U.S. Fish & Wildlife Service

Fire Management Plan Review

Yukon Flats National Wildlife Refuge

May 2012

Review and Approvals

Prepared by Eastern Interior Fire Management Officer	Date 5/22/12
Submitted by Yukon Flats NWR Refuge Manager	Date 5/22/2012

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1. Introduction

1.1. Purpose and Need for Action

This document is the Fire Management Plan (FMP) for the Yukon Flats National Wildlife Refuge (Yukon Flats NWR). The FMP is written to meet United States Department of the Interior (DOI) and U.S. Fish and Wildlife Service (FWS) requirements that all agency lands with burnable vegetation must be managed under an approved Fire Management Plan (620 DM 1.4).

The goal of the U.S. Fish and Wildlife Service (Service) wildland fire management program is to plan and implement actions to help accomplish the mission of the National Wildlife Refuge System. The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. (095 FW 3.2)

To maintain currency, fire management plans must be reviewed each year using the nationally established annual review process. Plans must be revised when significant changes occur or substantial changes in management are proposed. Minor plan revisions may be accomplished through an amendment added to the plan and signed by the line officer and servicing fire management officer. Major scheduled revisions to fire management plans will follow the 15 year Comprehensive Conservation Plan revision cycle to provide consistency in objectives and management strategy formulation. Without a current FMP, prescribed fires cannot be conducted and response to unplanned ignitions can only consider suppression strategies. Preparedness and prevention activities can continue in the absence of an approved plan. (FWS FMH 2010)

This FMP provides the planning framework for all refuge fire management decision-making, within the context of the Yukon Flats NWR Comprehensive Conservation Plan (CCP), approved in October 1987. It provides direction for activities including preparedness, appropriate management response, fire prevention and education, monitoring, research, and hazardous fuel reduction using prescribed fire and non-fire treatments. The goal of the FMP is to integrate these activities into a unified management strategy that protects human life and identified property values and to conserve, protect, and enhance habitats and maintain desired ecological conditions for the benefit of fish and wildlife on the Refuge.

1.2. General Description of the Yukon Flats NWR

1.2.1. Location and Description

The refuge lies totally within the Service's Interior Ecosystem Unit and contains a diverse mosaic of plant communities representative of all major habitat types occurring in Interior Alaska. The refuge straddles the Arctic Circle in eastern interior Alaska, and its dominant physical feature is the Yukon River, which flows through the heart of it. The refuge contains lowlands associated with the Upper Yukon River and its tributaries, which form the Yukon Flats Basin. The southern boundary of the refuge is about 70 air miles north of Fairbanks, and the refuge stretches about 220 miles east-west and about 120 miles north-south. As of 2010, more than 8.4 million acres within the refuge boundary were federally managed (USFWS Land Status Database 2010).

1.2.2. **History and Land Status**

The Yukon Flats is considered to have been part of the route traveled by the ancestors of the American Indians from Asia to the Americas. The earliest human inhabitants may have arrived in the area from 9,000 to 11,000 years ago (Clark 1981a). The Native people currently living in the area are mainly of Gwich'in Athabascan descent, but also include Koyukon Athabascan and Inupiat Eskimo (USFWS 1994). Historically, these peoples spent much of the year wandering the region in bands to exploit seasonal abundances of fish, wildlife, and plants (Nelson 1973).

Fort Yukon was established in 1847 as a Hudson's Bay Company's trading post (Caulfield 1983). Few Europeans lived in the area, but impacts on the Native population through smallpox, measles, and other diseases were severe (McClellan 1981). The subsistence lifestyle of local natives began to change with introduction of trapping for European fur traders. A cash economy was begun in the late 1800's by cutting wood for steamboats, hauling freight, and building boats and further developed later by other wage employment (Caulfield 1983; Hosley 1981b; McClellan 1981; Nelson 1973, 1983). Despite these changes, in the 1940's, subsistence hunting and fishing was still providing all or a major part of the food to 70% of the people in the area (Caulfield 1983).

Currently, the refuge is surrounded by state selected and conveyed lands to the southwest, southeast, and east; BLM lands to the east, south, west, and northwest; the Native Village of Venetie to the north; and Arctic NWR to the north and northeast. Within the refuge boundaries, there are approximately 2.5million acres of land selected by or conveyed to Native corporations and Native allotment holders (Figure 1). These tracts range from small lots (160-acre allotments or fractions of them) to entire townships. The status of these allotments is either selected, interim conveyed, or conveyed. Some allotments have cabins or fish camps.

The area is sparsely populated. Some people may spend part of the summer in fish camps on Native allotments, but otherwise they reside in villages. No roads pass through the area, although roads reach Circle, southeast of the refuge, and cross the Yukon River just west of the refuge boundary. Travel is by air throughout the year, by boat in summer, and by snow machine and dog sled in winter. Five villages are within refuge boundaries, and three villages are adjacent to the refuge. The population of the Yukon Flats is currently about 1,335 people (USFWS 2010).

1.3. Significant Values to Protect

Human life is the single, overriding value to be protected by actions authorized under this plan. Priorities for the protection of human communities and community infrastructure, other property and improvements, and natural and cultural resources will be incident specific, and will be based on the values at risk, human health and safety, and the costs of protection.

The specific purposes for which the refuge was established and is managed, as specified by ANILCA are:

- To conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to canvasbacks and other migratory birds, Dall sheep, bears, moose, wolves, wolverines and other furbearers, caribou (including participation in coordinated

ecological studies and management of the Porcupine and Fortymile caribou herds) and salmon;

- Fulfill international treaty obligations with respect to fish and wildlife and their habitats;
- Provide, in a manner consistent with purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents; and
- Ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary quantity within the refuge.

Sixteen miles of Beaver Creek within the refuge, as well as 111 miles within adjacent Bureau of Land Management (BLM) lands, have been designated as a National Wild River. A corridor containing about 8,500 acres of refuge lands is to be managed in accordance with the Wild and Scenic Rivers Act "to protect and enhance the values which caused it to be included in said system." The entire lower Sheenjek River in the refuge is a proposed National Wild River (USDI 1999).

Wild land fires are a natural part of the boreal forest, and the plants and animals in it are adapted to fire, which maintains ecosystem health. If fire is excluded, ecosystem processes, function, vigor, and diversity will be altered. There are objects and resources within the refuge boundary that warrant special consideration regarding fire and/or protection from fire. They include real property on the refuge, private property within the refuge, sensitive plant and wildlife species, and sensitive biological communities.

Abundant and diverse wetlands (including marshes, wet meadows, muskeg, lakes, ponds, rivers, and streams) are dominant features of the refuge. The lowland Yukon Flats region contains an estimated 17,000 lakes and ponds, and approximately 7,100 miles of streams and rivers (USFWS 2010). Because the Yukon River drains relatively undisturbed terrain, and continuously suspends, transports, and re-deposits sediment, the Yukon River is still considered pristine (USGS and Yukon River Intertribal Watershed Council 2007). Water quality in Birch Creek and Beaver Creek has historically been poor, mainly caused by mining in their headwaters outside the refuge, but that has been largely repaired (USFWS 1990). Local residents remain concerned about water quality because of its effects on fish and wildlife populations and because at least some residents in each village depend on streams and rivers within the refuge for drinking water.

Wetlands provide habitat for millions of migrating water birds. The Yukon Flats Basin is one of the greatest waterfowl breeding areas in North America and provides habitat for many species of conservation concern. It is a nominated “Important Bird Area” and provides waterfowl habitats of international significance. The refuge also includes a full suite of large mammals indicative of an intact predator/prey system including moose, caribou, Dall’s sheep, wolves, black bear, and grizzly bear.

Air quality is generally good. Wind occasionally stirs up silt off river bars, and air pollution from Europe and Asia is present as "Arctic haze." Smoke from fires can be significant during active fire seasons and linger for extended periods, although most summers have little smoke.

The refuge has no developed recreational or interpretive sites. One interagency interpretive site is present along the Dalton Highway west of the refuge. Refuge headquarters are in Fairbanks. A refuge administrative cabin is located on Canvasback Lake near the center of the refuge and there is a fuel storage facility in Beaver. There is also a cabin and warehouse in Fort Yukon.

About forty private cabins and tent frames are permitted on the refuge for subsistence or trapping activities. Real property is listed in Table 1.

Property	Number	Value ($)
Canvasback Lake Administrative Cabin	1	70,000
Fort Yukon Administrative Site	1	250,000
TOTAL	2	320,000

Table 1: Real Property on Yukon Flats NWR

There are two primary categories of public use on the refuge: subsistence use and recreational use. Subsistence uses are provided for by ANILCA and account for the vast majority of public use on the refuge. Subsistence users harvest more than 50 species of fish, mammals, birds, and plants (Sumida 1988). The six wildlife-dependent recreational activities, dictated by the National Wildlife Refuge System Improvement Act of 1997, are "hunting, fishing, wildlife observation, and photography, environmental education and interpretation." The main recreational activities are hunting, fishing, floating rivers, and incidental activities such as camping and wildlife observation (USFWS 1994). For a more detailed discussion of subsistence activities on the refuge see the Environmental Assessment (Appendix I), Refuge CCP (USFWS 1987), annual narrative reports (USFWS 1994, 1996), the 2010 final EIS for the proposed refuge land exchange (USFWS 2010), Caulfield (1983), Sumida (1988, 1989), and Sumida and Andersen (1990).

1.4. Effects of Climate on Biotic Composition

It is widely accepted by the scientific community that the earth, which has always experienced climate variation, is now undergoing a period of rapid climate change that is enhanced by anthropogenic atmospheric carbon enrichment during the past 100 years (Inkley et al. 2004). Historical trends and projections of declining snow cover during this century portend changes in boreal and alpine ecosystems. If air temperatures increase at projected rates, alpine snow cover will likely recede (IPCC 1996). Even small amounts of warming may eliminate some wetland plant and animal species in alpine regions (Burkett and Kusler 2000). Interactions and changes in forest dynamics due to disease and insects are also very likely in areas where warming is greater (Inkley et al. 2004).

Such climate change has the potential to affect fish, wildlife, and plants throughout North America—either directly or indirectly through responses to changing habitat conditions. The geographic ranges of North American flora and fauna are expected to shift upwards in elevation and northward over the next 100 years (IPCC 2002). Although the response will be diverse, such shifts could cause significant restructuring of existing plant and animal communities (Inkley et al. 2004).

Climate change in boreal and arctic Alaska is well documented (Arctic Climate Impact Assessment 2005, IPCC 2007, Hinzman et al. 2005). Mean annual air temperature in interior Alaska has increased by 1.3° C in the last 50 years and is expected to increase another 3 – 7° C by the end of the 21st century (Chapin et al. 2010). The snow-free period has increased, up to 10 days in some areas, largely due to earlier spring snowmelt (Hinzman et al. 2005, Euskirchen et al. 2006). These changes will have numerous effects on vegetation, hydrology, insect occurrence, and wildlife that could fundamentally change boreal forest and tundra ecosystems. Effects include:

- Melting permafrost;
- Melting sea ice, which has implications for marine mammals and regional weather patterns (Hu et al. 2010);
- Drying wetlands (Riordan et al. 2006);
- Changing fire regimes(Kasischke et al. 2010), including changes in the initiation and end of fire season, and changes in the frequency and severity of fires;
- Shifts in distribution of plants and animals (Murphy et al. 2010, Beck et al. 2011);
- Increased likelihood for invasive plant establishment (Villano 2008), and
- Increased possibility of wildlife disease and insect outbreaks.

Research and modeling efforts provide insight on potential future conditions, but specific agency guidance on addressing these changes is limited. The Service has developed a strategic plan for responding to climate change that includes three broad approaches: adaptation, mitigation, and engagement (USFWS 2010). The core of the Service's response will be adaptation, defined as planned, science-based management actions, including regulatory and policy changes, taken to help reduce the impacts of climate change on fish, wildlife, and their habitats.

Yukon Flats NWR's mandate to conserve fish and wildlife populations and habitats in their natural diversity presents a challenge for fire managers who must consider this and other legal mandates, as well as safety obligations in the face of changing climate and fire regimes.

A number of questions about the Service's response to these changes have yet to be answered:

- At what scale should diversity be addressed in management plans- the refuge or beyond?
- Should naturally occurring fires be suppressed to maintain natural diversity if old-growth or sensitive habitats become rare due to fire or other stressors?
- The primary goal for mitigation in the Service's strategic plan is to sequester carbon. How will sequestration objectives be applied in Alaska, where numerous species depend on fire and where many naturally occurring, landscape-scale fires are currently allowed to burn if they do not threaten life or property?

In the absence of specific guidelines, Refuge fire management decisions will be based on guidance provided in Refuge Comprehensive Conservation Plan and associated step-down plans, ANILCA, the Alaska Interagency Fire Management Plan, and evolving scientific data about the effects of climate change. Activities will be coordinated with Landscape Conservation Cooperatives and the regional Inventory and Monitoring Program when appropriate. Continued monitoring of fire effects and participation in research efforts will better inform management decisions in the face of climate change.

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2. **Policy, Land Management Planning and Partnerships**

2.1. Fire Policy

See **Appendix I f**or complete citations of policy documents.

2.1.1. **Federal Interagency Wildland Fire Policy**

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 fires is based on ecological, social and legal consequences of the 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 response to the fire.

This FMP implements the guiding principles of federal wildland fire policy excerpted from the *Review and Update of the 1995 Federal Wildland Fire Management Policy (January 2001)*:

1) Firefighter and public safety is the first priority in every fire management activity.
2) The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the planning process. Federal agency land and resource management plans set the objectives for the use and desired future condition of the various public lands.
3) Fire management plans, programs, and activities support land and resource management plans and their implementation.
4) Sound risk management is a foundation for all fire management activities. Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of an activity.
5) Fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives,
6) Fire management plans and activities are based upon the best available science.
7) Fire management plans and activities incorporate public health and environmental quality considerations.
8) Federal, State, tribal, local, interagency, and international coordination and cooperation are essential.
9) Standardization of policies and procedures among federal agencies is an ongoing objective.

In addition, the following guidelines from *Guidance for Implementation of Federal Wildland Fire Management Policy (February 2009)* are considered in order to provide consistent implementation of federal wildland fire policy:

1) Wildland fire management agencies will use common standards for all aspects of their fire management programs to facilitate effective collaboration among cooperating agencies.

2) Agencies and bureaus will review, update, and develop agreements that clarify the jurisdictional inter-relationships and define the roles and responsibilities among local, State, tribal and federal fire protection entities.

3) Responses to wildland fire will be coordinated across levels of government regardless of the jurisdiction at the ignition source.

4) Fire management planning will be intergovernmental in scope and developed on a landscape scale.

5) Wildland fire is a general term describing any non-structure fire that occurs in the wildland. Wildland fires are categorized into two distinct types:

   a) Wildfires – Unplanned ignitions or prescribed fires that are declared wildfires

   b) Prescribed Fires - Planned ignitions.

6) A wildfire may be concurrently managed for one or more objectives and objectives can change as the fire spreads across the landscape. Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives.

7) Management response to a wildfire on federal land is based on objectives established in the applicable Land/Resource Management Plan and/or the Fire Management Plan.

8) Initial action on human-caused wildfire's will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.

9) Managers will use a decision support process to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions.

Federal Wildland Fire Cost Effectiveness Policy

Maximizing the cost effectiveness of any fire operation is the responsibility of all involved, including those who authorize, direct, or implement operations. Cost effectiveness is the most economical use of resources necessary to accomplish mission objectives. Accomplishing fire operations objectives safely and efficiently will not be sacrificed for the sole purpose of "cost-saving." Care will be taken to ensure that expenditures are commensurate with values to be protected, while understanding that other factors may influence spending decisions, , including those from the social, political, economic, and biophysical environments. *(2012 Interagency Standards for Fire and Fire Aviation Operations, Chapter 1).*

2.1.2. **National Fire Plan**

This FMP emphasizes the following overarching goals and performance measures described in *A National Cohesive Wildland Fire Management Strategy (2011)*

Restore and Maintain Landscapes:

> **GOAL:** *Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.*

Outcome-based Performance Measure:

- Risk to landscapes is diminished.

Fire Adapted Communities:

GOAL: *Human populations and infrastructure can withstand a wildfire without loss of life and property.*

Outcome-based Performance Measure:

- Risk of wildfire impacts to communities is diminished.
- Individuals and communities accept and act upon their responsibility to prepare their properties for wildfire.
- Jurisdictions assess level of risk and establish roles and responsibilities for mitigating both the threat and the consequences of wildfire.
- Effectiveness of mitigation activities is monitored, collected and shared.

Wildfire Response:

GOAL: *All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.*

Outcome-based Performance Measure:

- Injuries and loss of life to the public and firefighters are diminished.
- Response to shared-jurisdiction wildfire is efficient and effective.
- Pre-fire multi-jurisdictional planning occurs.

2.1.3. Department of the Interior (DOI) Fire Policy

This FMP meets DOI policy in the *Departmental Manual (620 DM 1 and 620 DM 2)* by making full use of wildland fire as a natural process and as a tool in the planning process, and by providing for the following:

- Wildland fires, whether on or adjacent to lands administered by the Department, which threaten life, improvements, or are determined to be a threat to natural and cultural resources or improvements under the Department's jurisdiction, will be considered emergencies and their suppression given priority over other Departmental programs. (620 DM 1.6 B)
- Bureaus shall cooperate in the development of interagency preparedness plans to ensure timely recognition of approaching critical wildland fire situations; to establish processes for analyzing situations and establishing priorities, and for implementing appropriate management responses to these situations. (620 DM 1.6 E)
- Bureaus will enforce rules and regulations concerning the unauthorized ignition of wild land fires, and aggressively pursue violations. (620 DM 1.7) Wild land fire will be used to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, be allowed to function in its natural ecological role *(620 DM 1.4.D)*.

Additionally, this FMP implements the policy outlined in 620 DM 2.4 that sets out the lead fire protection role of the *Bureau of Land* Management (BLM) for the DOI agencies in Alaska.

"BLM will maintain and operate the Department of the Interior wildland fire suppression organization in Alaska with the primary intention of providing cost-effective suppression services and minimizing unnecessary duplication of suppression systems for Department of the Interior agencies. BLM will also provide consistency in State and Native wildland fire relationships and provide State-wide mobility of wildland fire resources.

BLM is authorized to provide safe, cost-effective emergency wildland fire suppression services in support of land, natural and cultural resource management plans on Department of the Interior administered land and on those lands that require protection under the Alaska Native Claims Settlement Act, as amended (43 U.S.C. 1620(e)), herein after referred to as Native land. BLM will execute these services within the framework of approved fire management plans or within the mutually agreed upon standards established by the respective land managers/owners."

a. Nothing herein relieves agency administrators in the Interior bureaus of the management responsibility and accountability for activities occurring on their respective lands.

b. Wildland fire suppression and other fire management activities provided on Native lands under the authority of the Alaska Native Claims Settlement Act, as amended (43 U.S.C. 1620(e)), will consider Native land managers on an equal basis with Federal land managers.

c. Each bureau will continue to use its delegated authority for 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 the wildland fire suppression organization on respective bureau lands."

2.1.4. **U.S. Fish and Wildlife Service Fire Policy**

The goal of fire management as stated in the Service Manual (621 FW 1.2) is "to protect or enhance habitat and ecosystems for the benefit of fish and wildlife." Service policy (621 FW 1.3) states that the Service will use prescribed fire whenever it is an appropriate tool for managing Service resources, and will protect against wildland fire whenever it threatens human health, private property, or Service resources.

Any response to wildland fire occurring on Yukon Flats NWR will be based on direction provided in this FMP. The FMP addresses the management of all fire related activities, and considers a full spectrum of strategic options (from monitoring to intensive management actions) designed to meet Fire Management Unit (FMU) objectives. It fully applies procedures and guidelines in the FWS *Fire Management Handbook (FWS FMH 2011)* and the *Interagency Standards for Fire and Fire Aviation Operations (2011 Red Book)* and affirms these key elements of FWS fire policy:

- Firefighter and public safety is the first priority of the wildland fire management program and all associated activities.
- Only trained and qualified leaders and agency administrators will be responsible for, and conduct, wildland fire management duties and operations.

- Trained and certified employees will participate in the wildland fire management program as the situation requires; non-certified employees will provide needed support as necessary.
- Fire management planning, preparedness, wildfire and prescribed fire operations, other hazardous fuel operations, monitoring, and research will be conducted on an interagency basis with involvement by all partners to the extent practicable.
- The responsible agency administrator has coordinated, reviewed, and approved this FMP to ensure consistency with approved land management plans, values to be protected, and natural and cultural resource management plans, and that it addresses public health issues related to smoke and air quality.
- Fire, as an ecological process, has been integrated into resource management plans and activities on a landscape scale, across agency boundaries, based upon the best available science.
- Wildland fire is used to meet identified resource management objectives and benefits when appropriate.
- Prescribed fire and other treatment types may be employed when they selected as the appropriate tool to reduce hazardous fuels and the associated risk of wildfire to human life, property, and cultural and natural resources; and to manage our lands for habitats as mandated by statute, treaty, and other authorities.
- Response to Wildfires will consider firefighter and public safety, cost effectiveness, values to protect, and natural and cultural resource objectives.
- Staff members will work with local cooperators and the public to prevent human ignition of wildfires on service lands.

2.1.4.1. Region 7 FWS Policy

All activities authorized under this FMP will comply with Region 7 FWS policies, including but not limited to:

- *Region 7 Policy for Management of Permitted Cabins on National Wildlife Refuges in Alaska (August 2010) (RW-1)*
- *U.S. Fish and Wildlife Service Region 7 Bear Awareness and Firearms Safety Training Policy (February 22, 2008)*
- *U.S. Fish and Wildlife Service Region 7 Watercraft Safety and Training Annex (January 12, 2011)*

2.1.5. Alaska Region Interagency Fire Management

Background on Fire Management Policy in Alaska Region(1939-2010):

The history of fire control within Interior Alaska dates back to 1939 when the Alaskan Fire Control Service was established under the General Land Office. Headquartered in Anchorage, it was given responsibility for fire suppression on an estimated 225 million fire-prone acres of public domain lands in Alaska. When the Bureau of Land Management (BLM) was formed in

1946, it received the management authority for most of Alaska's federal lands and also absorbed the Alaska Fire Control Service. The BLM fire organization was based in Fairbanks and Anchorage and the two offices worked cooperatively but separately. The BLM also kept a Division of Fire Management at the State Office.

In 1959, the first of three big divestures of land managed by BLM-Alaska began and, with the changes in land management authority, issues regarding wildland fire suppression responsibilities arose.

- Under the Statehood Act 1959, the State was granted 104 million acres of land.
- Alaska Native Claims Settlement Act of 1971 (ANCSA) established Native corporations and an entitlement of 44 million acres for those corporations.
- The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) transferred approximately 100 million acres from BLM administration to the National Park Service and Fish and Wildlife Service.

Under ANCSA, the federal government was directed to continue to provide wildland fire suppression on lands conveyed to Native regional and village corporations. In response to ANILCA, Secretarial Order #3077, dated March 17, 1982, creating "a fire line organization with headquarters in Fairbanks" was issued. BLM, Alaska Fire Service (AFS) was formed and, in Department of Interior Manual 620, AFS was assigned the fire suppression responsibility for all Department of Interior-administered lands in Alaska and Native Corporation land conveyed under ANCSA. Department of Interior-administered lands include land managed by the BLM, the National Park Service, Fish and Wildlife Service, and the Bureau of Indian Affairs. Each agency remained accountable for following its agency's mandates and policies for resource and wildland fire management. The role of AFS is to implement each agency's direction.

BLM Anchorage and Fairbanks districts fire suppression authority was delegated to AFS. The Division of Fire Management in the State Office was phased out. Today, in conjunction with his interagency role, the AFS Manager works directly for the BLM State Director and serves as the BLM State Fire Management Officer. The BLM Field Offices[1] retain the fire management responsibilities; AFS implements the fire direction given by the Field Offices and provides technical fire management expertise. This same principal applies to FWS and NPS lands. The State of Alaska established a wildland fire suppression organization in the Department of Natural Resources, Division of Forestry, and, in the mid-1970s, began to gradually assume suppression responsibilities in the Anchorage area and on the Kenai Peninsula.

A reciprocal fire protection agreement was signed by the BLM, AFS and the State to cooperatively provide fire suppression operations in fire-prone areas. (AFS also has an agreement with the U.S. Army-Alaska for wildland fire suppression on BLM-managed lands withdrawn for military use.) Under the State agreement, AFS has the suppression responsibility for wildland fires in the northern half of the Alaska, regardless of ownership, including the Yukon Flats NWR. The State has the suppression responsibility for wildland fires in Southcentral, most of Southwestern Alaska and portions of the Central Interior. Most State protection areas are lands previously protected by the BLM Anchorage District; most of AFS

[1] BLM Districts are now called Field Offices.

protection is in areas once protected by the BLM Fairbanks District. As of 1985 when the State took over protection responsibilities for 66 million acres in southwest Alaska, the State and AFS each protect roughly half of the fire-prone lands in Alaska. The Forest Service protects State, Federal, and Native lands within the boundaries of Chugach and Tongass National Forests.

An Interagency fire response plan, the **Alaska Interagency Wildland Fire Management Plan 2010 (AIWFMP)**, was developed in Alaska during the 1980s and 1990s in order to help prioritize initial attack responses, and allow for some fires to be managed for resource benefit.

In 2010 the reciprocal fire protection agreements between the protection agencies (DNR, BLM AFS and USFS) and the individual memorandum of agreement between land management agencies (FWS, NPS, BIA) were consolidated into the **Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement 2010 (Master Agreement)**. The Master Agreement and its exhibits (including the AIWFMP) define the roles and responsibilities of the jurisdictional and protection agencies as well as operating procedures for fire management in Alaska.

2.2. Land/Resource Management Planning

2.2.1. **Yukon Flats NWR Comprehensive Conservation Plan (CCP)**

This FMP steps down from the Yukon Flats NWR Comprehensive Conservation Plan (1987). The land and resource management goals and objectives that form the basis of this FMP have been identified in the CCP (**See Section 3.1.1**). The Yukon Flats CCP revision process began in May 2012. This FMP will undergo a major revision in concert with that process.

2.2.2. **Compliance with Regulatory Acts**

The management direction and actions specified in this FMP were evaluated in the approved Refuge CCP (1987), in accordance with National Environmental Policy Act of 1969 (NEPA), and Sections 304 and 810 of ANILCA. Public participation in the CCP process was used in the development of alternatives and in the selection of a preferred management alternative.

In addition, an environmental assessment was conducted in 2001 in order to evaluate the effects of this FMP. The EA resulted in a Finding of No Significant Impact and a Finding of No Significant Restriction of Subsistence Uses.

Prescribed fires and fuel reduction activities authorized under this FMP require completion of an initial NEPA Compliance Checklist in order to determine whether additional NEPA documentation is necessary. Fire suppression activities are normally categorically excluded from further Environmental Assessment analysis (516 DM 2 and 16 DM 6); however, before implementing any fire management project not categorically excluded, the appropriate level of NEPA compliance will be completed. Fire management activities authorized within the scope of this plan will also comply with all of the following Regulatory Acts:

- *Endangered Species Act of 1973 (ESA)*
- *National Historic Preservation Act of 1966 (NHPA)*
- *Archeological Resources Protection Act of 1979 (ARPA)*
- *Alaska National Interest Lands Conservation Act of 1980 (ANILCA)*

- *Alaska Native Claims Settlement Act of 1971 (ANCSA) [43 USC 1620(e)]*
- *Director's Order 172: Migratory Birds*
- *Subsistence Evaluation and Finding, Section 810 - Alaska Lands Act*

2.3. Fire Management Partnerships

2.3.1. **Internal Partnerships**

Contributors to this FMP included many current and former Yukon Flats NWR employees, staff from other Alaskan refuges, the Service Fisheries Research Office in Fairbanks, and the Regional Office. Disciplines represented include wildlife biology, fire management, refuge operations, archeology, forestry, botany, refuge management, subsistence program, and refuge information. Contributions came from individuals both at the technician level and the professional level.

2.3.2. **External Partnerships**

2.3.2.1. Alaska Interagency Coordinating Groups

2.3.2.1.1 ***Alaska Interagency Coordination Center (AICC)***

National fire resource coordination is accomplished through the National Interagency Coordination Center (NICC) located in Boise, ID and through eleven Geographic Area Coordination Centers (GACCs) located throughout the country. AICC is Alaska's GACC, located on Fort Wainwright in Fairbanks. The principal mission of AICC is to provide safe, cost effective, and timely response of national and area resources for all aspects of wildland and prescribed fire management activities, and other emergency management activities within Alaska.

2.3.2.1.2 ***Alaska Wildland Fire Coordinating Group (AWFCG)***

The Alaska Wildland Fire Coordinating Group (AWFCG) group provides coordination and recommendations for all interagency fire management activities in Alaska. Membership, procedures, and guidelines are documented in the AWFCG Memorandum of Understanding and Standard Operating Procedures available at http://fire.ak.blm.gov/administration/awfcg.php. The Region 7 Fire Management Coordinator represents the Service on this group.

2.3.2.1.3 ***Alaska Multi Agency Coordinating Group (AMAC)***

The Alaska Multi-Agency Coordination Group (AMAC) 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. When activated and as warranted, the AMAC is tasked with the following: incident prioritization; resource allocation; coordination of state and federal disaster responses; political interfaces; media and agency information; anticipation of future resource needs; and the identification and resolution of issues. The *AMAC Operations Handbook* is available at http://fire.ak.blm.gov/administration/mac.php. The Region 7 Fire Management Coordinator represents the Service on this group.

2.3.2.2. Interagency Agreements and Planning Documents

2.3.2.2.1 *Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement 2010 (Master Agreement)*

The Master Agreement and its exhibits define the roles and responsibilities of the jurisdictional and protection agencies as well as operating procedures for fire management in Alaska. It documents the commitment of its signatories to improve the efficiency of fire management activities in Alaska by facilitating the coordination and exchange of personnel, equipment, supplies, services, and funds. The Master Agreement also facilitates improved coordination regarding other incidents covered under the National Response Framework (NRF).

Signatories include:

- The State of Alaska, Department of Natural Resources (DNR)
- The United States Department of Agriculture Forest Service, Region 10 (USFS)
- The United States Department of the Interior, National Park Service, Alaska Region (NPS)
- The United States Department of the Interior, Fish and Wildlife Service, Alaska Region (Region 7) (FWS)
- The United States Department of the Interior, Bureau of Indian Affairs, Alaska Regional Office (BIA)
- The United States Department of the Interior, Bureau of Land Management, Alaska (BLM)
- The United States Department of the Interior, Bureau of Land Management, Alaska Fire Service (AFS)

2.3.2.2.2 *Alaska Statewide Annual Operating Plan (Alaska AOP)*

The *Alaska AOP*, exhibit C of the Master Cooperative Agreement addresses cooperation, interagency working relationships and protocols, financial arrangements, and joint activities. The *Alaska Interagency Mobilization Guide* and the *Alaska Interagency Wildland Fire Management Plan* are incorporated by reference into the *Alaska AOP*. Signatories to the *Alaska AOP* include: State Forester, AFS Manager, USFS Regional Forester, FWS, NPS, BLM and BIA Regional Director.

