)*	LIVE						R	R	R
	Dmg____						S	S	S
	DEAD								
	Dmg____						M	M	M
Larch Tamarack (*Larix laricina*)	LIVE						R	R	R
	Dmg____						S	S	S
	DEAD								
	Dmg____						M	M	M

Tree Measurements

Park Unit: _____ Project: _____ Plot ID: _____ Pre or Post _____ yrs
Field Date: _____ Field Crew: _____ Plot Dimensions: _____

Record the following for two live trees (> 4.5 feet tall) of each species and size class observed within the tree density plot. Select trees located within the tree density plot and closest to the plot center point. Record measurements to 1 decimal place (e.g. 4.3 m, 2.2 cm). Note observed tree damage (including fire damage), insects or disease using damage codes where possible. *For deciduous tree species record tree height and DBH only*.

Tree No.	Tree Species	DBH (cm)	Height (m)	Crown Radius (cm)	Ht to Dead Ladder Fuel (cm)	Ht to Live Ladder Fuel (cm)	Main Crown Base Ht (cm)	Location	Comments

Active Layer/Soils

Park Unit: _____ Project: _____ Plot ID: _____ Field Date: _____ Field Crew: _____ Plot Dimensions: _____

Point	Distance	Active Layer Depth (cm)	Surface Layer Fuel Code	Comment (Permafrost/ Rock)	Soil Moisture (%) Depth:	pH	Soil Temp (°C) Depth:	Notes
1	2-m							
2	4-m							
3	6-m							
4	8-m							
5	10-m							
6	12-m							
7	14-m							
8	15-m							

Fuel Codes: LC = lichen, FM = feather moss, SM = sphagnum moss, DM = dead moss, UD = upper duff, LD = lower duff, MIN = mineral, LTRH = Litter herbaceous, LTRNDL = Litter needle litter

Burn Severity/Duff Consumption

		Post-Fire		Pre-fire	Post-fire	
Point	Distance	Burn Severity Code (Substrate)	Burn Severity Code (Vegetation)	Burn Pin above surface (cm) (A)	Burn Pin Exposed (cm) (B)	Burn Depth cm (=B-A)
1	2-m					
2	4-m					
3	6-m					
4	8-m					
5	10-m					
6	12-m					
7	14-m					
8	15-m					

Down Woody Debris & Duff Thickness

Park Unit: _____ Project: _____ Plot ID: _____ Pre or Post _____ yrs

Field Date: _____ Field Crew: _____ Transect Length: _____

Record the number of intercepts of woody fuels by diameter size class along the transect. Record 1hr (0 - 1/4") and 10 hr (1/4"- 1") from 0 to 6 ft along transect, 100 hr (1" - 3") from 0 to 12 ft along transect, and 1000hr (> 3") from 0 to 52.49 ft. Or use meters to define segments: 1.82-m (6 –ft), 3.66-m (12-ft), and 16-m (52.49 ft). Record the species and diameter of fuels >3". Record litter and duff layerthickness at each end of the transect in location off-set by at least 1-m from transect.

	# of intercepts			**>3" Diam: Record Diameter (in) and Species** (0-53 ft)		**Litter and Duff Thickness (cm)**			
Transect	**0 – 0.25" 1 hr** (0-6 ft)	**0.25 - 1" 10 hr** (0-6 ft)	**1 - 3" 100 hr** (0-12 ft)	**3"+ solid 1000 hr S**	**3"+ rotten 1000 hr R**	**Sample site 1**	**Thickness cm**	**Sample site 2**	**Thickness cm**
Dir. ____ Slope ___						Litter		Litter	
						Lichen		Lichen	
						Live Moss		Live Moss	
						Dead Moss		Dead Moss	
						Upper Duff		Upper Duff	
	Total:	Total:	Total:			Lower Duff		Lower Duff	

Transect	**0 – 0.25" 1 hr**	**0.25 - 1" 10 hr**	**1 - 3" 100 hr**	**3"+ solid 1000 hr S**	**3"+ rotten 1000 hr R**	**Sample site 3**	**Thickness cm**	**Sample site 4**	**Thickness cm**
Dir. ____ Slope ___						Litter		Litter	
						Lichen		Lichen	
						Live Moss		Live Moss	
						Dead Moss		Dead Moss	
						Upper Duff		Upper Duff	
	Total:	Total:	Total:			Lower Duff		Lower Duff	

Definitions & Tally Rules

>Downed woody material are dead twigs, branches, stems and boles of trees and shrubs that have fallen and lie on or above the ground.
>Measure woody material first to avoid disturbing it and biasing your estimates.
>Do not count dead woody stems and branches still attached to standing shrubs and trees (see below)
>If more than 45 degrees and dead, but still attached at the bole it is still counted
>Do not tally any particle having a central axi that coincides perfectly with the sampling plane.
>If the sampling plane intersects a curved piece more than once tally each intersection
>For rotten logs that have fallen apart try to estimate its original diameter
>Tally uprooted stumps and roots not encased in dirt. Do not tally undisturbed stumps.

Composite Burn Index (CBI) Data Sheet (FFI 2007)

FFI -- BURN SEVERITY -- COMPOSITE BURN INDEX

PD - Abridged	Examiners:			Fire Name:		
Administrative Unit		Project Unit		Macro Plot		
Field Date mmddyyyy	/ /	Fire Date mmyyyy	/			
Plot Aspect		Plot % Slope		UTM Zone		
Plot Diameter Overstory		UTM E plot center		GPS Datum		
Plot Diameter Understory		UTM N plot center		GPS Error (m)		
Number of Plot Photos		Plot Photo IDs				

BI – Long Form	% Burned 100 feet (30 m) diameter from center of plot =					Fuel Photo Series =		
STRATA RATING FACTORS	**BURN SEVERITY SCALE**							**FACTOR SCORES**
	No Effect	**Low**		**Moderate**		**High**		
	0.0	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	
A. SUBSTRATES								
% Pre-Fire Cover: Litter =	**Duff =**		**Soil/Rock =**		**Pre-Fire Depth (inches): Litter =**	**Duff =**	**Fuel Bed =**	
Litter/Light Fuel Consumed	Unchanged	--	50% litter	--	100% litter	>80% light fuel	98% Light Fuel	
Duff	Unchanged	--	Light char	--	50% loss deep char	--	Consumed	
Medium Fuel, 3-8 in.	Unchanged	--	20% consumed	--	40% consumed	--	>60% loss, deep ch	
Heavy Fuel, > 8 in.	Unchanged	--	10% loss	--	25% loss, deep char	--	>40% loss, deep ch	
Soil & Rock Cover/Color	Unchanged	--	10% change	--	40% change	--	>80% change	
CBI_1								
B. HERBS, LOW SHRUBS AND TREES LESS THAN 3 FEET (1 METER):								
%Pre-Fire Cover =			**% Enhanced Growth =**					
% Foliage Altered (blk-brn)	Unchanged	--	30%	--	80%	95%	100% + branch loss	
Frequency % Living	100%	--	90%	--	50%	< 20%	None	
Colonizers	Unchanged	--	Low	--	Moderate	High-Low	Low to None	
Spp. Comp. - Rel. Abund.	Unchanged	--	Little change	--	Moderate change	--	High change	
CBI_1								
C. TALL SHRUBS AND TREES 3 to 16 FEET (1 TO 5 METERS):								
%Pre-Fire Cover =			**% Enhanced Growth =**					
% Foliage Altered (blk-brn)	0%	--	20%	--	60-90%	> 95%	Signifcnt branch loss	
Frequency % Living	100%	--	90%	--	30%	< 15%	< 1%	
% Change in Cover	Unchanged	--	15%	--	70%	90%	100%	
Spp. Comp. - Rel. Abund.	Unchanged	--	Little change	--	Moderate change	--	High Change	
CBI_1								
D. INTERMEDIATE TREES (SUBCANOPY, POLE-SIZED TREES)								
%Pre-Fire Cover =	**Pre-Fire Number Living =**				**Pre-Fire Number Dead =**			
% Green (Unaltered)	100%	--	80%	--	40%	< 10%	None	
% Black (Torch)	None	--	5-20%	--	60%	> 85%	100% + branch loss	
% Brown (Scorch/Girdle)	None	--	5-20%	--	40-80%	< 40 or > 80%	None due to torch	
% Canopy Mortality	None	--	15%	--	60%	80%	%100	
Char Height	None	--	1.5 m	--	2.8 m	--	> 5 m	
CBI_1								
Post Fire: %Girdled =			**%Felled =**		**%Tree Mortality =**			
E. BIG TREES (UPPER CANOPY, DOMINANT, CODOMNANT TREES)								
%Pre-Fire Cover =	**Pre-Fire Number Living =**				**Pre-Fire Number Dead =**			
% Green (Unaltered)	100%	--	95%	--	50%	< 10%	None	
% Black (Torch)	None	--	5-10%	--	50%	> 80%	100% + branch loss	
% Brown (Scorch/Girdle)	None	--	5-10%	--	30-70%	< 30 or > 70%	None due to torch	
% Canopy Mortality	None	--	10%	--	50%	70%	%100	
Char Height	None	--	1.8 m	--	4 m	--	> 7 m	
CBI_1								
Post Fire: %Girdled =			**%Felled =**		**%Tree Mortality =**			

Σ =
N =
$\overline{X}$ =

Community Notes/Comments:	**CBI = Sum of Scores / N Rated:**	**Sum of Scores**	**N Rated**	**CBI**
	Understory (A+B+C)			
	Overstory (D+E)			
	Total Plot (A+B+C+D+E)			

% Estimators: **20 m Plot:** 314 m^2 1% = 1x3 m 5% = 3x5 m 10% = 5x6 m
30 m Plot: 707 m^2 1% = 1x7 m (<2x4 m) 5% = 5x7 m 10% = 7x10 m

After, Key and Benson 1999, USGS NRMSC, Glacier Field Station.
Version 4.0 8 27, 2004 (updated 11/26/07 for FFI)

Strata and Factors are defined on the reverse side of this form. See the FIREMON Landscape Assessment, Chapter 2, available at http://frames.nbii.gov/firemon, for more information.

CBI Instruction (FFI 2007)

STRATA

Substrates—Inert surface materials of soil, duff, litter, and downed woody fuels. **Herbs, Low Shrubs and Trees**—All grasses + forbs, and shrubs + small trees <3 ft (<1 m). **Tall Shrub and Trees**—Shrubs and trees 3–16 ft (1–5 m) tall. **Intermediate Trees (pole-size, subcanopy)**—Trees between tall shrubs/trees and upper canopy, approximately 4–10 inches (10–25 cm) diameter, and 25–65 ft (8–20 m) tall. May be stratified heights and extend to upper canopy, but crowns receive little direct sunlight. Size is relative to upper canopy and varies by community. If this size is upper canopy, count as intermediate trees. **Big Trees (mature, dominant and co-dominant, upper canopy)**—Larger than intermediate trees, occupy upper canopy, receive direct sunlight; tallest may extend above average big-tree level. **Understory**—Substrates, herbs/low shrubs+trees, tall shrubs+trees. **Overstory—**Intermediate and big trees. **Total Plot, or Overall**—All strata of the plot combined.

GENERAL

Pre-fire exposed soil/rock is considered unburned if there is no sign of overlying substrates or vegetation that burned. Avoid sites with >50% exposed pre-fire soil/rock, see guidelines. **Rehab Site**—Mulch or other does not count, estimate as if that was not present. Planted, growing vegetation can be tallied where appropriate, but not as new colonizers. A specific factor may not be rated if is not relevant, shows inconsequential presence or insignificant indication of severity (write in N/A for not applicable), or when effects are unclear and cannot be reasonably judged (write in UC for uncertain). **Percent Plot Area Burned**—Record the percent surface area (burned substrates and low-growing plants) showing any impact from fire for the 98-ft (30-m) diameter plot, and for the nested 66-ft (20-m) plot, if that is used for the understory. **Prefire Variables**—Report cover (percent area), depth (inches) and density (number of trees) plot-wide as if before fire. Consider burned evidence + unburned areas within plot or nearby; reasonable approximation of prefire conditions. If too difficult to estimate, write in UC for uncertain. **Enhanced Growth Factors**—100 percent + percent productivity above that, judged to be fire-enhanced; regard amount of green biomass in terms of cover, volume and density. If plots show about the same or less productivity than before fire, then enter as not applicable (N/A). If plot shows enhanced growth, then enter the percent productivity that is augmented by fire, with 100 percent being the same postfire productivity as prefire (for example, 200 percent represents double the estimated prefire productivity); write in UC if uncertain.

SUBSTRATE RATING FACTORS (Do not count litter or fuels built up after fire.)

Litter/Light Fuel—Relative amount consumed of leaves, needles, and < 3-inches (<7.6-cm) diameter wood on the ground at time of fire. Not new litter-fall. Count litter/light fuel even if it occurs under living plants. **Duff condition**—Relative amount consumed and charring of decomposed organic material lying below the litter. Not fine root mass. Count duff even if it occurs under living plants. **Medium Fuel**—Consumption of down woody fuel between 3–8 inches (7.6–20.3 cm). **Large Fuel**—Loss and charcoal from down woody fuel >8-inch diameter (20.3 cm). Base both classes on change to fuel load. Omit or join as one if either fuel class < 5 percent plot cover, see text. Include stumps in appropriate size class, if relevant. **Soil Cover/Color**—New exposed soil and color change; lightening at moderate to high, ~10 percent red at high severity— overlook ash. Consider soil or rock surface *not* covered by litter, duff or low herbaceous cover less than about 30 cm. If such occurs under taller shrubs and trees, count it.

HERBS, LOW SHRUBS AND TREES LESS THAN 3 FEET (1 METER) RATING FACTORS

Percent Foliage Altered—Only low shrubs and trees (<3 ft), prefire live or dead cover that are newly brown, black or consumed. Ignore resprout. **Frequency Percent Living—**Percent of prefire vegetation that is still alive after fire, based on number plot-wide; survivorship, not cover, not new seedlings. Include unburned as well as burned, resprouting perennial herbs, low shrubs and trees (<3 ft) pot-wide. Include all green vegetation as well as burned plants that have not had enough time to resprout but remain viable. Burned plants may need to be examined for viable growth points. Do not include new plants from seed or suckers. **Colonizers**—Potential dominance 2–3 years postfire of new (native or exotic) plants from seed; includes herbs and tree seedlings, plus aspen or other tree-to-shrub suckers, and nonvascular plants (for example, thistle, fireweed, pokeweed, ferns, moss, fungi, seedlings of lodgepole pine, slash pine, western larch, many weedy spp.). Rate only if spp. response to fire is known. **Species Composition/Relative Abundance—**Change in spp. and/or relative abundance of spp. anticipated 2–3 years postfire. How much does postfire spp. composition resemble prefire stratum? Consider presence of new or absence of old spp., plus how dominance is spread across spp.

TALL SHRUBS AND TREES 3 TO 16 FEET (1 TO 5 METERS) RATING FACTORS

Percent Foliage Altered—Percent prefire live-or-dead crown volume (leaves, stems) newly brown, black or consumed. Ignore new resprout; it does *not* lessen the amount of prefire foliage altered. **Frequency Percent Living**—Percent of prefire tall shrubs/trees that are still alive after fire. This is a measure of survivorship based on numbers of individuals. Include unburned as well as burned but viable tall shrubs/trees 3–6 ft (1–5 m) tall plot wide; examine growth points for viability if needed. Do not include new plants from seed or suckers. Account for potential mortality that could occur up to 2 years postfire. **Percent Change in Cover**—Overall *decrease* in cover of tall shrubs/trees between 3 and 16 ft tall (1 and 5 m), relative to the area occupied by those plants before fire. Count resprouting from plants that burned, plus the unburned plants as cover that lessens the amount of decrease in cover. Do not include suckers or plants newly germinating from seeds. **Species Composition/Relative Abundance** Change in spp. composition and/or relative abundance of spp. Anticipated 2 to 3 years postfire.

INTERMEDIATE AND BIG TREE RATING FACTORS (COMBINED)

Percent Unaltered (green)—Percent prefire live-or-dead crown volume unaltered by fire. Include new resprout from burned mcrowns, not from bases. **Percent Black (torch)**—Percent prefire live-or-dead crown volume that actually caught fire (black or consumed stems, leaves). May or may not be viable postfire; resprout from black crowns does not lessen percent black. At high severity, consumption of fine branching is evident. Include deciduous blackened crowns. **Percent Brown (scorch)—**Percent prefire live crown volume affected by scorch or girdle without direct flame contact. Brown is due to proximal heating, where foliage did not catch fire. Includes delayed mortality, insect damage, and brown foliage that has fallen to ground. **Percent Canopy Mortality** —Percent prefire live canopy volume made up by trees killed directly or indirectly by fire within 1–2 years. Proportion of a plot's total once-living canopy lost to dead trees (include insect/disease kill) in relation to total prefire canopy volume. **Char Height**—Mean char height from ground flames averaged over all trees. The mean is halfway between upper and lower heights on a tree. Include unburned (char height = 0) and burned trees ***only*** when char height is discernable. Do ***not*** include black from crown fire; enter N/A for most crown fire burns.

RECORD FOR EACH OVERSTORY STRATUM, BUT DO NOT COUNT IN CBI SCORES

Percent Girdled (at root or lower bole)—Percent of trees effectively killed by heat through the lower bark, sufficient to kill cambium around lower boles or buttress roots. Include trees either dead or likely to die within 1–2 years. Do not include trees killed by torch or scorch to crown. May or may not char through bark and into the wood; may have loose sloughing bark in 1–2 years. **Percent Felled (downed)—**Percent live-or-dead trees, that were standing before fire but now are on the ground. Usually from wind throw after fire, they exhibit fresh up-turned root masses, and different charring patterns than trees that were down when fire occurred. **Percent Tree Mortality**—Percent of once living trees on the plot that were killed by the fire, based on number of trees. Suspected insect and disease effects also may be included, if such contributed to killing whole trees relatively soon after fire (for example, within 1–2 years).

RATING ADVICE

Factors that are not applicable or cannot be resolved in a plot are not rated; they are omitted from that plot's composite ratings. Moreover, if there is much uncertainty about how a specific factor should be rated, or whether it is even relevant to the plot, then that factor should be left unranked. Only the number of rated factors is used to compute averages. If a factor is not rated, enter not applicable (N/A) or uncertain (UC) on the CBI data form. Do not just leave the field blank; such factors are not part of the CBI average, but one wants to know whether these factors were actually assessed and it was decided not to rate them, or just accidentally overlooked and skipped. Zeros, on the other hand, are valid entries and do get averaged into composite scores. Zeros should be used when a rating factor is applicable and exhibits an unburned condition. A zero represents no detected change in an observable factor.

Fuel Moisture Data Sheet

Site Name: _____ Recorders: _____ Date: _____/_____/_____

Location/Unit: _____ Fuel Type Sampling (Veg Community): _____ Phenology: _____ Time: _____

Latitude (DD): N_____ Longitude (DD): W_____ Datum: _____

Avg Slope: _____% Aspect:_____deg Elevation :_____(ft/m) Nearest RAWS:_____

Sample #	Type	Fuel Code	Sample Depth (cm)*	Thickness (cm)**	V/G*	Bottle #	Wet Wt	Dry Wt	Tare Wt	Comments
1-example	Duff	LM	0-3cm	3	G	23	75.3	58.7	52.9	HYSP
1-example	Duff	DM	3-7cm	4	G	22	80.5	58.7	52.9	
1-example	Foliar	PIMA	-	-	-	153	79.8	67.8	52.8	

Type: Duff, Woody (shrubs), Herb (grass or forbs), Foliar (spruce). **Fuel Codes**: *DUFF:* LM =live moss (feather), DM = dead moss, UD = upper duff, LD = lower duff; *FOLIAR:* PIMA = black spruce, PIGL = white spruce, *WOODY:* BEGL = shrub birch, LEPA = Labrador tea, VAVI = cranberry, VAUL = blue berry; *HERB:* CACA = blue joint grass, ERVA = Tussock cotton grass, CAREX = Carex sedge. **V/G:** Volumetric or Gravimetric

Shrub Density

Park Unit: _____ Project: _____ Plot ID: _____ Pre or Post _____ yrs

Field Date: _____ Field Crew: _____ Plot Dimensions: _____

Tally all individuals for each tall shrub (alder and tall willow) species within the 4-m radius circular plot by life status. Individuals are defined by >10 cm gaps between stems. If individuals are indistinguishable then record the number of tall shrub stems at ground level. Record average shrub height by species. Mature (more live than dead) and decadent (more dead than live).

Shrub Species	Avg. Hgt. (m)	Life Status			
		# Resprout	# Mature	# Decadent	# Dead

Moose Browse Architecture Data Sheet

Park Unit: __________ Project: ______________ Plot ID: _____________________________________ Pre or Post ____ yrs

Field Date: ___________Field Crew: ____ Plot Dimensions: ________________

For <u>each</u> preferred species individual within the 8-m radius circular plot select 2 individuals located closest to the circular plot center point and within the 8-m radius plot. Identify species, record height, mature class, dead class, whether broken by moose, evidence of browse by hares as well as architecture classification based on moose browse evidence. Architecture classes are defined as:

Broomed - 1) *sapling type plants*: the main apical stem has been broken by moose. Look back through the history of the plant, this may have happened 2–10 years before you measured it; 2) *bushy type plants*: more than half of the CAG stems arise from lateral stems that were produced as a result of browsing.

Browsed - Has been browsed some in the past, but browsing has not significantly affected its growth. Less than half of CAG twigs between 0.0 and 3.0 m arise from lateral stems that were produced from browsing.

Unbrowsed - There is no visible evidence that moose have ever browsed this plant.

Note in comments evidence of bark stripping and other evidence of moose or other wildlife use in the area.

Plant #	Species	Ht (m)	Mature Class (taller than 3m)	Dead Class (% dead)	Architecture (extent of moose utilization)	Broken	Hare Browse	Comments
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	
			>50% <50%	>50% <50%	Brmd Brwd Unbrw	Y N	Y N	

Moose Browse Architecture Density

Park Unit: _____ Project: _____ Plot ID: _____ **Page ___ of ___**

Pre or Post ____ yrs Field Date: _____Field Crew: _____

For each preferred species plant (see protocol for details) within a 4 meter radius circular plot assign an architecture classification and height class. [**Broomed** - (sapling type plants) the main apical stem has been broken by moose. Look back through the history of the plant, this may have happened 2–10 years before you measured it; (bushy type plants) more than half of the CAG stems arise from lateral stems that were produced as a result of browsing. Look back through stems that are many years old. **Browsed** - Has been browsed some in the past, but browsing has not significantly affected its growth. Less than half of CAG twigs between 0.0 and 3.0 m arise from lateral stems that were produced from browsing. **Unbrowsed** - There is no visible evidence that moose have ever browsed this plant.] Note in comments evidence of bark stripping and other evidence of moose or other wildlife use in the area.

Species	***Average Height Class***	***Unbrowsed***	***Browsed***	***Broomed***

Height classes: 0-0.5m, 0.5-1m, 1-3m, 3-5m, > 5m

Alaska Exotic Plant Management Team (EPMT) Datasheet (Modified for NPS Alaska Fire Ecology)

Record instances and coverage of invasive plant species where observed. Record ***taxon*** (species 4-letter code), ***phenology*** (life cycle stage), ***buffer*** (ocular estimate of area of species infestation; defined as the radius of a circle which would encompass all plants), and ***control estimate*** (hours required to hand-pull all individuals in buffer).

Park Unit:				**Date:**		
Site/Location Description:				**Disturbance Type:**		
Taxon	**Buffer (m)**	**% Cover (circle one)**	**Phenology (circle one)**	**Control Estimate (circle one)**	**Coordinates**	**Comments**
		1-5% 6-25% 26-50% 51-75% 76-95% 96-100%	Rosette No flower Full flower In seed Senesced	<1 person hour between 1 and 8 person hours > 8 person hours	X: Y:	
		1-5% 6-25% 26-50% 51-75% 76-95% 96-100%	Rosette No flower Full flower In seed Senesced	<1 person hour between 1 and 8 person hours > 8 person hours	X: Y:	
		1-5% 6-25% 26-50% 51-75% 76-95% 96-100%	Rosette No flower Full flower In seed Senesced	<1 person hour between 1 and 8 person hours > 8 person hours	X: Y:	
		1-5% 6-25% 26-50% 51-75% 76-95% 96-100%	Rosette No flower Full flower In seed Senesced	<1 person hour between 1 and 8 person hours > 8 person hours	X: Y:	
		1-5% 6-25% 26-50% 51-75% 76-95% 96-100%	Rosette No flower Full flower In seed Senesced	<1 person hour between 1 and 8 person hours > 8 person hours	X: Y:	

Quick Reference

Common codes

Trees

Code	*Name*
PIGL	Picea glauca – White spruce
PIMA	Picea mariana – Black spruce
BEPA	Betula papyrifera – Paper birch
POTR	Populus tremuloides – Aspen
POBA	Populus balsamifera – Balsam poplar

Shrubs

Code	*Name*
BENA	Betula nana- Dwarf birch
ALNUS	Alnus spp – Alder ,
LEPA11	Ledum palustre – Labrador tea
VAUL	Vaccinium uluginosum – blue berry
VAVI	Vaccinium vitis-idaea – lowbush cranberry
SALIX	Willow

Ground

Code	*Name*
FMOSS	Feather moss
HYSP70	Hylocomium splendens – Stair step moss
SPHAG2	Sphagnum spp (moss)
LTRH	Leaf Litter
LTNDL	Needle Litter
DUFF	Organic duff
MIN	Bare Mineral soil
1 HR, 10HR…	Woody debris by size class

Code	*Name*
CHAN	Chamerion angustifolium – Tall Fireweed (EPAN2)
POAL	Polygonum alpinum – Wild rhubarb
MEPA	Mertensia paniculata - Tall blue bells
LIBO3	Linnaea borealis – Twin flower
EQUIS	Equisetum spp – Horsetail
CACA4	Calamagrostis canadensis – blue joint grass

Tree Crown Measurements

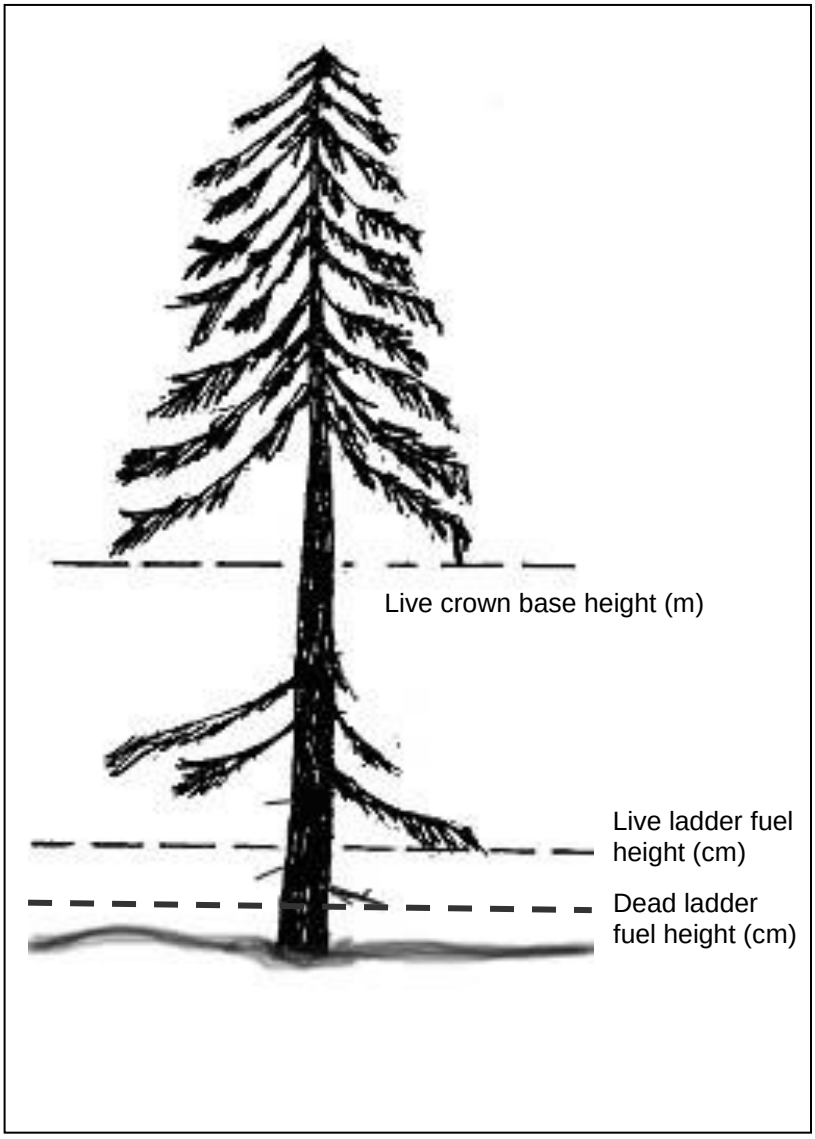


Fig. B.2 Tree crown and ladder fuel measurements. Figure modified from USFS FMH Manual, 2002.

Tree Height Measurements

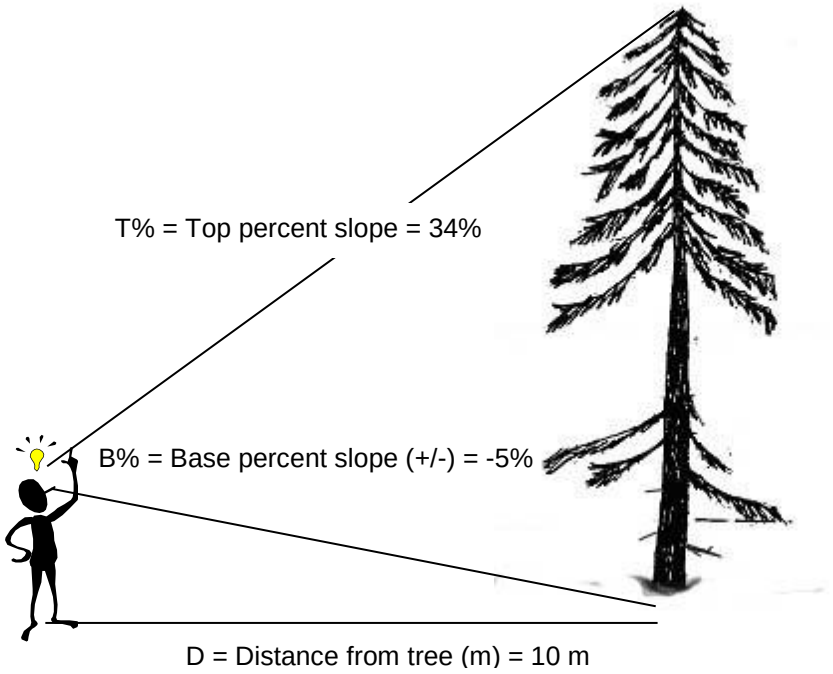


Figure B.3 Tree height equals: Height (m) = D x (T% - B%). If the base percent is negative (reading eye-level to tree or on slope above tree DBH), then add B%, if base percent is positive (on slope below tree DBH) then subtract B%. Ht = 20m x (0.34 + 0.05) = 7.8 m

Remember to use percent side of clinometer (right side scale or look for percentage sign at top or bottom of scale) and to move the clinometer up and down, not your head if possible. *Hint:* 10-m and 20-m distances makes easier math, but you must go back far enough to accommodate tree heights.

Damage Codes for Trees

Damage Type	Damage Code	Brief Description
Physical	FORK	Forked top of a tree, multiple primary leaders in a tree crown.
	BROK	Broken tree top.
	DTOP	Upper portion of tree is dead
	BURL	A hard, woody and often rounded outgrowth on a tree.
	DAMG	Mechanical damage to tree
	FIRE	Evidence of fire damage or death.
	LEAN	Tree is leaning.
	MAMM	Damage caused by mammals, such as bear claw marks, porcupine, rabbit or beaver chewing.
	REDB	Red belt, winter desiccation. Foliage and buds killed or faded. May be worse on windward side of tree. New growth is green & normal. Pg. **202** AK I &D
Other	RUST	Spruce needle rust. Current year spruce needles are infected leaving the trees with a distinct orange tinge when the rust is fruiting on the needles. Pg.**129**AK I & D
	BRM	Spruce broom rust. Branches or twig swelling, large burls on main bole or witches' broom (branch proliferation in tree crown). Rust tints needles in the broom yellow/orange. Pg.**146** AK I & D
	GALL	Spruce gall aphids, cause the tree to form conspicuous cone shaped galls on spruce twigs. Dark purple to green initially and then turning brown. Pg. **58** AK I&D
Rots	HRT	Heart rots. *Phellinus pini* conks are hard and woody, upper surface dark brown, hairy (when young), with concentric ridges and a narrow velvety, light brown margin. Lower surfaces dark brown with pores. Coring shows discoloration of the heartwood, light purplish to gray and later changing to reddish brown. Decay pockets may be empty or filled with a mass of white fibers. Other heart rots would be brown cubicle rots, cores will show brown, yellow crumbly rot. Rots described Pg. **162-193** AK I & D.
	ROOTRT	Tomentosa root rot (*Inontus tomentosus*) and Armillaria. Both may have chloritic thin crown, reduced growth, distressed cone crop, resin flow or saturation near root collar. Wind thrown trees lacking major roots. Lose needles oldest to youngest. In Tomentosa roots honeycombed and filled with white mycelium, pink staining. Armillaria has white mycelium and black stringy rhizomorphs under the bark. Rhizomorphs may also be on roots or in soil. Decay in root produces yellow stringy rot w/ fine black lines. Pg. **160** AK I & D
	ROT	Unknown cause of rot, try to record if brown or white rot (Br or W).
Beetles and Bore	BB	Unknown bark beetles, not identifiable as either spruce bark beetle or *Ips* spp. Describe galleries or collect insects.
	IPS	*Ips* spp., engraving beetle. Easily confused with spruce bark beetle. They are smaller (1/8 to 1/4 in) with concave wing covers with projections at the rear. Y, H or star shape galleries. Differences from spruce bark beetle; forked egg galleries, lighter (yellow brown to red orange), and finer boring dust, little boring dust in galleries. Pg. **79** AK I & D
	SPB	Spruce bark beetle damage. Spruce trees. Pg. **71-77** AK I & D.
	BORE	Other boring insect damage – e.g.Carpenter ants, Long-horn beetles, wood wasps, ambrosia beetles
	BRNZ	Bronze birch bore damage. Stem swelling on birch or aspen due to larval galleries are winding – 6mm wide filled with boring dust. Adult may feed on foliage. Pg. **94** in AK I &D.
Defoliators	ASLM	Aspen leaf miner. Larvae feeds on leaves of aspen, leaving galleries in the leaves. Pg. **43** in AK I&D.
	BUDW	Spruce bud worm, brown head, with a lighter body and ivory spots. Web new foliage together and feed in web. Pg. **24** AK I & D
	TUSS	Rusty Tussock Moth. Caterpillars (four yellow tussocks of hair on back) consume leaves of trees and shrubs. Large areas of defoliation can occur. Hosts: Willow, birch, spruce and blue berry Pg. **41**
	UNKN	Tree is damaged or dead, but cannot determine cause.