2.3.2.2.3 *Alaska Interagency Wildland Fire Management Plan 2010 (AIWFMP)*

The purpose of the *Alaska Interagency Wildland Fire Management Plan 2010 (AIWFMP)* is to promote a cooperative, consistent, cost-effective, interagency approach to wildland fire management in Alaska and it is the interagency reference for wildland fire operational information. It has been incorporated by reference into the *Alaska AOP*

The AIWFMP specifies direction for the response to a wildland fire that is based on a management option designation, and provides guidelines to jurisdictional and protection agencies for decision support requirements as the complexity of a wildland fire increases. The

AIWFMP is designed to be used in conjunction with this FMP which contains definitive objectives and constraints for the Yukon Flats National Wildlife Refuge.

The following AIWFMP fire management objectives were developed to meet and support agencies' goals and to provide implementation guidance for fire operations:

- 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 (fire suppression, monitoring, prescribed fire, thinning and other vegetation treatment projects, prevention and education programs, scientific studies, etc.) to achieve ecosystem sustainability including its interrelated ecological, economic, and social components.
- 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.

The AIWFMP provides for a range of suppression responses to wildfire that protects human life and property and other identified resources and developments, balances suppression costs with values at risk and is in agreement with Refuge resource management objectives. The result is that developed areas and other high resource value areas are protected and the natural occurrence of fire in the ecosystem is maintained in remote areas with minimal and cost-effective intervention. Currently many special concern areas (such as archaeological/cultural/historic sites and administrative sites/cabins) have been identified and taken care of through the process of changing the fire management option to one that provides the level of suppression needed to protect the resource(s) at risk. As new areas become known, they will be assigned a protection level and their locations provided to AFS.

Four wildland fire management options are established in the AIWFMP.

- ***Critical*** is the highest priority area/sites for suppression actions and assignment of available firefighting resources.

- ***Full*** is the second highest priority area/sites for suppression actions and assignment of available firefighting resources.
- ***Modified*** is a high priority for surveillance, suppression, and site protection during the peak of the fire season and less priority (often surveillance only) after a designated conversion date in the latter stages of the fire season, normally after July 10.
- ***Limited*** requires only a surveillance response as long as fires within this designation do not threaten to escape into higher priority areas; if a threat is ascertained, a suppression response may be initiated.

The **Critical management option** was specifically created 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. Fires that threaten a critical site have priority over all other wildland fires. These areas are the priority for detection coverage. The initial response to wildland fire is to provide protection to the area/sites. Use of wildland fire would only be appropriate in extraordinary circumstances.

The **Full management option** was established for the protection of cultural and paleontological sites, developed recreational facilities, physical developments, administrative sites and cabins, uninhabited structures, high-value natural resources, and other high-value areas that do not involve the protection of human life and inhabited property. Structures on or eligible for inclusion on the National Register of Historic Places and non-structural sites on the National Register are placed in this category. Fires occurring within or immediately threatening this designation will be high priority for initial action depending on the availability of firefighting resources but are less priority than wildland fires within or threatening a Critical Management Option area. The intent is to control wildland fires at the smallest acreage reasonably possible.

The **Modified management option** is intended to be the most adaptable option available to land managers. This option provides a higher level of protection when fire danger and probability of significant fire growth are high. A lower level of protection is considered when the fire danger and potential for fire growth decrease. Unlike the Full management option, the intent is not to minimize burned acres but to balance acres burned with suppression costs and to accomplish land and resource management objectives. After the conversion date (usually around July 10), the default action for all fires occurring within this option will be surveillance and assessment to ensure that identified values are protected and that adjacent higher priority management areas are not compromised.

In the **Limited management option** fire may be allowed to function in its ecological role while providing for the protection of human life and site-specific values. Most natural ignitions will be managed for maintaining fire's natural role in the ecosystem. Low impact or indirect suppression methods will be used whenever possible, if suppression action is needed. The intent is to reduce overall suppression costs through minimum resource commitment without compromising firefighter safety.

The AIWFMP allows the land manager to authorize the Protecting Agency to provide an increased or decreased level of suppression action depending on the situation at hand (non-standard response). Additionally, the selected fire management option area should be re-evaluated during the next annual review period. The AWFCG may approve departures from the selected management options during periods of "unusual fire conditions" for a specific

geographic area(s). These decisions will be based not only on fires and acres burning, but also on anticipated fire behavior and acreage likely to be burned, existing and anticipated smoke problems, probability of success, the experience and judgment of Service and Protecting Agency personnel, and decisions of the Multi-agency Coordinating Group (MAC Group).

Signatories include:

- The State of Alaska, Department of Natural Resources (AKDNR)
- The State of Alaska, Department of Environmental Conservation (ADEC)
- The State of Alaska, Department of Fish and Game (ADF&G)
- The United States Department of the Interior, National Park Service, Alaska Region (NPS)
- The United States Department of the Interior, Fish and Wildlife Service, Alaska Region (Region 7) (FWS)
- The United States Department of the Interior, Bureau of Indian Affairs, Alaska Regional Office (BIA)
- The United States Department of the Interior, Bureau of Land Management, Alaska (BLM)
- The United States Department of Agriculture Forest Service, Region 10 (USFS)
- The Association of Village Council Presidents
- Tanana Chiefs Conference, Inc. (TCC)
- Chugachmiut, Inc.
- Anchorage Fire Department

2.3.2.2.4 ***Alaska Interagency Mobilization Guide (AIMG)***

The *Alaska Interagency Mobilization Guide (AIMG)* identifies policy and agreements that establish the standard procedures that guide the operations of multi- agency/jurisdictional logistical support activities. The guide is an extension of Agency Manuals, Handbooks, Directives, and Instructional Memorandums relating to logistical support. The guide is intended to promote uniformity of logistical support communications, facilitate interagency dispatch coordination, and ensure that the most timely and cost effective support services are provided. It is designed to accommodate amendments and will be recognized as currently applicable until amended.

2.3.2.2.5 ***2009 Alaska Enhanced Smoke Management Plan (ESMP)***

The *Alaska Enhanced Smoke Management Plan (ESMP)* developed by the Alaska Department of Environmental Conservation (ADEC) in coordination AWFCG helps fulfill Alaska's responsibilities for protection of air quality and human health under federal and state law and reflects the *Clean Air Act* requirement to improve regional haze in Alaska's Class I areas. Under state regulation all agencies, corporations and individuals that burn areas larger than forty acres of land a year, whether slash or *in situ*, require a controlled burn approval application and written

approval from ADEC. The *ESMP* outlines the process and identifies issues that need to be addressed by ADEC and land management agencies or private landowners / corporations to help ensure that prescribed fire (e.g. controlled burn) activities minimize smoke and air quality problems. Adoption of this document enables the State to certify to the U.S. Environmental Protection Agency (EPA) that we are implementing a smoke management plan which addresses elements of the EPA's *Interim Air Quality Policy on Wildland and Prescribed Fire, April 23, 1998 (EPA's Interim Policy).* The *ESMP* and accompanying volume of appendices have been adopted by ADEC and participating Wildland owners and managers through a Memorandum of Understanding (MOU).

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3. **Yukon Flats Refuge Fire Management Unit Characteristics**

A Fire Management Unit (FMU) is a land management area definable by objectives, management constraints, topographic features, access, values to protect, political boundaries, fuel types, major fire regime groups, etc. that set it apart from the characteristics of an adjacent FMU. The Refuge Manager has decided that wild land fires will be managed in three distinct refuge FMUs.

Refuge fire management objectives resulted in selection of wild land fire management option area boundaries, which help define FMU boundaries (**Table 2**). General resource management objectives and habitat modification alternatives are nearly identical among them; slight differences in management objectives may exist between specific sites. Wild land fire management option designation is the main factor influencing how wildfires are managed. Fire management objectives for each FMU are included in (**Table 2**). Boundaries of areas in a specific fire management options may be changed annually as resource management objectives change on the refuge or on adjacent private land.

FMU	Size (acres)	Option	Wild land Fire Management Objectives
Refuge Limited	8.26 Million	Limited	1. Protect human life and site-specific values. 2. Allow fire to burn under the influence of natural forces within predetermined areas, subject to item 1 above. 3. Prevent fire from burning into Full or Critical management option areas. 4. Reduce overall suppression costs through minimum resource commitment. 5. Protect integrity of designated National Wild Rivers. (See **Section 3.2.2** and **Appendix F**)
Refuge Modified	884,000	Modified	1. Protect human life and site-specific values. 2. Protect identified resources and prevent the fire from burning into Full or Critical management option areas. 3. Reduce overall suppression costs through minimum resource commitment. 4. After conversion to Limited status, adopt objectives of units with Limited management option.
Interface	127,000	Full & Critical	1. Protect human life, property, designated sites, and designated natural resources. 2. Minimize acreage burned during initial attack.

Table 2: Yukon Flats FMUs, Management Options, and Fire Management Objectives

The Refuge Manager is responsible for all refuge fire management activities, both planned and unplanned ignitions. Unplanned ignitions (wildfires) include lightning-caused or human-caused fires. Prescribed fires are planned ignitions managed under approved prescribed fire plans. Appropriate management action (AMR) is applied to all wildfires. For some wildfires, surveillance may be the best AMR; for others, management under a wild land fire use (WFU) strategy may be the selected AMR. Such fires must be lightning-caused, must have a prescription applied, and must comply with NEPA requirements.

Adjacent lands in Modified, Full, or Critical management option designation affect fire management on the refuge. Of the 1.89 million acres of conveyed Native lands within refuge

boundaries, about 76% is designated Full or Critical management option, about 23% is Modified, and less than 1% is Limited.

3.1. Refuge-Wide Management Considerations

3.1.1. **CCP Management Goals, Objectives, and Constraints**

The Refuge CCP, which was adopted in 1987, provides direction in habitat management objectives, specifically to "emphasize the maintenance of the refuge's natural diversity and key fish and wildlife populations and habitat," to "maintain the refuge in an undeveloped state," to "provide opportunities for continued subsistence use of refuge resources," and to "maintain opportunities for hunting, fishing, and other recreational activities" (USFWS 1987).

The CCP states on page 133: Fires will generally be allowed to burn naturally where not endangering life or property. If fire suppression becomes necessary, state of the art techniques and the "minimum appropriate tool" concept will be used. Private lands within or adjacent to the refuge and special value refuge lands will receive the maximum protection practicable from fires.

A potential problem identified in the CCP is the impact of fire suppression on fish and wildlife habitats. Issues of concern identified by the public included management of refuge habitats and the impact of fire on wildlife. The CCP outlines the use of prescribed fire on the refuge "in order to improve moose habitat, to return a portion of the habitat to an earlier vegetation state, and to reduce hazardous fuel loadings." This plan is the implementing document for that use.

The objectives of cultural resource management include to "protect, maintain, and plan for the use of Service managed cultural resources for the benefit of present and future generations" (614 FW 1.2.A). Cultural resources include archaeological resources, historic property, objects of antiquity, cultural items, and traditional/ religious values. The refuge CCP (USFWS 1987) states that archeological and historical sites will be protected in accordance with all federal and state laws. The next section of the FMP will discuss constraints to fire suppression tactics imposed to protect these sites.

The CCP also references area-wide fire management planning (i.e., Alaska Interagency Wildland Fire Management Plan (AWFCG 2010) which describes the use of suppression to help meet management objectives.

3.1.2. **Management Goals, Objectives, and Constraints From Other Documents and Plans**

3.1.2.1. ANILCA

ANILCA established the upper reaches of Beaver Creek as a National Wild River, including 16 river miles within the refuge boundary. By designating the area as a "wild" river, Congress mandated that the river "be managed to be free of impoundments and generally inaccessible except by trail, with watersheds or shorelines primitive, and waters unpolluted... representing vestiges of primitive America." The Beaver Creek National Wild River Management Plan stated that considerations for fire management should include use of fire to maintain the area's "natural, primitive condition" and to benefit wildlife habitat (USDI 1983). That portion of the Sheenjek River within the refuge boundary (99 miles in length) has been recommended for designation as a National Wild River (USDI 1999).

3.1.2.1. Guidance from Other Refuge Plans

The refuge Fishery Management Plan (USFWS 1990) describes the importance of aquatic resources on the refuge and calls for monitoring of fish species and water quality to maintain fisheries for subsistence, commercial, and sport fishing uses.

The North American Waterfowl Management Plan (USDI 1986) identifies the Yukon Flats as a waterfowl habitat area of major importance. That plan stresses the value of maintaining an adequate habitat base to ensure perpetuation of North American waterfowl populations.

The Forty mile Caribou Herd Management Plan (BLM and others 1995) calls for allowing a natural fire regime to help maintain habitat quality. The refuge is partly within the herd's historic range.

3.1.3. **Combined Guidance**

3.1.3.1. Yukon Flats Fire Management Goals:

1. Protect life, property, and identified resources from fire. Priorities in fire suppression are (1) human life and (2) property and natural/cultural resources.
2. Manage wild land fire and prescribed fire to protect or enhance habitat and ecosystems for the benefit of fish and wildlife.
3. Communicate, coordinate, and cooperate with suppression organization staff, adjacent land owners (including Village and Regional Native Corporations), and the general public.

3.1.3.2. Yukon Flats Fire Management Objectives:

1. Protect human life. This is the top priority. (Other objectives are not listed in priority order.)
2. Protect refuge-owned cabins and buildings, permitted cabins, and private property from fire to the extent possible given safety considerations and the availability of suppression resources.
3. Minimize the threat of wild land fire incursion into areas with higher protection levels through sound and timely fire management decisions and through hazard reduction activities.
4. Consider public health and environmental quality in decisions.
5. Maintain naturally ignited fire as a dynamic ecosystem process to the maximum extent possible in order to maintain the natural diversity of wildlife habitat.
6. Manage fire to meet resource objectives.
7. Utilize fire to minimize the occurrence of large catastrophic fires by reducing the extent and build-up of hazardous fuels.
8. Protect critical refuge resources from undue damage from wild land fire and from fire suppression actions.

9. Balance suppression costs against resource values at risk. Balance expenditures for prescribed fire against resource and hazard reduction benefits. Consider commodity, non-commodity, and social values in analyses.
10. Maintain communications with suppression organization staff, adjacent landowners, and the general public, coordinate management actions with them, and cooperate in reaching common goals and objectives.
11. Educate the public through personal contacts, school programs, the media, public meetings, and other ways about fire prevention, hazard reduction, and the role of fire in boreal ecosystems.
12. Annually evaluate protection level designation and change designation as needed.
13. Annually monitor and evaluate effectiveness of actions.

3.1.3.3. Yukon Flats Fire Management Strategies

1. Naturally ignited wildland fires or portions of naturally ignited wildland fires may be managed for resource benefits. Although these fires are naturally occurring events, and thus exempt from NEPA requirements, appropriate management controls will be put in place to minimize resource damage.
2. Suppression action will be taken on all wildland fires not managed as wild land fires used for resource benefits; however, a full range of suppression actions is available, from surveillance to indirect attack to aggressive direct attack. Suppression effort will be commensurate with values at risk.
3. Except for fires that threaten identified values or are in Critical or Full management option areas, minimizing acreage burned is not a priority. For example, indirect attack on large fires using natural barriers can be an effective strategy and reduce exposure of firefighters to risk, allowing an incident commander (IC) to choose favorable places to take action. Such strategies can be timed to take advantage of changes in the weather to maximize effectiveness.
4. Strategies that use natural barriers, indirect attack, and changes in weather are preferred. Innovative approaches and adoption of techniques to foster cost-effective fire suppression are encouraged. Blacklining with coldtrailing (no constructed line, extinguishment of individual hotspots near the fire edge with water and hand tools) is the preferred method of direct attack on small fires. Aerial ignition in combination with indirect attack is encouraged on large fires.
5. Fires in the boreal forest can produce large amounts of smoke, and fires must be managed to minimize impacts and maintain air quality. reduction and resource management objectives.
6. Prescribed fire and off-Refuge mechanical treatments may be used to achieve hazard reduction and resource management objectives.

3.1.3.4. Yukon Flats Fire Management Constraints

- ANILCA states that subsistence uses of the refuge have precedence over other consumptive uses. Effect of fire management activities, especially the use of prescribed fire, on subsistence uses must be evaluated (see Section 810 of ANILCA).
- The use of retardant or foam must first be approved in writing by the Refuge Manager or acting Refuge Manager.
- All-terrain vehicles, tractors, tracked vehicles, or other equipment that cause long-lasting adverse impacts on resources will not be used without specific, written approval of the Refuge Manager.
- Fire line explosives may not be used for surface trenching without specific approval by the Refuge Manager, to be documented in writing.
- Minimum impact suppression guidelines (**Appendix F)** shall be adhered to.
- The Refuge Manager may place restrictions on suppression aircraft flight altitudes over certain waterfowl and raptor nesting and/or staging areas depending upon time of year and amount of flyovers required.
- Peregrine falcons are a species of management concern. The falcons often nest on the tops of bluffs, and although it is unlikely that nests will be directly impacted by fire, helispots and fire camps located in proximity to nests may cause disturbance. Nesting sites are marked on interagency fire maps; some are near Native allotments. AFS will notify the refuge immediately when fires are discovered near these areas. The refuge will notify AFS of new nest sites. Extreme care must be taken to not disturb nests during the critical period from April 1st to August 15th because adults may abandon eggs or young.
    - Ground personnel are to keep away from nesting sites unless absolutely necessary. If they must be near a nest site, they should stay there the absolute minimum of time required and be as unobtrusive as possible.
    - Camps must be located at least two miles from nesting sites.
    - Aircraft will avoid operating within one mile horizontal distance and below 1,500 feet above ground level over known nesting sites unless it is absolutely necessary to do so.
    - No retardant or foam is to be dropped over known nesting sites.
- Protect the integrity of designated and proposed National Wild Rivers. These areas receive considerable public use, and little or no trace of suppression operations should remain after demobilization:
    - Beaver Creek National Wild River--within one-half mile of the bank, from the refuge boundary to river mile 127, at the extreme northern end of Township 12 North, Fairbanks Meridian.
    - Sheenjek River, recommended for designation as National Wild River status--within one-half mile of the bank, from the refuge boundary to its mouth at the Porcupine River.

Extra care should be taken to protect the “natural, primitive” condition of the land, to protect water quality from retardants, foams, fuel, other chemicals, and minimize erosion caused by fire management activities.

All fire management activities undertaken in these areas shall adhere to the same minimum impact suppression guidelines (**Appendix F**) that apply elsewhere on the Refuge; however the Refuge Manager will explicitly approve all repair actions in writing prior to demobilization of the fire.

3.1.4. **Common Characteristics of the Fire Management Units**

3.1.4.1. Climate and Fire Season

The refuge has a subarctic continental climate, characterized by extreme seasonal variation in temperature and day length. Climate information is taken from USFWS (1994) and Selkregg (1976). Summers are short but warm with temperatures occasionally exceeding 90°F. Because of its northern location, the sun stays up nearly all day for much of the summer, leaving little time for cooling during the short "night." Even when the sun does go down during the summer, lighting conditions still exceed "civil twilight" continuously from May 13 to August 4. Its latitude and climatic patterns cause the Yukon Flats to have higher summer temperatures than at any other place of comparable latitude in North America. Data in table 3 is from 1922-1984 (1934 is missing), from Arctic Environmental Information and Data Center, University of Alaska, Fairbanks.

Table 3: Average temperature, precipitation, snowfall, and snow depth at Fort Yukon and Central

Climate Statistics	Fort Yukon[1]		Central[2]	
	Temperature (degrees Fahrenheit)			
	Average Maximum	Average Minimum	Average Maximum	Average Minimum
January	-10.9	-27.8	-10.8	-28.6
February	-3.6	-23.4	-0.7	-22.5
March	14.7	-11.5	15.9	-13.5
April	34.8	9	38	10.2
May	56.1	32.1	57.2	31
June	70.9	47.9	70.3	43.7
July	73.2	51.2	72.2	46.8
August	66.3	44.7	66.4	41
September	50.6	32.1	52.4	29.2
October	27.2	12.4	27.4	10.6
November	1.3	-14.2	5.7	-12.2
December	-8.7	-24.6	-4.9	-23.1
Average aAnnual temperature	31.0	10.7	32.4	9.4
Average annual total precipitation	6.6 inches		10.6 inches	
Average annual total snowfall	41.9 inches		53.8 inches	
Average annual snow depth	9 inches		8 inches	

[1]Fort Yukon data from 1938 to 1990.

[2]Central data from 1962 to 2005.

Source: WRCC 2007.

Precipitation averages 6.58 inches annually at Fort Yukon, ranging from 6 to 10 inches. July and August average the most rainfall, with 0.94 and 1.22 inches, respectively. Precipitation occurs mainly as thunderstorms and rain showers, and large differences may be recorded within relatively short distances. The refuge is large enough so that part of it may be in a drought, and another part may be well above average in rain. Snow covers the ground from October to May,

and average snowfall each winter is about 45 inches. Because of the presence of snow for over half the year and the presence of permanently frozen subsoil, the low precipitation is relatively effective for plant growth, and in some places creates saturated soils. The growing season is short; green-up begins in late May, and leaves begin to drop in mid-August.

Because of high summer temperatures and low precipitation, the area is described by Trigg (1971) as "warm arid" and ranks among the most severe fire climates in the state. The area's high summer temperatures and topography are conducive to lightning activity, which is the primary cause of fires on the refuge. Prevailing winds are southwesterly or westerly during summer (July and August) and average about 9 miles per hour. Thunderstorms are common during that period, and wind from those storms can quickly change wind direction and increase wind speed. During the rest of the year, prevailing northeasterly winds average five to 10 miles per hour.

The average freeze-up date for the Yukon River is October 28, although open water is usually found until November. The river's average date of break-up at Fort Yukon is May 15. Most ponds and lakes freeze up a week or two before the Yukon River does, and they usually thaw within a week or two of the Yukon River. Flooding sometimes accompanies breakup in the spring, as ice blocks the river channel and water spreads over the broad lowlands along the Yukon. Many ponds and lakes in floodplains depend on this flooding to be recharged because of low precipitation. Summer thundershowers often cause floods along creeks and rivers that drain mountainous areas.

Fires can occur from early May to mid-September. About 60% of reported fires occur in the 30-day period June 10 – July 10. Nearly 70% of ignitions have occurred by July 10th, about 80% by July 20th, and around 90% by August 1st. Most of the total acreage burned is usually accounted for by the end of July, although "late" fire seasons can see active burning into August and September. The fire season on the refuge proper tends to be shorter than adjacent Native corporation lands, because early- and late-season fires are usually started by humans, and human activity is concentrated on Native lands.

A normal fire season pattern is described below, but not every year is normal. Large fires require dry fuels, ignitions, and wind. Some fire seasons have a high incidence of lightning occurrence that is tempered by accompanying by rain. Other seasons are extremely dry, but with relatively little lightning occurrence to spark ignitions, fire occurrence is limited. The Refuge is large enough that different portions may have different fire activity levels, because of these differences in rainfall and lightning.

Fire activity typically begins in late April or early May, when snow cover disappears, and ends in late May or early June when green-up begins. Fires during this time usually are low intensity because of high relative humidity (RH) at night, moderate daytime temperatures, and high soil and duff moistures. However, winds and low humidity can produce more intense fires. Black spruce is moisture stressed at this time of year, promoting crown fires, and birch and aspen also can sustain crown fires during green-up because of low foliage moisture content. Spring fires can smolder and flare up later when fuels are drier. Figure 3 shows how the Canadian Buildup Index (BUI), a measure of dryness in the forest floor, changes throughout the fire season.

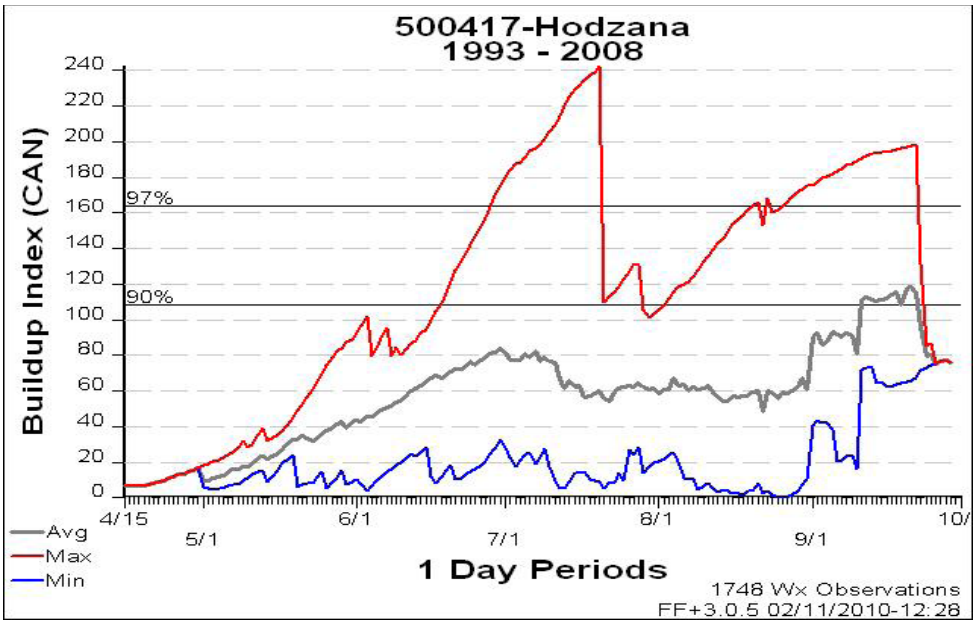

Figure 1: Buildup Index - Hodzana RAWS (HOZ) Yukon Flats NWR

The second period of fire activity occurs in mid-June, and is characterized by thunderstorms. This is when most ignitions occur. Depending on the air mass, storms may be wet or dry. Wet storms may produce significant lightning, but start few fires and those fires remain small. Dry storms start more fires and encourage fire spread. Early hot, dry, and windy weather allows large fires, and the resulting large perimeters allow rapid burning of large areas when conditions grow even warmer and drier. Wet weather and/or little lightning in this and the following period result in few ignitions and relatively few acres burned. A few human-caused fires are typical during this time.

The time with the most fire activity is typically late June through the end of July, when lightning is accompanied by little nighttime RH recovery due to the continuous daylight. Fire danger indices commonly reach very high or extreme, temperature is high, humidity is low, and there is little precipitation. Furthermore, new lightning fires add to those still burning from the first and second periods. Human-caused fires can exacerbate the fire situation during this period as well. If fuels are dry, rates of spread and intensities will be high. Resistance to control may be high, and indirect attack may be the only viable suppression option. Low-pressure weather systems with rain usually end fire activity.

The final period of fire activity usually begins in late July or early August and runs through mid to late September. There are few ignitions, mostly human-caused and often correlated with hunting, fishing, and other subsistence or recreational activities. Fires normally burn with low intensity because of increased humidity at night. However, years with continuing warm, dry, and windy conditions create "late fire seasons," when active fires can burn extremely large acreages (e.g., 1979 and 1988). During 1988, numerous ignitions, rapid early fire growth, and an extended burning season resulted in 49 fires that burned more than 1.1 million acres on the refuge. Nine of those fires each burned more than 20,000 acres, and the largest burned 375,000 acres of refuge lands.

The Alaska Interagency Coordination Center (AICC) Predictive Services website http://fire.ak.blm.gov/predsvcs/weather.php maintains links to statewide fire weather forecasts

and weather data. Fire weather briefing products including Red Flag Warnings and Fire Weather Watches are posted daily on the site throughout the fire season, and a link is included to the National Weather Service Spot Forecast Request page.

Alaska Red Flag Warning & Fire Weather Watch Criteria (if combined with burnable fuels)		
1.	**Strong Wind**:	Wind* ≥ 25 mph & RH ≤ 30%
2.	**Low Humidity**:	RH ≤ 15%
3.	**Strong Wind Low Humidity**:	Wind* ≥ 25 mph & RH ≤ 15%
4.	**Dry Thunderstorms**:	Dry thunderstorms w/ scattered coverage (25% Areal) and < 0.10" rainfall
* Wind is defined as frequent gusts or sustained for one hour or more		

Table 4: Alaska Red Flag Warning & Fire Weather Watch Criteria

Yukon Flats NWR maintains eight permanent, Weather Information Management System (WIMS) compliant Remote Automated Weather Stations (RAWS) on the Refuge. The Eastern Interior FMO is responsible for maintaining station catalog information for these stations to meet NFDRS standards (green up date, cured, freeze date, etc. Daily observation into WIMS dispatch responsibility.

Short Name	Full Name	Station Type	WIMS ID	Latitude	Longitude	Elevation	Zone	WX Zone	Valid for FWI	AICC ArcIMS ID	Site Description
CIK	Chalkyitsik	RAWS	500421	66.59306	-144.3389	450	UYD	AKZ220	Y	001034	none
GRF	Graphite Lake	RAWS	500416	67.03389	-143.2881	850	UYD	AKZ220	Y	001014	Site is a FTS platform mounted on a 20`403 handar tower
HOZ	Hodzana	RAWS	500417	66.74555	-148.6778	1075	UYD	AKZ220	Y	001016	Site is a FTS platform mounted on a Handar 403 20` tower and
LBK	Little Black	RAWS	500424	66.08472	-143.3728	1300	UYD	AKZ220	Y	001015	none
LCR	Lost Creek	RAWS	500425	66.03389	-147.9828	700	UYD	AKZ220	Y	001032	Site is an FTS platform mounter on a Handar 20` 403 tower
PCK	Preacher Creek	RAWS	500738	65.93195	-145.01691	1038	UYD	AKZ220	Y	001031	Site is a FTS platform mounter on a 20` 403 Handar tripod
VZK	Vunzik Lake	RAWS	500420	66.79639	-146.7117	525	UYD	AKZ220	Y	001035	Site is a FTS platform mounted on a Handar tripod with a 20
WBQ	Beaver (wbq)	RAWS	500418	66.27111	-146.5253	483	UYD	AKZ220	Y	001053	Site is an FTS platform mounted on a handar 20`403 tower It has Handar sensors. accessible only by helicopter.

Table 5: Yukon Flats NWR Remote Automated Weather Stations

3.1.4.2. Fire Danger

Since the 1990s, fire danger indices in Alaska have been calculated using the Canadian Forest Fire Danger Rating System - Fire Weather Index (CFFDRS - FWI) instead of the National Fire Danger Rating System (NFDRS) used throughout most of the rest of the U.S. For most purposes the CFFDRS focus on duff moisture better represents Alaskan fuels than the NFDRS woody fuels classes. However, the reliance of FSPro and other fire behavior modeling tools has prompted Alaskans to ensure that fire weather stations are cataloged and maintained in WIMS as NFDRS stations.