Appendix A.2. Fire Effects Paired Plot Protocol

Alaska NPS Fire Ecology Program
Fire Effects Paired Plot
Field Method Protocol 2005

Background: Fire Effects Paired Plots

The fire effects paired plot project began in 1981 under the direction of Gary Ahlstrand, NPS Alaska Regional Research Ecologist. The purpose of the project was to assess vegetation change and succession as a result of fire and to determine fire history. Fire staff established paired vegetation 15-m x 30-m plots in burned and representative unburned habitat adjacent to the burned areas of varying ages. Burned sites were identified and selected for the study from historic fire reports, 1:63,360 color infrared aerial photography, and aerial reconnaissance. Some plots were established in front of active wildfires and control plots were not established. Between 1981 and 1988, at least 525 plots were installed across 9 different parks in Alaska. Plot data that was collected included: photographic slides of plot, tree density by species and diameter size class on 15-m x 30-m quadrats, vegetation cover class for 30 Daubenmire frames (20 x 50 cm), tree cores/cookies, fuels and soils data (on some plots), and general plot site descriptions.

Up until 2008 most of the data were only available in paper format, except for the vegetation cover data was in a TWINSPAN text format. Between 2003 and 2008, paired plot data for all the parks was entered into an Access database and plot locations were digitized off topographic maps and aerial photos. The Access database was converted to Interagency Fire Ecology sequel server database called FFI V1.02 through a contract in 2008. Original copies of data and photos are archived at the Alaska Regional Office. Scanned copies of data and photos are stored at the regional office and with the Regional Fire Ecologist in Fairbanks.

Data from this project can be used to determine the vegetative and structural components that have changed over time since fire. Currently the data is being utilized to develop fire successional models to update landcover vegetation maps and fuels maps utilized by the fire management program. This information is being used to understand the potential impacts of shortened fire return intervals and future climate warming.

Plot Locations and Layout: Fire Effects Paired Plots

Plot Locations

Plots were located in an area of the stand free of ecotonal effects in which environment, overstory and understory were as homogenous as possible. Originally the plot locations were pin pricked on 1:63,000 aerial photography and marked on 1:63,360 topographic maps. Some of the plots have since been digitized, although they are not precise locations. For most of the permanently marked plots, there are written instructions with marker trees and azimuths to re-locate the plots. Plots that were permanently marked appear to have 4 corner markers of rebar or welding rod with aluminum cans. Use the photos, maps and written instructions to locate the plots. For all plots that are re-visited, GPS locations will be collected and recorded, corners will be re-established with re-bar.

Plot Layout

A 15-m x 30-m rectangle plot was laid out so that the long axis paralleled the contour of the slope. Use a 100-m tape to outline the 15-m x 30-m plot. Two 30-m vegetation transects are established within the 15 x 30-m rectangle, at 5-m and 10-m along the 15-m end of the rectangle (see plot layout Figure C.4.1). To measure vegetation cover, thirty 20 x 50 cm microplots (Daubenmire frames) were placed every 2-m along the inside edges of the two vegetation transects (A and B). The central transects will be used for point intercept measurements, active layer depths and burn severity code scores if recently burned.

Plot Naming Convention
The plots were named with a three letter acronym based on a physical feature or the fire name. In general plots ending in a "B" were burned plots and plots ending in an "A" were control plots. For example: plots were established near Trout Creek in Yukon-Charley Rivers. The burn plot was named TCB-1 and the control plot was TCA-1. However over the different years that plots were established and among the different parks the plot names often got duplicated. For example, YUCH also had plots established at Todd Cr and were also named TCA-1/TCB-1. Therefore it is recommended that the original plot designators utilize the park code first, and if repetitive names occur within the parks that an "a", "b" or "c" be added to the end of the plot name to distinguish between different plots.

Data Collection: Fire Effects Paired Plots

Site and Photo Points

General site information will be collected and recorded for each plot on the *SITE AND GENERAL DESCRIPTION* Datasheet. It is recommended that additional site location descriptions, diagrams of plots, and additional notes on the plot be written up on separate sheet. The definitions of the fields for the *SITE AND PLOT DESCRIPTION* Datasheet are given below:

- **Land Unit** – land unit identifier or write out land unit name - (i.e. Steese White Mtns, Yukon-Charley NP) (NPS - four letter park acronym)
- **Project** – Description of project: PPF (pre/post fire), CBI (burn severity), HZF (for hazard fuels), PP (paired plots).
- **Plot ID** – Identifier for the plot within the project, i.e. ECA-1, TCB-1 etc
- **Fire Name and Fire Date** – Fire name/number or project location or cabin name and thinning date if hazard fuels
- **Fire Date** - Date of fire or fuels treatment (pre-treatment will be blank).
- **Field date** – Sample date
- **Field Crew** – Names of crew members
- **WP number and GPS number** – record the WP number of the collected point and the name or number of the GPS used.
- **Lat/Long** – Using a GPS (Garmin V recommended), collect a lat/long averaging the time of collection for 20 points. Record in Decimal Degrees - i.e. Lat: N 65.634891° Long: W 142.982340°
- **GPS Error** - Record the error EPE and units, this needs to be recorded before you save the waypoint in Garmin handhelds.
- **Datum** – GPS datum used for collecting and navigating to plots, use NAD-83 (this is the same as WGS-84).
- **Transect Azimuth** – record the azimuth of the transect facing from the zero end to the 30-m end.
- **Declination used** – record the declination setting used on your compass, for the initial reading, base your declination on the most recent topographic map. For future reading use the declination used in the original setup.
- **Transect slope** – record the slope looking down the transect
- **Slope** – Percent slope, use clinometer
- **Aspect** – Slope aspect (facing downhill) azimuth in degrees
- **Elevation** – Taken from GPS or maps in feet or meters (record units)
- **Viereck Class** – Using Viereck's (1992) Alaska Vegetation Classification, determine the vegetation class to level IV, or if possible level V for the plot area. Either write it out: Open PICMAR/LEDGRO/HYSPLE or use numeric: I.A.2.f with Labrador tea.
- **Soil** – Estimate of soil drainage: wet, moist, dry.
- **Disturbance** – General note of disturbances, record date estimate if known. This is for the plot and general vicinity.
- **Evidence of fire**
- **Photo number, time and camera** – record the photo number in the digital camera or keep a photo log if standard camera, record the time of the photos (for digital cameras) and the camera used.

At least four photos will be taken for each plot. The photos will be taken from each end of the vegetation sampling transect looking towards the plot center. Label a dry-erase board with the date, park, plot ID, transect letter (A or B), transect azimuth (direction facing) and designate as 0-m ---> 30-m and vice-versa. Hold the board to the edge of the photo view within the first 1.5 - 2 m of the transect. In addition, original photos that were taken at the plot will be duplicated as closely as possible.

Map of Plot Layout

Record the latitude/longitude for all four corner markers. If corners cannot be relocated estimate using tapes and azimuths. Draw corner plot identification and direction of daubenmire frame readings or any other plot information pertinent to the plot.

Vegetation and Ground Cover

Point-Intercept Vegetation Sampling- Two 30-m point intercept transects will be established along the two transects A and B within the macroplot (see Figure 1). The zero end of the transect will be the start of the transect. Every 1-m along the 30-m transect, all plant species and forest floor surface cover (mosses, lichens, litter) that are intercepted at that point will be recorded. Using a ¼" diameter pole (6 ft fiberglass bike flag), gently lower the pole so that the rod is plumb to the ground (on slopes this will not be perpendicular to the ground). At each point intercept record the species that touch the pole from top to bottom, for example if black spruce was the tallest vegetation at that point hit it would be recorded first, similarly ground cover will always be last. Record the species code on the *POINT INTERCEPT* Data Sheet. This data was not originally collected at the Paired Plots – added in 2005.

Daubenmire Vegetation Cover Class - To estimate vegetation cover, thirty 20 x 50 cm microplots (Daubenmire frames) are placed every 2-m along two transects A and B, starting at the 1-m point and continuing with every odd meter. The long edge of the frame parallels the transect. Estimate canopy cover for each species of live shrub, herb, bryophyte, lichen and for tree species less than 1-m tall, that is rooted in the plot frame. The following cover classes are used: **0 = 0-5%; 1 = 5-25%; 2 = 25-50%; 4 = 50-75%; 5 = 75-95% ; 6 = 95-100%**
Record the cover estimate of each species for each frame, number 1 through 30. Frame 1 begins at the 1-m point on transect A, continuing to frame 16 -30 on transect B. (Note: the exact sequence of frames was not recorded in any of the plot methodologies written up for the plots in the 1980's, the sequence shown was drawn for a plot in YUCH CCPB-1.)

Active Layer Depths and Burn Severity

Active Layer Depths - Ten active layer points are located along the two transects (A & B) at 3-m intervals, except last point is placed at 29-m. At each point measure the depth of the active layer with the bike flag rod and tape measure. Measure the depth in cm to the point of permafrost or bedrock. If it is possible to determine that depth is to rock, note this on the datasheet.

Burn Severity (1 yr post fire) **-** Up to 1 yr postfire, at each active layer depth point determine burn severity code (BSC) as described in FMH 2003 for the substrate and vegetation at each active layer point, see Appendix for codes. Burn severity for the plot can be determined using the Composite Burn Index methodology (See FIREMON 2004).

Forest Density

All live trees taller than 1 meter within the 15 x 30-m macroplot will be tallied by species and diameter size classes (< 5 cm, 5.1-10 cm, 10.1-15 cm, 15.1-20 cm, 20.1-25 cm, 25-30 cm, and > 30 cm DBH). To facilitate the counting of trees, tally each 5 x 30-m sub-plot separately – either use one data sheet for each sub-plot or label on the datasheet within each size class columns with 1, 2, and 3. This is also being done so that we can reduce the plot size to the central 5 x 30-m subplot for subsequent measurements. Label the subplot number on the plot map. Count all trees less than 1.4 m tall along two 1-m wide strips along the inner side of the central subplot (Note: it's unclear in original documentation if the whole plot was tallied for seedlings/saplings or a sub-sample)

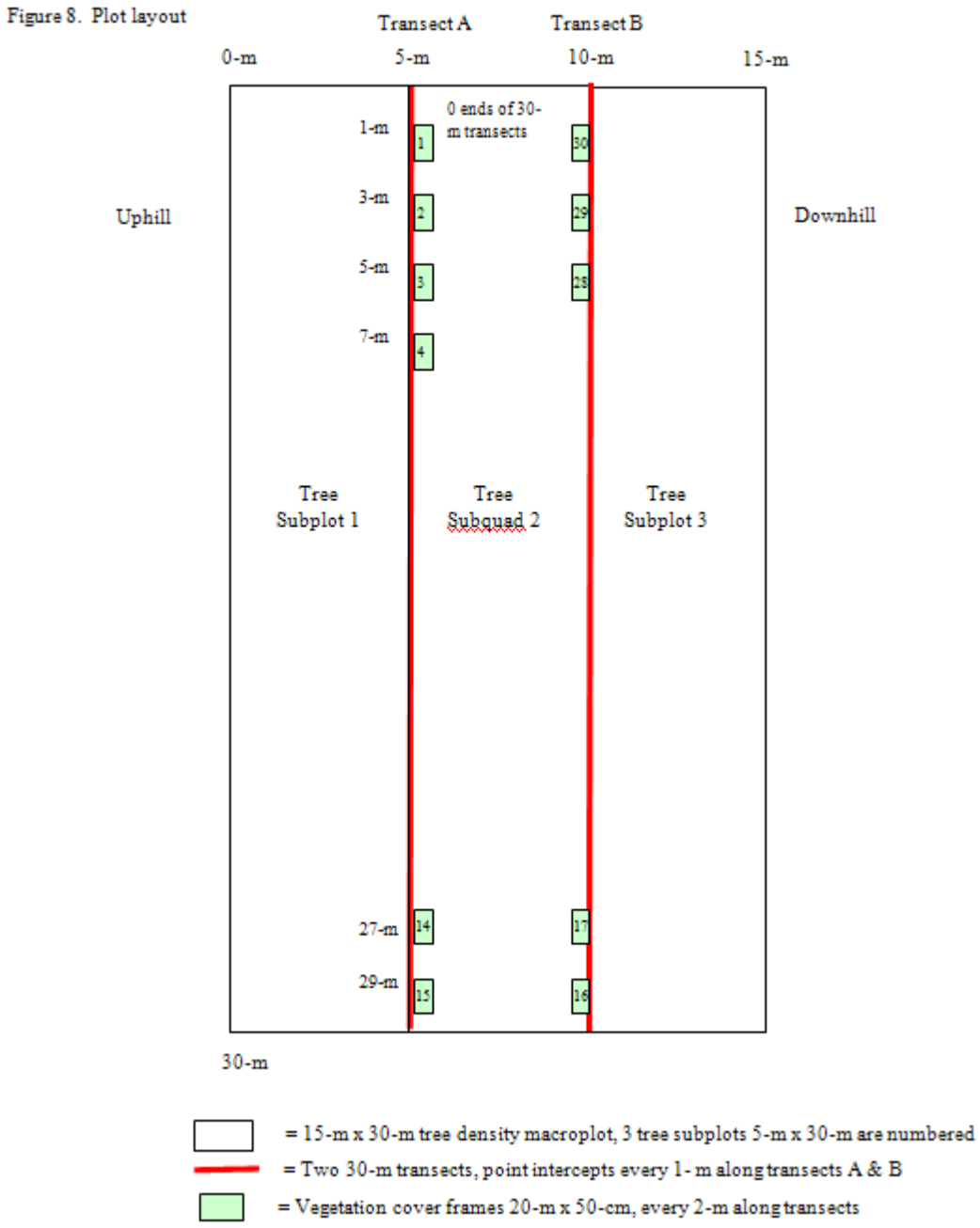


Figure C.4.1 Plot diagram for Paired Plots.

Site and General Description: Fire Effects Paired Plots

Unit: _____ Project: _____ Plot ID: _____ Pre or Post ___ yrs

Field Date: _____ Field Crew: _____

Fire Number _____ Fire Date: _____ Fire Name:_____

Transect Azimuth: _____ Transect Slope: _____ Declination used: _____

Slope: _____% Aspect: _____ Elevation: _____ ft Viereck class: _____

Soil (circle): Wet Moist Dry **Disturbance** (circle): Fire Wind Insect Other: _____

Evidence of Fire/ Fire Indicators: Burn Snags Burned Stumps Fire Scars Charcoal (circle all that apply)

Photo numbers: _____ **Time of photos**: _____ **Camera used**: _____

Mark all four corners of the 30-m x 15-m plot and record corner directions (N, S, E, W or NE, SW, SE etc.)

GPS Type: _____ GPS Identification: _____ GPS Datum: _____

Corner Direction:_____ WP No: _____ Latitude: N_____ Longitude: W_____ GPS Error: ___(m/ft)

Corner Direction: _____ WP No: _____ Latitude: N_____ Longitude: W_____ GPS Error: ___(m/ft)

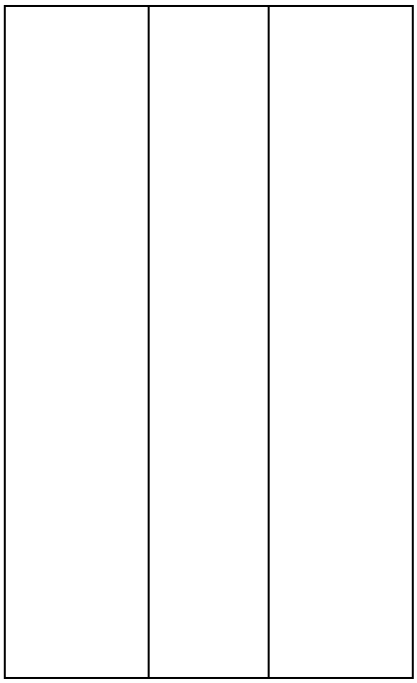
Corner Direction: _____ WP No: _____ Latitude: N_____ Longitude: W_____ GPS Error: ___(m/ft)

Corner Direction: _____ WP No: _____ Latitude: N_____ Longitude: W_____ GPS Error: ___(m/ft)

Map of Plot Layout: Label direction of daubenmire frames read, tree subplot #, and corner marker directions or numbers.

Provide notes on relocating or LZ, burn information and other plot notes as needed below.

Upslope



Down slope

Plot Notes:

A B

Vegetation Point Intercept: Fire Effects Paired Plots

Park Unit: _____ Project: _____ Plot ID: _____ Pre or Post ____ yrs

Field Date: _____ Field Crew: _____ Control or Burn Plot

Record substrate and species codes of trees, shrubs, forbs and groundcover intercepted at each 1-m interval along the two 15-m transects (A and B), for a total of 60 pts. Record plants from tallest to lowest.

PNT	Meters	SPP	SPP	SPP	SPP	SPP	SPP
A 1	1						
2	2						
3	3						
4	4						
5	5						
6	6						
7	7						
8	8						
9	9						
10	10						
11	11						
12	12						
13	13						
14	14						
15	15						
16	16						
17	17						
18	18						
19	19						
20	20						
21	21						
22	22						
23	23						
24	24						
25	25						
26	26						
27	27						
28	28						
29	29						

Plot ID: _____Field Date: _____

PNT	Meters	SPP	SPP	SPP	SPP	SPP	SPP
30	30						
B 31	1b						
32	2b						
33	3b						
34	4b						
35	5b						
36	6b						
37	7b						
38	8b						
39	9b						
40	10b						
41	11b						
42	12b						
43	13b						
44	14b						
45	15b						
46	16b						
47	17b						
48	18b						
49	19b						
50	20b						
51	21b						
52	22b						
53	23b						
54	24b						
55	25b						
56	26b						
57	27b						
58	28b						
59	29b						
60	30b						

0 - 5 % = 1	50 - 75 % = 4
5 - 25 % = 2	75 - 95 % = 5
25 - 50 % = 3	95 - 100 % = 6

Vegetation Cover – Daubenmire Frames: Fire Effects Paired Plots

Park Unit: __________ Project: __________ Plot ID: _______________ Field Crew: ________________ Field Date: _________________

To estimate vegetation cover, thirty 20 x 50 cm microplots (Daubenmire frames) are placed every 2-m along the inner edges of the central 5 x 30-m subplot, starting at the 1-m point. Canopy cover estimates are made for each species of shrub, herb, bryophyte, lichen and for tree species less than 1-m tall. The following class coverages are used: 0-5 %, 5-25 %, 25-50 %, 50-75 %, 75-95 %, 95-100 % using the numbers above.