3.1.4.2.1 ***CFFDRS - FWI***

The Canadian Forest Fire Weather Index (FWI) tracks the effects of weather on forest fuels. In doing so, it gives an estimation of potential fire danger and fire behavior in the area adjacent to a weather station at which the weather is recorded. It is based on the moisture content of three classes of surface forest fuels, plus the effect of wind, on fire behavior. The FWI system is probably best explained as a bookkeeping system in which, for a particular weather station, fuel moisture is added in the form of precipitation and subtracted in the form of drying. Precipitation is the only input component that will add to fuel moisture while the other inputs of temperature, relative humidity, wind speed, and time of year, control the rate of drying.

The system consists of six components; three primary indexes, or codes, representing fuel moisture for each of the three fuel layers, two intermediate indexes representing rate of spread and fuel consumption, and a final index representing fire intensity as energy output per unit length of fire front. Each year, for each representative weather station the system is initiated three days following the station's snow-free date; and shut down following the station's freeze-up date.

1. The Fine Fuel Moisture Code (FFMC) represents the moisture content of litter and cured fine fuels, 1-2 cm deep. It expresses the ease of ignition and fuel flammability. FFMC is sensitive to daily changes in temperature, rainfall, relative humidity, and wind speed. Time lag is 2/3 day, which means that it takes two thirds of a day for the fine fuels to react to a change in the weather.

2. The Duff Moisture Code (DMC) represents the moisture content of loosely compacted, decomposing organic matter, 5-10 cm. deep, which determines resistance to control. DMC is sensitive to temperature, rainfall, and relative humidity. Time Lag is 12 days.

3. The Drought Code (DC) represents the deep layer of compacted organic matter, 10-20 cm. deep, which determines resistance to extinguishment. It indicates seasonal drought and smoldering fires in deep duff or large logs. DC is sensitive to temperature and rainfall. Time lag is 52 days.

4. The Initial Spread Index (ISI) represents a numerical rating of fire spread immediately after ignition without the influence of variable fuel quantity (the fuel type isn't considered). It fluctuates with wind speed and time of day. ISI is a combination of FFMC and wind.

5. The Build Up Index (BUI) represents total fuel available for combustion. In the absence of rain, BUI fluctuates little throughout the day. BUI is a combination of DMC and DC.

6. The Fire Weather Index (FWI) represents the intensity of a spreading fire. FWI is a combination of ISI and BUI.

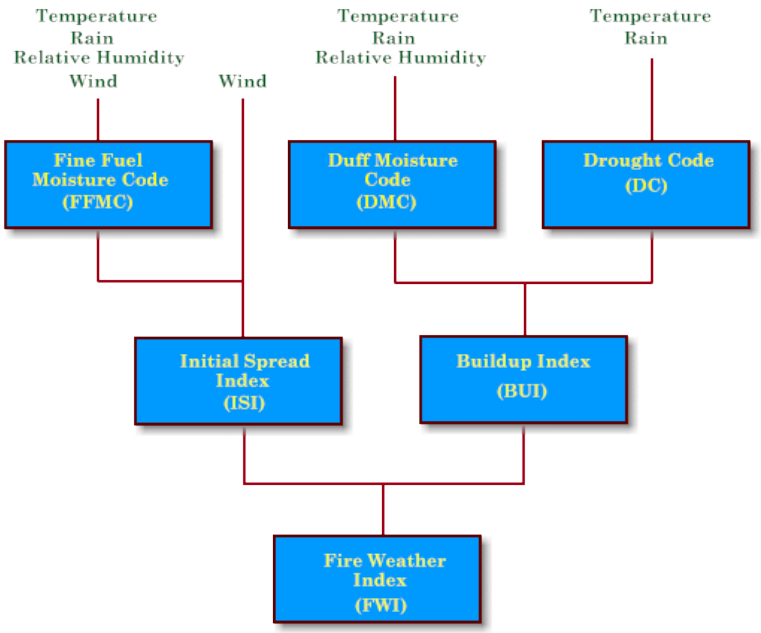

Figure 2: CFFDRS Fire Weather Index (FWI) system

Weather readings taken at 13:00 solar noon local standard time (14:00 daylight savings time in Alaska) at weather stations for temperature, rainfall, relative humidity, and wind speed are used as inputs into a computer program that calculates the six indices for each station.

Fuel Moisture Code	Soil horizon	Water capacity mm	Rain fall thresholds mm	Timelag* days	Nominal fuel depth cm	Bulk density Mg/m^3
FFMC	L	0.62	0.6	2/3	1.2	0.021
DMC	F	15	1.5	15	7	0.071
DC	H	100	2.9	53	18	0.139

* A fuels time-lag is expressed as that amount of time required for the fuel to lose 1 – 1/e (about 2/3) of the free moisture above equilibrium on a standard day (noon temperature of 21.1^{o}C, relative humidity of 45%, 13 km/h wind, during the month of July) (Merrill and Alexander 1987).

Figure 3: Properties of the FWI System's fuel moisture codes. (Wilmore 2001)

3.1.4.2.1 *NFDRS*

Fire weather station WIMS catalogs require annual Green-up and Freeze-up dates to be entered in order to maintain WIMS compliance and properly generate NFDRS indices.

3.1.4.3. Fire Behavior

Several modeling systems are available for predicting fire behavior in Alaska. The thirteen original National Forest Fire Laboratory (NFFL) fuel models have been applied directly, as well as with adjustment factors (Norum 1982).

A custom Black Spruce model based on NFFL parameters has also been developed. The 40 model extension of the original 13 models, released in 2005, provides additional flexibility for adapting the NFFL system used in Behave Plus modeling software to Alaska fuels. All of these models, however, are driven by 1 hour woody fuels and/or leaf litter and do not directly address the characteristics of feathermoss duff fuels that drive surface fires over much of interior Alaska.

Vegetation Type	Canadian	NFFL Fire Behavior	NFDRS	Acres[2]
Black Spruce Forest	C-2	custom black spruce[1]	Q	2,151,000
White Spruce Forest	C-2	8 or 10 (heavy downed fuel)	H	
Mixed Spruce and Hardwood Forest	M-2 (can set amount of spruce)	8 (few spruce) or 9 (moderate spruce)	R	1,416,000
Hardwood Forest	M-2	8	R	1,324,000
Shrublands/Brush	M-2	2 (grass w/ flammable shrubs) or 5 (dwarf flammable shrubs) or 6 (heavy dead woody load)	B	3,452,000
Marsh Grasses	O-1	3	N	185,400
Tundra	O-1	1 (tussocks < 1 foot high) or 3 (tussocks > 1 ft.)	S	278,100

[1] Also see discussion below and Norum (1982)
[2] Derived from Table 2.

Table 6: Yukon Flats Estimated Acreage of Vegetation Types and Fuel Models

The Canadian Fire Behavior Prediction System (FBP) offers several fuel types based on feathermoss duff. FBP relies on Canadian Forest Fire Danger Rating System (CFFDRS) Fire Weather Index System FWI inputs, which are officially tracked in Alaska, instead of the NFDRS inputs commonly used in the Lower-48.

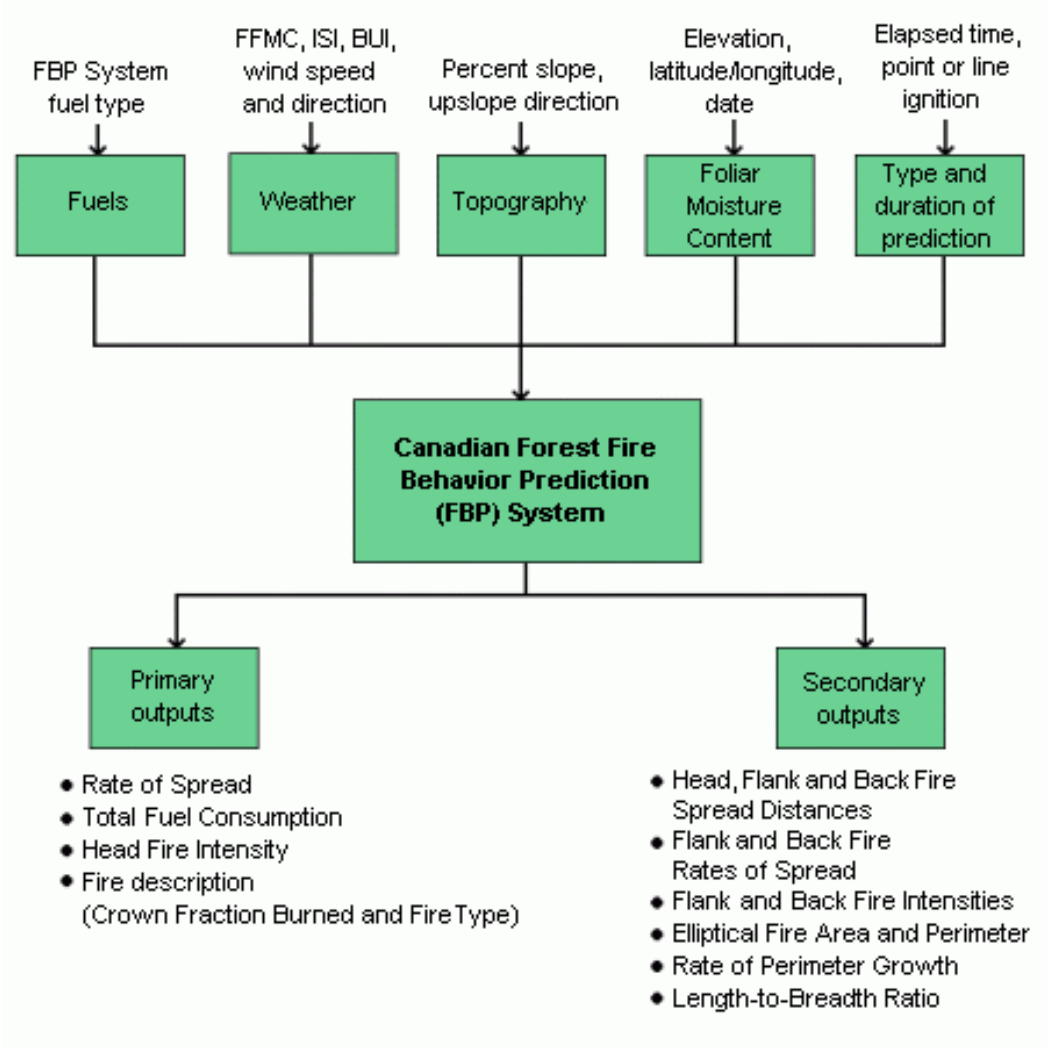

Figure 4: CFFDRS FBP Structure

Intensity and spread rate outputs in the FBP also account for the effect of aerial fuels, unlike NFFL which only models surface behavior. Unfortunately fire modeling tools such as Farsite and FSPro do not currently support the FBP system.

The *Fuel model guide to Alaska vegetation* (Cella et al. 2008) includes crosswalks from *The Alaska Vegetation Classification* (Viereck et al. 1992) to fuel models from each of these systems (**Table 7**). The Guide should be used as a starting point for Alaska fuel modeling exercises but should not be considered as definitive. Departures from the Guide should be documented.

Y NWR Fuel Model Crosswalk (condensed from The Fuel Model Guide to Alaska Vegetation)					
Guidebook Group #	Description	Primary Carrier of Fire	Fuel Model		
			40	13	CFFDRS
2	Closed White Spruce Forest	feather moss, litter, duff	TU1	10	C3
3	Closed Black Spruce Forest	feather moss	TU3	9 ADJ	C2
5	Open White Spruce Forest	shrub & litter	TU5	10	C7
6	Open Black Spruce Forest	feather moss	TU4	9 ADJ	C1
7	Open Black Spruce-Tamarack Forest	feather moss & shrub	TU5	10	C1
9	White Spruce Woodland	feather moss & shrub	TU5	10	C1
10	Black Spruce Woodland with tussock	shrub & tussocks	GR2	1	O1
11	Black Spruce Woodland with lichen-moss	feather moss & lichen	TU4	9 ADJ	C2
12	Closed Red Alder Forest	leaf litter	TL2	8	M2
13	Closed Black Cottonwood-Balsam Poplar Forest	leaf litter	TL2	8	M2
14	Closed Paper Birch-Quaking Aspen Forest	leaf litter & sparse grass	TU1	8	M2
15	Open Paper Birch Forest	leaf litter & grass	TU1	9	M2
16	Open Quaking Aspen Forest	leaf litter, grass, shrub & slope	TL2	8	D1
17	Open Balsam Poplar (Black Cottonwood) Forest	leaf litter	TL2	8	M2
18	Woodland Paper Birch-Balsam Poplar	lichen or grass & leaf litter	GR1	1	O1A
19	Spruce-Paper Birch-Balsam Poplar	leaf litter	TL6	8	M2
20	White Spruce - Paper Birch - Balsam Poplar - Spruce	leaf litter & herbaceous plants	TU1	8	M2
22	Dwarf Tree Black Spruce Scrub	feather moss & shrub	TU4	9	C2
23	**Closed Tall Alder Willow Shrub**	leaf litter & woody debris	TU1	6	M2
24	Closed Tall Birch Shrub	shrubs	SH3	6	M1
25	Tall Shrub Swamp	herbaceous, shrub & leaf litter	SH1	1	O1A
26	Open Tall Willow Alder Shrub	grass & shrub litter	TU1	5	M2
27	Open Tall Birch/Birch-Willow Shrub	shrubs	SH3	5	M1
28	Closed Low Birch/Birch-Willow/Ericaceous Shrub	shrub	SH2	5	M1
29	Closed Low Willow/Alder-Willow Shrub	grasses	TU1	6	M2
30	Open Low Mixed Shrub-Sedge Tussock Tundra/Bog	tussocks	GR2	1	O1
31	Open Low Birch-Ericaceous Shrub/Bog	grass & dwarf birch	GR3	1	O1
32	Open Low Birch-Willow/Ericaceous Shrub/Bog	grass & shrub	GR2	1	O1
33	Open Low Willow/Sweetgale	herbacous	GR1	1	O1A
34	Open Low Alder/Alder-Willow Shrub	grass & low shrubs	GS1	1	O1
35	Sagebrush-Juniper	juniper	SH2	8	O1A
36	Sagebrush-Grass	grass & shrub	GS1	2	O1
37	Dwarf Shrub Tundra	herbaceous & low shrub	GR1	1	O1A
38	Elymus	grass	SH4	8	O1A
39	Grass-Shrub	short grass	GR2	1	O1
40	Grass-Herb	short grass & herbaceous	GR1	1	O1A
41	Bluejoint Meadow	grass	GR4	3	O1
42	Bluejoint Shrub Herb	grass	GR2	1	O1
43	Tussock Tundra	tussocks	GR3	3	O1
44	Mesic Sedge-Grass-Herb Meadow Tundra	grass & herb	GR2	1	O1
45	Sedge Willow Dryas Tundra	herbaceous	GR1	1	O1A
46	Sedge-Birch Tundra	herbaceous & shrub	GR2	1	O1
47	Wet Meadow Tundra	herbaceous	GR1	1	O1A
48	Wet Sedge-Grass Meadow-Marsh	grass	GR1	1	O1A
49	Wet Sedge Meadow-Bog-Shrub	herbaceous	GR1	1	O1A
50	Dry Species - Non Burnable		NB7	99	
51	Wet Species - Non Burnable		NB6	99	
52	Mesic Forb Herbaceous		GR1	1	O1A
53	Foliose and Fruticose Lichen		GR1	1	O1A
54	Crustose Lichen		NB9	99	
55	Aquatic Herbaceous		NB8	99	
56	Downed Beetle-killed spruce	downed woody fuel	SB1	11	M4

** The NB7 fuel model is a custom model for drier vegetated areas that typically do not burn.*
*** The NB6 fuel model is a custom model for wet vegetated areas that typically do not burn.*

Table 7: Yukon Flats NWR Fuel Model Crosswalk

3.1.4.4. Fire Return Interval

Year	Full Protection		Modified Protection		Limited Protection		Total	
	Fires	Acres	Fires	Acres	Fires	Acres	Fires	Acres
1981	9	4,184	0	0	0	0	9	4,184
1982	5	9	0	0	0	0	5	9
1983	24	1,622	0	0	0	0	24	1,622
1984	3	2	7	105	6	62	15	169
1985	6	3,847	4	18,282	4	144,442	12	166,573
1986	3	600	3	10,613	7	34,942	10	46,156
1987	0	0	4	83	5	18,001	9	18,084
1988	5	6,667	18	203,576	30	942,071	49	1,152,313
1989	1	1	2	4	1	4	4	9
1990	3	412	9	277,525	8	77,216	19	355,153
1991	3	42	12	64,580	8	227,450	22	292,072
1992	0	0	1	1	9	42,002	10	42,003
1993	2	22	4	29,101	9	63,467	13	92,590
1994	2	2	0	0	10	22,533	12	22,535
1995	4	1	0	0	2	420	6	421
1996	3	7,587	7	2,552	6	145,880	14	156,019
1997	2	1	2	10	4	30,750	8	30,761
1998	0	0	0	0	1	5	1	5
1999	0	0	0	0	7	151,531	7	151,531
2000	1	1	1	1	5	6,161	7	6,163
2001	0	0	0	0	0	0	0	0
2002	0	0	0	0	5	17,952	5	17,952
2003	0	0	0	0	2	192965	2	192,965
2004	4	96	3	30,334	24	1,670,003	31	1,700,433
2005	1	114,596	6	20,316	9	780,580	16	915,492
2006	0	0	1	13	1	4255	2	4,268
2007	0	0	0	0	14	9,232	14	9,232
2008	0	0	2	31	7	49,901	9	49,932
2009	1	3	1	3	5	406,524	7	406,530
TOTAL	82	139,695	87	657,130	189	5,038,349	358	5,835,176
Annual Average	2.8	4,817	3	22,659	6.5	173,736	12.3	201,212

Table 8: Yukon Flats Fires and Acres Burned by Management Option 1981-2009

Fire in the boreal forest is characterized by a combination of high intensity crown fires and severe surface fires. Weather, fuels, and topography can combine to create extremely large fires (Viereck 1983). Large-scale weather patterns set up conditions that control fire activity over large areas (Cahoon and others 1994, Johnson 1992). Much of the area burned is accounted for in periodic severe fire years (Davis and Mutch 1994, Johnson 1992).

Large (natural) fires in the boreal forest are caused by lightning that occurs during persistent high-pressure systems that dry out fuels, and fire frequency is driven by climate rather than an age-dependent probability of burning (Johnson et al. 2001, Duffy et al. 2005). The classical approach to computing fire frequency implies an underlying stability of frequency, but this situation does not exist in the Alaskan boreal forest because the annual area burned is driven so strongly by weather patterns (P. Duffy, pers. commun. 2011).

Nevertheless, it is useful to examine known patterns in fire history, keeping in mind the effects of periodic large scale climate processes (e.g., Pacific Decadal Oscillation) and climate change. Relatively little empirical information is available about average forest stand age in interior Alaska, although there have been some studies that use tree rings to reconstruct fire history. Fires in Alaskan spruce forests are typically stand-replacing, making it difficult to find fire-scarred trees for aging purposes. Tree ring analysis of a study site in the Porcupine River drainage indicated stand ages of 36 years for black spruce and 113 years for white spruce (Yarie 1981). Fastie et al. (2002) estimated fire intervals of 100 to 250 years for upland forests in interior Alaska.

3.1.4.5. Landcover/ Vegetation

Land Cover Class	Percentage of Refuge	Approximate Acreage	Subtotals (acres)
Open spruce forest	15	1,383,000	
Closed spruce forest	8	768,000	
TOTAL SPRUCE FOREST	(23)	--	2,151,000
Mixed spruce/deciduous forest	15	1,416,000	
Deciduous forest and scrub	14	1,324,000	
Closed deciduous scrub	9	834,300	
Open deciduous scrub	1	92,700	
TOTAL DECIDUOUS FOREST/SCRUB	(40)	--	3,667,000
RECENT BURN, 1988+ Herbaceous/Seedling spruce /Deciduous shrub	(27)	--	2,525,000
Grass-sedge marsh	2	185,400	
Alpine scrub/barren	1	92,700	
Prostrate dwarf shrub tundra	2	185,400	
TOTAL MARSH/TUNDRA	(5)	--	463,500
Lowland alluvium and mud	<1	<92,700	
Open water	4	370,800	
TOTAL UNVEGETATED	(<5)	--	<463,500
Cover class percentages from Yukon Flats CCP (1987), adjusted for area burned from 1988-1999.			

Table 9: Yukon Flats NWR Landcover

The most conspicuous characteristic of refuge vegetation is the complex mosaic of different vegetation types resulting from differences in soils, drainage, erosion, permafrost, flooding, and fires. Fire and other disturbances and the resulting succession changes cause cover types to vary considerably in acreage over time. Over one-third of the refuge is covered by forest; about one-

quarter is covered by recent burns (1988 or later) dominated by herbaceous plants, shrubs, and seedlings; about one-quarter is covered by other shrubby types; and meadows, alpine tundra, and open water make up the rest (**Table 9**).

The major cover types are pure or mixed stands of spruce and deciduous trees. Spruce forests are made up of black and white spruce. Deciduous tree species on the refuge are quaking aspen, paper birch, balsam poplar, and tamarack. Woody species in scrub habitats include two alder species, bog birch, and many species of willow. See Foote and others (1989, 1995) for descriptions of vegetation on the refuge and also Viereck and others (1992). See Heglund (1992) for a discussion of wetland vegetation types.

Chemical compounds present in some plant species and vegetation structure make many species of the boreal forest quite flammable. Black spruce is the typical example, but crowberry and Labrador tea burn even hotter (Johnson 1992).

3.1.4.6. Fire Effects

Site characteristics, including biotic and abiotic factors, are important factors in determining forest resilience and what may become re-established on a site following fire. For example, poorly drained sites underlain by permafrost where stands of open black spruce are prevalent will likely return to that vegetation type following fire. Shifts in the fire regime to more severe or more frequent fires may lead to alternate successional pathways in black spruce forests, but this vegetation type will likely persist in landscape positions that favor moist, cool conditions (Johnstone et al. 2009). Availability of a seed source or ability of plants to re-sprout following fire will also strongly influence what comes back; if no willows are present on a site prior to fire, one cannot expect willows to significantly appear after fire.

Recent work has highlighted the role of burn severity in seedling establishment, survival, and subsequent vegetation patterns (Johnstone and Chapin 2006, Johnstone and Kasischke 2005). Variation in burn severity, measured by depth of the remaining organic layer, can have a strong influence on tree recruitment and succession on stand and landscape levels. Based on a number of field observations and modeling efforts from various studies, (Barrett et al. 2011) summarized forest recovery relative to post-fire organic soil depths as follows: sites with >10 cm of organic soil post-fire are expected to regenerate as black spruce, with permafrost eventually recovering; sites with 3-10 cm of organic soil are expected to come back as mixed hardwood/spruce stands with longer recovery of permafrost; and sites with <3 cm of organic soil remaining are expected to become dominated by deciduous trees with no permafrost.

Information regarding the effect of fire on specific plant and wildlife species is summarized in the national Fire Effects Information System (FEIS) database, accessible through the Internet at http://www.fs.fed.us/database/feis/. Information is available for many bird, mammal, and plant species which occur on the Refuge.

Descriptions of common Refuge habitats along with general discussions of fire behavior and fire effects follow.

3.1.4.6.1 ***Black Spruce (Picea mariana)***

Black spruce is found most commonly on cold, poorly drained lowland sites and north-facing slopes, often associated with the presence of permafrost. Black spruce occurs in closed (≥60%

canopy cover), open (25-59% cover), and woodland (10-24% cover) stands (Viereck et al. 1992) On better drained sites, some mixing with white spruce (*P. glauca*) and paper birch *(B. neoalaskana*) occurs.

A carpet of feather mosses and lichens is very common as a primary component of the understory. Graminoid tussocks, various shrubs, including willows (*Salix* spp.) and ericaceous shrubs such as blueberry (*Vaccinium uliginosum*), crowberry (*Empetrum nigrum*), and Labrador tea (*Ledum decumbens*) may also be present. Sphagnum moss may be present on moister sites.

Dead lichen-covered branches are often present on live tree boles from the forest floor to the tree canopies, creating flammable ladder fuels. Live lower branches may also reach the ground, where they can take root, called "layering," creating clusters of smaller trees around parent trees. Litter is primarily composed of a light loading of needles and understory leaves.

Fires characteristically burn in black spruce forests with relatively high intensities and slow, predictable rates of spread. Fires in black spruce are generally carried by surface fuels such as feather mosses, lichens and graminoids. Ignition of the tree crowns (individuals or groups of torching trees) will occur just behind the flaming fire front if flame lengths are sufficient enough to ignite the lower lichen covered black spruce branches. During dry years, the combination of dryness, lichens on the tree branches and fine surface fuels, results in more persistent flammability throughout the fire season than any other fuel type on the Refuge. Long duration smoldering is usually limited to red squirrel middens and peat accumulations unless conditions are very dry. Areas where fire has only partially burned surface fuels may be susceptible to re-burns. Spotting by aerial firebrands from torching trees is common. Instability of the atmosphere, surface winds, and fuel moisture of receptor fuels are critical factors influencing the degree and scope of spotting.

Mosaics of varying burn severity are common. Black spruce are easily killed by fire even in low severity burns. However, seeds from the semi-serotinous cones normally survive and provide a readily available seed source for a few years following fire. Seedling establishment is most effective where mineral soil is exposed, but seeds will germinate on numerous substrates if there are favorable moisture levels. Aerial stems of shrubs are often killed, but resprouting and regeneration are stimulated if root systems are not destroyed. The low shrub layer quickly regenerates in lightly burned areas. Lichens may not return in the short term unless residual fragments are present in unburned or very lightly burned areas. Common feathermosses in spruce forests are obligate climax species (*Hylocomium splendens*, *Pleurozium schreberi*) and are generally killed by fire although small patches may survive low-severity fire. Neither of these species will spread until tree canopy is reestablished.

3.1.4.6.2 ***White Spruce (Picea glauca)***

White spruce is commonly found on warmer well-drained sites and on alluvial deposits along major river courses on the Refuge. White spruce also forms stringers along streams and around lakes, but on better drained sites than those on which black spruce is found. White spruce may reach 70 feet in height. On lowland sites, paper birch and balsam poplar (*Populus balsamifera*) may be components of the overstory, with quaking aspen (*Populus tremuloides*) as a component on upland sites. The understory may include tall shrub willow, alder (*Alnus* spp.), prickly rose (*Rosa acicularis*) and a shallow carpet of feather mosses. Smaller white spruce with larger components of willow, ericaceous shrubs, and sphagnum moss occur on moist marginal sites.

White spruce forest often transitions into scrub lands and broadleaf forests on upland sites. Dead downed woody fuels are predominantly white spruce logs and cast white spruce branch, needle and cone litter, but willow may also significantly contribute to loading where concentrations in the understory are heavy.

Fires in white spruce generally are slow spreading and burn with lower intensities than in black spruce. Smoldering fires in the root systems are common. Increased canopy cover and shading results in less fine fuels in the understory and tempers the response of fine fuels to changes in relative humidity. Ladder fuels of dead lichen-covered branches are not as prevalent in white spruce as they are in black spruce. Crowning only occurs under very dry conditions, especially in proximity to jackpots of dead fuels.

Mature white spruce stands may be replaced by broadleaf forest stands following fire—quaking aspen on drier sites and paper birch on moister sites—but white spruce will ultimately return. Open stands on dry sites may be replaced by shrub or broadleaf vegetation types if white spruce seed is not available. Crown fires can destroy seed-bearing cones. As fire intensity increases, survivability of aerial shrub stems decreases. Smoldering fires in root systems of mature white spruce can result in substantial blowdown following fire.

Plants possessing light, easily airborne seeds such as willow, birch, aspen, grasses and fireweed (*Chamerion angustifolium*) will readily invade burned areas. Sucker shoots from willow, alder, birch and aspen may encroach short distances into burned areas. Decadent tall shrubs will be stimulated by removal of dead stems and old growth in low to moderate intensity burns. Growth of herbaceous plants such as field horsetail and grass that were present pre-fire may be stimulated in low intensity burns

3.1.4.6.3 ***Broadleaf Forest and Mixed Spruce/Broadleaf***

Broadleaf forest types occurring on the Refuge include paper birch, quaking aspen and balsam poplar.

- Aspen stands typically occur on dry south-facing slopes on the Refuge with an understory commonly including willow, kinnikinnick (*Arctostaphylos uva-ursi*) and fireweed (*Chamerion angustifolium*).
- Paper birch occurs on a wide range of upland sites. Birch generally grows on moister, cooler sites than aspen. On drier sites, lichens are an important component of the understory. On moist sites, alder, willow and field horsetail (*Equisetum spp*.) may predominate in the understory.
- Mixes of birch and aspen are found on moderately warm sites, generally as a mid-successional stage to climax white spruce forests. Prickly rose, graminoids and bearberry are common in the understory.
- Stands of balsam poplar occur on the river floodplains with willow, alder and graminoids common in the understory.

Mixed spruce/broadleaf forests are especially common on drier upland sites. This is normally a mid-successional stage of climax white spruce or black spruce forests. Tree components can include combinations of white spruce, black spruce, quaking aspen and paper birch. Elevation, aspect, drainage and successional stage of the site are important determinants of which

coniferous and broadleaf trees are established. Plants common in the understory in mixed forests include willow, alder, bearberry, prickly rose, graminoids, and field horsetail.

Dead leaves and smaller branches cast from trees and shrubs are major contributors to the continuous litter layer on the forest floor. Since surface loading of dead fuels is low and is composed primarily of leaf litter, fires which occur in this fuel type are slow spreading and burn with relatively low intensities. Fuel and soil moisture are commonly higher in this fuel type than in black spruce fuel types due to increased shading and forest floor leaf litter cover. Except under very dry conditions, broadleaf forests often serve as natural fire breaks for fires spreading into them from adjacent black spruce stands, because of the significant reductions in intensity and rate of spread. Crowning spruce fires will normally drop to the forest floor when encountering a broadleaf forest stand. Smoldering fire in root systems, punky downed logs and in standing dead or partially dead broadleaf trees can also occur. In mixed spruce-broadleaf forests, fire intensities generally increase in relation to the proportion and density of spruce within the stand.

Following fire, this vegetation type will generally replace itself. Broadleaf seedlings and shoots, willow seedlings and shoots, and invaders such as fireweed and field horsetail will re-establish first, with other herbaceous vegetation slowly returning via seed sources from outside the burn. The herbaceous stage will ultimately be replaced by a shrub stage and then a tree stage. In the tree stage, broadleaf trees will initially predominate, with white spruce usually increasing in dominance over time.

3.1.4.6.4 ***Tussock Tundra***

Tussock tundra is dominated by tussock-forming sedges, usually tussock cottongrass (*Eriophorum vaginatum*) but sometimes Bigelow's sedge (*Carex bigelowii*). Tussocks are commonly 4-12 inches tall and 12-24 inches wide; vegetation between tussocks is comprised of low and dwarf shrubs, mosses (feathermoss and Sphagnum), and lichens (Viereck et al 1992). Tussock tundra can be a climax community in many areas, but tussocks can get overrun by mosses and shrubs. Fire may be necessary to maintain tussock tundra, particularly in southern portions of the interior.