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

Tree Density – Paired Plots

Park Unit: _____Project: _____ Plot ID: _____ Field Date: _____
Field Crew: _____ Subplot #: _____ Plot Dimensions: _____

All trees taller than 1.4 meter within the15 x 30-m macroplot will be tallied by species, diameter size classes (< 5 cm, 5.1-10 cm, 10.1-15 cm, 15.1-20 cm, 20.1-25 cm, 25-30 cm, and > 30 cm DBH) and type of damage (insect, fire etc). Tally and record for each of the 3 subplots (5-m x 30-m) within the macroplot. Count all trees <1.4 m (4.5') tall along the two 1-m wide strips along the inner side of the central subplot. **Resprouts:** new growth from older root stock < 1.37 m tall, **Seedlings:** new plants from seeds < 10cm high, **Mature** >10cm

		Tree Counts by DBH (cm)							"Seedlings" 1-m strip A	"Seedling" 1-m strip B
Tree Species	**Status**	**< 5cm**	**5.1-10 cm**	**10.1-15 cm**	**15.1-20 cm**	**20.1 -25 cm**	**25-30 cm**	**> 30 cm**		
Black Spruce (*P. mariana*)	LIVE								R	R
	Dmg____								S	S
	DEAD									
	Dmg____								M	M
White spruce *(Picea glauca)*	LIVE								R	R
	Dmg____								S	S
	DEAD									
	Dmg____								M	M
Aspen *(Populus tremuloides)*	LIVE								R	R
	Dmg____								S	S
	DEAD									
	Dmg____								M	M
Paper birch *(Betula papyrifera)*	LIVE								R	R
	Dmg____								S	S
	DEAD									
	Dmg____								M	M
Balsam poplar *(Populus balsamifera)*	LIVE								R	R
	Dmg____								S	S
	DEAD									
	Dmg____								M	M
Larch Tamarack (*Larix laricina*)	LIVE								R	R
	Dmg____									
	DEAD								S	S
	Dmg____								M	M

Active Layer/Burn Severity: Fire Effects Paired Plots

Park Unit: _____ Project: _____ Plot ID: _____

Pre or Post ____ yrs Fire Name/Number: _____ Fire Date: _____

Field Date: _____ Field Crew: _____

Record depth of active layer every 3-m along the transects A & B, for each point record if you hit permafrost (pf) or rock (r). If plot has burned within the last year record the burn severity code for the substrate and vegetation using the descriptions following this data sheet.

Transect A:

Point	Distance	Active Layer Depth (cm)	Burn Severity Code (Substrate)	Burn Severity Code (Vegetation)
1	3-m			
2	6-m			
3	9-m			
4	12-m			
5	15-m			
6	18-m			
7	21-m			
8	24-m			
9	27-m			
10	29-m			

Transect B:

Point	Distance	Active Layer Depth (cm)	Burn Severity Code (Substrate)	Burn Severity Code (Vegetation)
1	3-m			
2	6-m			
3	9-m			
4	12-m			
5	15-m			
6	18-m			
7	21-m			
8	24-m			
9	27-m			
10	29-m			

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Appendix G: Preparedness Activity Elements

Delegation of Authority for Fire Management Officer, Gates of the Arctic : Maintained on file at Alaska Eastern Area Fire Management duty station at FAC, Fairbanks, AK.

Park Superintendent – Fire Management Staff Roles – See Section 4.9 Organizational & Budgetary Parameters and Redbook Chapter 3.

Response Plan:

Response procedures will follow guidelines as established in the Alaska Interagency Fire Management Plan (2010) and the Alaska Interagency Agreement and supplemental Annual Operating Plan.

1. Initial Response and Notification Plan

(See Next Page)

To Report a Wildland Fire
Gates of the Arctic National Park & Preserve

The National Park Service is not responsible for the primary suppression efforts on wildland fires in the National Park and Preserve in Alaska. However, the NPS Regional Director and Superintendents are ultimately responsible for fire management actions taken on NPS lands.

To report a fire, first determine the location of the fire (latitude and longitude). Report this location to:

Alaska Fire Service

Galena Fire Management Zone	Tanana Fire Management Zone
907-656-1222 (Dispatch)	907-356-5553 (Dispatch)
During off season call	During off season call
907-356-5626 (Doug Downs– FMO)	907-356-5574 (Mike Butteri-FMO)
or	or
907-356-5623 (Willie Branson -AFMO)	907-356-5569 (Marlene Eno-Hendren-AFMO)

AND

Eastern Area Fire Management
National Park Service
Fairbanks, AK 907-455-0650

THEN CALL:

James Sullivan, National Park Service, NPS Alaska Eastern Area FMO
(w) 907-455-0651, (c) 907-460-4076

or if unsuccessful call:

Jason Devcich, National Park Service, Assistant Fire Management Officer.
(w) 907-455-0651, (c)

Alaska NPS Regional Duty Officer as indicated on the duty officer list distributed in April or if unsuccessful call:

Dan Warthin, NPS Regional Fire Management Officer
(w) 907- 644-3409, (h) 907-865-5984, (c) 907-444-8788

Listed below is some additional information that would be helpful to the dispatcher and NPS FMO:

1. Estimated fire size
2. Aspect the fire is burning on
3. Slope the fire is burning on
4. Fuel type (vegetation in and around the fire)
5. Smoke color
6. Structures threatened and distance to them
7. Name and phone number of person reporting the fire

This is an informal summary for reporting a wildland fire. A formal operations guide is located on the Alaska Region intranet at http://165.83.62.205/epr/fire/fire.htm

Questions? Contact….

1. James Sullivan, NPS Eastern Area Assistant Fire Management Officer
   (w) 907-455-0651, James Sullivan@nps.gov
2. Dan Warthin, NPS Regional Fire Management Officer
   (w) 907- 644-3409, Dan Warthin@nps.gov
3. Morgan Warthin, NPS Regional Fire Communication and Education Specialist
   (w) 907-644-3418, Morgan_Warthin@nps.gov

2. Strategic Fire Size-up Procedures

a. Confirm fire report and obtain location
b. Identify FMU (ie. Critical, Full, Modified, Limited)
c. Refer to Table below for "Default" action (See AIWFMP)

PROTECTION CATEGORY	POLICY/RESPONSE	INTENT
Critical	Initial Action - Aggressive suppression of fires within or threatening designated areas. Highest priority for available resources.	Prioritization of suppression actions for wildland fires threatening human life, inhabited property, and/or other designated structures. Complete protection of designated sites
Full	Initial Action - Aggressive suppression of fires within or threatening designated areas, depending upon availability of resources.	Protection of uninhabited cultural and historical sites, private property, and high-value natural resources.
Modified	Before Conversion Date: Initial Action - Suppression depending on availability of resources, unless land manager chooses otherwise and documents with the appropriate planning/ decision document. After Conversion Date: Initial Action - Identical to that of Limited zones.	Greater flexibility in selection of suppression strategies when chance of spread is high (e.g., indirect attack). Reduced commitment of resources when risk is low. Balancing of acres burned with suppression costs and with accomplishment of resource management objectives.
Limited	Initial Action - Surveillance. Continued protection of human life and site-specific values. Wildfires allowed to burn within predetermined areas.	Reduction of long-term costs and risks through reduced frequency of large fires. Reduction of immediate suppression costs. Facilitation of bio-diversity and ecological health

d. Determine location of administrative, private, cultural and natural sensitive resources in relation to the fire.
e. Determine point protection needs and risk to the aforementioned sites.
f. Determine likelihood of fire traveling into other FMU's.
g. Modify "Default" action accordingly. In general the goal is to allow fire on the landscape to fulfill its natural role while minimizing risk to sensitive or other jurisdiction resources in a safe manner. Considerations include:
    i. Is there sufficient time for resources to be mobilized and safely be deployed for point source protection?
    ii. Is the fire likely to grow and create sufficient complexity that additional resources beyond the BLM Alaska Fire Service Galena Zone or Tanana Zone, Region wide available resources, and AWAFM resource are insufficient to meet FMU and point source protection objectives.
    iii. Fire Activity around the state precludes ordering additional resources in a timely manner.
    iv. Political issues.

h. Communicate recommended action with Superintended or delegate.
i. Coordinate response action with BLM Alaska Fire Service Galena Zone or Tanana Zone Fire Management Officer.

List of Personnel

a. EAFM
   - James Sullivan – Fire Management Officer
   - Jason Devcich – Assistant Fire Management Officer
   - Jessica Sherwood – Helicopter Program Manager
   - Vacant – Fire Program Management Assistant
   - Four Seasonal Staff with various NWCG Qualifications

b. GAAR
   - Greg Dudgeon – Superintendent

Step-up Staffing

The Eastern Area FMO and associated fire staff is responsible for Gates of the Arctic NP/NP&P. The matrices outlined in Tables 1 and 2 below will be used to assist in the pre-positioning of these personnel and fire management resources.

Table 1: Complexity Level

Fire Indices	**0-3 fires**	**3-6 fires**	**6+ fires**
FFMC=<85	LOW COMPLEXITY LEVEL	LOW COMPLEXITY LEVEL	MODERATE COMPLEXITY LEVEL
FFMC=86-89	LOW COMPLEXITY LEVEL	MODERATE COMPLEXITY LEVEL	HIGH COMPLEXITY LEVEL
FFMC=90+	MODERATE COMPLEXITY LEVEL	HIGH COMPLEXITY LEVEL	HIGH COMPLEXITY LEVEL

Number of Current Fires—A measure of complexity due to the number of fires within or threatening the park regardless of the FMU that is burning. This is also an indication of potential suppression or monitoring resource shortages.

FFMC—the Fine Fuel Moisture Content (FFMC) is a numerical rating of the moisture content of litter and other cured fine fuels (needles, mosses, and twigs). The FFMC is representative of the top litter layer 1-2 cm deep. FFMC fuels are affected by temperature, wind speed, relative humidity, and precipitation. FFMC values change rapidly and reflect the weather conditions that have occurred over the past three days. The FFMC is used to indicate ease of ignition, or ignition probability with the scale ranging from 0-99. Of importance is the fact that fire starts increase exponentially with an increase in FFMC values at the high end of the scale.

Complexity Level

Low: Few fires within or threatening the GAAR park units and relatively abundant resources available. May be early or late in the year, hence fire behavior is reduced

and relatively easy to control and extinguish.

Moderate: Several fires within or threatening GAAR park units and resources becoming scarce within the AFS Zone. Fires are difficult to extinguish - carryover fires are occurring.

High: Many fires within or threatening GAAR park units and resources becoming scarce within the state. Fires are difficult to control and extinguish – multiple carryover fires occurring.

Table 2: Preparedness Levels

	Values at Risk		
Complexity	**Low**	**Moderate**	**High**
Low	Low Preparedness Level	Low Preparedness Level	Moderate Preparedness Level
Moderate	Low Preparedness Level	Moderate Preparedness Level	High Preparedness Level
High	Moderate Preparedness Level	High Preparedness Level	High Preparedness Level

Values at Risk
These values are life and property including historically significant sites. The low values at risk are those under limited protection. The medium values at risk are those under full protection. The high values at risk include sites that are under critical protection (see Chapter XVI Section A. Protection of Sensitive Resources for criteria for protection levels).

Preparedness Levels
Low: The weather and fire danger indices will be monitored daily.

Moderate: Fire staff will be available within the state. The weather and fire danger indices will be monitored daily. AFS will be contacted periodically for tactical and resource updates.

High: The contract helicopter, qualified helicopter manger and two fire staff will available within the park or prepared to travel to the parkland, dependent upon availability due to fire activity. The weather, fire and danger indices will be monitored daily. AFS will be contacted periodically for tactical and resource updates. The Eastern Area FMO will contact the GAAR Interpretive Specialist and/or the Regional Fire Communication and Education Specialist, as needed to provide information updates.

Minimum impact suppression tactics guidelines: See Section 4.4.1 Minimum Impact Suppression Tactics (MIST)

Fire Danger Rating Operating Plan: Alaska utilizes the Canadian Forest Fire Danger Rating System. Official fire danger rating records are maintained at the Alaska Interagency Coordination Center. Local dispatch offices are responsible for WIMS observation certifications. See the AWFCG Weather Committee, Annual Operating Plan.

Job Hazard Analysis for fire and fire aviation activities: Maintained in hardcopy format in the EAFM Office in Fairbanks, AK.

Agency Administrator's Guide to Critical Incident Management: As of 2014 this guide has not been completed.

GAAR current fire cache inventory: Maintained in electronic format in the EAFM office network drive. Additional resources are available through the Regional 20 person crew cache and the AWAFM cache located in Denali National Park and Preserve.

Structure Protection Inventory and Needs: Structure protection needs are in development. In 2010, field operations completed a portion of a project to develop a consolidated list of the total number and location of structure/site requiring protection measures.

Location of procedures for park evacuation and closures. See Section 4.1.2 Public Safety, Emergency Evacuation Procedures. The Agency Administrator may issue a Park Unit closure as warranted do to safety considerations.

Cooperative Agreement(s) and Annual Operating Plan: See Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement (2011) and the Alaska Statewide Annual Operating Plan (2011) and the Alaska Interagency Wildland Fire Management Plan (Amended 2010).

Additional Response Information/Considerations:

Location of Geospatial data
All fire related geospatial data is located on park network drives and maintained at the AK NPS Regional Office.

Operational Considerations

a. Aviation Considerations
    i. Park wide radio communication is poor. Aviation transportation is likely required for most field operations in GAAR.
    ii. Jet A is only commercially available in Bettles and Anaktuvik Pass.
b. Water Sources
    i. Multiple water sources available, but incident specific.
c. Staging Areas
    i. TBA – Likely locations are in Bettles, Coldfoot/Wiseman, and Anaktuvuk Pass.
    ii. Administrative Cabins throughout the park. Primarily administrative sites with helicopter or fixed wing access.
d. Natural Barriers and Control Lines
    i. Incident and CFFDRS specific. Generally a combination if saw line and wet line is effective in the early summer. As the CFFDRS Drought Code increases above 350, burning off of natural barriers is an effective tactic.
e. Other

Logistical Considerations

a. In addition to the aviation considerations stated above in Section 17 aviation fueling facilities must be planned ahead.
b. Weather may preclude pick up from aircraft. Plan accordingly.
c. Wildlife interactions are likely. Understand how to mitigate these interactions. Plan accordingly.

Planning Considerations

a. Park Base Maps – See Appendix S.2
b. Vegetation and Fuels Maps -- All fire related geospatial data is located on park network drives and maintained at the AK NPS Regional Office. [Landcover Class]

c. Land status map -- All fire related geospatial data is located on park network drives and maintained at the AK NPS Regional Office [NPS Land Status]. Also available on the AICC ArcIMS website.
d. Sensitive Natural and Cultural Resources -- All fire related geospatial data is located on park network drives and maintained at the AK NPS Regional Office [Fire Protection Points]. Also consult the appropriate resources specialist.
e. Restrictions and special concerns by management area. Reference Section III. C. Scope of Wildland Fire Management Program, Fire Management Units.

Designated locations for ICP and Base Camp (TBD) and other facilities:

a. Medical Facilities – Fairbanks Memorial Hospital, 907-452-8181, 1650 Cowles Street, Fairbanks, AK 99701. Allakaket Clinic, 907-968-2237, P.O. Box 10, Allakaket, AK 99720
b. Utilities
c. Radio Communications – NPS Headquarters in Bettles and Coldfoot (NPS Radio Network Only)
d. Other

Sample Delegation of Authority: See Alaska Interagency AOP (2011) for a sample delegation of authority.

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Appendix H: Communication and Education Plan

Gates of the Arctic National Park and Preserve is committed to providing high-quality, pro-active and coordinated fire communication and education to target audiences (listed below). Park staff, Eastern Area Fire Management Program, the regional fire communication and education program (RFC&E) and the regional fire management program, in concert will fulfill the plan outlined below in order to increase internal and external awareness and support. Fire management spans a broad spectrum of programmatic areas including operations, ecology, prevention, GIS, predictive services, fuels, leadership, etc. Based on evolving programs and situations, the park can determine the focus area as appropriate.

Vision
Recognition, acceptance and support of the role of fire in ecosystems and the management of fire and fuels in the National Park Service (NPS).

Mission
To pro-actively support the Alaska NPS Wildland Fire Management Program through a comprehensive communication and education program that emphasizes wildland fire management and the role of fire in ecosystems.

Goals
- Internal and external audiences understand and support the role of fire in ecosystems and the management of fuels and fire.
- As an integral part of the NPS, the Alaska Fire Management Program collaborates with all disciplines.
- Provide accurate and timely fire information for local, regional, and national fire operations as needed.
- Coordinate and collaborate with stakeholders, partners and peers for maximum efficiency and effect.
- Facilitate an effective, two-way dialogue about fire in national parks in order to build trust and understanding with internal and external audiences.

Staffing
The RFC&E Specialist steers the Alaska NPS Fire Communication and Education Program and serves as a resource to parks by coordinating all matters related to the program. The specialist assists parks in using ongoing communication and education strategies, consultation and collaboration to enhance fire management programs. When a fire incident occurs, regardless of the different scenarios that might unfold, the Eastern Area Fire Management Officer will contact the designated park Public Information Officer (PIO) and the RFC&E Specialist. The RFC&E Specialist then collaborates with the park's PIO through the duration of the incident. If the need arises and pending approval by the superintendent or delegate, the PIO and/or the RFC&E Specialist will recruit personnel for specific duties or outside resources will be requested through dispatch procedures. For further information, review the Information Officer Step-Up Plan (see Section 4.6.2.B). Park staff and Alaska NPS Regional and Eastern Area Fire Management Program staff actively participates in and supports the FC&E program.

If an incident management team deploys to manage a fire that affects Gates of the Arctic, park staff will interact with and support the team's PIO. Park staff and/ or the RFC&E specialist will share NPS messages with the IMT team for inclusion into information dissemination. The Interagency Master Agreement and Interagency Operating Plan and subsequent delegation of authority address specific IMT team procedures.

Key Messages
The cornerstone of any communication effort is a set of consistent, compelling messages for use in all proactive and reactive communication. Messages should be actionable where appropriate so that, in addition to educating, they will motivate the audiences to act on what they have learned. They help the communicator move beyond the facts and tell the fire story. Refer to the NPS wildland fire key messages tip card for tips on how to tell the story (what, why, and how); contact the RFC&E Specialist for hard copies.

Key messages are general concepts that can be incorporated into discussions, print materials, and other resources used in communication, education, information, and prevention efforts. Key messages are umbrella statements that require additional supporting points and examples for context. These messages are not meant as a script; however, they are intended to provide a foundation for crafting comments in response to inquiries from the public and media. It may also be helpful to review the National Interagency Fire Center (NIFC) themes, as these messages are updated on an annual basis to include pertinent, emerging topics. These themes are part of the PIO toolkit and can be located at http://www.nifc.gov/PIO_bb/pio_main.html.

The NPS Wildland Fire Management Program key messages are listed below. Details on the messages can be found in the NPS Wildland Fire Management Communication Plan. These messages and the Alaska wildland fire key messages are designed to meet the following criteria:

- **Coincide with *and not contradict* interagency messages.** It is critical that the wildland fire community speak with one voice to the public. The NPS wildland fire messages are designed to complement the interagency messages listed below. The NPS wildland fire messages also are designed to be fluid. These messages do not address specific policy issues. NPS staff will rely on policy-related messages as they are revised.
- **Allow for customization.** These messages are a guide, not a script. Users are encouraged to provide additional, local detail to ensure the messages touch audiences in a relevant, credible way.
- **Include a call to action.** In addition to educating, messages should motivate the audiences to act on what they have learned.
- **Answer the questions what, why, and how.** Categorizing messages in this way will help users recall the messages during appropriate situations.

NPS Wildland Fire Key Messages

What
1. The NPS is a leader in the wildland fire community.
2. The NPS Wildland Fire Management Program is committed to safety, science, and stewardship.

Why
3. Wildland fire is an essential, natural process.
4. *Science tells the story:* Today's environment includes hotter, drier, and longer fire seasons. Research also indicates poor ecosystem health and an increasing number of homes in fire prone areas.

How
5. The NPS works with our neighbors and other partners to preserve and protect park resources and mitigate wildfire risk in the wildland-urban interface (WUI).

The Alaska Wildland Fire Coordinating Group, Wildland Fire Education and Prevention Committee developed Alaska interagency key messages and can be viewed at http://fire.ak.blm.gov/administration/awfcg.php

Alaska Key Messages

1. Public and firefighter safety is our first priority.
2. Wildland fire happens, be ready.
3. Wildland fire is an essential, natural process.
4. Alaskans work together to manage wildland fire.
5. Managing wildland fire in Alaska balances risks and benefits in an ever changing environment.

Gates of the Arctic National Park and Preserve will provide supporting points and highlight pertinent key messages on an incident and park-specific basis depending on the details of the fire and the communities affected.

Target Audiences

The park has identified target audiences for fire education and key messages.

1. **Park Visitors** – In-park visitors and special groups
2. **Virtual Visitors** – Website visitors and those who utilize social web such as Twitter for information sharing
3. **Park Employees** - NPS, Alaska Geographic, concessions, and volunteers
4. **Local Communities** – Residents and property owners, local and tribal government, businesses near the park, and special interests such as city councils or advocacy groups.
5. **Student/Teachers** – K-12 students and teachers, college/graduate school students, and elder hostel groups
6. **Professional Peers/Partners –** Federal, state and local agencies, professional associations, and academics
7. **Special Interest and Tourism Related Groups**
8. **Commercial Use Authorizations –** Businesses that operate in the park such as flight services, guide services, and boat charters
9. **Elected Officials** – Federal, state and local
10. **Media** – Print, television, radio, film, and web-based news publications
11. **Incident Management Teams (IMT)** – Type 1, 2, and 3 IMT teams that may be from Alaska or the Lower 48

Communication Methods

The following methods will be used to communicate with the eleven target audiences listed. There are both personal and non-personal methods that will facilitate reaching the largest number of people. The park will continue to improve and expand this list.

Personal

1. **Interpretive Programs** – Park staff will integrate fire messages into the variety of programs offered by the interpretative division.
2. **Education Programs** – Park staff, Regional and Eastern Area Fire Management staff will incorporate fire ecology concepts into curriculum-based education programs, student field research experiences and in-class programs.
3. **Employee Training** – Eastern Area Fire Management Program and park staff will coordinate employee training sessions to improve staff understanding of the fire management program.
4. **Presentations** – Regional and Eastern Area Fire Management staff will give peer presentations at conferences about current fire research, planning, or operations.
5. **Special Events** – Park staff, Regional and Eastern Area Fire Management staff will participate in local events (festivals, July 4th celebrations) to promote the fire management program.
6. **Public Meetings** – As needed, regional, Eastern Area Fire Management staff and park staff will conduct special public meetings related to a specific fire event, planning effort or to share general program information
7. **Workshops** – With help from interagency and educational partners, RFC&E Specialist and the park staff will offer in teacher workshops that incorporate fire ecology and management issues. Regional and Eastern Area Fire Management staff and park staff will participate as needed.
8. **Interagency Meetings** – Park staff, Eastern Area Fire Management and RFC&E Specialist will participate in interagency work groups to collaborate with statewide and national partners to share information and complete special projects. One example is the pre-season meeting to discuss the *Annual Operating Plan*. Currently a draft plan, this document can be reviewed in the spring to help inform park staff of expected fire management operations. It will help define the role of information during the fire season and the collaboration between jurisdictional and protection agencies. A final version will be complete in late 2010.
9. **Media Interviews** – Park PIO and/or RFC&E Specialist will facilitate or complete in-person or phone interviews for print, radio, and television outlets. When necessary, the RFC&E Specialist will facilitate special media projects (books, documentaries etc.) by guiding research, scheduling interviews with appropriate staff, and coordinating filming schedules.
10. **Fire Interest List** – RFC&E Specialist maintains a listserv of individuals interested in receiving e-mails on all aspects of wildland fire.
11. **Recorded Phone Message** – Park PIO and/or RFC&E Specialist will maintain a recorded "Fire Information" message.

12. **Social Web** – Currently, Twitter is the main social web tool utilized by parks in Alaska. Park PIO (or designee) will update the GAAR Twitter page as necessary and the RFC&E Specialist will update the Alaska NPS Twitter page. Maintained year-round, these "tweets" will serve as brief updates on park information including fire. The RFC&E will coordinate with the park designee to disseminate information as necessary. This method of communication is two-way, allowing both the park and the public to make comments on the park page and providing the opportunity for the park to respond.

Non-Personal

1. **Webpage** – Park staff will maintain a fire management webpage that is linked to the main park webpage. RFC&E Specialist can assist as needed.
2. **Fire News, Inciweb** – Eastern Area Fire Management staff, park PIO, and/or park staff with support from RFC&E Specialist will update Fire News throughout the duration of an incident. Update InciWeb as an incident warrants.
3. **AK2day and Inside NPS** - Park PIO and/or RFC&E Specialist will submit information regarding fire management activities on these internal websites.
4. **Press Releases/ Updates** – Park PIO and/or RFC&E Specialist will use email, fax, and bulletin boards to distribute press releases/updates, photos and public fire maps for all target audiences as needed.
5. **Public Fire Maps** – Eastern Area Fire Management staff will produce internal and external fire incident maps. Regional Fire staff may provide some assistance.
6. **Press Kit** – RFC&E Specialist and park PIO will compile and annually update a fire information press kit.
7. **Fire Education Trunks** – RFC&E Specialist will supply the park with fire educational materials. Park staff, with assistance from the RFC&E Specialist, will resupply the materials as needed. Trunks are available; please contact RFC&E to discuss.
8. **Visitor Center Exhibits, Wayside Exhibits, Bulletin Boards, and Displays** – Park staff will maintain and update the interpretive information in visitor centers and wayside exhibits on fire management. RFC&E Specialist will provide support as needed.
9. **Portable Displays and Banner Stands** – RFC&E Specialist will store and organize several portable displays and banner stands for use at trainings, internal meetings, public events and conferences. These portable displays are kept in an area cache or can be shipped from the Anchorage office as needed.
10. **PIO Supplies** – Fire information banners, nametags, and vehicle magnets are available at the regional office and area program.
11. **Publications** – Park staff will include fire management information in regular park publications. Eastern Area Fire Management Program will engage with the park staff in development of park publications. RFC&E Specialist and/or Eastern Area Fire Management staff with park support will research, write, and design additional handouts specifically about fire management such as newspapers, fire stories, brochures, posters, and templates. The area fire management program and RFC&E Specialist maintain a variety of fire brochures available for the park.
12. **Scientific Papers** – Park researchers and/or Regional and Eastern Area Fire Management staff will publish park papers in scientific journals and/or periodicals regarding new information from the park's fire management program.

Emerging Tools

This plan provides recommendations for regional and park level fire communication and education programs. Digital communication tools will continue to emerge. It is important to stay abreast of new technology in order to relay the NPS safety and educational messages about wildland fire. Currently, Twitter is the main social web tool used in parks; it is very likely that this will evolve and more tools will be used in the near future.

Guiding Documents

- The *NPS Wildland Fire Management Strategic Plan* represents input from all levels and disciplines within the NPS Wildland Fire Management Program, from parks to the national office, as well as the NPS Natural Resource Program and our interagency partners. It is intended to establish key strategies that should be applied at all levels of the NPS Wildland Fire Management Program to achieve critical management objectives in support of the mission. This plan is current through 2012; view the plan at http://www.nps.gov/fire/wildland-fire/resources/documents/wildlandfire-strategic-plan-2008-2012.pdf.
- The *NPS Wildland Fire Management Communication Plan* was written by the NPS Division of Fire and Aviation Management in coordination with the 20th anniversary of the 1988 fires in Yellowstone National Park and the Northern Rockies. This plan has developed a communications initiative to reach internal and external audiences with a clear, consistent message about the role of wildland fire management in NPS units and surrounding communities. The purpose of this initiative is to reinforce the National Park Service's position as a resource for fire management information and to better inform internal and external audiences about the role of wildland fire and the role of NPS Fire and Aviation in managing it. A subsequent goal is to reinforce the cultural significance of the NPS and its historical leadership in land management. View this plan at http://inside.nps.gov/waso/custommenu.cfm?lv=3&prg=777&id=8080.
- The draft *Alaska Region Fire Communication Strategy and Guide* introduces the duties and responsibilities of the NPS Alaska Regional PIO and is located at http://www.nps.gov/akso/nature/fire/PIO.cfm.
- NPS *Social Media Handbook*, written by NPS Alaska Region provides guidance to parks and programs in the use of Social web including multimedia sharing websites, blogs and microblogs, social networking websites, document sharing repositories and third party widgets. The handbook describes many types of technologies but does not provide an endorsement for their usage. Available on the NPS SharePoint site located at http://share.inside.nps.gov/sites/PWR/PWRIntEd/IRAC/MIT/socmed/Shared%20Documents/Example%20Social%20Media%20Plans/AKR%20Social%20Media%20Handbook.pdf.

The fire communication and education (FC&E) program, while tailored to the local level, complements the aforementioned plans in its vision, mission, and goals.

Other Important Fire Information References

While these documents provide the philosophy and general direction for the FC&E Program, there are two other important references for fire information work. Specific operational procedures (checklists, fax numbers, email lists, community contacts, etc. are outlined in Standard Operating Procedures: Fire Communication and Education. The Information Officer Step-Up-Plan, (found in Section 4.6.2.B) provides Public Information Officer (PIO) recommendations during a park fire incident.

Evaluation

To maintain a successful program, the NPS Wildland Fire Management Program will seek evaluation opportunities such as independent surveys of visitors/residents/employees. Staff will conduct program reviews for the regional and park fire management programs. After action reviews are a part of the fire culture and will be used as appropriate.

Education Annual Plan by Season

Table 1 describes the FC&E education annual plan which gives year-round recommended guidelines for the FC&E program. Educational elements and communication methods are emphasized according to season. The table highlights these emphasis areas and links them to communication methods and target audiences. It is important to remember that this plan is general and will not prevent the program from engaging in new, innovative methods in the future.

Table 1: Communication/ Education Annual Plan by Season (recommended guidelines): Gates of the Arctic National Park/Preserve.

Season	Communication/ Education Emphasis	Communication Methods	Target Audiences										
			Park Visitors	Virtual Visitors	Park Employees	Local Communities	Students /Teachers	Professional Peers	Tourism Groups	Commercial Use Authorizations	Elected Officials	Media	Incident Management Teams
Spring	Pre-Season Information	Interagency meetings Fire interest lists Social web Webpage Press releases /updates Portable displays Publications Brochure distribution	*		*	*		*	*			*	*
	Key messages	Employee training Special events/ public meetings Interagency meetings Media interviews/ press kit Social web Webpage Portable displays Publications	*	*	*	*	*	*	*	*	*	*	*
	Student/ Teacher Education	Education programs Workshops					*						
	Employee Education	Employee training Presentations Special events/ public meetings Fire interest lists AK 2day and Inside NPS			*								
	Restock Comm. Ed Cache	Publications			*								
	Interagency Cooperation	Presentations Interagency meetings Fire interest lists Scientific papers			*			*					*
	Recruitment	Interagency meetings Fire interest lists Webpage			*	*	*						*
Summer	Incident Information	Special events / public meetings Media interviews/ Press kit Recorded phone messages Social web Webpage Fire News/ Inciweb Press releases / updates Public fire maps Exhibits/ bulletin boards Portable displays/ banner stands	*	*	*	*		*	*	*	*	*	*
	Key messages	Special events/ public meetings Media interviews Social web Webpage Press kit Portable displays Publications	*	*	*	*		*	*	*	*	*	*
	Interpretation	Interpretative programs Fire education trunks Exhibits/ displays	*			*						*	
	Employee Education	Fire interest lists AK 2day and Inside NPS Presentations Scientific papers			*								
	Interagency Cooperation	Fire interest list Press releases / updates Fire News/ Inciweb			*			*					*

Season	Communication/ Education Emphasis	Communication Methods	Target Audiences										
			Park Visitors	Virtual Visitors	Park Employees	Local Communities	Students /Teachers	Professional Peers	Tourism Groups	Commercial Use Authorizations	Elected Officials	Media	Incident Management Teams
Fall	Post-Season Information	Special events / public meetings Media interviews Webpage Press releases / updates Publications	*		*	*	*	*	*			*	*
	Employee Education	AK 2day and Inside NPS Publications/ scientific papers			*								
	Interagency Cooperation	Interagency meetings Fire interest lists Press releases / updates Publications/ scientific papers			*			*					*
	Student/ Teacher Education	Education programs					*						
Winter	Post-Season Information	Webpage Publications	*	*	*	*							
	Development of New Materials	Exhibits/ displays Portable displays Printed publications Publications/ brochures	*		*	*	*	*				*	*
	Key message review	Employee training Interagency meetings			*			*					*
	Restock Comm. Ed cache	Publications											
	Employee Education	AK Today and Inside NPS Publications/ scientific papers			*								
	Interagency Cooperation	Presentations Interagency meetings Fire interest list						*					*
	Student/ Teacher Education	Education programs				*							

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Appendix I: Fire Prevention Plan

Gates of the Arctic National Park and Preserve does not meet the threshold of human caused fires to require fire prevention plan. Fire prevention programs and messages will be coordinated through the NPS Alaska Regional Office.

Appendix J: Duty Officer Manual

NPS Alaska Eastern Fire Management Area
Duty Officer Manual

NPS Duty Officer (DO) Responsibilities
All Fire Management Officers are responsible to provide DO coverage during any period of predicted incident activities. DO's responsibilities may be performed by any individual with a signed Delegation of Authority from the local agency administrator. The required duties for all DOs are:

- Monitor unit incident activities for compliance with NPS safety policies.
- Coordinate and set priorities for unit suppression actions and resource allocation.
- Keep agency administrators, suppression resources and Information Officers informed of the current and expected situation.
- Plan for and implement actions required for future needs.
- Document all decisions and actions.

DOs will provide operational oversight of these requirements as well as any specific duties assigned by fire managers through the fire operating plan. DOs will not fill any ICS incident command functions connected to any incident. In the event that the DO is required to accept an incident assignment, the FMO will ensure that another authorized DO is in place prior to the departure of the outgoing DO.[1]

Wildfire Activity

- Duty Officer (DO) is the point of contact for the Protection Agencies for Yukon-Charley Rivers National Preserve (YUCH), Gates of the Arctic National Park and Preserve (GAAR), and Wrangell-St. Elias National Park and Preserve (WRST). The Bureau of Land Management Alaska Fire Service (AFS) and The Alaska State Division of Forestry (DOF) are the Protecting Agencies for the Eastern Area Fire Management (EAFM). YUCH is protected by the Upper Yukon Zone (AFS); GAAR is split with the Tanana Zone (AFS) in the east and the Galena Zone (AFS) in the west. WRST is protected by the Copper River Area Forestry (DOF). The defined differences between the Jurisdictional Agency and Protecting Agencies are located in Appendix J.1.