The predominance of fine flashy fuels in this fuel type, especially substantial accumulations of cured graminoids common in tussocks, in combination with wind can result in fires with potentially high rates of spread and high intensities. Taller tussocks correspond with higher rates of spreads and intensities. Long term smoldering occurs only occasionally in root systems of shrubs present. Depth of burn into the organic layer is dependent primarily upon subsurface moisture, fine fuel moisture, and flaming front duration.

E. vaginatum can regenerate quickly following fire, often within the same year. The growing tips are protected from fire to a certain extent as they are within an insulating shield of dead and living plant material, sheaths, and scales; if the fire does not reach the growing tips, they quickly produce new stems. In very dry years, high intensity burns may kill the tussocks, leaving only burned tussock "stumps." If the tussock survives, new growth, including flower production, can be significantly stimulated by the removal of buildups of dead thatch, which helps to increase surface and soil temperatures, and increased nutrient availability.

3.1.4.6.5 ***Tall Shrub – Birch***

Shrub birch is found on the Refuge in open boggy areas in association with ericaceous shrubs, labrador tea, sweetgale and sedges as well as on sub-alpine sites near tree line. Upland shrub birch will carry moderate to high intensity fires, especially with a well-developed grass, moss, lichen, and/or ericaceous understory. Floodplain shrub birch sites with ericaceous associates react to fire similarly to other open ericaceous sites.

3.1.4.7. Wildlife

The quality of habitat within the refuge is reflected in its diversity and abundance of wildlife: 166 bird species, 39 mammal species, 19 fish species, and one amphibian species have been found on the refuge (USFWS 1996).

The refuge provides breeding habitat for more than one hundred species of birds and serves as a migration corridor for birds breeding farther north and west. The Yukon Flats was identified as a major breeding ground for waterfowl in the early 1950's, which was a major factor leading to its designation as a national wildlife refuge. Ducks banded on the Yukon Flats have been recovered in 45 states, 8 provinces of Canada, several Latin American countries, Japan and Russia. The Yukon Flats is considered one of the most productive waterfowl breeding grounds in North America.

Thirty-nine species of mammals, representing seven orders and 17 families, have been recorded on the refuge. Some of the more important or noteworthy species include moose, caribou, black bear, brown (grizzly) bear, gray wolf, marten, wolverine, lynx, beaver, muskrat, and snowshoe hare.

Nineteen species of fish have been found on the refuge. Important species include three species of salmon that move up the major rivers and spawn in side channels. Other important species include northern pike and whitefish, which are found in many streams and stream-connected lakes, and burbot and sheefish, which are found in the major rivers (USFWS 1990). An important spawning area for sheefish has been identified on the Yukon River between Fort Yukon and Circle (R. Brown, personal communication).

The American peregrine falcon (*Falco peregrinus anatum*) was delisted from endangered status in 1999 and still is of management concern. It nests on bluffs along portions of the Yukon and Porcupine Rivers and in the White Mountains. These sites are shown on interagency fire maps. Five to eight breeding pairs have been observed during recent surveys.

Arctic peregrine falcons (*Falco peregrinus tundrius*) migrate through the refuge, and they were down listed from threatened status in 1994. American bald eagles, listed as Endangered in the Lower 48, but not listed in Alaska, are present on the refuge primarily along lake margins and in riparian areas.

The following species are species of concern and are included on the National Audubon Society Watchlist due to local or national declines and /or threats to habitat: the olive-sided flycatcher which occurs on the refuge mainly in mature spruce forest associated with edges, especially streams and rivers, the solitary sandpiper and rusty blackbird which are wetland oblicate species, the American peregrine falcon, and the gray-cheeked thrush, and blackpoll warbler. These species and subspecies are of concern because of a long-term decline in abundance or are vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance.

The USFWS has also documented long term declines in both scoters and lesser scaup. Both of these species are receiving special attention through refuge research efforts.

3.1.4.8. Geology/ Hypsography

Much of the Yukon Flats region is covered by deep, poorly drained wind and water-deposited soils (histic pergelic cryofibrists). Also present are deep, well-drained silts (typic cryochrepts) and deep, well-drained loess and silty or sandy, well-drained loams (typic cryorthents). Intermediate elevations and higher alluvial fans have well-drained, deep silt loams and fine sandy loams (typic fluvic cryofluvents) and deep, well-drained silts (typic cryochrepts). Rolling hills in the area have shallow, poorly drained soils with a thick organic layer (histic pergelic cryaquepts); deep, well-drained silty soils (typic cryochrepts); and rock outcrop (SCS 1979).

Permafrost is continuous under large parts of the refuge and discontinuous under the rest. Subsoil's may be permanently frozen to depths exceeding 300 feet. Over the permafrost is the active surface layer of soil and duff, which thaws each summer. This layer may be from a few inches to several feet thick, depending on aspect, distance to a river, soil type, time since last wild land fire, vegetation type, and characteristics of the moss and litter layer. Soil drainage is poor in many places because of permafrost and lack of relief.

The Yukon River flows through the center of the refuge and is encompassed by the Yukon Flats basin and some of its surrounding highlands and mountains. There are four physiographic regions: Yukon Flats, Porcupine Plateau, Kokrine-Hodzana Highlands, and the Yukon-Tanana Uplands per Selkregg (1976) and Wahrhaftig (1965).

The Yukon Flats Basin lies in the middle of and covers over half the refuge. The central part consists of marshy, lake-dotted flats rising from 300 feet above sea level on the west to 900 feet on the north and east. The northern part of the region is made up of gently sloping outwash fans of the Chandalar, Christian, and Sheenjek Rivers, and the southern part is a broad, flat outwash fan of the Yukon River. Rising above the flats are rolling, silt and gravel covered terraces, often with sharp escarpments 150 to 600 feet high, which slope gradually upwards to surrounding uplands and mountains.

The Porcupine Plateau covers much of the eastern and northeastern portions of the refuge. The topography consists of relatively low, gentle ridges and mountains with rounded or flat summits 1,500 to 2,800 feet high. The Porcupine River flows through the center of the plateau. The Black and Little Black Rivers drain rolling to steep uplands in the southeastern part.

The Kokrine Hodzana Highlands that lie northwest of the Yukon Flats is characterized by mostly rounded ridges that reach 1,000 to 2,500 feet in elevation and some rugged peaks that rise to 4,200 feet. Some of the drainages are quite steep and dissected.

The Yukon Tanana Uplands lie along the southern boundary of the refuge and are the northern edge of the White Mountains (including the Crazy Mountains). This area is characterized by rounded ridges and small mountains, with peaks reaching 2,500 to 4,100 feet.

3.1.4.9. Humans & Human Activity

The refuge provides an area in which local residents conduct subsistence activities, an area for them and others to ply commercial ventures, and a wild, remote area for recreationists. All

recreation and subsistence uses depend on healthy habitat and wildlife populations. Much of the following discussion is drawn from USDI (1974), USFWS (1994), and USFWS (1987).

Among its other purposes, the refuge is mandated by ANILCA to provide for subsistence uses by local residents, and those uses have precedence over other consumptive public use. Subsistence uses are important not only for providing food, clothing, tools, and housing, but are important culturally and socially as well (Caulfield 1983, USFWS 1987). The residents of the eight villages in and adjacent to the refuge depend heavily on the refuge's resources. Exact usage is not documented, because users often do not differentiate between refuge land or Native corporation land, and many wildlife species move back and forth across these boundaries. Recent surveys have documented that 90-100% of households in area villages harvest wild resources, and that 450-680 pounds of wild resources are harvested for human consumption per person per year. Much larger amounts of fish are harvested for dog food (Sumida 1988, 1989; Sumida and Andersen 1990).

The refuge has social importance beyond its value for subsistence and recreational activities. Although the area's remoteness and isolation result in relatively low levels of public use, those characteristics are what make it attractive to many people.

Fish and wildlife that have spawned hatched, and or which spend part of their life on the Refuge are also important to commercial, subsistence, and recreational users elsewhere. Salmon, waterfowl, migratory non-game birds, and caribou are important to people downstream on the Yukon, out on the Pacific, in Canada, in the Lower 48, and in Russia, Mexico, and Central and South America.

Cash-paying jobs are scarce in the refuge area. Unemployment averages 32% in area villages and 38% of people live below the poverty level (DCRA 1994). Cash incomes assist subsistence activities by allowing the purchase of supplies such as gasoline, oil, firearms, ammunition, tools, and other materials. Economic exploitation of the refuge is limited by law and by the nature of the area. Tourism, trapping, and commercial fishing take place on the refuge.

Commercial harvesting of timber is not allowed on the refuge (USDI 1987). Although no commercial logging currently occurs in the area, white spruce stands on adjacent private lands are in Full Management Option areas partly because of their potential value as timber. Commercial firewood and house log cutting does take place on private lands.

Firefighting is and has been an important source of income for many local residents, mostly connected with organized village Emergency Firefighting (EFF) Crews involved in the suppression of large fires. Gross earnings of local residents from firefighting have totaled more than $5 million during the years 1985-1994 (latest figures available), although there is high variability from year to year because this income follows the boom-and-bust cycle of large fires (Sylvester 1971). Most EFF use is within Alaska, but use in the Lower 48 is increasing.

There are opportunities for village EFF crew participation in other aspects of fire management. The refuge has used village EFF in prescribed burning, and EFF may be used in any projects constructing fuel breaks to improve the protect ability of developed areas from wild land fires. The refuge places a high priority on involving local crews in the refuge fire management program.

3.1.4.10. Values to Protect – All FMUs

3.1.4.10.1 ***Priority to Protect Human Life***

Human life is the single, overriding value to be protected by actions authorized under this plan. Priorities for the protection of human communities and community infrastructure, other property and improvements, and natural and cultural resources will be incident specific, and will be based on the values at risk, human health and safety, and the costs of protection.

3.1.4.10.2 ***Allotments***

Allotments in the vicinity of Yukon Flats Refuge are trust lands under the jurisdiction of the Bureau of Indian Affairs (BIA). Titles to these parcels are held by individual Alaska Natives referred to as allottees. As trustee of these lands, the United States Government must ensure that these lands and their resources are maintained in perpetuity for the benefit of their Indian owners. One element of the trust responsibility is the protection of the land and resources from damaging wildland fires.

The Tanana Chiefs Conference (TCC), through an Indian Self Governance Compact, has assumed management of fire preparedness activities for allotments in the TCC service area, which includes the Yukon Flats Refuge. All allotments in the vicinity of Yukon Flats Refuge currently receive protection commensurate with the Full or Critical Fire Management Option. Allottees may authorize changes to the fire management option assigned to their allotment through the TCC fire program.
Whenever an allotment is threatened by fire, the Upper Yukon Zone FMO will notify BIA directly, or through TCC of the threat. It will be the responsibility of the BIA to contact all current allotees and to keep them informed of the situation throughout the incident.

3.1.4.10.3 ***Refuge Infrastructure***

Refuge Repeaters

The Refuge maintains three mountaintop radio repeaters. The Lone, Frozen Calf, and Wolf Mountain repeaters are accessible by helicopter and will receive protection commensurate with the Full Fire Management Option.

Refuge Remote Automated Weather Stations (RAWS)

The Refuge maintains eight permanent RAWS (See Table 2). Refuge RAWS will receive protection commensurate with the Full Fire Management Option.

Administrative Cabins

Two Administrative cabins exist on the Refuge to support the Refuge mission. The cabins are located in Fort Yukon and on Canvasback Lake. Both cabins may require fuels mitigation and maintenance work. The Canvasback Lake cabin site will receive protection commensurate with the Full Fire Management Option and its estimated replacement value. The Fort Yukon cabin will received protection commensurate with the Critcal Fire Management Option due to its location within the village of Fort Yukon. Administrative cabins will be included in the AICC Known Sites database.

Cultural/Historical Sites

The Alaska Office of History and Archaeology (OHA) carries out the responsibilities of the State Historic Preservation Office. The National Historic Preservation Act of 1966 set up the position of State Historic Preservation Officer (SHPO) for each state, to be appointed by the Governor. In Alaska, the Governor has designated the Chief of the Office of History and Archaeology as the SHPO. OHA maintains The Alaska Heritage Resources Survey (AHRS), a restricted statewide inventory of Alaska's reported historic, prehistoric, and archaeological resources. This inventory of cultural resources includes objects, structures, buildings, sites, districts, and travel ways, with a general provision that they are over 50 years old. The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction. Various state and federal agencies and private companies use the inventory when planning or reviewing development projects. By knowing of reported cultural remains prior to construction, efforts can be made to avoid project delays and prevent unnecessary destruction of these non-renewable resources. Listing on the AHRS does not, in and of itself, provide protection for sites. But it does allow for knowledgeable decisions to be made concerning the future of these sites.

To date, few potential historic sites on the Refuge have been documented. Documented sites will be included in the AICC Known Sites database and will be identified as **Full Historical** and will receive protection commensurate with the Full fire management option.

Permitted Cabins

Approximately 40 tent frames and cabins are currently permitted for subsistence or commercial use on the Refuge. The *Region 7 Policy for Management of Permitted Cabins on National Wildlife Refuges in Alaska (RW-1)* states that, *"the Service does not guarantee protection of a permitted cabin or its contents in the event of fire. Public and firefighter safety is the first priority in wildland fire activities and decisions. Firefighter safety will not be compromised for structure protection.*

Current cabin permittees will be authorized to establish defensible space around the permitted cabin/structure using Alaska Wildland Fire Coordinating Group Fire Wise standards. New permits for cabins may be issued without authorizing Fire Wise standards because of other resource concerns. In all cases, the cabin permit must clearly state that the permittee understands the inherent risk in wildfire and that the cabin and its contents may not be protected in the event of a wildfire."

Permitted cabins will be included in the AICC Known Sites database and will be identified as **Non-Sensitive Structure**. A note will be made in the comment field that indicates the permitted status of the cabin. The Refuge Manager may choose to provide protection for individual permitted cabins commensurate with their value on a case by case basis, as long as safety concerns have been mitigated.

Unpermitted/Abandoned Cabins

Unpermitted or abandoned cabins on Refuge lands will not be protected except on a case-by-case basis with Refuge Manager approval and Incident Commander concurrence. Known unpermitted/abandoned cabins will be included in the AICC Known Sites database and will be identified as **Non-Sensitive Structure**. Unpermitted cabins will not be protected by default;

however, the Refuge Manager may choose to provide protection for individual unpermitted cabins commensurate with their value on a case-by-case basis, as long as safety concerns have been mitigated.

Trails

Trails within the Refuge may provide opportunities for low impact holding lines. Trails may also require Emergency Stabilization action, and/or post fire Burned Area Rehabilitation to clear deadfall following the passage of a fire or identify and eradicate invasive species.

3.1.4.10.4 *Subsistence Values*

An important purpose of the Refuge, among the other purposes outlined in ANILCA is to provide subsistence opportunities for local residents. Wildland fire may have both positive and negative effects on subsistence resources and infrastructure. Although periodic fire often increases habitat diversity and encourages species productivity leading to increased subsistence opportunities, large fires may temporarily decrease productivity in certain areas. The effects of fires on established trails and camps must also be considered. All fire management decisions will include consideration of the effect of fire as well as the effect of fire management actions on subsistence values.

3.1.4.10.5 *Refuge Lands and Natural Values*

3.1.4.10.5.1. Natural Diversity

Conservation of fish and wildlife populations and habitats in their natural diversity, including, but not limited to, waterfowl, raptors and other migratory birds, furbearers, moose, and caribou is another one of the primary purposes for which the Yukon Flats National Wildlife Refuge was established. Thus, habitat diversity and species productivity within the Refuge and throughout the Upper Yukon Valley are the core natural resource values that the refuge fire management program is designed to protect. These values are largely dependent on the continued existence of a relatively natural fire regime.

3.1.4.10.5.2. Raptor Nesting Sites

River corridor bluffs, snags, and open summits may host raptor nests including peregrine falcon nests. Although wildland fire is unlikely to adversely affect nesting sites, fire management and other actions undertaken in and around these locations may have negative effects. Disturbance of known nesting sites will be avoided during fire management activities. Known raptor nesting sites will be identified in the Statewide Known Sites database as **Avoid T&E Species**. Any raptor nests discovered during fire management activities should be reported to refuge biologists.

3.1.4.10.5.3. Sensitive Biological Communities

Steppe-bluff communities are generally restricted to steep, south-facing bluffs near the larger rivers and are quite unique in comparison to surrounding boreal forest communities. Steppe-bluff communities contain sagebrush and grasses and drought-tolerant forbs, including many endemic plant species such as the Species of Concern listed above (Murray and Lipkin 1987, Wesser and Armbruster 1991). Two species new to science have recently been discovered in this community: a fleabane (Erigeron), and a liverwort (Asterella). The community is mapped on interagency fire maps.

3.1.4.11. Safety Considerations – All FMUs

Public safety is a critical concern in all aspects of the Refuge fire management program. One way that the Refuge seeks to improve public safety is by managing wildland fire so that hazardous fuels are broken up or reduced in the vicinity of values at risk, as well as across the landscape as a whole. By allowing some fires to burn naturally, the landscape is broken up by areas of limited flammability, and the risk of future fires growing unmanageably large is lessened. Although specific incidents may still threaten villages or other values with fire or smoke impacts, that require suppression actions, this strategy provides long-term smoke and fire management benefits.

People may have to leave villages for a variety of reasons related to wildland fire. Unhealthy smoke concentrations may require evacuation of residents, especially those who are particularly sensitive to smoke (e.g., very young or old, asthmatic). In addition, there may be a precautionary evacuation because of fire threat, or there may be an evacuation under imminent threat from fire.

Because the Refuge operates under minimal management strategies, there are no developed recreational sites on the Refuge. Recreational users are not required to register and may be widely scattered across the Refuge. In most cases recreational users are not tracked and there are no effective, consistent means of providing them with notification of potential hazards. However, nearly all recreational use of the Refuge is associated with river systems, which provide high mobility and can allow recreational users to avoid fire and smoke on their own. Fire is one of many hazards present on lands as remote and wild as the Refuge; others include wildlife interactions, water related hazards, and unpredictable weather.

3.2. Yukon Flats Limited FMU

This FMU includes four Alaska Interagency Fire Plan units with Limited management option designation: Hodzana Highlands, Sheenjek River, Black River, and White Mountains. They total about 8,259,000 acres and are the areas farthest from villages.

The Refuge management goals include managing for natural habitat diversity. Extinguishing or limiting the spread of naturally-ignited wildland fires within the Limited FMU may have potentially serious and long-lasting effects on the landscape. Suppression actions will not be conducted in this FMU unless necessary to protect human life, property, or other identified values. Human-caused wildfires, accidental and intentional, have also affected the landscape for centuries (Lutz 1956, Pyne 1982), but it is currently against Departmental policy to use these fires to achieve resource objectives. Management of human-caused fires will consider other factors, including protection of human life, property, and identified values, as well as suppression costs and potential damage from suppression operations, and may range from a monitoring only response to full suppression and acreage minimization.

3.2.1. **Yukon Flats Limited FMU Characteristics**

- Remote
- All fuel types are present
- Dominant types include black spruce/stunted white spruce and herbaceous or shrub types caused by recent burns.

3.2.2. **Yukon Flats Limited FMU Values to Protect**

The White Mountains Unit includes part of the Beaver Creek National Wild River, and the Sheenjek River unit contains a proposed National Wild River. These areas receive considerable public use, and little or no trace of fire management activities should remain following a fire. Extra care should be taken to protect the "natural, primitive" condition of the land, to protect water quality from retardants, foams, fuel, other chemicals, and minimize erosion caused by fire management activities.

All fire management activities undertaken in these areas shall adhere to the same minimum impact suppression guidelines (**Appendix F**) that apply elsewhere on the Refuge; however, the Refuge Manager will explicitly approve all repair actions in writing prior to demobilization of the fire.

3.2.3. **Yukon Flats Limited FMU Management Guidance**

- Manage wildfires to meet refuge and habitat objectives.
- Ensure protection of special area in the White Mountains Sheenjek River units.
- Careful and continual evaluation to identify areas to change to Limited management option or areas in need of prescribed burns for hazard reduction or resource purposes.
- Allowing fires to burn for resource benefit may be employed in this unit.
- Minimizing acreage burned by wild land fire is not a management priority.
- The use of retardant or foam must first be approved in writing by the Refuge Manager or acting Refuge Manager. Aerial retardants and foams will not be used within 300 feet of any waterway.

3.3. Yukon Flats Modified FMU

This unit consists of areas with Modified management option designation, currently totaling about 884,000 acres. During early planning efforts, this level of protection was often given to land to help protect adjacent high value areas. Very little of this unit has burned since fire suppression began in the 1950s, which has contributed to an increase in extent and loading of hazardous fuels in proximity to high value areas.

3.3.1. **Yukon Flats Modified FMU Characteristics**

All fuel types are represented. Dominant types include white spruce, hardwoods, and willow shrub lands, although some large areas of black spruce/stunted white spruce is also present.

3.3.2. **Yukon Flats Modified FMU Values to Protect**

All Refuge fire management decisions will consider impacts to neighboring landowners. The Fire Management Option for Refuge lands near some boundaries has been elevated in order to reduce the risk of fire spread and damage to neighboring values in Full and Critical Management Option lands. Neighboring landowners include:

Regional Native Corporations	
Doyon Regional Native Corporation	
Village Native Corporations	
Corporation	**Village**
Beaver Kwit'Chin Corporation	Beaver
Chalkyitsik Native Corporation	Chalkyitsik
Danzhit Hanlaii Corporation	Circle
Dinyea Corporation	Stevens Village
Gwitchyaazhee Corporation	Fort Yukon
Neechootaalichaagat Corporation	Birch Creek
Tihteet'aii Inc.	Birch Creek
Venetie Indian Reservation	Venetie
Other Ownership	
Native Allotment Owners	
Alaska Department of Natural Resources	
USFWS – Arctic National Wildlife Refuge	

Table 10: Yukon Flats Adjacent Landowners

3.3.3. Yukon Flats Modified FMU Management Guidance

- Manage wildfires to meet refuge and habitat objectives.
- Careful and continual evaluation to identify areas to change to Limited management option or areas in need of prescribed burns for hazard reduction or resource purposes.
- Allowing fires to burn to meet resource objectives may be employed in this unit.
- Minimizing acreage burned by wild land fire is not a management priority.

3.4. Yukon Flats Interface FMU

This unit contains areas given Full or Critical management option designation. The Refuge currently has about 128,000 acres in this unit, mainly around villages and concentrations of Native allotments. Land ownership around villages is in a checkerboard pattern and the Refuge Full management option buffers these adjacent lands.

Full management option areas should be discussed with village and regional corporation representatives to ensure that the true values are being protected. Local interest has been expressed in allowing fire in these areas for resource reasons (W. James, personal communication, R. Mayo, personal communication, P. Williams, Sr., personal communication, Natcher 1996). In these areas, the potentially negative effects of suppression on natural resource values and the long-term build-up of hazardous fuels must be weighed against immediate threats to villages, allotments, and other values.

3.4.1. **Yukon Flats Interface FMU Characteristics**

- All fuel types are present
- Dominant types include white spruce, hardwoods, and willow shrub lands
- Large areas of black spruce/stunted white spruce are also present
- Very little of the FMU has burned since fire suppression began
- Hazardous fuel situations exist around the settled areas

3.4.2. **Yukon Flats Interface FMU Values to Protect**

3.4.2.1. Communities and Other Adjacent Infrastructure

A partial list of specific sites on neighboring lands includes:

- Beaver
- Fort Yukon
- Stevens Village
- Circle
- Birch Creek
- Chalkyitsik
- Venetie
- Native Allotments

3.4.2.2. Adjacent Lands

All Refuge fire management decisions will consider impacts to neighboring landowners. The Fire Management Option for Refuge lands near some boundaries has been elevated in order to reduce the risk of fire spread and damage to neighboring values in Full and Critical Management Option lands.

3.4.3. **Yukon Flats Interface FMU Management Guidance**

Wild land fires in this unit have highest priority to receive aggressive suppression action.

- Minimize acres burned during initial attack
- Consider cost an important factor in selecting strategies and tactics for extended attack and escaped fire
- Safety and protection of identified sites or features is a priority
- Hazard situations around the settled areas should be identified and mitigated
- Hazard reduction may be implemented in the Interface FMU through:
    - Prescribed fire
    - Non-fire fuel reduction treatments (off-Refuge only)
    - Management of fires or portions of fires for resource benefit where threats to values can be mitigated.
    - Review and updates to management options, ensuring efficient allocation of suppression resources.

4. **Wildland Fire Operational Guidance**

The national policy and procedure guidance in the current edition of the *Interagency Standards for Fire and Fire Aviation Operations*, (Red Book) is incorporated into this plan, and must be followed. Alaska operational guidance for the management of fires is located in the Alaska Interagency Annual Operating Plan (AOP).

4.1. Management of Wildfires

Initial response to Refuge fires will be carried out according to the procedures and guidelines in the *Alaska Interagency Wildland Fire Management Plan* (AIWFMP). All wildfire management decisions will include consideration of risks to public and firefighter safety, threats to the values to protect, costs of various mitigation strategies and tactics, and potential wildfire benefits.

4.1.1. **Staffing**

The Eastern Interior Refuges District includes the Tetlin, Arctic, Kanuti, and Yukon Flats Refuges. The District shares fire management staff duty stationed in Tok and Fairbanks. All positions are currently funded through the Kanuti cost center.

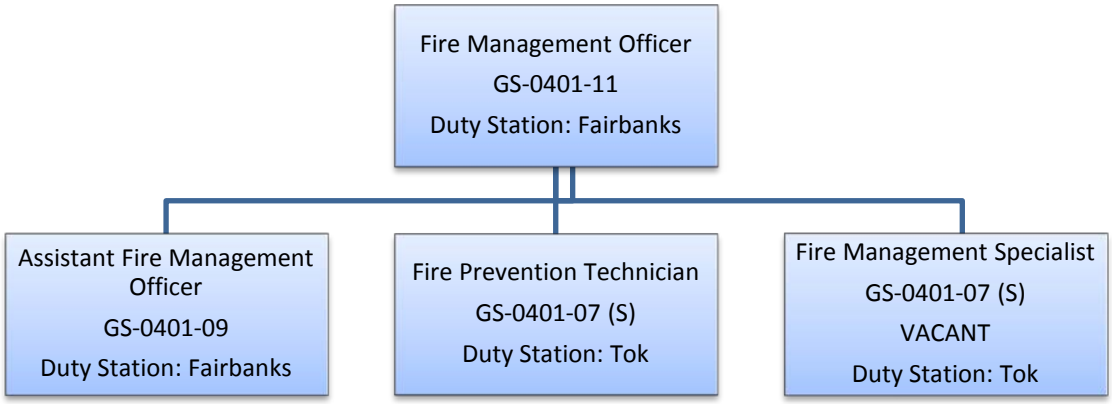

Figure 5: Eastern Interior Refuges fire management staffing

The Fire Management Officer (FMO), duty stationed in Fairbanks, is supervised by the Kanuti Refuge Deputy Manager. Refuge Managers from each of the Eastern Interior Refuges delegate specific fire management duties and responsibilities to the FMO (**Appendix D)**. In addition, the incumbent takes an active role in fire management activities on the refuges, cooperating and coordinating with the appropriate protection agency - Alaska Division of Forestry (DOF) for Tetlin, and Alaska Fire Service (BLM-AFS) for the other three refuges including Yukon Flats, as well as with incident management teams (IMTs). The FMO is responsible for providing refuge managers with up to date fire information and for advising them on fire management decisions.

The Assistant Fire Management Officer (AFMO) is also duty stationed in Fairbanks, assists with overall program management, and serves as acting FMO when the FMO is assigned to fires or otherwise absent. The AFMO and FMO rotate duty officer responsibility during the fire season.

The Fire Management Specialist, duty stationed in Tok, is currently vacant. The incumbent is primarily responsible for coordinating fuels reduction projects, managing agreements in order to

accomplish treatments, and field supervision of the Fire Prevention Technician (FMO retains official supervisory duties).

The Fire Prevention Technician duty stationed in Tok works closely with the Tok Area DOF counterpart to implement refuge specific prevention and outreach efforts and assist with local Community Wildland Fire Protection Plan (CWPP) efforts. The incumbent has primary responsibility for maintenance of the Refuge cache and Type 5 engine. The Fire Prevention Technician is a shared position and is also responsible for providing prevention services to the other three Refuges including Yukon Flats.

Due to limited fire program staffing, most prescribed fire and mechanical fuels treatments require outside assistance. Qualified Service personnel from other Refuges and programs, interagency partners, and assistance agreement cooperators play key roles in treatment accomplishment. Fire program and other qualified personnel may be available for Local, Regional and National fire assignments with supervisory approval.

The Regional Office in Anchorage has a fire management staff to assist the Refuge with fire ecology and fire research needs, fire planning, outreach and public information, and fuels management. Regular communication between Refuge staff, the Regional Fire Coordinator, and other Regional fire program staff provide for two-way information flow between the Refuge, the Region, and other Regional fire programs.

4.1.2. Training and Qualifications

Refuge personnel will meet *National Interagency Incident Management System Wildland Fire Qualification System Guide, PMS 310-1* training, experience, and fitness levels for prescribed fire and suppression positions. All personnel funded with fire funds who are hired under a position description containing firefighting duties will meet PMS 310-1 requirements for the appropriate fire position. Individuals will not be assigned to duties for which they lack training and qualification. All personnel hired as primary firefighters must meet the arduous fitness standard to maintain full fire funding and if the position is career status, arduous is required to meet special retirement considerations for fire. Additional training policy and guidance is available in the *Interagency Standards for Fire and Fire Aviation Operations* and in the *U.S. Fish and Wildlife Service Fire Management Handbook*.

4.1.2.1. Incident Qualifications and Certification System

The Eastern Interior Fire Management Officer is responsible for input and maintenance of all pertinent Refuge employee data into the Incident Qualifications and Certification System (IQCS), and for ensuring that employees are trained, qualified, and certified at levels which meet preplanned needs for appropriate management response, initial attack and prescribed fire, and for ensuring the accuracy of annual Incident Qualification Cards.

The Eastern Interior FMO has been delegated the duties of the Certifying Official from the Refuge Manager (**Appendix D**), and confirms through the issuance of an incident qualification card that an individual is qualified to perform in a specified position. The Incident Qualification Card has a currency of 12 months. Current fire qualifications for fire program and collateral duty employees will be documented annually in the Eastern Interior Preparedness/ Dispatch Plan (**Appendix B**).

Only PMS 310-1 and USFWS specific positions are approved for use by agency employees. IQCS Account Managers will proactively maintain organization codes for which they are responsible. Employees that are no longer employed by the FWS should be placed in inactive status (INAC) upon termination of duty.

4.1.2.2. National Incident Management System (NIMS) Training Requirements

Service personnel, who may become involved in emergency response activities, including wildland fire, are required to meet minimum training requirements established by the Department of Homeland Security in order to be NIMS compliant. Information regarding specific position requirements is outlined in the Service NIMS required training memorandum from the Director dated December 5, 2008 and the DOI Bulletin dated May 31, 2007.

4.1.2.3. Interagency Fire Program Management (IFPM) Requirements

Service personnel in IFPM covered positions must meet the NWCG qualification and additional required training requirements identified for their positions. Minimum qualification standards for Eastern Interior Fire Management positions is as follows:

Position	IFPM Position Standard	IFPM Complexity
Fire Management Officer	Unit Fire Program Manager	Moderate
Assistant Fire Management Officer	Wildland Fire Operations Specialist	Low
Fire Management Specialist	Prescribed Fire Fuels Specialist	Low
Fire Prevention Technician	N/A	N/A

Information regarding specific position requirements is available at http://www.ifpm.nifc.gov/.

4.1.2.4. Physical Fitness and Conditioning

Employees serving in wildland fire positions that require a fitness rating of arduous as a condition of employment are authorized one hour of duty time each work day for physical fitness conditioning. Employees not having a fitness rating of arduous as a condition of employment, but who are required by a Critical Performance element or other written agreement to maintain an arduous level, will be authorized three hours per week of duty time for physical fitness condition. All other wildland firefighting personnel holding qualifications requiring ratings of moderate or arduous may be authorized, by their supervisor, up to three hours per week of duty time for fitness conditioning. Prior to any duty time being allowed for physical fitness conditioning, employees and supervisors must agree, in writing, what physical conditioning activities the employee will engage in, and when and where they will occur (**Appendix H)**. Activities outside of the agreement will not be authorized or allowed. A combination of activities designed to increase both physical strength and aerobic fitness, while minimizing the possibility of physical injury, should be utilized.

4.1.3. **Preparedness**

Annual preparedness activities are documented in the *Eastern Interior Refuges Preparedness/ Dispatch Plan* (**Appendix B**).

4.1.3.1. Delegation of Authority to Fire Management Officer

The Refuge Manager will annually provide the Fire Management Officer a written delegation of authority to perform fire management duties for the Refuge. See (**Appendix D**).

4.1.3.2. Preparedness Planning

Eastern Interior Refuges Fire Preparedness Level will mirror the statewide preparedness level identified in the AICC Daily Situation Report. National preparedness levels will be identified in the NICC Situation Report. The *Eastern Interior Refuges Preparedness/ Dispatch Plan* (**Appendix B**) will identify step up actions to be taken when these preparedness levels change.

4.1.3.3. Equipment and Supply Levels

N/A

4.1.3.4. Communications

All Wildfire radio communication for Refuge and other Upper Yukon Zone fires will take place on the BLM Alaska Fire Service radio network. Prescribed fire and other fuels project communications will normally be conducted on the Refuge radio network; however, interagency projects and communications with the Upper Yukon/Tanana Dispatch Center will occur on the BLM AFS network. Telephone contacts and radio channel plans appear in the *Eastern Interior Refuges Annual Dispatch/Preparedness Plan* (**Appendix B**)

4.1.3.5. Aviation Management

The Refuge aviation program primarily supports resource missions and is not under fire management control. When authorized by the Refuge Manager, Refuge aircraft may sometimes be used to perform fire related missions including detection, fire reconnaissance, and logistical support at the request of the protection agency. Aircrew and passengers will be appropriately briefed prior to performing fire related missions. All fire-related aviation operations will follow applicable guidelines of the DOI National Business Center - Aviation Management Directorate. All fire-related Refuge aviation activity will coordinate with the Upper Yukon/Tanana Dispatch Center.

Refuge personnel performing fire-related aviation missions in cooperator aircraft will meet DOI standards and will additionally comply with cooperator policy and procedures when they are more stringent than DOI policy.

4.1.3.6. Fire Detection

Detection services for the Upper Yukon Zone including the Refuge are the responsibility of the protection agency – BLM AFS, Upper Yukon Zone. Detection flights are scheduled based on area lightning detections and fire danger rating, and are often combined with reconnaissance of ongoing fires. At the request of Upper Yukon Zone, Refuge aircraft and/or personnel may be used to perform detection missions when authorized by the Refuge Manager. An aircraft

resource order/ request number (A-number) will be issued by the local dispatch center if the refuge is charging flight time to the detection flight or a specific fire.

4.1.3.7. Initial Report of Fire and Initial Response Dispatching

The Upper Yukon/Tanana Interagency Dispatch Center (AK-UYTC) will be responsible for initial attack dispatching on all refuge fires. The Center will operate from 08:00 to 18:00 hours, 7 days per week. Center season and hours will be extended as needed and an after-hours contact protocol will be included in the *Eastern Interior Refuges Annual Preparedness/ Dispatch Plan* (**Appendix B**). The Alaska Interagency Coordination Center (AICC) will be responsible for dispatching outside of AK-UYTC's operating season.

Upon discovery of a fire, AK-UYTC is responsible to determine, verify and document the incident location, management option, and cause, and implement the initial response based on the management option designation as described in the AIWFMP and mapped on the Map atlas maintained by AICC. Notification procedures are addressed in the AIWFMP and Clause 24 of the Alaska AOP and can be summarized as follows:

Fire notifications are required to the jurisdictional agency for any fires occurring on federal lands and Alaska Native village and regional corporations lands A Wildland Fire Decision Support System (WFDSS) entry by the Protecting Agency, as described in **Section 4.1.4.6,** is required as part of the notification process. The following notification protocols will be followed:

- When a fire occurs on refuge lands, the Refuge FMO or Duty Officer will be notified promptly by phone or other pre-arranged contact method.
- When a fire occurs on non-Service lands but threatens to burn onto refuge lands, the Refuge FMO or Duty Officer will be notified.
- As a courtesy, the Refuge FMO or Duty Officer should be notified when a fire occurs within five miles of the Refuge ANILCA boundary.
- The Refuge FMO or Duty Officer will be notified of all false alarms and natural outs reported on Refuge lands.

All notification attempts should be documented. The notification process should not delay any initial response necessary within AIWFMP guidelines; however a non-standard response should not be initiated until the Refuge Manager or designee has been consulted, unless life or property are immediately threatened. AK-UYTC will initiate WFDSS documentation for all Refuge fires and will transfer ownership to the Refuge FMO or Duty Officer. At a minimum, fire notification will include the following information:

- DOI Fire Number
- State Fire Number (only applicable if State resources are assigned to the fire)
- Fire Name
- Management Option
- Date and Time Fire Reported
- Geographic Coordinates (Latitude/ Longitude)
- Legal Description (¼ ¼ Section, Township, Range, Meridian)

- Current Size
- Fuels
- Values Threatened

Initial response to Refuge fires will be in accordance with the AIWFMP procedures. Non-Standard responses will be approved by the Refuge Manager unless threats to life or property preclude this. Non-standard responses will be documented through a decision in the WFDSS process.

Reports of fires occurring in the Upper Yukon Zone should be made directly to AK-UYTC or to the after-hours duty-officer at **1-800-237-3652**. The following information should be recorded before the person reporting the fire hangs up or leaves:

1. Name, phone number, and calling location of person reporting the fire:
2. Date and time report is received: ___/___/_____ AM/PM
3. Date and time fire was observed: ___/___/_____ AM/PM
4. Immediate threats/hazards:
5. Estimated fire size:_____(acres or length x width in feet).
6. Fire location (be as specific as possible, e.g. lat./long, street name, milepost, homeowner's name, etc.):
7. Topographical features (hillside, valley bottom, ridge top, etc.):
8. Fire behavior (i.e. smoldering, surface fire, torching trees, etc.):
9. Smoke color, direction of spread, and column description:
10. Anyone observed in the fire area or leaving the scene? (vehicle description, license #, etc.)
11. Fuel type (spruce, brush, tundra, dump, etc.):
12. Name of person receiving or recording this report:

When a fire is reported directly to refuge personnel the reporting party should be kept available while the Upper Yukon/Tanana Zone Dispatch Center is called (on another line if necessary). If this is not possible, the information should be recorded and relayed to the AK-UYTC fire dispatcher immediately.

4.1.3.8. Incident Commander Responsibilities

Operational control of a Refuge wildfire is the responsibility of BLM AFS Upper Yukon Zone as authorized in the Master Agreement and Annual Operating Plan. The Upper Yukon Zone FMO will assign a qualified Incident Commander (IC) and provide supervision and support including oversight, direction and logistical support. When a fire is not staffed, the Upper Yukon Zone FMO will retain operational control and will be the de facto Incident Commander. Upper Yukon Zone will be responsible for fulfilling daily interagency incident reporting requirements directed in the AIMG and will complete the final fire report which will be provided to the Service.

The Refuge Manager and Upper Yukon Zone FMO will provide all Type 1, 2, and 3 incident commanders with a written delegation of authority authorizing fire management actions to be

taken on Refuge lands. The Master Agreement and Annual Operating Plan will serve as a delegation of authority to the Upper Yukon FMO for initial action on Type 4 fires.

The IC is responsible to:

- Provide a size-up to dispatch as soon as possible upon arrival on scene. A size-up checklist is in the *Incident Response Pocket Guide* (IRPG).
- Assess potential management by suppression and/ or by wildfire for resource benefits as incident objective(s) and contact the Upper Yukon Zone FMO with recommendations which will be relayed to the Refuge Manager.
- Use guidance in this FMP, a Delegation of Authority, and WFDSS decision documentation to implement selected response and manage an organization to implement effective strategies and tactics. Minimize suppression impacts where possible without reducing the effectiveness of the actions being undertaken.
- Determine resource needs and order as needed through local dispatch.
- Ensure that all resources assigned to the incident and those incoming receive a briefing and document these briefings. Refer to the Briefing Checklist in the IRPG.
- Continually re-assess incident complexity using the checklist in the IRPG. When a more qualified IC is needed, inform dispatch and delegated unit administrator and place the order for a higher level IC.
- Depending on incident complexity, additional responsibilities may apply. The NWCG Fireline Handbook provides a more detailed description of IC responsibilities.
- All resources, including mutual aid resources, will report to the IC (in person or by radio) and receive an assignment prior to tactical deployment.

All Refuge fires must be investigated to determine fire cause, and if negligence or criminal intent were factors. If the IC suspects a fire may be human-caused, the point of origin will be protected and the Refuge Manager will be consulted. Based on the evidence provided by the IC, the Refuge Manager will determine whether further investigative action is warranted. If so, the Refuge Manager will request that a Fire Investigator be resource-ordered. A Service Law Enforcement Officer may be paired with the Fire Investigator to conduct the investigation.

4.1.3.9. Mutual Aid and/or Cross-Boundary Operations

4.1.3.9.1 ***BLM AFS / Yukon 10 Mile Border Corridor Initial Attack Agreement***

This agreement allows protection agencies in Alaska and Canada to commence initial attack activity on any wildland fire within ten miles of either side of the border between the Alaska and the Yukon Territory.

4.1.3.9.2 ***Northwest Wildland Fire Protection Agreement (Northwest Compact)***

It is unlikely that Canadian fire management resources will be used on a Yukon Flats wildfire.

Although Canadian resources may be requested through a resource-order by DNR under the terms of the *Northwest Wildland Fire Protection Agreement* (Northwest Compact), those resources must remain under the operational control of DNR while operating in Alaska unless inspected and certified by the appropriate federal agency (BLM).

4.1.4. **Incident Management**

4.1.4.1. Dispatching Beyond Initial Attack (IA)

The IC will notify AK-UYTC whenever it appears a fire will escape initial attack efforts, cross Service boundaries, or when fire complexity will exceed the capabilities of command or operational forces. When additional resources are needed, they will be ordered through the AK-UYTC, which will mobilize any additional resources, including higher level ICs and Incident Management Teams.

AK-UYTC or the Upper Yukon Zone FMO will notify the Refuge Duty Officer who will notify and provide technical assistance to the Refuge Manager through the decision making process:

- Assisting the Refuge Manager to complete a WFDSS analysis.
- Assisting the Refuge Manager to complete a Delegation of Authority for Type 3 and higher complexity incidents.

4.1.4.2. Delegation of Authority to Incident Commander (IC)

The Master Agreement will serve as the Delegation of Authority from the Refuge Manager to Upper Yukon Zone to implement initial response activities in accordance with the AIWFMP. A written delegation will be developed jointly by the Upper Yukon Zone FMO and the Refuge Manager with the assistance of the Eastern Interior FMO for All Type 1, 2, and 3 complexity fires. The delegation will be jointly signed by the Upper Yukon Zone FMO and the Refuge Manager.

Upper Yukon Zone and Yukon Flats NWR will participate in Incident Management Team (IMT) in-briefings to provide information on local issues, personnel, facilities and identify key representatives. Upper Yukon Zone will authorize and provide oversight for incident resources regardless of the complexity level and will assign a liaison to out-of-state IMT Type 1 & 2. Yukon Flats NWR may assign Resource Advisors and/or an Agency Administrator Representative.

Upper Yukon Zone and Yukon Flats NWR will be given timely notification and will participate in IMT closeouts. Each agency may contribute to the written evaluation of IMTs' performance in the implementation of the direction contained in the Delegation of Authority. Lessons learned will be included as an Interagency Fall Fire Review agenda item. IMTs will be provided written After Action Reviews.

See the current Red Book for supporting guidelines including an Agency Administrators Briefing to an IMT. **Appendix E** displays a Sample Delegation of Authority from Agency Administrator to Incident Management Team.

4.1.4.3. Minimum Impact Suppression

All fire management activities undertaken on the Yukon Flats NWR shall adhere to minimum impact suppression guidelines in **Appendix F**.

4.1.4.4. Resource Allocation and Prioritization

Initial Attack priorities will be based on the following:

- AIWFMP Management Option
- Values at risk
- Resource Availability

Fire resources will be allocated and prioritized based on procedures outlined in the Alaska Statewide Annual Operating Plan. Under Alaska Preparedness Levels 1-3, the Protecting Agencies' fire operation leads set resource allocation priorities; under Preparedness Levels 4 and 5, the AMAC determines those priorities. Reference AMAC Handbook:

http://fire.ak.blm.gov/administration/mac.php

and Alaska Preparedness Levels in the AIMG:

http://fire.ak.blm.gov/logdisp/aimg.php

4.1.4.5. Regulatory Compliance for Managing Unplanned Ignitions

NEPA analysis is not required for wildfires because they are unplanned events. Suppression activities are Categorically Excluded from NEPA (516 DM 8.5(5).

No endangered species or critical habitat as recognized by the Endandered Species Act are likely to be impacted by wildland fire or by fire management actions on the Refuge; however, restrictions may be placed on suppression aircraft flyover altitudes of certain waterfowl and raptor nesting areas depending upon time of year and amount of flyovers required.

Smoke assessments are the responsibility of both the Upper Yukon Zone and Yukon Flats NWR. The need for air resource advisors is increasing and additional technical expertise for addressing air quality and health related issues may be available through the DEC. The AWFCG-approved "Smoke Effects Mitigation and Public Health Protection Protocols" are available at:

http://fire.ak.blm.gov/administration/awfcg.php.

For current smoke information, forecasts, regulations, advisories, and educational materials, refer to the DEC website:

http://www.dec.state.ak.us/air/anpms/index.htm.

The *Alaska Enhanced Smoke Management Plan for Planned Fire* (ESMP) was developed by DEC in coordination with the AWFCG Air Quality Committee. The ESMP and its appendices are located at:

http://fire.ak.blm.gov/administration/awfcg_committees.php.

The ESMP outlines the process and identifies issues that need to be addressed by DEC and federal and state agencies or private landowners/corporations to help ensure that prescribed fire activities minimize smoke and air quality degradation. The ESMP Appendices provide additional assistance for interagency sharing of information, the applicability and availability of current

smoke management techniques, monitoring protocol, public education strategies, and emission reduction techniques.

4.1.4.6. Use of Decision Support Tools

Decisions for extended response, non-standard responses and escaped prescribed fires will be documented using the Wildland Fire Decision Support System (WFDSS), and will support the objectives listed in the AIWFMP and the Refuge Fire Management Plan. Upper Yukon Zone will initiate the WFDSS process by entering the required information into the Incident Information tab within the WFDSS program. Upper Yukon Zone will transfer the "ownership" as defined within WFDSS to the refuge WFDSS contact; both Upper Yukon Zone and the Refuge will work collaboratively to complete documentation as required. For all incidents:

- Public and firefighter safety issues will continue to be the primary consideration.
- Upper Yukon Zone and the Refuge will jointly complete a complexity analysis or operational needs assessment to determine the management level of the incident.
- Upper Yukon Zone will authorize and provide oversight for all incident resources regardless of the complexity level.
- Operational guidelines for special management considerations are contained in the AIWFMP and in this FMP.
    - No retardant will be used on federal lands without prior approval of the agency administrator unless there is an immediate threat to life.
    - Each agency's structure and site protection policies will be reviewed and applied as directed by the Refuge Manager and based on priorities, the overall statewide fire situation and resource availability.
- IMT in-briefings and close-outs will be conducted jointly with Upper Yukon Zone as the lead.

Approval authority for WFDSS decisions rests with the Refuge Manager. Upper Yukon Zone may develop and implement incident tactics based on verbal approval from the Refuge FMO or Refuge Manager while WFDSS approvals are being finalized. WFDSS decisions exceeding two million dollars will additionally require BLM approval of costs with a CC to the FWS Region 7 Fire Management Coordinator. Upper Yukon Zone will notify the Refuge Manager or Eastern Interior FMO when costs are approaching approval thresholds.

4.1.4.7. Wildfire Reporting Requirements

Accurate and timely completion of the Incident Status Summary is a critical factor in the allocation of available resources during multiple fire situations. The information included on the form often determines the priority of a given fire, and thus its share of the resources available.

Reports are generally required for incidents where life and/or real property are threatened or destroyed, on incidents with high resource damage potential, and complex incidents that have extensive press interest, or could have political ramifications. Reports are filed on a daily basis until the incident is declared controlled. In addition to the national standard, Alaska requires an Incident Status Summary (ICS 209) for all fires (whether in Critical, Full, Modified or Limited) that have a commitment of 17 or more personnel for more than one burning period (overnight).

ICS 209s are the primary source of Alaska fire activity information for national fire managers. AK-UYTC is responsible for completing ICS 209s in the event that the Incident Commander fails to submit one. Alaska ICS-209's should be submitted by 10:00 p.m. (2200 hrs.) Alaska DST.

The Alaska Interagency Coordination Center may also request ICS 209s for other fires not covered by the above criteria as determined by the Predictive Services section. Managers determine the allocation of firefighting resources on a national basis. ICS 209s are therefore an essential element in our ability to obtain national resources such as smokejumpers, airtankers, helicopters, and type 1 crews.

Fires with Resource benefit acres will be documented in the National Fire Plan Operations and Reporting System (NFPORS) by the FMO. For all wildland fires, a Fire Management Information System (FMIS) report will be submitted by the Refuge FMO within five days of receiving the final fire report from AICC or the burn boss.

4.1.4.8. Suppression Damage Repair

Repairing the impacts of suppression activities is the responsibility of the Incident Commander and is funded by the wildfire account. Such work should be completed by incident resources prior to final demobilization whenever practical. However, it may be more cost-effective and practical to delay repairs to improve the probability of success. It is the responsibility of the Refuge Manager/line officer to ensure that suppression activity damage repair is completed.
Repair of suppression damage can include:

- Removing all trash from incident facilities, work areas and firelines,
- Replace soil dug from any trenched firelines to refill them to level; add water bars as needed,
- Fell and buck up hazardous trees and snags,
- Flush cut all stumps as close to ground level as practicable,
- Roll back and compact sod and peat overturned by plowing (with a grader or by hand) to preserve native grass rootstock and reduce thawing of permafrost by retaining the insulative properties of the vegetation mat.

4.1.5. Emergency Stabilization (ES)

Natural recovery is the preferred choice for recovery following unplanned ignitions. However, when natural recovery is not likely, ES treatments may be needed to prevent further degradation of cultural and natural resources in the burned area and downstream influence areas from erosion and invasion of undesirable species. ES uses emergency appropriations and activities must be completed within one year of fire containment. An IC may initiate ES actions before the fire is demobilized, as delegated by the agency administrator. Emergency stabilization activities were not used in Alaska until after the 2004 fire season. The Regional Fire Ecologist will be the primary contact person for ES activities in Region 7 and should be consulted if a plan is anticipated.

4.1.5.1. ES Planning and Post-Fire Assessments

Because of the emergency nature of the fire event, the Emergency Stabilization Plan (ES) must be developed expeditiously and is frequently developed by a local unit or designated burned area Emergency Stabilization Rehabilitation (ESR) team. The Refuge Manager/Line Officer is responsible to order or assign teams to develop ES plans. The first step in developing a plan is to review available data about the fire and affected resources. Field inspections will likely be necessary to assess values at risk as a result of the fire. The Refuges/unit may not have sufficient expertise to conduct burned area assessments; resource specialists from cooperating units or from the Region may be needed to assist in developing a plan.

The ES Plan specifies treatments approved to implement post-wildfire emergency stabilization on a single incident. The plan specifies only emergency activities and treatments to implement within one year of wildfire containment, although emergency stabilization funding can be used for up to three years following containment of the fire in order to monitor treatment effectiveness or to replace/repair emergency stabilization treatments if failure to do so would imperil watershed functionality or result in serious loss of downstream values. Funding beyond the first year requires an approved amendment to the plan. Funding beyond the first year cannot be used to continue seeding, plantings, or invasive plant treatments. The plan must be completed within seven calendar days of wildfire containment and approved within six business days of receipt by the approving office. An interdisciplinary team prepares this plan during or immediately after wildfire containment. Information and a plan template are at:

http://fire.r9.fws.gov/ifcc/esr/home.htm.

A DOI Memo (September 5, 2007) states that "all Emergency Stabilization planning must adhere to Department of the Interior policy (620 DM 3.6.B) requiring that standard treatments are to be used that have been validated by monitoring data from previous projects, or when there is documented research establishing the effectiveness of such actions. All plans must justify proposed treatment(s) with existing research or monitoring documentation that demonstrates that the proposed treatment(s) are significantly more effective in achieving the emergency stabilization objective than natural recovery…" Reports of previous stabilization efforts in Alaska can be consulted for information about techniques.

4.1.5.2. ES Post-Wildfire Issues and Values to Protect

Wildfire damage to improvements is a concern. Developments are typically protected from fire damage, but dispersed improvements such as fences, public use facilities, and gates are likely to be damaged by severe or large fires.

ES actions likely to be needed deal with erosion, invasive plant infestation, or loss of sensitive and protected species habitat or native vegetation post-fire, as identified in 620 DM 3, include

- 3.7 M (2) placing structures to slow soil and water movement,
- 3.7 M (7) seeding or planting to prevent permanent impairment of designated Critical Habitat for Federal and State listed, proposed or candidate threatened and endangered species,
- 3.7 M (10) direct treatment of invasive plants,
- 3.7 M (12) monitoring of treatments and activities for up to three years.

Few invasive plants have been documented on the Refuge, but they are spreading throughout the state. Disturbed areas, such as burns, provide a favorable substrate for establishment of invasive plants. Invasive plants are associated with areas of human activity (e.g., trails, roads, cabins, airstrips), so these areas are likely seed sources. Fire crews, particularly those from outside the state, may import seeds of non-native, invasive plants on clothing and equipment. Helicopter buckets and tanks, and Canadair CL2-15 tanks are required to be cleaned prior to scooping water in Alaska to prevent the spread of aquatic invasive species. ES funds can be used to control invasive plants only if an approved management plan and existing program are in place addressing non-native invasive species control. It is allowable to conduct assessments to determine the need for treatment if there are known infestations, possibility of new infestation due to management actions, or there are suspected contaminated equipment use areas. Systematic inventories are not allowed under ES funding. See the 2006 Interagency Burned Area Emergency Response Guidebook for additional information (http://www.fws.gov/fire/ifcc/esr/Policy/es_handbook_2-7-06.pdf). The Alaska Exotic Plants Information Clearinghouse (AKEPIC; http://aknhp.uaa.alaska.edu/botany/akepic) provides information about invasive plants, including species information, known location of infestations, and field data sheets.

Cultural resource sites, including prehistoric ones, can be exposed after fire removes vegetation and thick organic layers. Exposure of these sites can lead to loss of important artifacts and further degradation. The regional archaeologist should be contacted if you think cultural sites may have been exposed by fire. Efforts should be concentrated on known or suspected cultural sites; systematic inventories or surveys are prohibited.

Trail systems on the Refuge serve as more than a platform for recreational activities; winter trails are often primary inter-village transportation routes. Hazard trees can obstruct trails, making travel difficult or impossible. Emergency Stabilization funds may be used to restore a trail to its pre-fire condition; however, ES funds may not be used to improve a trail to a standard above its pre-fire condition.

4.1.5.3. ES Treatment Maintenance and Monitoring

Treatment monitoring protocols and maintenance requirements will be specified within individual ES plans. The Regional Fire Ecologist can help with developing these plans. See **Section 5.2** for an overview of effects monitoring.

4.1.5.4. ES Reporting Requirements

Annual accomplishment reports are required for ES activities, and accomplishment reports including treatment and activity information are also required in the National Fire Plan Operations and Reporting System (NFPORS). A Final Accomplishment Report documenting all accomplishments, implementation costs, and monitoring results will be archived in the Refuge project files with electronic copies sent to the RFMC and Branch of Fire Management in Boise, Idaho, no later than 3 years and 60 days following wildfire containment. The Eastern Interior FMO will be responsible for initiating ES reports end entering accomplishments in NFPORS prior to October 1 of the fiscal year in which they occur.

4.1.6. **Burned Area Rehabilitation (BAR)**

Burned Area Rehabilitation activities are "undertaken within three years of containment of a wildland fire to repair or improve fire-damaged lands unlikely to recover naturally to management approved conditions or to repair or replace minor facilities damaged by fire" (620 DM 3.3M). Information on the BAR process can be found in the 2006 Interagency Burned Area Rehabilitation Handbook (http://www.fws.gov/fire/ifcc/Esr/Policy/BAR_Guidebook11-06.pdf).

Rehabilitation treatments include only the following allowable actions:

1. Repair or improve lands unlikely to recover naturally from wildland fire damage by emulating historical or pre-fire ecosystem structure, function, diversity, and dynamics consistent with existing land management plans.
2. Chemical, manual, and mechanical removal of invasive species, and planting of native and non-native species, consistent with DM 3.8F, restore or establish a healthy, stable ecosystem even if this ecosystem cannot fully emulate historical or pre-fire conditions.
3. Tree planting to reestablish burned habitat, reestablish native tree species lost in fire, prevent establishment of invasive plants, and regenerating Indian trust commercial timberland as prescribed by a certified silviculturalist to not regenerate for ten years following the fire.
4. Repair or replace fire damage to minor operating facilities (e.g., campgrounds, interpretive signs and exhibits, shade shelters, fences, wildlife guzzlers, etc.). Rehabilitation may not include the planning or replacement of major infrastructure, such as visitor centers, residential structures, administration offices, work centers and similar facilities. Rehabilitation does not include the construction of new facilities that did not exist before the fire, except for temporary and minor facilities necessary to implement burned area rehabilitation efforts.

4.1.6.1. BAR Planning

A BAR plan is a document that specifies treatments required to implement post-fire rehabilitation policies; it is separate from the ES plan. A BAR plan may be developed at any time within three years from the containment date as long as work can be completed by the third anniversary of containment, but it will likely be developed in conjunction with the ES plan. BAR funds are competitive among DOI Bureaus. Refuge rehabilitation plans will be prepared by an interdisciplinary team of specialists; prior to developing a BAR plan, the refuge should consult with the regional fire ecologist. Information and a BAR plan template are at the DOI ESR website at http://fire.r9.fws.gov/ifcc/esr/home.htm.

4.1.6.2. BAR Issues and Values to Protect

Likely post-wildfire BAR issues on the Refuge include:

- The establishment of invasive species within the burned area
- Damage to existing trails

Allowable actions concerning invasive species are similar to those allowed under ES funding. BAR funds cannot be used for restoration of any cultural resource or heritage site. Other issues

correctable by any of the four allowable actions listed in **Section 4.1.6** may also merit BAR action.

4.1.6.3. BAR Regulatory Compliance

Two Categorical Exclusions (CX) may apply to BAR. The first is a DOI CX (516 DM 2, Appendix 1(1.13)) and the second is a FWS CX (516 DM 8.5(5). When utilizing the FWS Categorical Exclusions, the Refuge/unit staff will complete and submit the most recent version of the NEPA Compliance Checklist (FWS Form 3-2185) with the BAR plan. Before using the DOI Cat X, consult with the Regional Office regarding its use.

BAR projects must comply with NHPA. Plans will be submitted to Regional archeologist for review and cultural / archeological clearance. To the greatest extent possible, project implementation will follow recommendations of the Regional archeologist and/or SHPO. BAR projects that may affect Threatened & Endangered species/their habitats must comply with Section 7 of the ESA. Any such projects will be submitted for Section 7 consultation.

Routine BAR operations on the Refuge will be conducted using non-motorized means to the extent practical. Motorized equipment may be used with Refuge Manager approval.

4.1.6.4. BAR Monitoring Protocols

Treatment monitoring protocols and maintenance requirements will be specified within individual BAR plans. The Regional Fire Ecologist can help with developing these plans. See **Section 5.2** for an overview of effects monitoring.

4.1.6.5. BAR Contact Information

In addition to the Eastern Interior FMO, Refuge biologists would be involved in creating and implementing a BAR plan. Assistance would also be sought from the Regional Fire Management Coordinator and the Regional Fire Ecologist. See the Communications section of the *Eastern Interior Refuges Annual Preparedness/Dispatch Plan* (**Appendix B)** for specific names and contact numbers.

4.1.6.6. BAR Public Information and Public Concerns

Meetings in local communities to inform the public of planned activities, obtain input from partners and neighbors, and identify issues needing further discussion and resolution should be held early in the BAR plan development process.

4.1.6.7. BAR Reporting Requirements

Reporting requirements for BAR are similar to those for ES treatments. An Annual Accomplishment Report is required for funding in years two and three. Detailed Annual Accomplishment Reports will be completed by fiscal year end to document actual accomplishments, costs and monitoring results. Reports will be kept in field unit project files, with a copy of the Annual Accomplishment Report sent to the Regional office and to the national office in Boise. Annual accomplishments are also summarized and reported in the NFPORS treatment/activity form. The final accomplishment report must be completed no later than 3 years and 60 days following containment of the fire. NFPORS Accomplishment updates are the

responsibility of the Refuge FMO; they are to be completed by the 23rd of every month and at the end of the fiscal year until the project is shown as completed.

4.2. Management of Planned Fuels Treatments

By this reference, guidelines and procedures of the current Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide, and corresponding chapters of the FWS Fire Management Handbook and the Red Book are incorporated into this FMP and must be followed.