- In the event of a wildfire on a Park or Preserve the DO will converse with the protection agency to determine the location, size, protection option, and resources on scene. The DO will call the Chief of Resources and or acting Chief of Resources for the appropriate location and brief them on the status of the fire. In addition the DO will notify the EAFM Fire Management Officer or acting and Regional Fire Management Officer or acting. If the fire progresses to a Type 3 incident then a Delegation of Authority to the protecting agency will be reviewed and signed by the Superintendent of the park or preserve. Plus a local EAFM fire manager will be advising the Park or Preserve and the Protecting Agency in the event of a type 3, 2 or 1 fire.

[1] Interagency Standards for Fire & Aviation Operations 2013, National Park Service Program Organization & Responsibilities, p. 03-13, January 2013.

- The DO is also responsible for inputting data into the ***WFDSS***. The ***WFDSS*** will be initiated by the Protecting Agency.

Fire Management Options:

Critical: Highest suppression priority to protect human life, inhabited property, and improvements specified by land manager. Fires receive immediate, aggressive action depending on resource availability.

Full: Protection of cultural and historical sites, uninhabited private property, natural resource high-value areas, and other values that do not involve the protection of human life and inhabited property. Fires receive suppression efforts, depending on resource availability.

Modified: This option provides a management level between Full and Limited. The intent is to balance acres burned with suppression costs and to accomplish land and resource management objectives when conditions are favorable. Site-specific actions are taken as warranted.

Limited: Recognizes areas where the cost of suppression may exceed the value of the resources to be protected, the environmental impacts of fire suppression activities may have more negative impacts on the resources than the effects of the fire, or the exclusion of fire may be detrimental to the fire dependent ecosystem. Actions may be taken to keep a fire within the boundary of the Management Option or to protect identified higher value areas/sites.

Wildfire Standard Response

Use Standard Operations according to each park's FMP:

- Limited Response
  - Gather intel on nearest full response management points, weather and expected fire behavior.
  - Brief FMO, Regional FMO and Park Superintendent
- Full Response
  - Call FMO if not on an assignment.
  - What action is to be taken on the fire*: suppression, Point Protection or no action*?
  - No Retardant or Dozer Line unless threat to life and property is imminent must have Park Superintendent approval.
  - Gather intel on weather and expected fire behavior.
  - Send an Agency Rep to protection Agency, if not in Fairbanks.
  - Brief Regional FMO and Park Superintendent.
- Modified Response
  - Dependent on time of year follow Limited or Full Response.
- Critical Response
  - ***Call FMO if not on assignment.***
  - ***If asked to use Retardant or Dozer Line ask what the current fire behavior is and if life and property are in immediate danger. If so contact Park Superintendent or acting to have approval for use.***
  - Gather intel on weather and expected fire behavior.
  - If the fire goes into extended attack is a team needed? ***Park Superintendent has to give approval.***

- Send an Agency Rep to the Protection Agency ASAP.
- Brief Regional FMO, plus contact Park Superintendent

Wildfire Information Distribution List

Yukon- Charley (YUCH)	Gates of the Artic (GAAR)	Wrangell – St. Elias (WRST)
NPS YUGA All Employees	NPS YUGA All Employees	WRST All Employees
Jeff Rasic	Jeff Rasic	Rick Obenesser
Greg Dudgeon	Greg Dudgeon	Eric Veach
Mary Sanders (Pat)	Dalelynn Gardner	Mark Keogh
Lou Flynn	Scott Sample	NPS WRST Dispatch Center
Morgan Warthin	Morgan Warthin	Morgan Warthin
Dan Warthin	Dan Warthin	Dan Warthin
James Sullivan	James Sullivan	James Sullivan

Duty Officer Schedule

The Duty Officer will rotate every 21 days. The transition will happen at 14:00 on the 21st day of the outgoing DO's tour of duty. The transition will include a briefing on:

- Fires in the Parks or Preserves
- Location of Helicopter
- Location of Fire Resources
- Up-coming details at AFS
- Up-coming projects: resources assigned to the project, Transportation, logistical needs

The Duty Officer schedule is subject to change due to fire assignments or uncontrollable circumstances that may arise.

James Sullivan (FMO) W: 907-455-0651 C: 907-460-4076 James_Sullivan@nps.gov
Jason Devcich (AFMO) W: 907-455-0650 C: 907- 699-2142 Jason_Devcich@nps.gov
Jessica Sherwood (HMGB) W: 907-455-0658C: 907-460-4381 Jessica_Sherwood@nps.gov

IT and Other Resources

- Eastern Area Fire Management (EAFM) Handy Dandy
  This little booklet has everything you will need to know about Eastern Area Fire Management. Make sure you have one when you are in the field or in the office.
- EAFM Detailer Packet
- Support documents for the Duty Officer: I:\OPERATIONS\Duty Officer
  On the I Drive in the Duty Officer folder are electronic versions of documents that the DO may find helpful. The folder includes this manual, examples of delegation of authority, contact lists with phone numbers, electronic copies of the Handy Dandy, EAFM Detailer Packet and the Alaska Master Cooperative Agreement, Detailer Emergency Notification Info Form, CFFDRS Weather Guide.
- Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement: http://fire.ak.blm.gov/administration/asma.php
- Eastern Area Primary Network Drives

- W: \\165.83.62.203\akrwanshare
- X: \\165.83.59.32\gis_data
- I: \\165.83.59.27\fire
- K: \\165.83.59.29\everyone

- A GIS folder has been set up to capture fire activity, MODIS, and perimeters in the DO folder at I:\OPERATIONS\Duty Officer\GIS.
  - The ArcMap project is named "AK_DO_Info" which is preloaded with common layers including the cabin layers including protection buffers to aid in the development of trigger points with the Protecting Agencies. To add additional layers or shape files using the NPS Theme Manager is the place for all your needs.
  - For other GIS related questions, Brian Sorbel is the best contact for your NPS Alaska Fire GIS needs.
- Web sites:
  - Alaska Interagency Coordination Center, one stop shopping for Alaska fire information: http://fire.ak.blm.gov/
  - Alaska Fire Orientation YouTube videos are a series of short videos, 1 to 8 minutes long. They are an excellent orientation to fire in Alaska: http://www.youtube.com/watch?v=a1eRs0bNg9U. Definitely watch Part 15: Alaska Interagency Wildland Fire Management Plan, Part 01: Alaska Fire Orientation, Part 2: Topography, Part 03: State Fire Regimes, Part 04: Weather, Part 05: Fuels & Fire Behavior, Part 06: Canadian Forest Fire Danger Rating, Part 07: Tactics
  - NPS Alaska wildland fire page: http://www.nps.gov/akso/nature/fire/index.cfm
  - Alaska Fire Science Consortium: http://akfireconsortium.uaf.edu
- Cabins Databases
  - I:\CULTURAL RESOURCE PROJECTS\NPS_Fire Cabins_Current
    This database describes condition of cabins in all AKR parks and whether they are sensitive or non-sensitive.
  - http://fire.ak.blm.gov/predsvcs/maps.php
    Go to the known sites database on the AICC website. This database requires a user name and password that you can get from the FMO. This site allows you to see all sensitive or non-sensitive sites on the Alaska Interagency Coordination Center (AICC) Google Earth site.

Field Resources
The DO is the point of contact for the fire field resources on YUCH, GAAR and WRST. This includes communicating with the resources on the status of the project, logistical needs and issues that may arise. The DO will also schedule transportation for the field resources as needed. Refer to the 2014 field schedule (*I:\OPERATIONS\2014 Field Season*). This schedule may be inaccurate due to fire activities in the state and the national planning levels in the lower 48.

In-Coming Detailers
The DO will set up transportation for in-coming detailers and set up lodging for them. (Lodging may be established in the AFS barracks.) The detailers will also be briefed on Eastern Area Fire Management policy, the Parks and Preserves, work assignments and watch the Alaska Fire Operations DVD provided by AFS.

Appendix J.1

Jurisdictional Agency: The agency having overall land and resource management responsibility for a specific geographical or functional area as provided by federal or state law.

"Nothing herein relieves agency administrators of the responsibility and accountability for activities occurring on their respective land." (620 DM 2.4A) "Each agency will continue to use its delegated authority for the application of wildland fire management activities such as planning, education and prevention, use of prescribed fire, establishing emergency suppression strategies, and setting emergency suppression priorities for wildland suppression organizations on respective agency lands." (620 DM 2.4C) The Jurisdictional Agencies are:

- For the Tongass and the Chugach National Forests, the USFS is the Jurisdictional Agency.
- For DOI-administered lands, Jurisdictional Agencies are BIA, BLM, FWS, and NPS.
- For State, private and municipal lands, the DNR is the Jurisdictional Agency. (DNR Department Order 113)
- For Alaska regional and Village Corporation lands conveyed under Alaska Native Claims Settlement Act, the Native Corporation who has the surface rights is the Jurisdictional Agency; however, when necessary, AFS may act as the Jurisdictional Agency Representative for those corporate lands.

Jurisdictional Agencies are responsible for all planning documents i.e. land use, resource and fire management plans, for a unit's wildland fire and fuels management program. Figure A lists the agencies and their jurisdictions. If a Jurisdictional Agency administrator or Fire Management Officer (FMO) is dissatisfied with the services provided by the Protecting Agency or if there is an issue or concern irresolvable at the local level, that information should immediately be elevated to the regional fire management staff to adjudicate and discuss with the Alaska Fire Service (AFS) Manager, the DNR chief of Fire and Aviation or Forest Service Fire and Fuels Group Leader. Lessons learned from this process should be included in the Interagency Fall Fire Review agenda.

1. Ensure management actions taken by the Protecting Agency are compliant with unit plans and Jurisdictional Agency policy.

2. Set the strategic fire direction pre-season as defined in the AIWFMP; ensure management option designations are appropriate and reviewed annually; and identify general restrictions and constraints on their administrative unit. Management option change procedures are addressed in the AIWFMP.

3. Identify resources and sites which require site-specific protection in accordance with AIWFMP.

4. Approve non-standard responses as defined in AIWFMP.

5. Work collaboratively with Protecting Agency and other affected Jurisdictional Agencies to develop the complexity analysis and provide strategic incident objectives and constraints to ensure land and resource management objectives are met and documented during the decision support process. For incidents on federal lands or Alaska Native village and regional corporation lands, use of the Wildland Fire Decision Support System (WFDSS) is required.

6. Approve the incident's decision document, when required.

7. Develop and jointly sign a Delegation of Authority to implement the decision document when incident complexity is Type 3 and above.

8. Assign, as the incident complexity warrant, an Agency Representative and/or Resource Advisor.

9. Participate in Incident Management Team (IMT) briefings to discuss local issues, personnel and facilities and establish a formal recognition of agency roles.

10. Collaborate with Protecting Agencies and IMTs regarding media releases concerning resource conditions, policies and management objectives for their agency.

11. Participate in IMT closeouts and contribute to the written evaluation of their performance in the implementation of the direction contained in the Delegation of Authority.

12. Investigate and pursue all legal actions that are deemed necessary for human-caused fires.

13. Provided written standards that address wildfire suppression activity damage repair.

14. Determine the need for, develop and manage Emergency Stabilization and Burned Area Restoration activities.

15. Manage fire prevention and education programs.

16. Coordinate and manage fire closure/restriction programs for agency lands.

Appendix K: Standards for MIT, BAER and Rehabilitation

See Section 4.4 Burned Area Emergency Response.

Appendix L: Cooperative and Interagency agreements

The following documents are on file in the Fire Management Officer's office at FAC:

- 2010 Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement
- 2013 Alaska Statewide Annual Operating Plan

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Appendix M: Contacts for Wildfire and Prescribed Fire Resources

Alaska Interagency Coordination Center (AICC):

Center Manager	Ray Crowe	356-5677
Tactical Resources Coordinator	Jon Gregg	356-5690
Galena Fire Management Zone:	**All Galena Station Employees**	**656-1222**
Fire Management Officer	Doug Downs	356-5626(FBK)
Assistant FMO	Willie Branson	356-5623
Fuels Management Spec.	Vacant	356-5617
Galena Zone Dispatch	Hudson Plass	656-1222

Tanana Fire Management Zone:

Fire Management Officer	Mike Butteri	356-5574
Assistant FMO	Marlene Eno-Hendren	356-5569
Fuels Management Spec.	Vacant	356-5570
Upper Yukon-Tanana Zone Dispatch	Hilary Shook	356-5551

National Park Service:

Superintendent, GAAR	Greg Dudgeon	457-5752 (Office)
Fire Management Officer, Alaska Region	Dan Warthin	644-3409 (Office) (907) 444-8788 (Cell)
Fire Management Officer, Eastern Area	James Sullivan	455-0651 (Office) (907) 460-4076 (Cell)
Assistant Fire Management Officer, Eastern Area	Jason Devcich	455-0650 (Office) (Cell)
Helicopter Manager, Eastern Area	Jessica Sherwood	455-0658 (Office) (907) 460-4381(Cell)
Fire Program Management Assistant, Eastern Area	Vacant	455-0653 (Office)

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Appendix N: Notification Procedure

See the 2010 Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement and the 2013 Alaska Statewide Annual Operating Plan Section 24 for notification procedures.

Appendix O: Serious injury or Death Procedure

All person assigned to a wildfire shall be under the operational control of the Protection Agency. Serious injury or death procedures will follow the guidelines as established by the 2010 Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement and the 2013 Alaska Statewide Annual Operating Plan. In general, procedures will be conducted jointly between the Protection and Jurisdiction Agencies for serious injury or death procedures that occur associated with a wildfire incident. Serious injury or death procedures for non wildfire incidents will follow the local SOP process, or Regional process.

Appendix P: Safety Program/Plan

See Section 4.1 Safety. Additional Safety information can be found through the NPSafe Program.

Appendix Q: Smoke Management Plan

See Section 4.7 Air Quality/Smoke Management.

Appendix R: WFDSS Objectives and Requirements

See Sections 3.1 Park-wide Fire Management Considerations and 3.2 Fire Management Unit Specific Characteristics.

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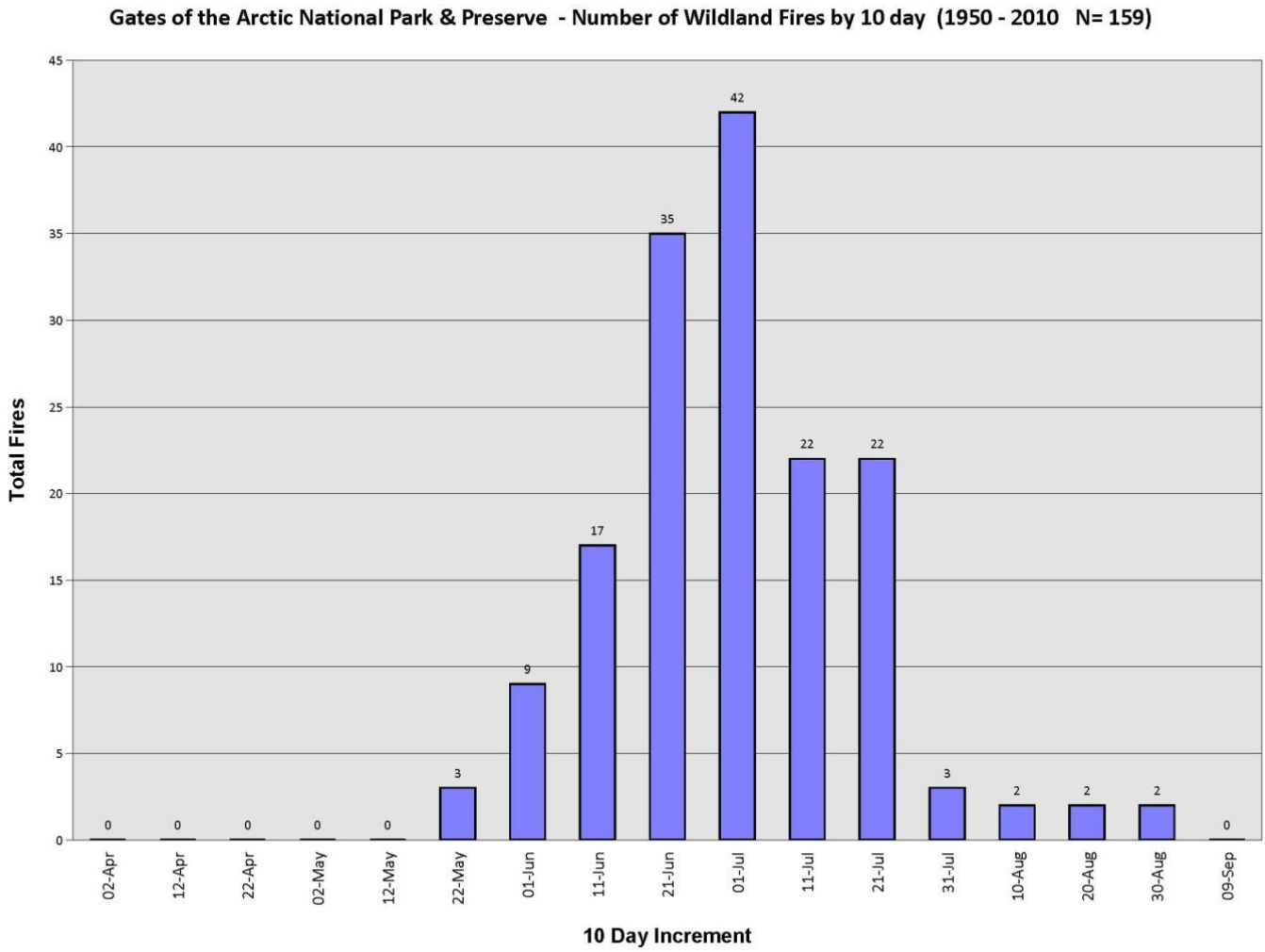
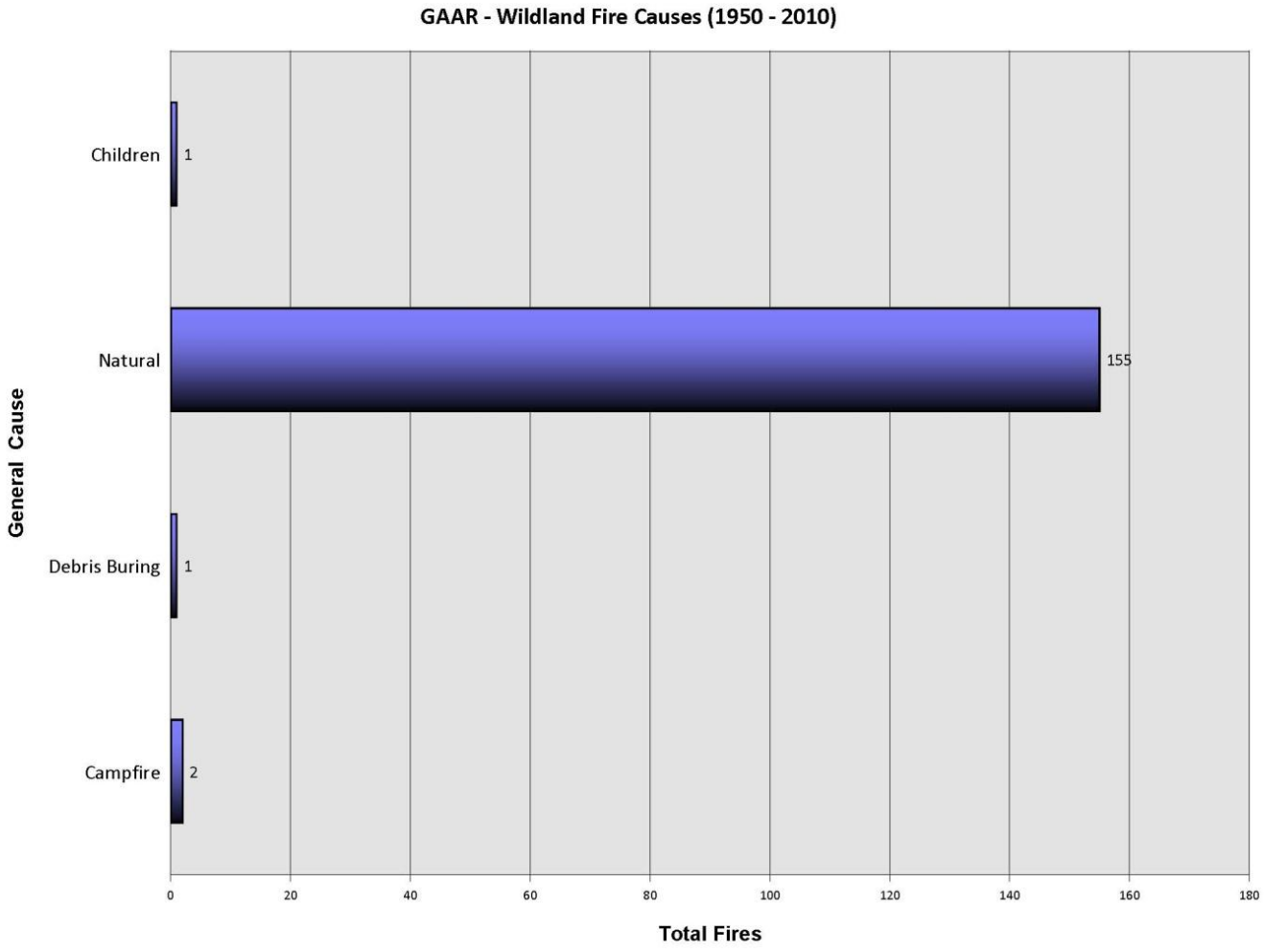
Appendix S: Unit specific supplemental information

Appendix S.1: Fire Statistics and Graphs

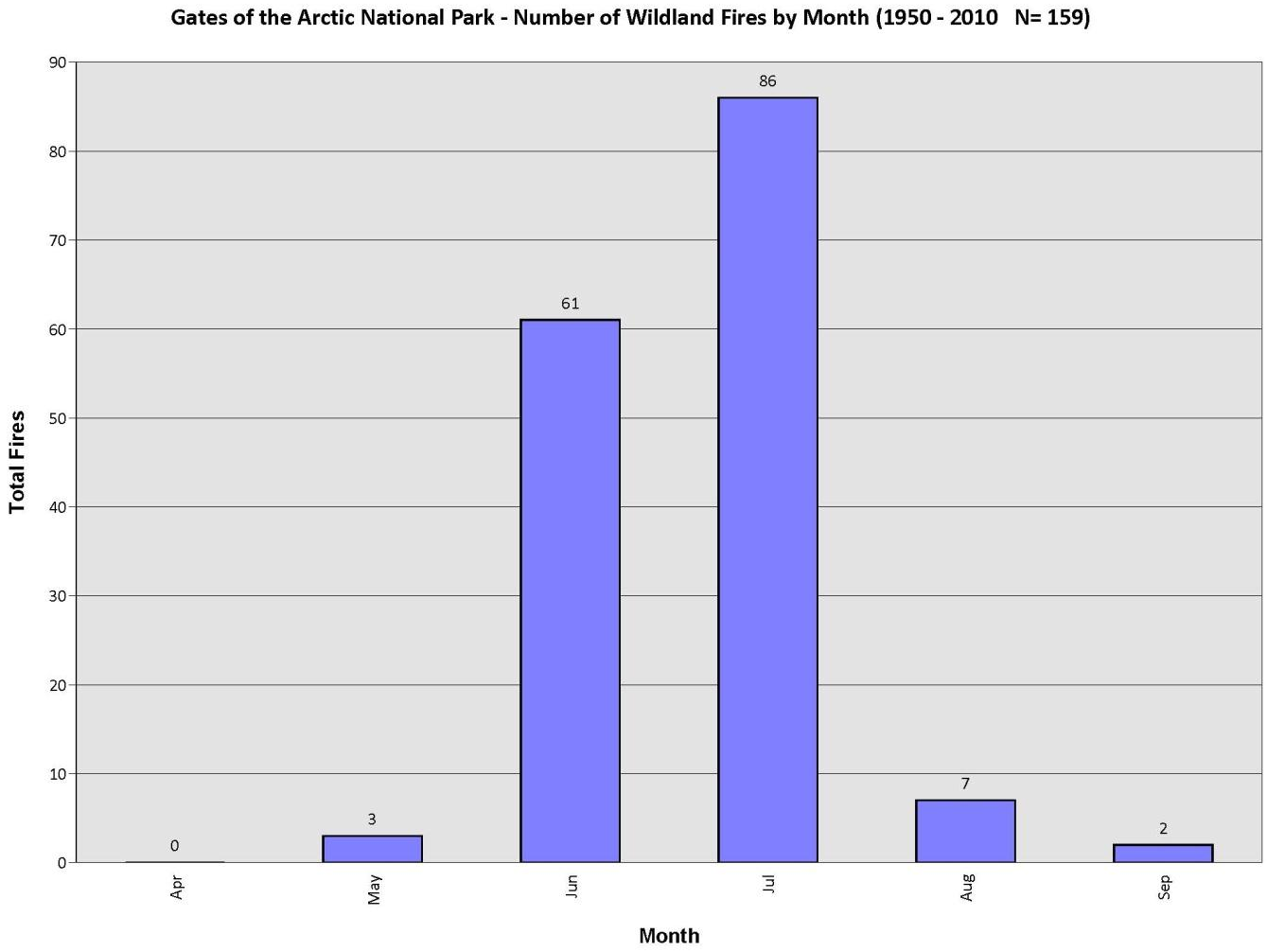
Fire Statistics and Graph 1: Wildland Fire Occurrence by 10 Day Increments in GAAR



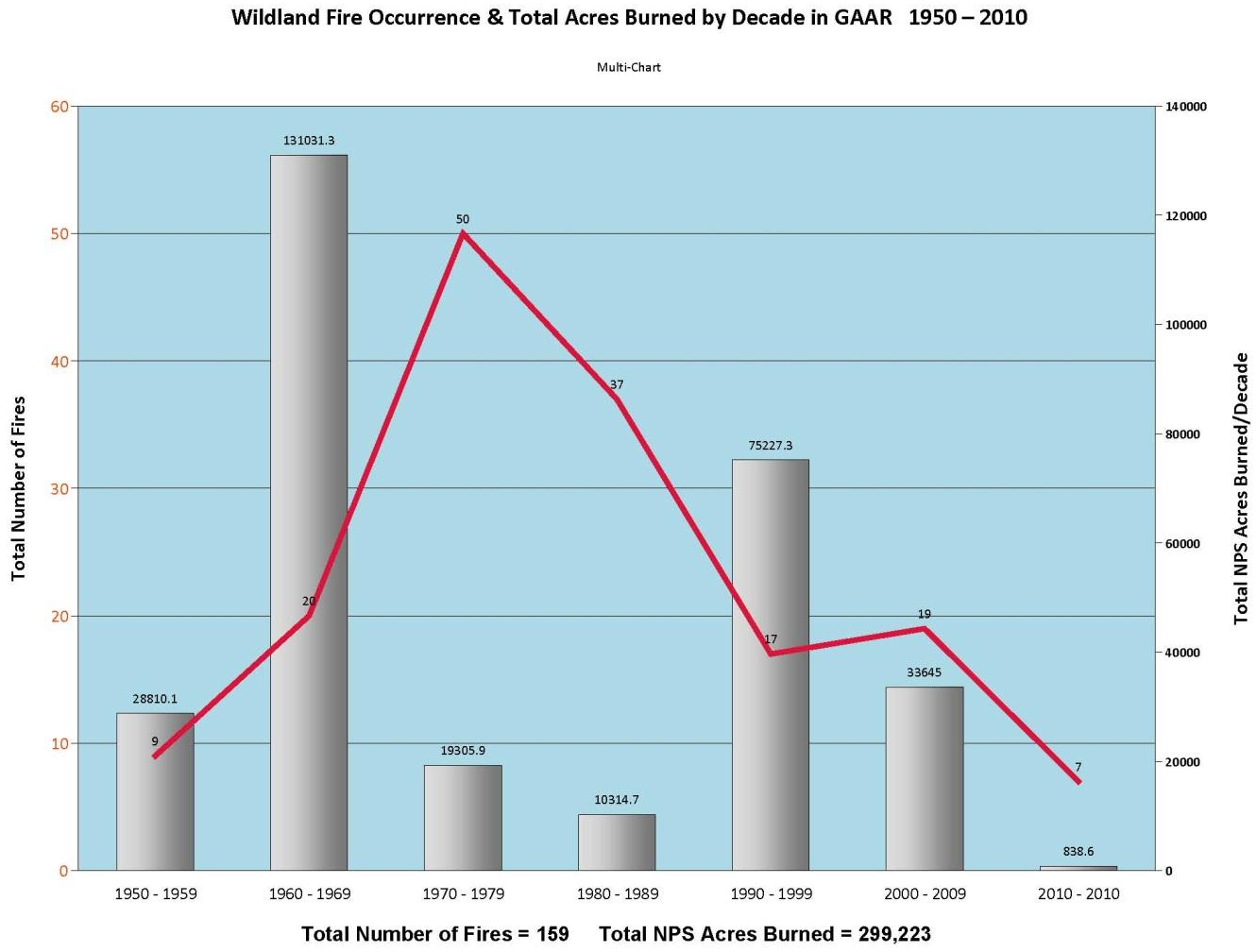
Fire Statistics and Graph 2: General Fire Cause in GAAR (1950-2010)



Fire Statistics and Graph 3: Wildland Fire Occurrence by Month in GAAR 1950-2010

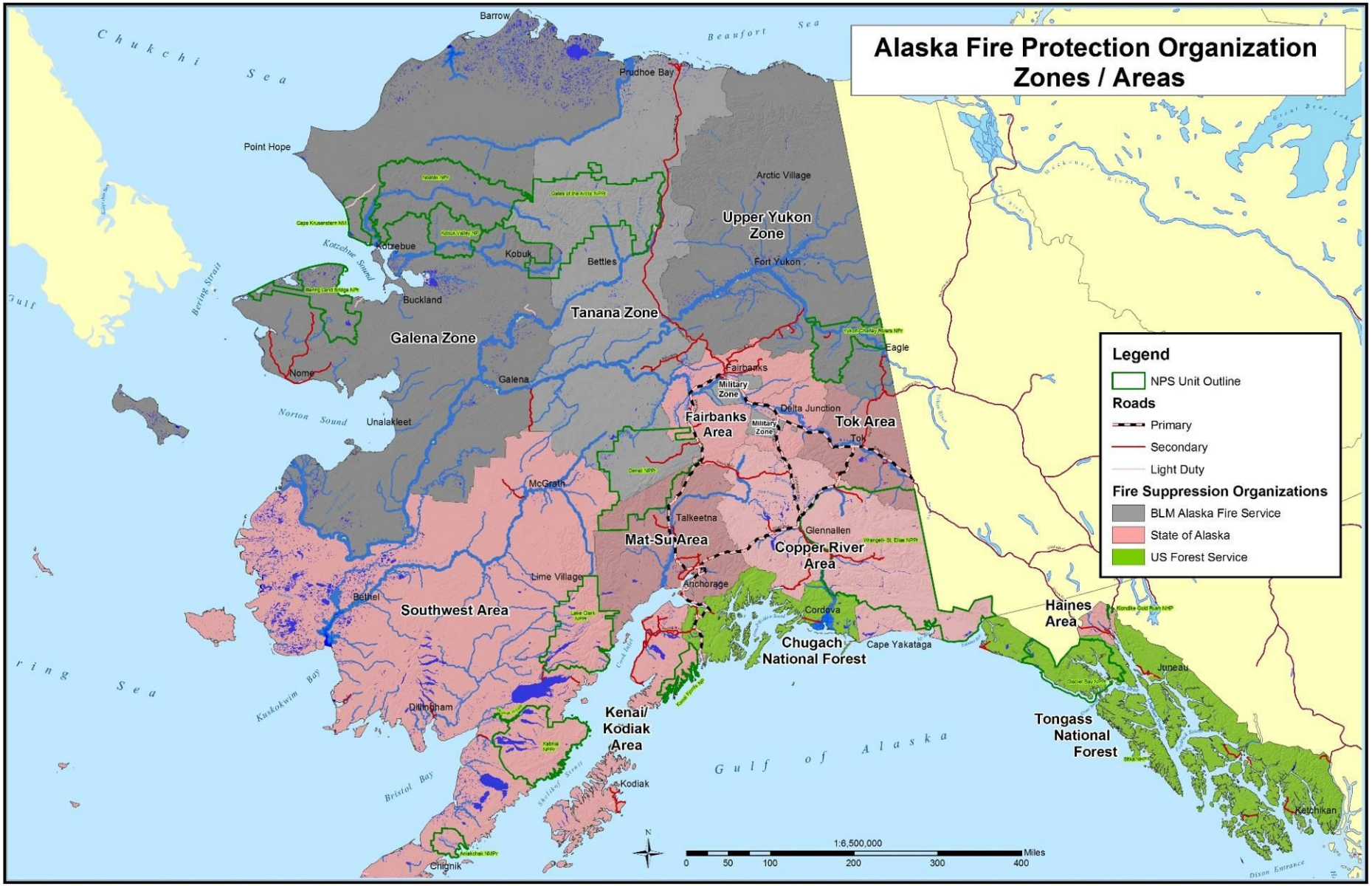


Fire Statistics and Graph 4: Wildland Fire Occurrence & Total Acres Burned by Decade