The refuge CCP provides for prescribed burning for "hazardous fuel reduction or restoration of natural vegetation patterns" (USFWS 1987, p. 118). Because the selected alternative dictates "minimal management" for the entire refuge, prescribed burning is one of few habitat management tools allowed on Refuge lands

Mechanical reduction of hazard fuels is not permitted on Refuge lands under the current CCP except for localized thinning around permitted cabins. However, the Refuge may cooperate with adjacent landowners on mechanical treatments of their lands where the treatment will benefit both parties.

Potential treatment areas are identified in the Eastern Interior Multi-year Treatment Plan (**Appendix C**). Some projects are accomplished with Refuge force account labor, but most are carried out under agreements or contracts with the State, Village Councils, and/or private entities.

4.2.1. **Processes to Identify and Prioritize Hazardous Fuels Treatments**

Hazardous fuels reduction planning for the Upper Yukon Zone, including the Refuge, is based on Community Wildfire Protection Plans (CWPPs) for local communities, and is accomplished on an interagency level. Partners include BLM AFS, Yukon Flats NWR, the Tanana Chiefs Conference, and individual communities. Potential treatment areas are identified in the Eastern Interior Multi-year Treatment Plan (**Appendix C**) and are often located on State and private lands. Refuge sponsored treatments will be identified in NFPORS by April of the fiscal year prior to implementation.

4.2.2. **Prescribed Fire Project Implementation**

Prescribed fire implementation will follow the standards set forth in the *FWS Fire Management Handbook*, the *Redbook*, and the *Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide 2008 (Prescribed Fire Guide)*, which is available for download at www.nifc.gov/fire_policy/rx/rxfireguide.pdf.

4.2.2.1. Prescribed Fire Planning

Prescribed fires may be used to accomplish hazardous fuels objectives and land and resource management objectives in accordance with the Refuge CCP and will be carried out only under a written and approved Prescribed Fire Plan.

Hazardous fuels treatment projects must be identified in advance and entered into the National Fire Plan Operations & Reporting System (NFPORS) for funding consideration.

All prescribed fire plans will comply with the Alaska Enhanced Smoke Management Plan, and will include monitoring for smoke impacts. Test fires will be used to assess smoke dispersal. When necessary and available, spot weather forecasts will be obtained the day of the burn to aid in decision making for implementation.

Project planning generally begins six to ten months in advance of implementation. Preparation of treatment areas may be assigned to qualified personnel or a contractor. If a project requires pre-burn preparation, this will be identified in the burn plan.

It is the responsibility of the Burn Boss to provide timely notification to and place orders with the AK-UYTC and to adhere to the DEC open burn approval stipulations. AK-UYTC will be notified daily of location planned ignition time and planned acreage; a point and method of contact will be established; and the contingency forces identified including their location and point of contact. The Burn Boss is responsible to order and inform the contingency forces of any planned burning and ensure their availability.

4.2.2.2. Prescribed Fire Operations

During the project, the Burn Boss will report acres burned to AK-UYTC each evening so that the information may be included in the AICC Daily Situation Report. Billing procedures and charge codes will be established prior to orders being placed and included in the project plan. Extended hours for AK-UYTC will be negotiated prior to ignition. Reimbursable costs may include required dispatch staffing beyond normal business hours, travel and transportation expenses, crew salaries, and other project expenses incurred by BLM AFS.

Ignition of prescribed fires is subject to National and Alaska Preparedness Levels. (Reference AIMG for Alaska Preparedness Level information.) Prescribed fires may be ignited during Regional or National Preparedness Levels 4 or 5 if requirements specified in the AIMG and the National Interagency Mobilization Guide are met.

Cooperators, contractors, and casual hires (AD) may be used to implement prescribed fires. ADs must meet FWS standards. Cooperators, such as members of Volunteer Fire Departments, must have appropriate qualifications certified by their agency. Those who supervise FWS employees during prescribed fires must meet *National Interagency Incident Management System Wildland Fire Qualification System Guide* (PMS-310-1) standards.

4.2.2.3. Prescribed Fire Public Notification

The public will be kept informed about the Refuge prescribed fire program through news releases, interpretive messages, and educational programs. Public notification of planned prescribed fire ignitions will be made according to the timeframes specified in the burn plan.

4.2.2.4. Multiple Prescribed Fire Projects

A burn boss may not manage multiple prescribed fires in non-adjacent burn blocks where ignition or active holding is being implemented.

4.2.2.5. Prescribed Fire on State and Private Lands

Refuge sponsored fuels projects on State and private lands may include prescribed fire treatments. Prescribed fires will be planned, conducted, and reported based on the policy of the

Agency having operational control of the burn. The jurisdictional agency representative (i.e. mayor, 1st Chief) is the signing and responsible official for burn plans conducted on their lands.

4.2.2.6. Prescribed Fire Conversions and Reviews

If a Refuge prescribed fire is declared a wildfire, the Upper Yukon Zone FMO will assume operational control with the cooperation of the Burn Boss and burn resources. A wildfire number will be assigned and all wildfire management costs will be charged to that number. The same analysis and WFDSS decision support documentation that applies to all wildfires is required.

As dictated by individual agency policy, the Refuge Manager is responsible for conducting the appropriate level of investigation when a prescribed fire is declared a wildfire. The level and scope of the review will be determined by policy and procedures of the *Interagency Standards for Fire and Fire Aviation Operations* and the *FWS Fire Management Handbook.*

4.2.2.7. Planning, Preparing and Implementing Non-Fire Hazardous Fuels Treatments

Mechanical reduction of hazard fuels is not permitted on Refuge lands under the current CCP except for localized thinning around permitted cabins. However, the Refuge may cooperate with adjacent landowners on mechanical treatments of their lands where the treatment will benefit both parties.

Off-Refuge fuels projects typically include mechanical treatments followed by prescribed fire (often pile burns). Emphasis is on appropriately scaled treatments in the immediate vicinity of values at risk. The bulk of Refuge fuels treatments are now planned and implemented on an Interagency basis and are located on State and private lands. Some projects are accomplished with Refuge force account labor, but most are carried out under agreements or contracts with the State, Village Councils, and/or private entities.

As with prescribed fires, non-fire treatments must be identified in advance and entered into the National Fire Plan Operations & Reporting System (NFPORS) for funding consideration. Project planning generally begins six to ten months in advance of implementation. Preparation of treatment areas may be assigned to qualified personnel or a contractor.

4.2.3. Hazardous Fuels Treatment Regulatory Compliance

4.2.3.1. NEPA

Fire management activities were analyzed in the Refuge CCP. The FMP is a step-down plan based on that document and is in compliance with DOI's wildland fire management policy (Departmental Manual (DM) 620 1-2) and the National Environmental Policy Act of 1969 (NEPA). NEPA requires that the environmental effects of proposed major federal actions be considered in the decision-making process. Fire suppression activities are normally categorically excluded from this requirement (516 DM 2 and 16 DM 6). Prescribed fires and fuel reduction activities require completing an initial NEPA Compliance Checklist. This usually results in a categorical exclusion for the project (621 FW 2), but if necessary the project will require an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). Before implementing any fire management project, an EA or EIS will be prepared for those activities not categorically excluded.

An environmental Assessment of the Fire Management Plan was conducted in 2001 resulting in findings of no significant impact and no significant restriction of subsistence uses.

4.2.3.2. Compliance with other Legislative Mandates

Refuge fire management activities must comply with all applicable laws including the Wilderness Act, the National Historic Preservation Act, the Wild and Scenic Rivers Act, the Endangered Species Act, the Alaska National Interest Lands Conservation Act (ANILCA), and the Clean Air Act.

Section 106 of the National Historic Preservation Act requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties. The agencies must allow the State Historic Preservation Officer and the Advisory Council on Historic Preservation, a federal agency, to comment on a project. The Alaska Historic Preservation Act contains a provision similar to Section 106 ([A.S.] 41.35.070) which mandates that any project with state involvement be reviewed in a similar manner. For cooperative projects off Refuge lands the process may be initiated by the Service or the State.

Through the Section 106 review process, OHA staff work with federal and state agencies during the early stages of project planning to protect cultural resources. They do this by providing information on the location of sites and on cultural resources surveys previously done in an area. If the potential to discover unknown sites is high, a survey may be recommended. When there are sites in a project area, OHA consults with the agency on National Register eligibility, on how the project will affect sites, and on ways to lessen unavoidable damage. A copy of the Request for SHPO Section 106 Review (36 CFR 800) form appears in **Appendix G**.

4.2.3.3. Smoke

The *Alaska Enhanced Smoke Management Plan for Planned Fire* (ESMP) was developed by DEC in coordination with the AWFCG Air Quality Committee. The ESMP and its appendices are located at http://fire.ak.blm.gov/administration/awfcg_committees.php. The ESMP outlines the process and identifies issues that need to be addressed by DEC and federal and state agencies or private landowners/corporations to help ensure that prescribed fire activities minimize smoke and air quality problems. The ESMP Appendices provide additional assistance for interagency sharing of information, the applicability and availability of current smoke management techniques, monitoring protocol, public education strategies, and emission reduction techniques.

The AWFCG-approved "Smoke Effects Mitigation and Public Health Protection Protocols" are available at http://fire.ak.blm.gov/administration/awfcg.php, For current smoke information and forecast, regulations, advisories, and educational materials, refer to the DEC website http://www.dec.state.ak.us/air/anpms/index.htm.

By reference, this section incorporates the text of the Red Book related to Smoke Management and Air Quality and will follow recommendations of the latest edition of the *NWCG Smoke Management Guide for Prescribed and Wildland Fire*.

4.2.4. **Fuels Treatment Monitoring**

4.2.4.1. Pre-treatment monitoring

For prescribed fires, the Burn Boss will review current and forecast weather prior to Burn Day. On Burn Day morning, a spot weather forecast from the local National Weather Service will be requested that will include time periods to complete ignition and holding and immediate mop-up needs.

Prescribed fires and mechanical treatments may be monitored for pre-treatment condition using similar protocols to post-treatment effects monitoring described in Section **5.2**. When followed up with post-treatment effects monitoring this has the benefit of allowing direct comparison of treatment states.

4.2.4.2. Burn-day monitoring (Prescribed fire only)

Burn day monitoring will document that the fire is within prescription. Weather variables typically monitored are dry bulb temperature, relative humidity, mid-flame wind speed and direction, and cloud cover. Measurements are taken immediately prior to test fire ignition and at intervals specified in the burn plan. Documentation of first order fire effects such as rate of spread, flame length, etc. are desired if personnel are available.

4.2.4.3. Effects monitoring

Treatment effects monitoring protocols and maintenance requirements will be specified within individual treatment plans. The Regional Fire Ecologist can help with developing these plans. See **Section 5.2** for an overview of effects monitoring.

4.2.5. **Fuels Treatment Reporting Requirements**

4.2.5.1. Prescribed Fire Reporting

The burn plan is a primary report for an individual prescribed fire. In it, a Burn Boss will document fire and weather observations, actions and decisions, and assess attainment of project treatment objectives. A fire report must also be completed for the Service FMIS within one week of project completion.

4.2.5.2. Non-fire Treatment Reporting

Treatments completed under an agreement or contract typically have financial and accomplishment reporting requirements specified in the agreement or contract document. A treatment report must be completed for the Service FMIS within one week of project completion.

4.2.6. **Fuels Committees and other Collaborative Groups**

Hazardous fuels reduction planning for the Upper Yukon Zone, including the Refuge, is based on CWPPs for local communities, and is accomplished on an interagency level. Partners include BLM-AFS, Yukon Flats NWR, the Tanana Chiefs Conference, and individual communities. Consideration is given to the AWFCG Fuels Committee State-wide prioritization of communities, though this list is currently out of date and not considered to be a true reflection of priorities.

4.2.7. **Fuels Treatment Funding Processes**

The fuels funding process is based on the Eastern Interior Multi-year Treatment Plan (**Appendix C**). Potential projects and treatments for individual refuges are identified in the plan, approved by the appropriate Refuge Manager, and entered into NFPORS. Individual projects are capped at $500,000 per year with no limit on the amount of treatments proposed. Projects are typically entered into NFPORS by April 1st of the year prior to funding.

Projects throughout the region are annually compared and prioritized according to FWS and DOI criteria. Project goals and objectives (i.e. WUI, Protects Treasured Landscapes, Hazardous Fuels, and Habitat) are extracted from NFPORS data entry and used in scoring the projects. The criterion for project scoring comes from the Office of Wildland Fire in negotiation with the DOI Bureaus and is subject to annual change.

The Region's program of work (POW) is usually fully developed by August, with room for nominal project substitution in September. Refuge units should have an estimation of funded projects at the start of the fiscal year.

4.2.8. **Debris Burning**

Debris burns may be implemented under State laws and regulations, and are not required to comply with prescribed fire requirements. In order to be exempt from prescribed fire requirements debris burners must:

- Burn no more than four piles at a given time.
- Limit pile size to less than 16' in diameter and 10' high.
- Have a valid State issued burn permit for the burn location and comply with its direction. There is currently no requirement for a burn permit in the Upper Yukon Zone.
- Comply with all State laws and regulations pertaining to burning practices.

  (AS 41.15.010-41.15-170 and 11 AAC95 Article 6).
- Call AK-UYTC the day of the burn to confirm restrictions, suspensions, and closures are not in effect.

4.3. Prevention, Mitigation and Education

4.3.1. **Wildfire Investigation and Trespass Policies**

The inadvertent or intentional ignition of wildland fuels by humans is illegal. Agency policy requires any wildfire to be investigated to determine cause, origin, and responsibility. All fires suspected of being human-caused will be investigated to the degree possible by the initial response Incident Commander. The Refuge Manager will be notified immediately of suspected human-caused fire. The Refuge Manager will determine if the fire scene is to be formally investigated, and if so, will direct that an investigator be ordered. The Service will pursue any legal actions deemed necessary. When incidents impact multiple agencies lands, collections will be pursued jointly and cooperatively by each affected agency to the extent practical. The Incident Commander will:

- Locate and protect the point of origin of fire.

- Search for and protect evidence.
- Identify and document witnesses and other persons at fire scene (Name and contact information, if possible).
- Document observations, actions, and findings.

Wildland fire trespass refers to the occurrence of unplanned ignitions on Service lands where the source of ignition is tied to some type of human activity. Fire trespass is a legal/law enforcement activity and the appropriate local law enforcement authorities should be contacted and standard criminal and/or civil investigative procedures and reports used. The Red Book as well as the FWS Fire Management Handbook provides detailed information regarding investigation and trespass procedures.

4.3.2. **Prevention/Mitigation Program**

To date, the Refuge has not had a formally established fire prevention program. Prevention and Firewise homeowner defensible space messages have been incorporated into fuels treatment agreements and outreach products whenever possible, but without planned goals and objectives.

In FY 2012 the Eastern Interior Fire Management Program has established and filled a Prevention Technician position with the intent of establishing a formal prevention program for the District. The Refuge Prevention Technician will work with protection agencies, local communities, and other Refuge programs to develop and implement program specific prevention goals and objectives.

It is intended that specific prevention goals and objectives will be presented in the 2013 review of this FMP. Wildland fire prevention activities outlined in the plan will be coordinated with interagency partners and with other Yukon Flats Refuge and Regional programs.

Fire prevention activities for 2012 will include:

- Fire prevention literature and brochures will be made available at Refuge public use sites.
- Training in fire prevention and reporting procedures will be provided to Refuge employees.
- Fire danger restrictions will be posted at Refuge facilities.
- Prevention staff will participate in local CWPP efforts.
- Prevention staff will coordinate with protection agency prevention personnel to provide a consistent prevention message in an efficient manner.
- Prevention staff will work with interagency partners and local communities to identify and prioritize areas in need of fuels mitigation treatment.
- Trail and/or area closures may be implemented by the Refuge Manager during periods of extreme fire danger.

4.3.3. **Education/Outreach Activities**

Informing the public is an important part of fire suppression, fire prevention, and the FWS mission. During wildfires occurring on Service lands coordination among agencies is crucial in

communicating with the public about fire. The following language in the Alaska Statewide Annual Operating Plan provides direction on how this coordination will occur.

The Protecting Agency and the Incident Management Team, when assigned, are responsible for the release of operational and public safety information to the media and public during the initial response to and during ongoing wildfires. The Protecting Agency and Incident Management Team will coordinate with the Jurisdictional Agency on the release of fire information, specific Jurisdictional Agency direction will be stipulated in the Delegation of Authority. Releases will be approved by the Incident Commander prior to release and copies distributed to all stakeholders. Jurisdictional Agency policy and messaging will be included when requested by the agency administrator. Policy questions will be referred to the Jurisdictional Agency. A suggested format for incident news releases can be found in the Alaska Statewide Annual Operating Plan appendix.

The goal of Refuge fire management outreach efforts is to enhance knowledge and understanding of wildland fire management policies and fire effects through internal and external communication and education. Information about fire ecology and the differences between planned and unplanned ignitions will be incorporated into outreach programs and informal contacts. Information and education are critical to increasing support for prescribed fires. Education and outreach programs will include components of the nationally sanctioned FIREWISE program. Information about this program is available at www.firewise.org.

Public education is an important Refuge mission. At every opportunity the fire management staff will actively develop and contribute to fire education efforts on the Refuge and incorporate fire education efforts within fire management activities. These activities have included, but are not limited to:

- Communicating information on the role of fire in the boreal forest. The Fire Information and Resource Education Program includes prepared teacher packets (the statewide Role of Fire In Alaska Curriculum) emphasizing the important role natural and prescribed fires play in Alaska with particular regard to wildlife habitat enhancement. The packets include reference material and classroom activities for various grade levels. Fire effects field kits which include learning aids to supplement the curriculum are also available to be checked out. http://alaska.fws.gov/nwr/visitor/fire/curriculum.htm
- The Fire Management Slide Show and portable Fire Management Program display are used to provide information to the public. The Fire Management Program display is set up at the Tetlin National Wildlife Refuge Visitor Center, but is portable and can be taken to meetings or put on display elsewhere.
- Maintaining a library of fire education materials on the refuge headquarters.
- Supporting the GLOBE Protocol learning initiative (http://classic.globe.gov/)
- Facilitating the attendance of Refuge fire management and public education personnel at fire education and scientific conferences

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5. **Monitoring and Evaluation**

Monitoring and evaluation are the functions used to determine if the FMP is being implemented as planned to meet its goals and objectives as well as to determine whether the goals , objectives, strategies, and procedures outlined in the FMP and other plans remain relevant. Wildland fire is one of the primary sources of disturbance on the Yukon Flats Refuge. As such, it is integral to the management of the refuge's wildlife and plant communities. Through monitoring and evaluation methods, we seek to better understand the relationships between fire and other refuge resources. Monitoring also helps us improve our WUI and Hazardous fuels treatment techniques, and provides documentation to show how we address our performance measures.

This chapter is divided into two primary sections:

- Fire Management Plan Monitoring - covers the five management components in this fire management plan, and provides guidance to insure that our actions within these areas meet the goals of the Refuge and are in compliance with other national and service policies.
- Effects Monitoring - focused on the ecological effects that result from fire management activities on the Refuge.

5.1. Fire Management Plan Monitoring

5.1.1. **Annual FMP Review**

The Fire Management Plan is monitored for compliance with the National Fire Plan and resulting performance standards, National Wildlife Refuge System, Wildland Fire Management Program Strategic Plan, Alaska Interagency Wildland Fire Management Plan, compatibility with refuge plans, support of the applicable National Wildlife Refuge promises, and national and region policies of the Fish and Wildlife Service.

FMPs are intended to be dynamic and reflect current situations and policies; therefore, to maintain currency, FMPs must be reviewed each year using the nationally established annual review process. Plans must be revised when significant changes occur or substantial changes in management are proposed. Minor plan revisions may be accomplished through an amendment added to the plan and signed by the Refuge Manager and Eastern Interior Fire Management Officer. Major scheduled revisions to fire management plans will follow the 15 year Comprehensive Conservation Plan revision cycle to provide consistency in objectives and management strategy formulation. Major revisions are reviewed by the Regional Fire Management Coordinator and approved by the Region 7 Chief of Refuges. Without a current FMP, prescribed fires cannot be conducted and response to unplanned ignitions can only consider suppression strategies. Preparedness and prevention activities can continue in the interim period as outlined in the expired plan. All new FMPs and those needing revisions due to significant change in land use or other circumstances will use the most recent Interagency Fire Management Plan Template and apply the most recent Service-specific guidance.

The following partners should be given the opportunity to review major revisions to the FMP:

Regional Native Corporations	
Doyon Regional Native Corporation	
Village Native Corporations	
Corporation	**Village**
Beaver Kwit'Chin Corporation	Beaver
Chalkyitsik Native Corporation	Chalkyitsik
Danzhit Hanlaii Corporation	Circle
Dinyea Corporation	Stevens Village
Gwitchyaa Zhee Corporation	Fort Yukon
Neechootaalichaagat Corporation	Birch Creek
Tihteet'aii Inc.	Birch Creek
Venetie Indian Reservation	Venetie
Tribes	
Council	**Village**
Beaver Traditional Council	Beaver
Birch Creek Tribal Council	Birch Creek
Chalkyitsik Traditional Council	Chalkyitsik
Circle Traditional Council	Circle
Gwichyaa Zhee Gwich'in Tribal Government	Fort Yukon
Stevens Village IRA Council	Stevens Village
Venetie Traditional Council	Venetie
State and Federal Agencies	
Unit	**Agency**
Arctic National Wildlife Refuge	USFWS
Eastern Interior Planning Area	BLM
Department of Natural resources	State of Alaska
Alaska Regional Office	BIA

5.1.2. **Preparedness/Step-up Plan Review and Update**

The Eastern Interior Preparedness/Step-up Plan will be reviewed annually, and updated as necessary.

5.1.3. **Fire Management Options Review and Update**

A review of refuge Fire Management Options will be completed annually by March 1. Changes will be submitted in accordance with procedures outlined by the AIWFMP. Mid-season Management Option boundary changes will rarely be necessary but may be accommodated as outlined in the AIWFMP.

5.1.1. **Known Sites Review and Update**

A review of known sites on the Refuge and their default protection level will be completed annually by April 1. Changes will be submitted in accordance with procedures outlined by AWFCG.

5.2. Effects Monitoring

Effects monitoring can apply to all aspects of the fire program that involve changes on the ground. The goals of effects monitoring may include the following:

- Develop data that helps quantify the relationship of fire with Refuge resources.
- Develop data that helps quantify fire effects associated with a specific vegetation/fuel type in order to improve predictive capabilities for modeling fire distribution, spread, and behavior.
- Evaluate the effectiveness of a treatment (prescribed fire, mechanical treatment, or suppression action) in order to determine whether objectives have been met.
- Document unexpected treatment results.

This FMP outlines four management components that may require some level of effects monitoring and evaluation:

- Wildfire
- Prescribed fire
- Non-fire fuels treatment
- Emergency stabilization and rehabilitation

Similar monitoring methods and protocols can be applied to each of these activity types. The following sources are available for guidance if a post-fire monitoring program is implemented:

- AWFCG Fire Effects Monitoring Protocol. Contains Alaska-specific guidance. http://fire.ak.blm.gov/administration/awfcg_committees.php or http://frames.nacse.org/5000/5585.html

- FWS Fuel and Fire Effects Monitoring Guide. http://www.fws.gov/fire/downloads/monitor.pdf
- National Park Service Fire Monitoring Handbook. http://www.nps.gov/fire/download/fir_eco_FEMHandbook2003.pdf

For wildfires and prescribed fires, an evaluation of burn severity can provide a useful measure to understand fire effects and to predict vegetation response. For long-term monitoring sites detailed information on burn severity should be collected (for example the Composite Burn Index protocols by NPS http://fire.org/firemon/lc.htm or burn severity transects described in the FETG Fire Effects Monitoring Protocol).

Remote sensing techniques are available for development of burn severity maps for fires greater than 300 acres. The normalized burn ratio technique (dNBR) developed by the NPS is described on the FIREMON website at http://fire.org/firemon/lc.htm.

Unfortunately recent research, some of it conducted on the Refuge, suggests that this method does not adequately differentiate along the range of moderate to high burn severity in Alaskan boreal forests. Caution should be used in interpreting dNBR and ground-based validation should be invested in if the objective is to develop a burn severity map that captures the full range of variability in site conditions and provides a basis for predicting vegetation change in boreal forests (Murphy *et al.* 2008).

Monitoring protocols will be treatment/ incident specific and will be detailed in the appropriate planning document (prescribed fire plan, treatment plan, ES plan, BAR plan).

Appendices

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Appendix A. *List of Acronyms*

Terminology in this Plan is defined in the National Wildfire Coordinating Group Glossary of Wildland Fire, located at **http://www.nwcg.gov/pms/pubs/glossary/index.htm.** Additional terms that appear in this document but are not listed in the glossary are defined below:

AD= Administratively Determined Pay Plan

ADEC = Alaska Department of Environmental Conservation

ADF&G = Alaska Department of Fish and Game

AFS = Alaska Fire Service

AICC = Alaska Interagency Coordination Center

AIWFMP = Alaska Interagency Wildland Fire Management Plan

AK-DOF = Alaska Department of Natural Resources, Division of Forestry

AMAC=Alaska Multi-agency Coordination (Group)

AMD = (DOI) Aviation Management Directorate

AMR = Appropriate Management Response

ANCSA = Alaska Native Claims Settlement Act

ANILCA = Alaska National Interest Land Conservation Act

AOP= Annual operating plan

ATV= All-terrain Vehicle

AWFCG = Alaska Wildland Fire Coordinating Group

BAR= Burned Area Rehabilitation

BIA = Bureau of Indian Affairs

BLM = Bureau of Land Management

BUI = buildup index

CCP = comprehensive conservation plan

CDI = Canadian drought index

CFFDRS = Canadian Forest Fire Danger Rating System

CFR= Code of Federal Regulations

DC = drought code

Department = U.S. Department of the Interior

DM = departmental manual

DMC = duff moisture code

DNR=(State of Alaska) Department of Natural Resources

DOF= (State of Alaska) Division of Forestry

DOI = U.S. Department of the Interior

EA = environmental assessment

EFF = Emergency Firefighter

EIS = Environmental Impact Statement

ES= Emergency Stabilization

ESMP= (Alaska) Enhanced Smoke Management Plan

ESR= Emergency Stabilization Rehabilitation

FFMC = fine fuel moisture code

FMIS = (FWS) Fire Management Information System

FMO = fire management officer

FMP = fire management plan

FMU = fire management unit

FRCC = fire regime and condition class

FWS= U.S. Fish and Wildlife Service

IC= Incident Commander

IMT = Incident Management Team

IQCS= Incident Qualifications and Certification System

IRPG= Incident Response Pocket Guide

MAC = multi-agency coordination

MIST = minimum impact suppression tactics

MMA = maximum manageable area

mph = miles per hour

NEPA = National Environmental Protection Act

NFDRS = National Fire Danger Rating System

NFPORS= National Fire Plan Operations and Reporting System

NPS- National Park Service

NWR – National Wildlife Refuge

POW= Program of Work

Refuge = Yukon Flats National Wildlife Refuge

Refuge Manager = Refuge Manager, or, if unavailable, the Deputy Refuge Manager, or Refuge FMO, or their designee

RFMC = Regional Fire Management Coordinator

RH – relative humidity

Service = U. S. Fish and Wildlife Service

TES= threatened, endangered and sensitive(species)

UTV= All-terrain Utility Vehicle

VFD= Volunteer Fire Department

WFDSS= Wildland Fire Decision Support System

WFIP = Wildland Fire Implementation Plan (obsolete)

WFSA = Wildland Fire Situation Analysis (obsolete)

WFU = Wildland Fire Use (obsolete)

WUI= Wildland/ Urban Interface

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Appendix B. *Eastern Interior Annual Dispatch/Preparedness Step-up Plan*

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Appendix C. *Eastern Interior Multi-year Treatment Plan*

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Template Delegation of Authority for the Arctic, Kanuti, Tetlin, and Yukon Flats Fire Management Officer

Peter Butteri, Fire Management Officer for the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges is delegated authority to act on our behalf for the following duties, actions and expectations:

1. Represent the US Fish and Wildlife Service in the local area Multiagency Coordinating Group in setting priorities and working to assist the Protecting Agencies in fire emergencies.

2. Provide direction, supervision and leadership to the Refuge Fire Management Program outlined in the respective Refuge Fire Management Plans and provide a liaison to the Protecting Agencies for all wildfire activities on the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges.

3. Coordinate with and provide timely and accurate reports to the Refuge Managers, Deputy Refuge Managers or Acting Refuge Managers, and Regional Fire Management Coordinator for all wildland fire management activities on the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges.

4. Responsible for coordination and oversight of the fire management budget for the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges to assure adherence to agency fiscal guidelines.

5. Coordinate prescribed fire and hazardous fuels management activities for the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges including requests and oversight of funding for Hazardous Fuels projects (F31, F32 accounts).

6. Request and oversee distribution of Severity and Emergency Preparedness Funding for Arctic, Kanuti, Tetlin, and Yukon Flats Refuge fire activities in collaboration with Protecting Agency FMO's.

7. Ensure all Arctic, Kanuti, Tetlin, and Yukon Flats Refuge wildfire incidents are managed in a safe and cost-effective manner in collaboration with Protecting Agency FMO's.

8. Provide for the management of inventories and property records for supplies and equipment purchased with fire program funds.

9. Oversee the recruitment and hiring of fire management personnel on the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges as required.

10. Ensure all personnel participating in prescribed fire and wildfire operations on the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges are fully qualified for assigned positions.

11. Responsible for representing the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges and/or the Region in assigned interagency wildland fire management program activities and

collaborative efforts such as AWFCG sub-committees and working teams.

12. Coordinate wildfire prevention and mitigation activities and provide appropriate program direction and guidance for the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges.

13. Hire emergency firefighters for prescribed fires conducted by the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges in accordance with Department of Interior "Pay Plan for Emergency Workers." Coordinate FWS hosted emergency hires with Protection Agency FMO's.

14. Manage the Incident Qualification Certification System (IQCS) and certify Incident Qualification Cards for the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges. Coordinate incident management resources status (ROSS) with dispatch centers.

15. Initiate and Certify NWCG Position Task Books for Arctic, Kanuti, Tetlin, and Yukon Flats Refuge personnel per NWCG and agency guidelines.

16. After initial implementation of the Wildland Fire Decision Support System (WFDSS) by the Protection Agency, continue the WFDSS documentation through completion for fires occurring on the Arctic, Kanuti, Tetlin, and Yukon Flats Refuges.

17. In the rare event a Refuge Manager and Deputy Refuge Manager **are absent**; the FMO may approve the WFDSS, and Periodic Fire Assessment.

18. In the absence of the FMO the above listed authorities may be delegated to AFMO, Brian Haugen.

19. This delegation will be reviewed and signed annually prior to fire season.

_____	_____
(Arctic NWR Refuge Manager)	Date
_____	_____
(Kanuti NWR Refuge Manager)	Date
_____	_____
(Tetlin NWR Refuge Manager)	Date
_____	_____
(Yukon Flats NWR Refuge Manager)	Date

Appendix E. *Incident Commander Delegation of Authority Template*

Delegation of Authority
BLM Alaska Fire Service
Upper Yukon Zone

As of **1800**, **May 20, 2010**, **IC Name** is delegated authority to manage the **Black Hills Fire #123**. Within the authority, regulations and policies of the Alaska Division of Forestry you are responsible for adhering to the guidelines and considerations established by this delegation and the WFDSS:

1. Provide for firefighter and public safety.
2. Manage the fire with as little environmental damage as possible.
3. Key cultural features requiring priority protection are:
4. Key resources considerations are:
5. Restrictions for suppression actions include:
6. Minimum tools for use are:
7. My agency Resource Advisor will be:
8. Keep fire south of
9. Manage the fire cost-effectively for the values at risk.
10. Provide training opportunities for the resources area personnel to strengthen our organizational capabilities.
11. Minimum disruption of residential access to private property, and visitor use consistent with public safety.

_____ _____
(Signature and Title of Agency Administrator) (Date)

Amendment to Delegation of Authority

The Delegation of Authority dated **May 20, 2010**, issued to Incident Commander **IC Name** for the management of the **Black Hills Fire #123** is hereby amended as follows. This will be effective at **1800, May 20, 2010**.

12. Key cultural features requiring priority protection are:
13. Use of tracked vehicles authorized to protect Escalante Cabin.

_____ _____
(Signature and Title of Agency Administrator) (Date)

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Appendix F. *Minimum Impact Suppression Guidelines*

The following guidelines will be adhered to during fire operations on the Refuge:

Suppression Actions:

Fireline Construction:

- Use natural barriers wherever possible.
- Use blackline or wetline where it will be effective.
- Saw lines should be used sparingly and only where they are essential for holding and accessing hot perimeter and for holding indirect attack line during burnout operations.
- Construct sawline to minimum necessary width (trim ladder fuels near line for added effectiveness).
- Locate control lines so as to minimize erosion. If possible, lines dug down to mineral soil or permafrost should be located to meander obliquely across slope rather than to run straight downhill. Straight lines should be avoided, especially on large fires.
- A buffer of vegetation should be left immediately adjacent to water bodies to avoid running lines directly into them.
- Reduce total line length whenever possible by bridging fingers and burning out.
- Avoid flooding ash pits on steep slopes or within 100 feet of stream banks and lakeshores.
- Avoid trenching fireline wherever possible, especially in permafrost areas. If trenching is necessary do not exceed one foot trench width.
- The use of fireline explosives on refuge lands must be authorized by the Refuge Manager on a case by case basis.
- Consider using sprinkler systems and fire resistant wrap to protect cabins.
- Portable pumps and fueling operations will use approved spill containment measures and be staffed and run to ensure that no fuel or other chemicals are spilled into waterways.
- Constructed fire lines will avoid known cultural sites. If cultural sites (e.g., graves, collections of artifacts) are discovered during fire suppression operations, care will be taken to not damage the sites, and refuge staff will be notified of the site as soon as possible. Artifacts are not to be collected.
- Cultural resources will be stabilized and protected from further degradation if determined to be appropriate by agency archaeologists.

Equipment Use:

- The use of bulldozers, excavators, or other heavy equipment on refuge lands other than to mitigate an immediate threat to human life must be authorized by the Refuge Manager on a case by case basis.

- All-terrain Vehicle (ATV) and All-terrain Utility Vehicle (UTV) use on refuge lands other than to mitigate an immediate threat to human life must be authorized by the Refuge Manager on a case by case basis..

Foam & Retardant Use:

- Foam or retardant use on refuge lands other than to mitigate an immediate threat to human life must be authorized by the Refuge Manager on a case by case basis and documented in writing.
- When foam or retardant has been authorized for use:
    - Avoid using retardant or foam within 300 feet of waterways.
    - Avoid using retardant or foam where run-off into water source is likely. Especially upstream from communities, in important fish spawning areas, and in existing and proposed National Wild and Scenic Rivers.

Helipot Construction:

- Helispots should only be constructed where they are essential for the safe and efficient deployment and retrieval of suppression resources.
- Avoid sensitive biological communities.
- Minimize the cutting of large trees; use or improve natural openings if possible.
- Consider long-line use in lieu of helispot for gear delivery/retrieval.
- Choose impact resistant sites whenever possible.
- Construct helispot with irregular outlines whenever possible.
- Construct helispots to meet safety and utility requirements with the least environmental impact possible.

Type 2 Helicopter: 90' safety zone

Type 3 Helicopter: 75' safety zone

Camp Construction:

- Locate camps away from known historic or archaeological sites. Artifacts are not to be collected.
- Locate camps away from sensitive biological communities.
- Choose impact resistant sites whenever possible.
- Construct latrine(s) for any camp to be used for multiple days.
- Construct latrines 200' minimum from water sources.
- Cut and roll back moss and duff from firepots. Keep layer intact for replacement.
- Minimize clearing.
- Avoid trenching campsites.

Bear Safety:

- Both black bears are abundant and grizzly bears are common on parts of the Refuge, and some have been shot for the protection of life or property during fire suppression operations.
    - Incident Commanders will emphasize preventive measures. Camps will be kept clean. Food waste is to be removed as promptly as possible. All attempts (at driving a bear away from camp or suppression operations (should include use of non lethal deterrents: bean bag shot gun loads and bear spray) must be exhausted before destroying the bear.
    - Any person who takes a bear in defense of life and property must comply with all state regulations and immediately report the incident to refuge personnel through their chain of command. A Service bear incident report will be completed and filed.

Repair Actions:

Fireline repair:

- Rehabilitation efforts will be directed at mitigating suppression impacts.
- Burned area rehabilitation may be considered, but must be approved by the Refuge Manager.
- Flush cut stumps.
- Scatter brush along fireline. Avoid large piles inside or outside the line.
- Any control lines constructed on fires will have appropriate erosion control measures taken prior to the release of suppression forces. Those measures include building water bars on slopes and replacing organic material back into lines where permafrost or mineral soil has been exposed. Standards for rehabilitation will be set by the Refuge Manager or designee in a timely manner.
- Remove all flagging, trash.

Helispot repair:

- Flush cut and cover stumps with brush outside of pad area.
- Scatter brush and disperse any large brush piles.
- Remove all flagging and trash.

Camp Repair:

- Restore campsites to as natural a condition as possible.
- Dismantle and remove all tent and shelter frame materials. Local plant materials (e.g., logs and poles) used for construction should be spread throughout the site.
- Extinguish campfires. Only replace moss mat if campfire is dead out and cold.
- Completely fill cold fire pits with natural materials, such as duff, plant litter, and branches.
- Remove all garbage, such as food waste and plastics, from camp sites and fire lines. Trash such as paper products, and small amounts of visqueen, may be burned. Do not bury trash.

- Remove all equipment and gear.
- Fill latrines and replace moss.
- Police camp area and check it before crew departure.
- For large camps or camps that have been used for several days, camp rehabilitation must be approved by Refuge Manager or designee before demobilization is completed.

Request for SHPO Section 106 Review (36 CFR 800)
May also be used for review pursuant to Alaska Statute [A.S.] 41.35.070

Please use this form as a checklist and provide responses as an Appendix to this application. ***Incomplete forms may be returned.*** *At this time, we are unable to accept this application electronically.*

Please print, complete, and mail this form and accompanying material (typed) to:

STATE HISTORIC PRESERVATION OFFICE | OFFICE OF HISTORY AND ARCHAEOLOGY | DEPARTMENT OF NATURAL RESOURCES
550 West 7th Avenue, Suite 1310, Anchorage, AK 99501

Please note that as stipulated in 36 CFR 800.2(c), other consulting parties such as the local government and Tribes are required to be notified of the undertaking. Information provided by other consulting parties may cause us to re-evaluate our comments and recommendations. Please note that our comment does not end the 30-day review period provided to other consulting parties.

REQUIRED AGENCY INFORMATION

It is the statutory obligation of the Federal agency to fulfill the requirements of section 106 (36 CFR 800.2[a]). The agency official remains legally responsible for all required findings and determinations (36 CFR 800.2[a][3]).

Federal or State involvement? (Check all that apply) ☐ **Funding** ☐ **Jurisdiction** ☐ **Permit, license, approval**

☐ **Federal or State Agency contact information** (include name, title, and contact information for agency official)

☐ **Signature of agency official**

☐ **Secondary Contact Information** (if different from above)

I. GENERAL INFORMATION

☐ **Project Name**

☐ **Landowner**

☐ **Project Address / Location**

- ☐ **USGS Quad Map Name**
- ☐ **Meridian: Township: Range: Section:**
- ☐ **NAD 83 Latitude/Longitude:** (Decimal Latitude) (Decimal Longitude)

II. GROUND DISTURBING ACTIVITY

Examples include, but are not limited to excavation, trenching, grading, tree removal, hydroaxing, utility installation, new construction, access roads, borrow areas, and staging/storage areas.

DOES THIS PROJECT INVOLVE GROUND DISTURBANCE? ☐ YES ☐ NO

☐ **Description of length, width, and depth of proposed ground disturbance**

☐ **Previous and current land use, condition, and disturbances**

☐ **Are there archaeological resources on the property?** ☐ YES ☐ NO **How was this determined?**

III. DESCRIPTION OF THE PROJECT (UNDERTAKING)

☐ **Detailed written description of the project**

☐ **Attach localized project map**

☐ **Attach photographs of the project area** (Current, historic, and aerial photos are helpful)

IV. AREA OF POTENTIAL EFFECTS (APE)

The APE is the geographic area or areas within which an undertaking or project may cause direct or indirect changes in the character or use of historic properties. **Every undertaking has an APE.**

☐ **Identify the APE on the USGS map and localized project map**

☐ **Explain how the APE was developed and how it encompasses potential direct and indirect effects**

V. IDENTIFICATION OF HISTORIC PROPERTIES

Defined as prehistoric or historic sites, buildings, structures, objects, districts, landscapes, or properties of traditional religious and cultural importance to Tribes included in, or eligible for, the National Register of Historic Places (NRHP).

Record each cultural resource within the APE using the AHRS Data Form (http://dnr.alaska.gov/parks/oha/ahrs/ahrsform.pdf) and/or the AHRS Building Form (http://dnr.alaska.gov/parks/oha/ahrs/buildingform.pdf).

☐ **Describe the steps taken (methodology) to identify cultural resources in the APE**

☐ **Describe, date, map, and photograph all cultural resources located in the APE.**

Please select one or more of the following:

☐ Previously-unknown cultural resources present in the APE. Proceed to Section VI.

☐ Known or previously-reported cultural resources present in the APE. Proceed to Section VI.

Using professional judgment, determine if a site reevaluation and updated DOE is necessary. Provide basis for decision.

☐ No cultural resources present in the APE. Proceed to Section VII. Note: finding of effect will be "No historic properties affected."

Alaska Heritage Resources Survey (AHRS) REQUIREMENTS

AHRS numbers are required for all cultural resources in the APE. Shape files should be submitted for each AHRS site location as well as for surveyed areas. Alternatively, you may include a table containing survey and AHRS site boundary metadata in the report. To obtain AHRS numbers or for questions regarding AHRS requirements and shapefile schema, contact our office at 907.269.8721 or visit: http://dnr.alaska.gov/parks/oha/ahrs/ahrs.htm.

VI. DETERMINATION OF ELIGIBILITY

A determination of eligibility (DOE) should be provided for each cultural resource in the APE. Only a qualified professional in an appropriate field of study should make these determinations. Please see "How to Apply the National Register Criteria for Evaluation" available at: http://www.cr.nps.gov/nr/publications/bulletins/nrb15/. Provide the basis for each NRHP eligibility assessment using the following.

- Category of Historic Property (district, site, building, structure, object, other)
- Historic Context specific to the property type(s)
- Area/s of Significance
- NRHP Criteria for Evaluation (A, B, C or D and criteria considerations A-G)
- Level of Significance: local, state or national
- Seven Aspects of Integrity (location, design, setting, materials, workmanship, feeling and association)

☐ **Cultural resources present within the APE but none is eligible for inclusion in the NRHP.** Note: finding of effect will be "No historic properties affected."

☐ **Historic properties (36 CFR 800.16[d]) present within the APE.** Note: the next step is to determine if the effect will be adverse. Apply Criteria of Adverse Effect at 36 CFR 800.5.

VII. FINDING OF EFFECT

Please provide the basis for your finding.

☐ No historic properties affected [36 CFR 800.4(d)(1)].

☐ No Adverse Effect [36 CFR 800.5(b)]. See examples of adverse effects at 36 CFR 800.5(a)(2).

☐ Adverse Effect [36 CFR 800.5(d)(2)]. If an undertaking results in an adverse effect, further consultation must occur to resolve the adverse effect.

☐ **Consulting parties:** Has this material been provided to other consulting parties (36 CFR 800.2[c]) such as the local government and Tribes? Please explain / describe the nature of this consultation. We request being involved in the consultation process with other consulting parties, as appropriate, if additional information is provided that is relevant to the consideration of historic properties.

Appendix H. *Employee Fitness & Conditioning Agreement Template*

Eastern Interior Fire Management Physical Fitness Agreement

National policy authorizes physical fitness conditioning during duty time for firefighting personnel (Interagency Standards for Fire and Fire Aviation Operations 2012, 13-6).

FWS policy further defines the conditions under which this training will occur:

Employees serving in wildland fire positions that require a fitness rating of arduous as a condition of employment are authorized one hour of duty time each workday for physical fitness conditioning. Employees not having a fitness rating of arduous as a condition of employment, but who are required by a Critical Performance element or other written agreement to maintain an arduous level, will be authorized three hours per week of duty time for physical fitness condition. All other wildland firefighting personnel holding qualifications requiring ratings of moderate or arduous may be authorized, by their supervisor, up to three hours per week of duty time for fitness conditioning. Prior to any duty time being allowed for physical fitness conditioning, employees and supervisors must agree, in writing, what physical conditioning activities the employee will engage in, and when and where they will occur. Activities outside of the agreement will not be authorized or allowed. A combination of activities designed to increase both physical strength and aerobic fitness, while minimizing the possibility of physical injury, should be utilized (FWS Fire Management Handbook 2012, 13-3).

This agreement is in accordance with the above cited policies, and authorizes _____ to engage in physical fitness conditioning activities while on duty for up to _____ hour(s) per_____.

All duty time physical fitness conditioning activities will be performed during the employee's regular tour of duty. Overtime or compensatory time will not be authorized.

Workout facilities and equipment are absent at FWS duty stations in Tok and Fairbanks. Therefore, employees are authorized to seek out other means for exercise including:

- Cooperator Facilities (AK-DOF, AFS)
- Commercial gym facilities
- On and Off-site outdoor locations
- Home workout equipment

Authorized Activites include:

- Stretching/Calisthenics
- Weight training
- Cycling
- Running/Walking/Hiking
- Nordic Skiing
- Fitness equipment exercises
- Swimming
- _____
- _____
- _____

Team sports are not authorized.

Employee Signature Date

Supervisor Signature Date

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Appendix I. *References*

1. Authorities

The following statutes authorize and provide the means for managing wildland fires on FWS lands or threatening FWS lands and on adjacent lands:

A. Protection Act of September 20, 1922 (42 Stat. 857; 16 U.S.C. 594) Authorizes the Secretary of the Interior to protect, from fire, lands under his/her jurisdiction and to cooperate with other Federal agencies, States, or owners of timber.

B. Economy Act of June 30, 1932 (47 Stat. 417; 31 U.S.C. 1535). Authorizes Federal agencies to enter into contracts and agreements for services with each other.

C. Reciprocal Fire Protection Act of May 27, 1955 as amended by the Wildfire Suppression Assistance Act of 1989 (69 Stat. 66, 67; 42 U.S.C. 1856a)(102 Stat. 1615). Authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of agency facilities in extinguishing fires when no agreement exists.

D. National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 and the Refuge Recreation Act of 1962.(80 Stat. 927)(16 U.S.C. 668dd-668ee)(16 U.S.C. 460k-460k4). Governs the administration and use of the National Wildlife Refuge System.

E. Alaska Native Claims Settlement Act of December 18, 1971. (88 Stat. 668; 43 U.S.C. 1601). Alaska Natives' lands are to continue to receive forest fire protection from the United States at no cost until they become economically self-sufficient.

F. Disaster Relief Act of May 22, 1974. (88 Stat. 143; 42 U.S.C. 5121). Authorizes Federal agencies to assist State and local governments during emergency or major disaster by direction of the President.

G. Federal Fire Prevention and Control Act of October 29, 1974 et seq. (88 Stat. 1535; 15 U.S.C. 2201) as amended. Authorizes reimbursement to State and local fire services for costs incurred in firefighting on Federal property.

H. Federal Grants and Cooperative Act of 1977. (Pub. L. 95-244, as amended by Pub. L. 97-258, September 13, 1982. 96 Stat. 1003; 31 U.S.C. 6301-6308). Eliminates unnecessary administrative requirements on recipients of Government awards by characterizing the relationship between executive agencies and contractors, States and local governments and other recipients in acquiring property and services in providing U.S. Government assistance.

I. Alaska National Interest Lands Conservation Act of December 2, 1980. (94 Stat. 2371, 43 U.S.C. 1602-1784). Designates certain public lands in Alaska as units of the National Park, National Wildlife Refuge, Wild and Scenic Rivers, National Wilderness Preservation, and National Forest systems resulting in general expansion of all systems. Any contracts or agreements with the jurisdictions for fire management services listed above that were previously executed will remain valid.

J. Supplemental Appropriation Act of September 10, 1982. (96 Stat. 837). Authorizes Secretary of the Interior and Secretary of Agriculture to enter into contracts with State and local government entities, including local fire districts, for procurement of services in pre-suppression, detection, and suppression of fires on any unit within their jurisdiction.

K. Wildfire Suppression Assistance Act of 1989. (Pub. L. 100-428, as amended by Pub. L. 101-11, April 7, 1989). Authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of agency facilities in extinguishing fires when no agreement exists.

2. Other Policy References

A. A Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment: 10-Year Strategy Implementation Plan (December 2006)

B. Alaska State Statues 41.15.010 – AS 41.15.170

C. Bureau of Indian Affairs Act, as amended (67 STAT. 495:16 U.S.C.1b)

D. Cooperative Forestry Assistance Act of July 1, 1978, as amended (16 U.S.C. 2101) (FS)

E. Cooperative Funds Act of June 30, 1914, (16 U.S.C. 498) (FS)

F. Cooperative Funds and Deposits Act of Dec 12, 1975, (P.L. 94 148, 16 U.S.C. 565) (FS)

G. Department of the Interior and Related Agencies Appropriations Act, 1999, as included in P.L. 105-277, section 101(e);

H. Departmental Manual, 620 DM 1-3, Wildland Fire Management, General Policy and Procedures; Wildland Fire Management, General Policy and Procedures – Alaska; and Burned Area Emergency Stabilization and Rehabilitation.

I. Federal Land Policy and Management Act of Oct. 21, 1976, (P.L.94 579; 43 U.S.C.)(BLM)

J. Granger-Thye Act of April 24, 1950, (16 U.S.C., Sec 572) (FS)

K. Homeland Security Act of 2002 (H.R. 5005-8)

L. Homeland Security Presidential Directive-5 (HSPD-5)

M. Interagency Prescribed Fire Planning and Implementation Procedures Reference Guide, September 2006

N. Interagency Standards for Fire and Fire Aviation Operations, also known as the "Red Book."

O. National Fire Plan (September 2001) and Healthy Forest Initiative (August 2002)

P. National Indian Forest Resources Management Act (P.L. 101-630, Title III) (Interior Agencies)

Q. National Wildlife Refuge System Wildland Fire Management Strategic Plan (May 2006)

R. Region 7 Policy for Management of Permitted Cabins on National Wildlife Refuges in Alaska (RW-1)

S. Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-288) (Federal Agencies)

T. Taylor Grazing Act of June 28, 1934, (48 Stat. 1269; 43 U.S.C. 315) (BLM, FS)

U. United States Fish and Wildlife Service Fire Management Handbook

V. United States Fish and Wildlife Service Manual sections 095 FW 3 Emergency Preparedness and Response -- Wildland Fire Management, 241 FW 7 Wildland Fire Safety, 232 FW 6 Training Standards for Wildland and Prescribed Fire Operations, 621 FW 1 Wildland Fire Policies and Responsibilities, 621 FW 2 Fire Management Planning, and 621 FW 3 Prescribed Fire.

W. Watershed Restoration and Enhancement Act of 1998, P.L. 105-77;

X. Wildland Fire Leadership Conference Call Notes, March 24, 2008 "Modifying Guidance for Implementation of Federal Wildland Fire Policy (AMR), published on the Internet at http://www.forestsandrangelands.gov/leadership/meetings/index.shtml

3. References Cited

ADFG. 1995. Alaska wildlife harvest summary, 1993-1994. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, AK.

Ager, Thomas A. and Linda Brubaker. 1985. Quaternary palynology and vegetational history of Alaska. Pages 353-384 in Bryant, V.M. Jr. and K.G. Holloway (editors). Pollen records of late-Quaternary North American sediments. American Assoc. of Palynologists Foundation, Dallas, TX.

Alaska Interagency Fire Effects Task Group. 2007. Fire Effects Monitoring Protocol (version 1.0). Editors: J. Allen, K. Murphy, and R. Jandt. 43 pp.

Alexander, Clarence. Personal communication, November 1994. Resident of Fort Yukon, AK.

Alexander, Marty E. and Frank V. Cole. 1994. Predicting and interpreting fire intensities in Alaskan black spruce forests using the Canadian system of fire danger rating. Paper presented at the Fire Working Group Technical Session and the Poster Session at the Society of American Foresters/Canadian Institute of Forestry Joint National Convention, held at Anchorage, AK, on September 18-22, 1994.

Anderson, Hal E. 1982. Aids to determining fuel models for estimating fire behavior. General Technical Report INT-122. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Andrews, Elizabeth F. 1977. Report on the cultural resources of the Doyon region, central Alaska. Volumes 1 (discussion) and 2 (inventory). Cooperative Park Studies Unit, University of Alaska, Fairbanks.

Arctic Climate Impact Assessment. 2005. Arctic climate impact assessment scientific report. Cambridge University Press, Cambridge.

Armbruster, W. Scott and David A. Guinn. 1989. The solitary bee fauna (Hymenoptera: Apoidea) of Interior and Arctic Alaska: flower associations, habitat use, and phenology. Journal of Kansas Entomological Society 62:468-483.

AWFCG. 1998. Alaska Interagency Wildland Fire Management Plan, Amended October, 1998. Available from Alaska Division of Forestry, Anchorage, AK, and Alaska Fire Service, Fairbanks, AK.

Bailey, Robert G. 1995. Description of the ecoregions of the United States. Second edition. Misc. Publication 1391. U.S. Department of Agriculture, Forest Service, Washington, DC.

Baker, William L. 1994. Restoration of landscape structure altered by fire suppression. Conservation Biology 8:763-769.

Baldassarre, Guy A. and Eric G. Bolen. 1994. Waterfowl ecology and management. John Wiley and Sons, Inc., New York, NY.

Barney, Richard J. and Erwin R. Berglund. 1974. Wildfire smoke conditions: interior Alaska. Research Paper PNW-178. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Barrett, K., A.D. McGuire, E.E. Hoy, and E.S. Kasischke 2011. Potential shifts in dominant forest cover in interior Alaska driven by variations in fire severity. Ecological Applications. 21 702380-2396.

Beck, P.S.A., G.P. Juday, C. Alix, V.A. Barber, S.T. Winslow, E.E. Sousa, P. Heiser, J.D. Herriges, and S.J. Goetz. 2011. Changes in forest productivity across Alaska consistent with biome shift. Ecology Letters, no. doi:10.1111/j. 1461-0248.2011.01598.x.

Bendell, J.F. 1974. Effects of fire on birds and mammals. Pages 73-137 in Fire and ecosystems, T.T. Kozlowski and C.E. Ahlgren (editors). Academic Press, New York, NY.

Bertram, M., and D. Person. 2005. Biotic assessment of the Beaver Creek watershed in the southern Yukon Flats: Lakes in the proposed land exchange area (sampled 6/13/2003 through 6/25/2003).

BLM, FWS, NPS, and ADF&G. 1995. Fortymile Caribou Herd Management Plan. Bureau of Land Management, Fish and Wildlife Service, National Park Service, and Alaska Department of Fish and Game. Available from ADF&G, Tok, AK.

BLM. 1995. Alaska fire suppression field handbook (Handy-Dandy). Bureau of Land Management, Alaska Fire Service, Fairbanks, AK.

Brown, R.J.E. 1983. Effects of fire on the permafrost ground thermal regime. Pages 97-110 in Ross W. Wein and David A. MacLean (editors). The role of fire in northern circumpolar ecosystems. John Wiley and Sons Publ., Inc., New York, NY.

Brown, Randy. Personal communication, October 1999. Biological Technician, Fisheries Resource Office, U.S. Fish and Wildlife Service, Fairbanks, AK.

Bryant, John P., Robert K. Swihart, P.B. Reichardt, and Lucy Newton. 1994. Biogeography of woody plant chemical defense against snowshoe hare browsing: comparison of Alaska and eastern North America.

Buckley, John L. 1959. Effects of fire on Alaskan wildlife. Pages 123-126 in Proceedings of Society of American Foresters Meeting, Sept. 28-Oct. 2, 1958, Salt Lake City, UT. Soc. of Amer. Foresters, Washington, DC.

Burkett, V., and J. Kusler. 2000. Climate change: potential impacts and interactions in wetlands of the United States. Journal of the American Water Resources Association 36:313-320.

Cahoon, Donald R., Jr., Brian J. Stocks, Joel S. Levine, Wesley R. Cofer III, and Joseph M. Pierson. 1994. Satellite analysis of the severe 1987 forest fires in northern China and southeastern Siberia. Journal of Geophysical Research 99(D9):18,627-18,638.

Carroll, Richard. Personal communication, July 1995. Resides on Porcupine River near Canyon Village.

Caulfield, Richard A. 1983. Subsistence land use in upper Yukon Porcupine communities, Alaska. Technical Paper 16. Alaska Department of Fish and Game, Fairbanks, AK.

Caulfield, Richard A., Walter J. Peter, and Clarence Alexander. 1983. Gwich'in Athabaskan place names of the Upper Yukon-Porcupine Region, Alaska: a preliminary report. Technical Paper 83. Alaska Department of Fish and Game, Fairbanks, AK.

Cella, B.; Allen, J.; Butteri, P.; Cole, F.; Fleming, M.; Howard, K.; Koltun, J.; Long, G.; Martyn, P.; Murphy, K.; Noonan-Wright, E.; Passek, J.; Scott, J.; See, J.; Slaughter, K.; Sorbel, B.; Theisen, S. 2008. Fuel model guide to Alaska Vegetation.

Chapin, F.S. III, A.D. McGuire, R.W. Ruess, T.N. Hollingsworth, M.C. Mack, J.F. JOhnstone, E.S. Kasischke, E.S. Euskirchen, J.B. Jones, M.T. Jortenson, K. Kielland, G.P. Kofinas, M.R. Turetsky, J. Yarie, A.H. Lloyd, and D.L. Taylor. 2010. Resilience of Alaska's boreal forest to climatic change. Can J. For. Res. 40: 1360-1370.

Christiansen, Janet S. 1988. A spruce-lichen woodland in northern Alaska: post-fire regeneration and community dynamics. Unpublished Master's Thesis, University of Washington, Seattle, WA.

Clark, A. McFadyen. 1981b. Koyukon. Pages 582-601 in June Helm (editor). Handbook of North American Indians, vol. 6, subarctic. Smithsonian Institution, Washington, DC.

Clark, Donald W. 1981a. Prehistory of the western subarctic. Pages 107-129 in June Helm (editor). Handbook of North American Indians, vol. 6, subarctic. Smithsonian Institution, Washington, DC.

Clark, L.R. and R.N. Sampson. 1995. Forest ecosystem health in the Inland West: a science and policy reader. Forest Policy Center, American Forests, Washington, DC.

Conant, Bruce and Deborah J. Groves. 1995. Alaska-Yukon waterfowl breeding population survey. Unpublished report. U.S. Fish and Wildlife Service, Office of Migratory Birds, Juneau, AK.

Davis, Kathleen and Bob Mutch. 1994. Applying ecological principles to manage wildland fire. Fire in Ecosystem Management course. National Advanced Resource Technology Center, Marana, AZ.

DCRA. 1994. Community information summaries: excerpts from the DCRA community database. Department of Community and Regional Affairs, State of Alaska, Juneau, AK.

Deeming, John E., Robert E. Burgan, and Jack D. Cohen. 1978. The National Fire-Danger Rating System. General Technical Report INT-39. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Dissing, D., and D. Verbyla. 2004."Landscape Interactions with Thunderstorms in Interior Alaska." Accessed May 22, 2007. At http://nrm.salrm.uaf.edu/~dverbyla/gradstudents/dorte.html on the World Wide Web, produced by the University of Alaska Fairbanks.

Duffy, P.A., J.E. Walsh, J.M. Graham, D.H. Mann, and T.S. Rupp. 2005. Impacts of large-scale atmospheric-ocean variability on Alaskan fire season severity. Ecol Appl. 15(4):1317-1330

Durtsche, Bruce M., Winston Hobgood, and Jan Burris. 1990. Distribution, movements, and seasonal use areas of radio-tagged Dall sheep in the White Mountains-Tanana Hills, Alaska, 1983-1989. Open file report 30. Bureau of Land Management, Anchorage, AK.

Dyrness, C.T. and Rodney A. Norum. 1983. The effects of experimental fires on black spruce forest floors in interior Alaska. Canadian Journal of Forestry Research 13:879-893.

Dyrness, C.T., Leslie A. Viereck, and K. Van Cleve. 1986. Fire in taiga communities of interior Alaska. Pages 74-86 in K. Van Cleve, F.S. Chapin III, P.W. Flanagan, and others (editors). Forest ecosystems in the Alaskan taiga: a synthesis of structure and function. Springer-Verlag, New York, NY.

Eckert, C., W. Nixon, and P. Sinclair. 1996. Forest bird habitat associations in southeast Yukon, Canada. Paper presented at the 6th Alaska Bird Conference, April 8-10, 1996, Fairbanks, AK.

Edwards, Mary E. Personal communication, November 1994. Departments of Geology and Geophysics and Biology and Wildlife, University of Alaska, Fairbanks.

Edwards, Mary E. and Edward D. Barker, Jr. 1994. Climate and vegetation in northeastern Alaska 18,000 yr B.P.-present. Palaeogeography, Palaeoclimatology, Palaeoecology 109:127-135.

Emers, Mike. Personal communication, September 1997. Former Botanist, Arctic NWR, Fairbanks, AK.

Euskirchen, E.S., A.D. McGuire, D.W. Kicklighter, Q. Zhuang, J.S. Clein, R.J. Dargaville, D.G. Dye, J.S. Kimball, K.C. McDonald, J.M. Melillo, V.E. Romanovsky, and N.V. Smith. 2006. Importance of recent shifts in soil thermal dynamics on growing season length, productivity, and carbon sequestration in terrestrial high-latitude ecosystems. Global Change Biology 12:731-750.

Euskirchen, E.S., A.D. McGuire, F.S. Chapin III, and T.S. Rupp. 2010. The changing effects of Alaska's boreal forests on the climate system. Can. J. For. Res. 40:1336-1346.

Farjon, Aljos and Pieter Bogaers. 1985. Vegetation zonation and primary succession along the Porcupine River in interior Alaska. Phytocoenologia 13:465-504.

Fastie, C.L., A. Lloyd, and P. Doak. 2002. Fire history and postfire development in an upland watershed of interior Alaska. J. of Geophys. Res. 108:8150.

Flannigan, M.D. and Harrington, J.B.: 1988, A study of the relation of meteorological variables to monthly provincial area burned by wildfire in Canada (1953-80). Journal of Applied Meteorology, 27:441-452.

Fleener, Craig. Personal communication, October 1997. Resident of Fort Yukon.

Foote, Joan M. 1983. Classification, description, and dynamics of plant communities after fire in the taiga of interior Alaska. Research Paper PNW-307. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Foote, Joan M., Frank Jakubicek, Rick Lanctot, Johnna Roy, and Jim Jansen. 1989. Fire as a management tool in the Yukon Flats National Wildlife Refuge: Resource Unit G (2). Unpublished report. U.S. Department of Agriculture, Forest Service, Institute of Northern Forestry, Fairbanks, AK.

Foote, Joan M., Kristine Sowl, and Fred Deines. 1995. Fire and resource management on the Yukon Flats National Wildlife Refuge: Marten Island. Unpublished report. U.S. Department of Agriculture, Forest Service, Institute of Northern Forestry, Fairbanks, AK.

Foote, Joan M., Sharon Schlentner, and Rodney A. Norum. 1986. Fire as a management tool in the Yukon Flats National Wildlife Refuge: a feasibility study in Resource Unit 1. U.S. Department of Agriculture, Forest Service, Institute of Northern Forestry, Fairbanks, AK.

Foote, Joan M.. Personal communication, September 1999. Retired biologist, USDA Forest Service Institute of Northern Forestry, Fairbanks, AK.

Fox, John F. 1978. Forest fires and the showshoe hare-Canada lynx cycle. Oecologia 31:349-374.

Fox, John F. 1983. Post-fire succession of small-mammal and bird communities. Pages 155-180 in R.W. Wein and D.A. MacLean (editors). The role of fire in northern circumpolar ecosystems. John Wiley and Sons Publ., Inc., New York, NY.

Garfinkel, Harriet L. and Linda B. Brubaker. 1980. Modern climate-tree-growth relationships and climatic reconstruction in sub-Arctic Alaska. Nature 286:872-874.

Gasaway, W.C., S.D. DuBois, R.D. Boertje, D.J. Reed, and D.T. Simpson. 1989. Response of radio-collared moose to a large burn in central Alaska. Canadian Journal of Zoology 67:325-329.

Golden, Howard N. 1987. Survey of furbearer populations on the Yukon Flats National Wildlife Refuge. Final report. Alaska Department of Fish and Game, Fairbanks, AK.

Haila, Yrjo. 1994. Preserving ecological diversity in boreal forests: ecological background, research, and management. Ann. Zool. Fennici 31:203-217.

Hakala, John B., Robert K. Seemel, Robert A. Richey, and John E. Kurtz. 1971. Fire effects and rehabilitation methods--Swanson-Russian Rivers fires. Pages 87-99 in C.W. Slaughter, Richard J. Barney, and G.M. Hansen (editors). Fire in the northern environment--a symposium. University of Alaska, Fairbanks, AK.

Hart-Crowser and Associates. 1985. North warning system cultural resources survey of five proposed installation alternates and three associated staging areas. Hart-Crowser and Associates, Anchorage, AK/Seattle, WA. Submitted to Bureau of Land Management, Fairbanks District Office, Fairbanks, AK.

Hawkes, B.C., M.C. Feller, and D. Meehan. 1990. Site preparation: fire. Pages 132-149 in D.P. Lavender, R. Parish, C.M. Johnson, G. Montgomery, A. Vyse, R.A. Willis, and D.

Winston (editors). Regenerating British Columbia's forests. University of British Columbia Press, Vancouver, BC, Canada.

Heglund, Patricia J. 1988. Relations between waterbird use and the limnological characteristics of wetlands on Yukon Flats National Wildlife Refuge, Alaska. Unpublished Masters Thesis, University of Missouri-Columbia, Columbia, MO.

Heglund, Patricia J. 1992. Patterns of wetland use among aquatic birds in the interior boreal forest region of Alaska. Unpublished PhD Dissertation, University of Missouri-Columbia, Columbia, MO.

Heinselman, Miron L. 1971. The natural role of fire in northern conifer forests. Pages 61-72 in C.W. Slaughter, Richard J. Barney, and G.M. Hansen (editors). Fire in the northern environment--a symposium. University of Alaska, Fairbanks, AK.

Helle, Pekka, and Gerald J. Niemi. 1996. Bird community dynamics in boreal forests. Pages 209-235 in R.M. DeGraaf and R.I. Miller (editors). Conservation of faunal diversity in forested landscapes. Chapman and Hall Publ.

Herbert, Paul. Personal communication, November 1994. Resident of Fort Yukon.

Hildebrand, John. 1988. Reading the river: a voyage down the Yukon. Houghton Mifflin Co., Boston, MA.

Hinkes, Michael T. and Kate Engels. 1983. Bird communities of recently burned and unburned forest and scrub habitats in interior Alaska. Technical Report. Bureau of Land Management, Anchorage, AK.

Hinzman, L.D., N.D. Bettez, W.R. Bolton, F.S. Chapin, M.B. Dyurgerov, C.L. Fastie, B. Griffith, R.D. Hollister, A. Hope, H.P. Huntington, A.M. Jensen, G.J. Jia, T. Jorgenson, D.L. Dane, D.R. Klein, G. Kofinas, A.H. Lynch, A.H. Lloyd, A.D. McGuire, F.E. Nelson, W. C. Oechel, T.E. Osterkamp, C.H. Racine, V.E. Romanovsky, R. S. Stone, D.A. Stow, M. Sturm, C.E. Tweedie, G.L. Vourlitis, M.D. Walker, D.A. Walker, P.J. Webber, J.M. Whelker, K.S. Winker, and K. Yoshikawa. 2005. Evidence and implications of recent climate change in northern Alaska and other Arctic regions. Climatic Change 72:251-298.

Hobgood, Winston and Bruce M. Durtsche. 1990. Ecology of moose in the White Mountains National Recreation Area, Alaska, 1985-1988. Open file report 27. Bureau of Land Management, Anchorage, AK.

Hosley, Edward H. 1981a. Environment and culture in the Alaska Plateau. Pages 533-545 in June Helm (editor). Handbook of North American Indians, vol. 6, subarctic. Smithsonian Institution, Washington, DC.

Hosley, Edward H. 1981b. Intercultural relations and cultural change in the Alaska Plateau. Pages 546-555 in June Helm (editor). Handbook of North American Indians, vol. 6, subarctic. Smithsonian Institution, Washington, DC.

Hu, F.S., P.E. Higuera, J.E. Walsh, W.L. Chapman, P.A. Duffy, L. B. Brubaker, and M.L. Chipman. 2010. Tundra burning in Alaska: Linkages to climatic change and sea ice retreat. J. Geophys. Res. 115, G04002.

Inkley, D. B., M. G. Anderson, A. R. Blaustein, V. R. Burkett, B. Felzer, B. Griffith, J. Price, and T. L. Root. 2004. Global climate change and wildlife in North America. Wildlife Society Technical Review 04-2. The Wildlife Society, Bethesda, Maryland, USA.

Intergovernmental Panel on Climate Change 2007. Climate change 2007: the physical science basis. Contribution of the working group 1 to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

IPCC (Intergovernmental Panel on Climate Change). 1996. Climate change 1995, impacts, adaptations and mitigation of climate change: scientific-technical analyses. Cambridge University Press, New York, USA.

IPCC. 2002. Climate change and biodiversity. Technical paper V. Available online at http://www.ipcc.ch /pub/tpbiodiv.pdf (accessed April 2005).

Jacoby, G.C. and E.R. Cook. 1981. Past temperature variations inferred from a 400-year tree-ring chronology from Yukon Territory, Canada. Arctic and Alpine Research 13:409-418.

James, Winston. Personal communication, March 1998. Chief of Birch Creek village.

Johnson, A.H. and R.M. Strang. 1982. Forest fire history in the central Yukon. Forest Ecology and Management 4:155-159.

Johnson, E.A., K. Miyanishi, and S.R.J. Bridge. 2001. Wildfire regime in the boreal forest and the idea of suppression and fuel buildup. Cons.Biol. 15(6)1554-1557.

Johnson, Edward A. 1992. Fire and vegetation dynamics: studies from the North American boreal forest. Cambridge University Press, Cambridge, England.

Johnson, W. N., T. F. Paragi, and D. D. Katnik. 1995. The relationship of wildland fire to lynx and marten populations and habitat in interior Alaska. Final Report. U.s. Fish and Wildlife Service, Galena, Alaks. 145pp.

Johnstone, J.F. and E.S. Kasischke. 2005. Stand-level effects of soil burn severity on postfire regeneration in a recently burned black spruce forest. Can. J. For. Res. 35:2151-2163

Johnstone, J.F. and F.S. Chapin III. 2006. Effects of soil burn severity on post-fire tree recruitment in boreal forest. Ecosystems 9:14-31.

Johnstone, J.F., T.N. Hollingsworth, F.S. Chapin, III, and M.C. Macks 2010. Changes in fire regime break the legacy lock on successional trajectories in Alaskan boreal forest. Global Change Biol. 16:1281-1295.

Kasischke, E.S., D.L. Verbyla, T.S. Rupp, A.D. McGuire, K.A. Murphy, R. Jandt, J.L. Barnes, E.E. Hoy, P.A. Duffy, M. Calef, and M.R. Turetsky 2010. Alaska's changing fire regime-implications for the vulnerability of its boreal forests. Can. J. For. Res. 40:1313-1324.

Kasischke, Eric S., N.L. Christensen, Jr., and Brian J. Stocks. 1995. Fire, global warming, and the carbon balance of boreal forests. Ecological Applications 5:437-451.

Kelleyhouse, David G. 1979. Fire/wildlife relationships in Alaska. In: Hoefs, M.; Russell, D., eds. Wildlife and wildfire: Proceedings of workshop; 1979 November 27-28; Whitehorse, YT. Whitehorse, YT: Yukon Wildlife Branch: 1-36. [14071]

Kelsall, John P., E.S. Telfer, and Thomas D. Wright. 1977. The effects of fire on the ecology of the boreal forest, with particular reference to the Canadian north: a review and selected bibliography. Occasional Paper 32. Canadian Wildlife Service, Ottawa, Canada.

Klein, David R. 1982. Fire, lichens, and caribou. Journal of Range Management 35:390-395.

Knapp, Mark. Personal communication, April 1995. Trapper, resident of Fairbanks.

Koehler, Gary M.; Hornocker, Maurice G. 1977. Fire effects on marten habitat in the Selway-Bitterrroot Wilderness. Journal of Wildlife Management. 41(2): 500-505. [7637]

Koehler, Gary M.; Moore, William R.; Taylor, Alan R. 1975. Preserving the pine martin: management guidelines for western forests. Western Wildlands Summer 1975. Missoula, MT: University of Montana, Montana Forest and Conservation Experiment Station. 6 p. [8452]

Lacey, Dave, Deborah McLaren, and Katie Cook. 1999. Life along the Yukon River: the Koyukon Athabascan People of Stevens Village, Alaska. Rethinking Tourism Project/Tides Center, Minneapolis, MN, and Yukon river Tours, Fairbanks, AK.

Larsen, C.P.S. and G.M. MacDonald. 1998. An 840-year record of fire and vegetation in a boreal white spruce forest. Ecology 79:106-118.

Lawson, B.D.; Armitage, O.B. 2008. Weather guide for the Canadian Forest Fire Danger Rating System. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, AB.

LeResche, R.E., R.H. Bishop, and J.W. Coady. 1974. Distribution and habitats of moose in Alaska. Le Naturaliste Canadien 101:143-178.

Lewis, Henry T. 1982. A time for burning: traditional Indian uses of fire in the western Canadian boreal forest. Occasional publication number 17. Boreal Institute for Northern Studies, University of Alberta, Edmonton, Alberta, Canada.

Lewis, Henry T. and Theresa A. Ferguson. 1988. Yards, corridors, and mosaics: how to burn a boreal forest. Human Ecology 16:57-77.

Lipkin, Robert and David F. Murray. 1997. Alaska rare plant field guide. U.S. Fish & Wildlife Service, Anchorage, AK.

Lotspeich, Frederick B., Ernst W. Mueller, and Paul J. Frey. 1970. Effects of large scale forest fires on water quality in interior Alaska. U.S. Department of the Interior, Federal Water Pollution Control Administration, Alaska Water Laboratory, College, AK.

Lutz, H.J. 1956. Ecological effects of forest fires in the interior of Alaska. Alaska Forest Research Center Technical Bulletin no. 1133. U.S. Department of Agriculture, Forest Service, Juneau, AK.

MacCracken, James G. and Leslie A. Viereck. 1990. Browse regrowth and use by moose after fire in interior Alaska. Northwest Science 64:11-18.

MacLean, David A., Stephen J. Woodley, Michael G. Weber, and Ross W. Wein. 1983. Fire and nutrient cycling. Pages 111-132 in R.W. Wein and D.A. MacLean (editors). The role of fire in northern circumpolar ecosystems. John Wiley and Sons Publ., Inc., New York, NY.

Maier, J.A.K., J.M. VerHoef, A.D. McGuire, R.T. Bowyer, L. Saperstein, and H.A. Maier. 2005. Distribution and density of moose in relation to landscape characteristics: effects of scale. Can. J. For. Res. 35:2233-2243

Mann, Dan. Personal communication, November 1994. Alaska Quaternary Center, University of Alaska, Fairbanks.

Matthews, Kathleen, Dustin Wittwer, Ken Zogas, Ed Holsten, Lori Trummer, Paul Hennon, Mark Schultz, and Roger Burnside. 1997. Forest insect and disease conditions in Alaska--1997. General Technical Report R10-TP-67. U.S. Department of Agriculture, Forest Service, Forest Health Protection, Anchorage, AK.

Mayo, Randy. Personal communication, November 1997. Chief of Stevens Village.

McClellan, Catherine and Glenda Denniston. 1981. Environment and culture in the cordillera. Pages 372-386 in June Helm (editor). Handbook of North American Indians, vol. 6, subarctic. Smithsonian Institution, Washington, DC.

McClellan, Catherine. 1981. Intercultural relations and cultural change in the cordillera. Pages 387-401 in June Helm (editor). Handbook of North American Indians, vol. 6, subarctic. Smithsonian Institution, Washington, DC.

McCullough, Deborah G., Richard A. Werner, and David Neumann. 1998. Fire and insects in northern and boreal forest ecosystems of North America. Annual Review of Entomology 43:107-127.

McLean, L. Scott. 1992. The first ten years: a brief history of the biological program on the Yukon Flats National Wildlife Refuge. U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, AK.

Merrill, D.F.; Alexander, M.E. (editors). 1987. Glossary of forest fire management terms. Fourth edition. Natural Resources Council Canada, Ottawa, Ontario. Publication NRCC No. 26516

Miller, Melanie. 1994. Short term fire effects. Fire effects workshop, October 1994. Bureau of Land Management, Alaska Fire Service, Fairbanks, AK.

Murphy, Edward C. and William A. Lehnhausen. 1997. Woodpeckers and fire--do black-backed woodpeckers require recent burns? Presented at the Seventh Alaska Bird Conference, December 1997, Anchorage, AK. Sponsored by U.S. Fish and Wildlife Service, Anchorage, AK.

Murphy, K. A., J. H. Reynolds, and J. M. Koltun. 2008. Evaluating the ability of the differenced Normalized Burn Ratio (DNBR) to predict ecologically significant burn severity in Alaskan boreal forests. International Journal of Wildland Fire, v. 17, no. 4, p. 490-499. 10.1071/.

Murphy, K., F. Huettman, N. Fresco, J. Morton 2010. Connecting Alaska Landscapes into the Future. Results from an interagency climate modeling, land management and conservation project. Final Report, 96 pp.

Murray, Barbara M. 1992. Bryophyte flora of Alaskan steppes. Bryobrothera 1:9-33.

Murray, David F. and Robert Lipkin. 1987. Candidate threatened and endangered plants of Alaska. University of Alaska Museum, Fairbanks, AK.

Natcher, David C. 1996. Impact of non-indigenous fire policies on land and resource use of the Gwich'in Athabaskans of Birch Creek and adjacent areas, Alaska. Unpublished Masters Thesis, University of Alaska-Fairbanks, Fairbanks, AK.

National Wildfire Coordinating Group Operations and Workforce Development Committee. 2011. National Interagency Incident Management System Wildland Fire Qualification System Guide. PMS 310-1. National Wildfire Coordinating Group. 186 p.

Nelson, Richard K. 1973. Hunters of the northern forest: designs for survival among the Alaskan Kutchin. University of Chicago Press, Chicago, IL.

Nelson, Richard K. 1983. The Athabaskans: people of the boreal forest. Alaska Historical Commission Studies in History No. 27. University of Alaska Museum, Fairbanks, AK.

Norum, R. 1982. Predicting wildfire behavior in black spruce forests in Alaska. Res. Not. PNW-401. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest

Paragi, Thomas F., W. N. Johnson, and Donald D. Katnik. 1997. Selection of post-fire seres by lynx and snowshoe hares in the Alaskan taiga. Northwestern Naturalist, vol. 78, no. 3: 77-86.

Paragi, Tom. 1994. Memorandum: trapper interviews regarding fire - topics other than martens and lynx. U.S. Fish & Wildlife Service, Koyukuk/Nowitna National Wildlife Refuge, Galena, AK.

Perham, Craig, Terry Doyle, and William Route. 1995. Home range, habitat selection, and movements of lynx (Felis lynx) in eastern interior Alaska. Eighth northern furbearer conference abstracts. May 1995, Anchorage, AK.

Peter, Katherine. 1992. Neets'aii Gwiindaii: Living in the Chandalar Country. (Translated by Adeline Raboff.) Alaska Native Language Center, University of Alaska, Fairbanks.

Pyne, Stephen J. 1982. Fire in America. Princeton University Press, Princeton, NJ.

Pyne, Stephen J. 1984. Introduction to wildland fire: fire management in the United States. Wiley and Sons, New York, NY.

Quade, Cheryl A. 1993. Abundance of arvicoline rodents in post-fire forest communities of the Nowitna National Wildlife Refuge. Unpublished Masters Thesis, Univ. Washington, Pullman, WA.

Rieman, Bruce, Danny Lee, Gwynne Chandler, and Deborah Myers. 1997. Does wildfire threaten extinction for salmonids?--Responses of redband trout and bull trout following recent large fires on the Boise National Forest. Pages 47-57 in Proceedings--Fire effects on rare and endangered species and habitats, Nov. 1995. International Association of Wildland Fire, Fairfield, WA.

Rowe, J.S. 1983. Concepts of fire effects on plant individuals and species. Pages 135-154 in R.W. Wein and D.A. MacLean (editors). The role of fire in northern circumpolar ecosystems. John Wiley and Sons Publ., Inc., New York, NY.

Schaefer, James A. and William O. Pruitt, Jr. 1991. Fire and woodland caribou in southeastern Manitoba. Wildlife Monographs 116:1-39.

Schimmel, Johnny and Anders Granstrom. 1996. Fire severity and vegetation response in the boreal Swedish forest. Ecology 77:1436-1450.

Schindler, D.W., R.W. Newbury, K.G. Beaty, J. Prokopowich, T. Ruszczynski, and J.A. Dalton. 1980. Effects of a windstorm and forest fire on chemical losses from forested watersheds and on the quality of receiving streams. Canadian Journal of Fisheries and Aquatic Sciences 37:328-334.

SCS. 1979. Exploratory soil survey of Alaska. U.S. Department of Agriculture, Soil Conservation Service (Natural Resource Conservation Service), Washington, DC.

Selkregg, Lidia L. 1976. Alaska regional profiles: Yukon Region. University of Alaska, Arctic Environmental Information and Data Center, Anchorage, AK.

Sharratt, B.S. 1992. Growing season trends in the Alaskan climate record. Arctic 45:124-127.

Slaughter, Dale C. n.d. Yukon Flats cultural resource survey. Submitted to Doyon Lands Department and Yukon Flats National Wildlife Refuge, Fairbanks, AK.

Slobodin, Richard. 1981. Kutchin. Pages 514-532 in June Helm (editor). Handbook of North American Indians, vol. 6, subarctic. Smithsonian Institution, Washington, DC.

Smith, Craig S. 1984. An archeological reconnaissance of the Hodzana River, Yukon Flats National Wildlife Refuge, Alaska. Cultural resource report 8403-1-8414. P-III Associates, Inc., Salt Lake City, UT. Submitted to U.S. Fish and Wildlife Service, Anchorage, AK.

Stocks, Brian J. 1993. Global warming and forest fires in Canada. The Forestry Chronicle 69:290-293.

Stocks, Brian J., B.D. Lawson, Marty E. Alexander, C.E. Van Wagner, R.S. McAlpine, T.J. Lynham, and D.E. Dubè. 1989. The Canadian Forest Fire Danger Rating System: an overview. The Forestry Chronicle 65:258-265.

Strang, R.M. 1973. Succession in unburned subarctic woodlands. Canadian Journal of Forest Research 3:140-143.

Sumida, Valerie A. 1988. Land and resource use patterns in Stevens Village, Alaska. Technical Paper 129. Alaska Department of Fish and Game, Division of Subsistence, Fairbanks, AK.

Sumida, Valerie A. 1989. Patterns of fish and wildlife harvest and use in Beaver, Alaska. Technical Paper 140. Alaska Department of Fish and Game, Division of Subsistence, Fairbanks, AK.

Sumida, Valerie A. and David B. Andersen. 1990. Patterns of fish and wildlife use for subsistence in Fort Yukon, Alaska. Technical Paper 179. Alaska Department of Fish and Game, Division of Subsistence, Fairbanks, AK.

Sylvester, Roger A. 1971. Fire and resources in the subarctic--panel discussion. Pages 249-251 in C.W. Slaughter, Richard J. Barney, and G.M. Hansen (editors). Fire in the northern environment--a symposium. University of Alaska, Fairbanks, AK.

Szeicz, Julian M. and Glen M. MacDonald. 1995. Dendroclimatic reconstruction of summer temperatures in northwestern Canada since A.D. 1638 based on age-dependent modeling. Quaternary Research 44:257-266.

Telfer, E.S. 1993. Wildfire and the historical habitats of the boreal forest avifauna. Pages 27-38 in D.H. Kuhnke (editor). Birds in the Boreal Forest Workshop Proceedings, held March, 1992, Prince Albert, Sask. Northern Forestry Centre, Forestry Canada, Northwest Region.

Timoney, K.P. and Ross W. Wein. 1991. The areal pattern of burned tree vegetation in the subarctic region of northwestern Canada. Arctic 44:223-230.

Trigg, William M. 1971. Fire season climatic zones of mainland Alaska. Research Paper PNW-126. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

U.S. Fish and Wildlife Service. January, 2005.

U.S. Geological Survey, and Yukon River Inter-Tribal Watershed Council. 2007. Passing of the torch (presentation). Available at http://www.yritwc.com/Presentations/waterquality/schusterprojectdesign.pdf.

USDA and USDI. 1989. Final report on fire management policy. May 5, 1989. U.S. Department of Agriculture and U.S. Department of the Interior, Washington, DC.

USDA. 1979. Ecological effects of the Wickersham Dome Fire near Fairbanks, Alaska. General Technical Report, PNW-90. (L.A. Viereck and C.T. Dyrness, technical editors.) U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

USDA. 1999. Fire Effects Information System [Online] (1996, September). Prescribed Fire and Fire Effects Research Work Unit, Rocky Mountain Research Station (producer). Available: www.fs.fed.us/database/feis/.

USDI and USDA. 1995. Federal wildland fire management policy and program review: final report. U.S. Department of the Interior and U.S. Department of Agriculture, Washington, DC.

USDI. 1974. Final Environmental Statement: proposed Yukon Flats National Wildlife Refuge. U.S. Department of the Interior, Washington, DC.

USDI. 1982. Alaska Interagency Fire Management Plan: Tanana/Minchumina planning area. U.S. Department of the Interior, Bureau of Land Management, Alaska Fire Service, Fairbanks, AK.

USDI. 1983. River Management Plan: Beaver Creek, a component of the National Wild and Scenic Rivers System. U.S. Department of the Interior, Bureau of Land Management and U.S. Fish and Wildlife Service, Fairbanks, AK.

USDI. 1986. North American Waterfowl Management Plan. U.S. Department of the Interior, Washington, DC.

USDI. 1999. Final Wild and Scenic River study and legislative Environmental Impact Statement: Lower Sheenjek River, Alaska. U.S. Department of the Interior, National

Park Service (Program Manager, Anchorage, AK) and Fish and Wildlife Service (Yukon Flats NWR, Fairbanks, AK).

USFWS 2010. Rising to the urgent challenge. Strategic plan for responding to accelerating climate change. Washington D.C. 32 pp.

USFWS. 1986a. Environmental assessment: prescribed burning on the Yukon Flats National Wildlife Refuge. U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, AK.

USFWS. 1986b. Yukon Flats National Wildlife Refuge Fire Management Plan. U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, AK.

USFWS. 1987. Yukon Flats National Wildlife Refuge Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review. U.S. Fish and Wildlife Service, Anchorage, AK.

USFWS. 1990. Fishery Management Plan: Yukon Flats National Wildlife Refuge. U.S. Fish and Wildlife Service, Fairbanks Fishery Assistance Office, Fairbanks, AK.

USFWS. 1992. Prescribed burning position paper. In house correspondence dated March 13, 1992. U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, AK.

USFWS. 1994. Annual Narrative Report, Yukon Flats National Wildlife Refuge, 1993. U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, AK.

USFWS. 1995. (In preparation). Tetlin National Wildlife Refuge Fire Management Plan. U.S. Fish and Wildlife Service, Tetlin National Wildlife Refuge, Tok, AK.

USFWS. 1996. Annual Narrative Report, Yukon Flats National Wildlife Refuge, 1995. U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, AK.

USFWS. 1997a. Station purposes, mission, goals, and objectives: Yukon Flats NWR. Refuge Management Information System. U.S. Fish and Wildlife Service, Anchorage, AK.

USFWS. 1997b. Land protection plan for Yukon Flats National Wildlife Refuge, Fairbanks, Alaska. U.S. Fish and Wildlife Service, Anchorage, AK.

USFWS. 1997c. Annual Narrative Report, Yukon Flats National Wildlife Refuge, 1996. U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, AK.

USFWS. 2000. Fire management handbook. U.S. Fish and Wildlife Service, (Boise, ID).

USFWS. 2010. Proposed Land Exchange, Yukon Flats National Wildlife Refuge, Final Environmental Impact Statement, Volume 1.

UYTPT. 1984. Alaska Interagency Fire Management Plan: Upper Yukon/Tanana planning area. Upper Yukon/Tanana Planning Team. Available from U.S. Department of the Interior, Bureau of Land Management, Alaska Fire Service, Fairbanks, AK.

Van Wagner, C.E. 1983. Fire behaviour in northern conifer forests and shrublands. Pages 65-80 in R.W. Wein and D.A. MacLean (editors). The role of fire in northern circumpolar ecosystems. John Wiley and Sons Publ., Inc., New York, NY.

Van Wagner, C.E. 1988. The historical pattern of annual burned area in Canada. The Forestry Chronicle (June):182-185.

Van Wagner, C.E. 1987. Development and structure of the Canadian Forest Fire Weather Index System. Can. For. Serv., For. Tech. Rept. 35. 37 p.

Vanderlinden, Larry. Personal communication, November 1995. Former Fire Management Officer, Tetlin NWR, Tok; currently USFWS Region 7 Fire Management Coordinator, Anchorage, AK.

Viereck, LA.; Dyrness, C.T.; Batten, A.R.; Wenzlick, K.J. 1992. The Alaska vegetation classification, Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 p.

Viereck, Leslie A. 1973. Ecological effects of river flooding and forest fires on permafrost in the taiga of Alaska. Pages 60-67 in Permafrost: the North American contribution to the Second International Conference. National Academy of Sciences, Washington, DC.

Viereck, Leslie A. 1982. Effects of fire and firelines on active layer thickness and soil temperatures in interior Alaska. Proc. 4th Canadian Permafrost Conference, Calgary, Alberta, Canada, March, 1991. National Research Council of Canada, Ottawa.

Viereck, Leslie A. 1983. The effects of fire in black spruce ecosystems of Alaska and northern Canada. Pages 201-220 in R.W. Wein and D.A. MacLean (editors). The role of fire in northern circumpolar ecosystems. John Wiley and Sons Publ., Inc., New York, NY.

Viereck, Leslie A. and C.T. Dyrness. 1979. Ecological effects of the Wickersham Dome Fire near Fairbanks, Alaska. General Technical Report PNW-90. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Viereck, Leslie A. and Linda A. Schandelmeier. 1980. Effects of fire in Alaska and adjacent Canada--a literature review. BLM-Alaska Technical Report 6. Bureau of Land Management, Anchorage, AK.

Viereck, Leslie A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick. 1992. The Alaska vegetation classification. General Technical Report PNW-GTR-286. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Villano, K.L. 2008. Wildfire burn susceptibility to non-native plant invasions in black spruce forests of interior Alaska. M.S. Thesis, University of Alaska Fairbanks. 101 pp.

Wahrhaftig, C., 1965, Physiographic divisions of Alaska: U.S. Geological Survey. Professional Paper 482, 51 p., 6 plates.

Wesser, Sara D. and W. Scott Armbruster. 1991. Species distribution controls across a forest-steppe transition: a causal model and experimental test. Ecological Monographs 61:323-342.

West, Frederick Hadleigh. 1965. Archaeological survey and excavations in the proposed Rampart Dam Impoundment, 1963-1964. Produced under contract between the University of Alaska, Fairbanks, and the National Park Service.

Williams, Paul, Sr. Personal communication, November 1997. Refuge Information Technician, Yukon Flats NWR, Fairbanks, AK; resident of Beaver, AK.

Wilmore, B. 2001. Duff moisture dynamics in black spruce feather moss stands and their relation to the Canadian Forest Fire Danger Rating System [MSc thesis]. Fairbanks (AK): University of Alaska Fairbanks. 117 pp.

Yarie, J. 1981. Forest fire cycles and life tables: A case study from interior Alaska. Can. J. For. Res. 11:554-562.