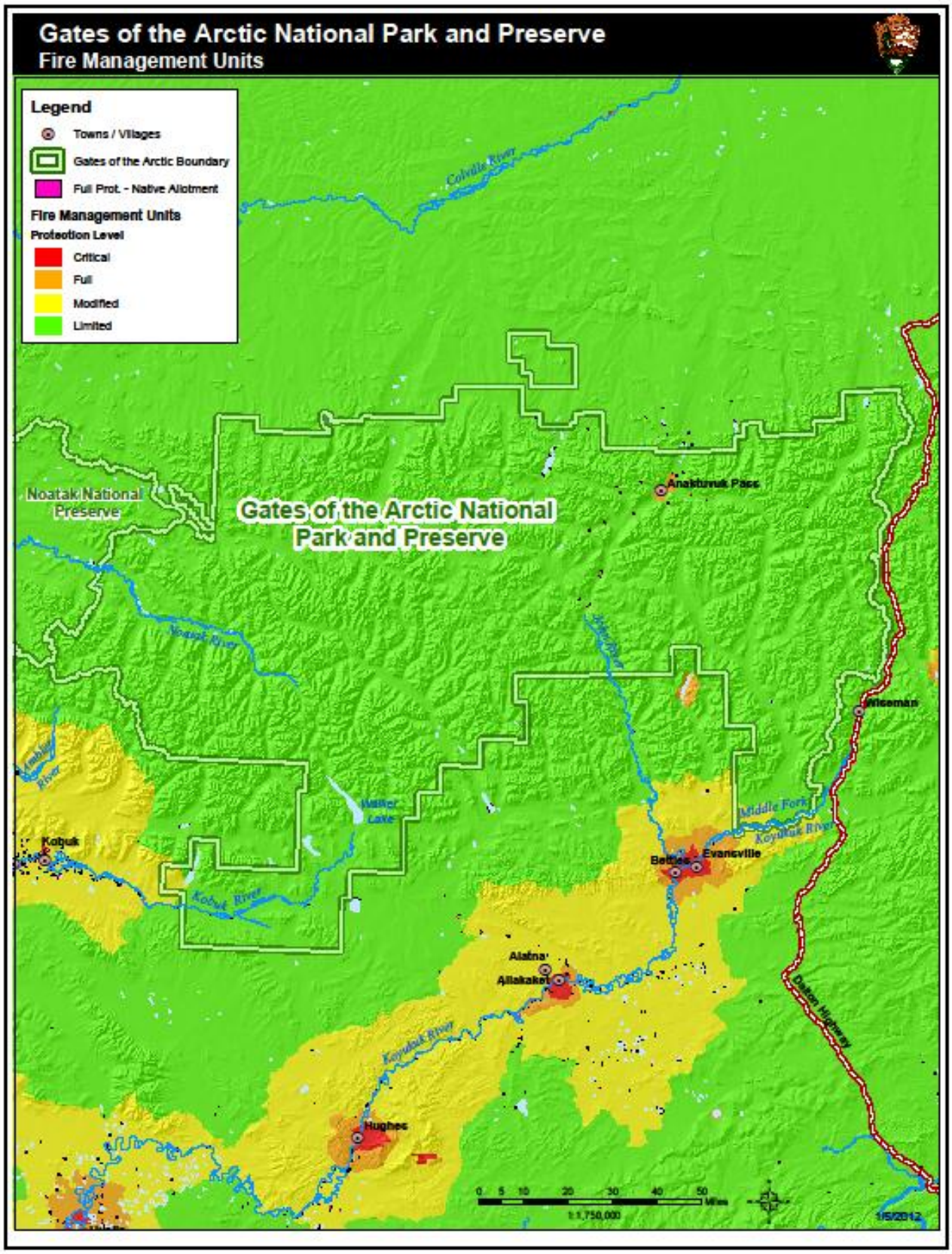


Appendix S.2: Maps

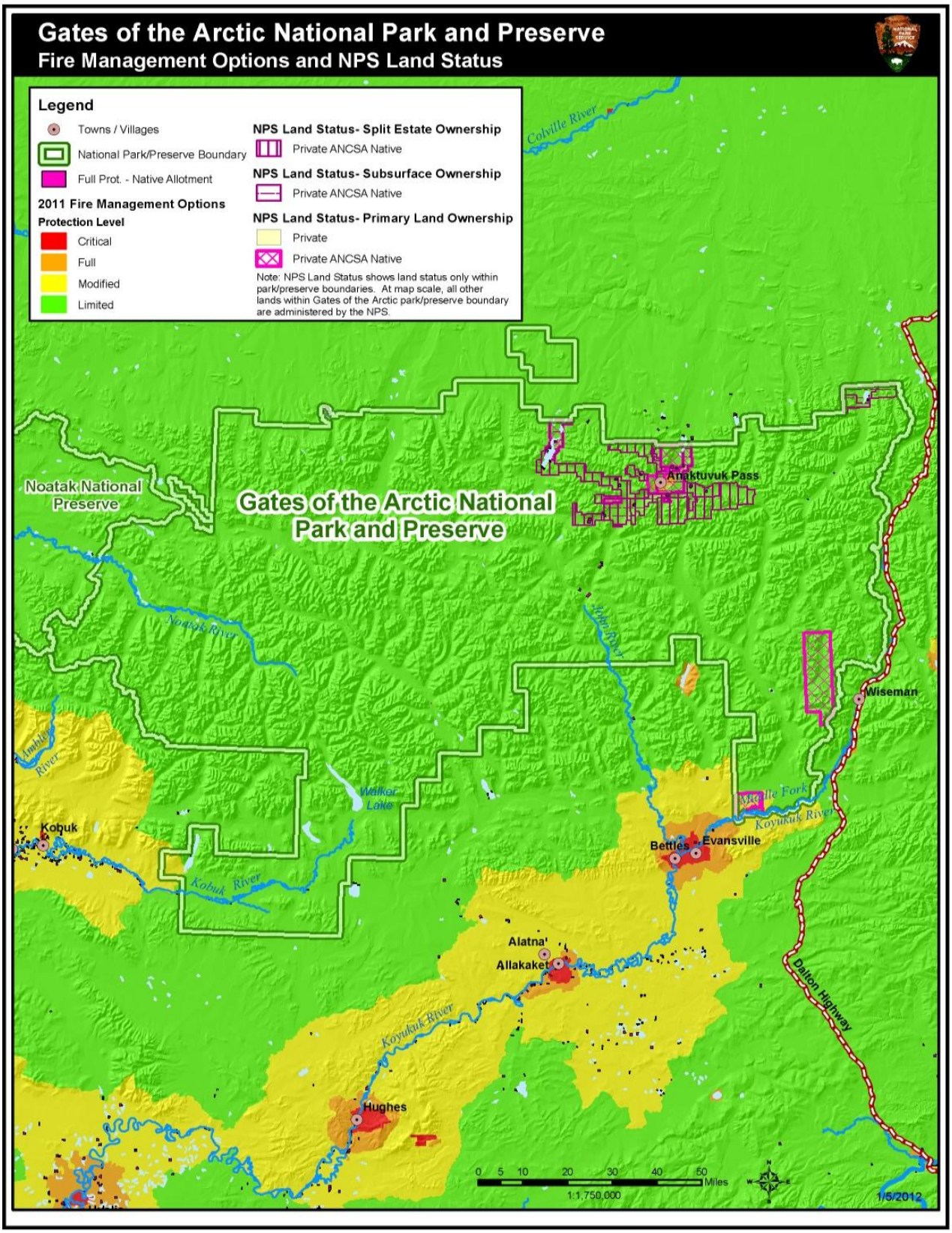
MAP 1: Protection Organizational Boundaries



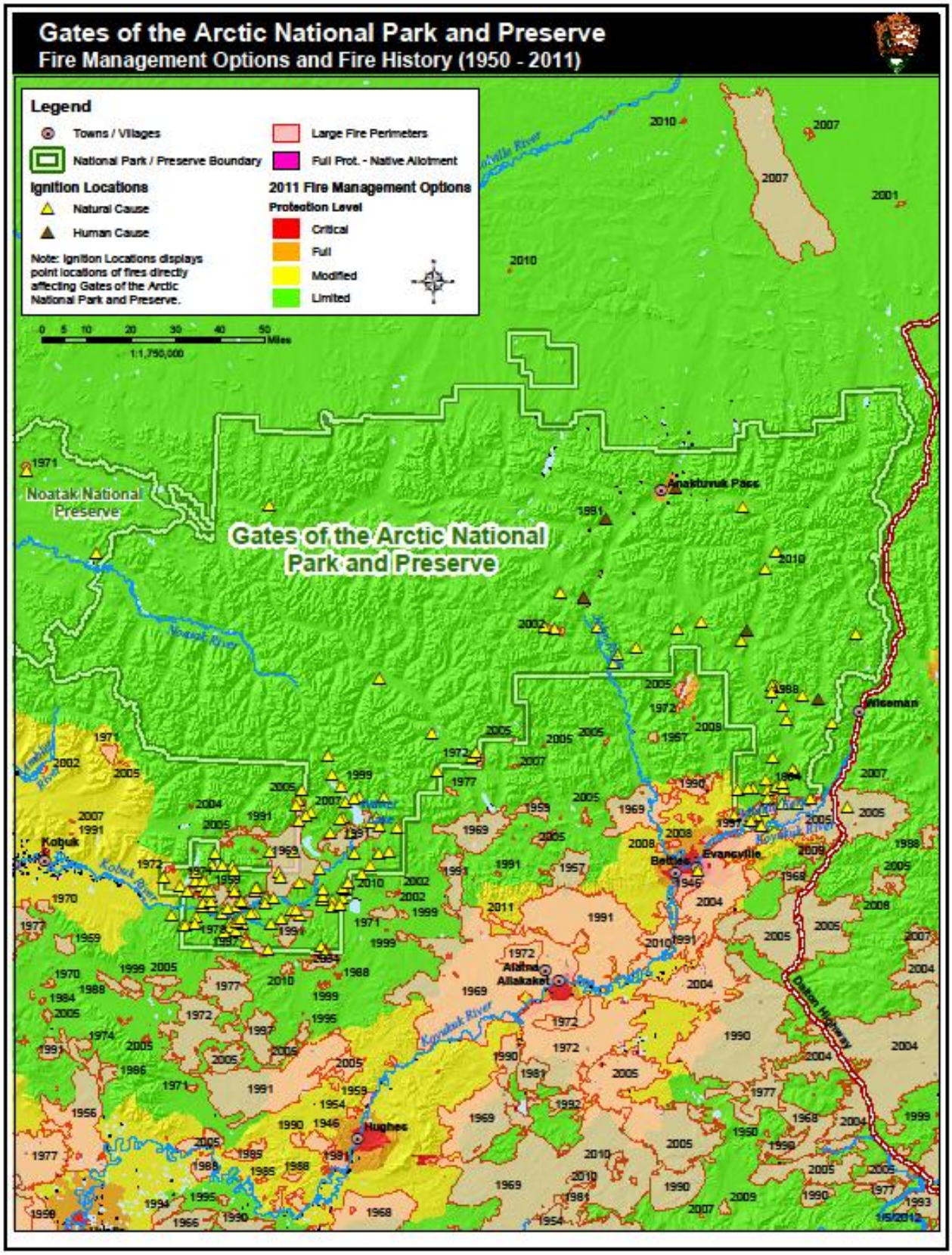
MAP 2: Fire Management Units (Options)



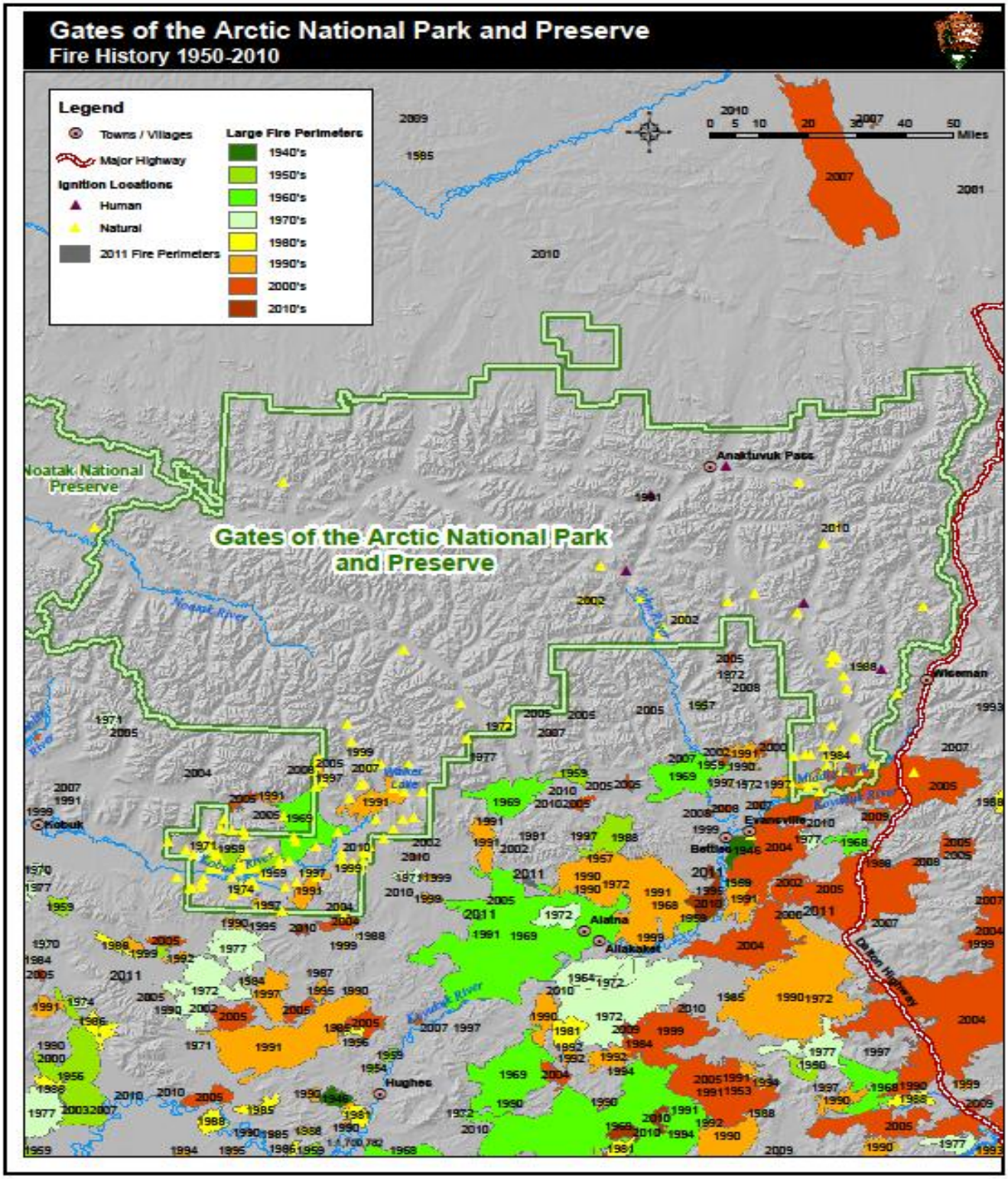
MAP 3: Fire Management Units (Options) and Land Status



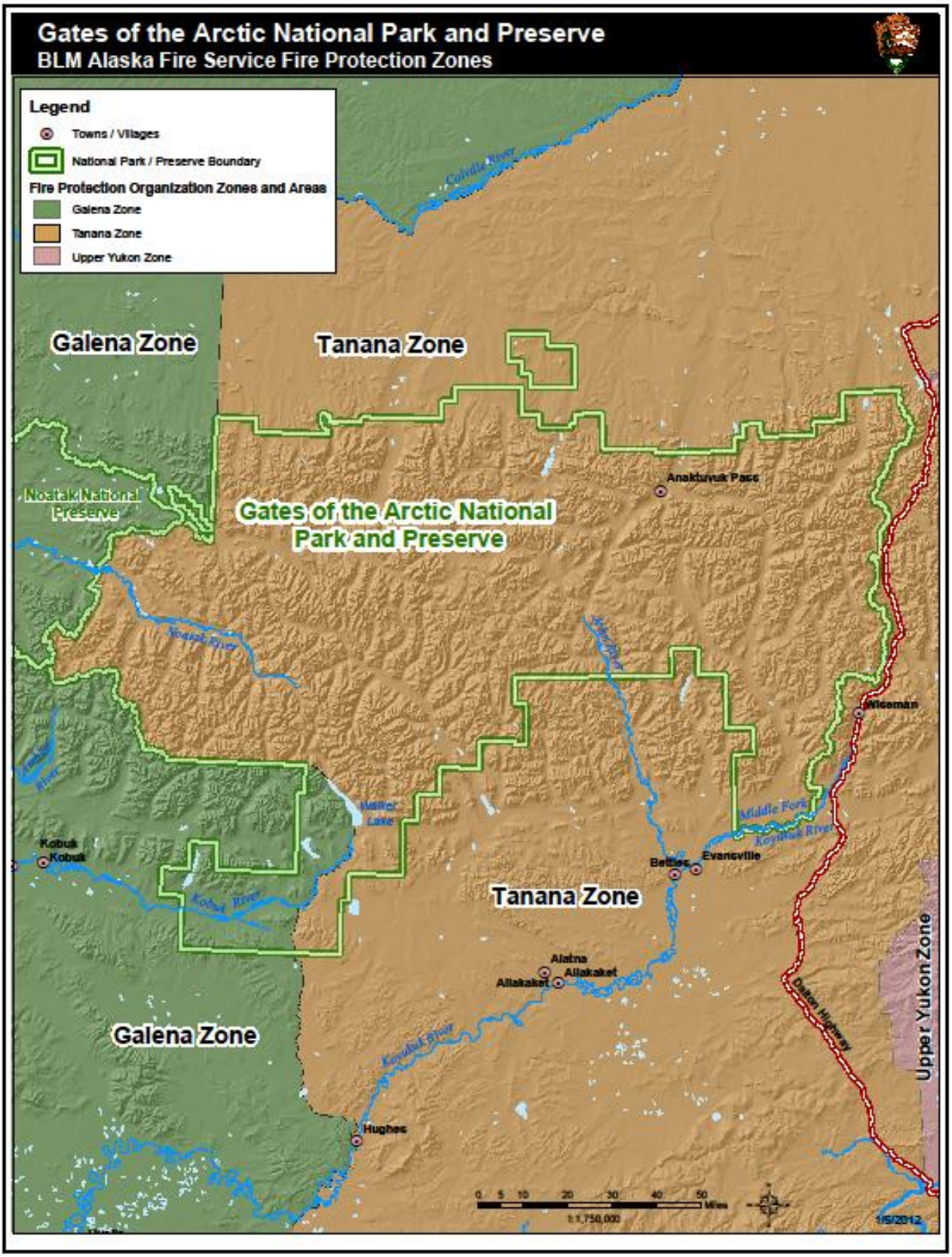
MAP 4: Fire Management Units (Options) and Fire History



Map 5: GAAR Fire History by Decade Map



Map 6: Gates of the Arctic Fire Protection Zones



Map 7: GAAR CFFDRS Fuels Map: