Chapter 3
Affected Environment and Environmental Consequences

For each proposed action by the federal government, NEPA requires a review of the affected human environment and environmental consequences of that action. The proposed action is the Preferred Alternative, the Land Use Plan Amendment for Wildland Fire and Fuels Management.

In addition to this analysis, the planning unit[1] specific information on the affected environment and environmental consequences contained in the 13 Interagency Fire Management Plans written in the 1980s is incorporated here by reference. Appendix D discusses the history of the interagency planning effort for following units:

- Tanana/Minchumina Planning Area 1982 and Amendment 1984
- Copper Basin Planning Area 1983
- Kuskokwim/Iliamna Planning Area 1983
- Fortymile Planning Area 1984
- Kenai Planning Area 1984
- Kobuk Planning Area 1984
- Seward/Koyukuk Planning Area 1984
- Upper Yukon/Tanana Planning Area 1984
- Yukon/Togiak Planning Area 1984
- Arctic Slope Planning Area 1986
- Kodiak/Alaska Peninsula Planning Area 1986, Matanuska/Susitna Planning Area 1986
- Southeast Planning Area 1988.

Since the Preferred Alternative was developed using the policies, terminology and appropriate management responses already in place through the AIWFMP into the BLM-managed land use plans, the anticipated impacts of the Preferred and the No Action alternatives are very similar.

This analysis will focus on the effects of wildland fire, suppression actions, fuels management, and the exclusion of fire on ecosystem health and the human environment. The main difference between the two alternatives is that the Preferred Alternative prioritizes and broadens the opportunities for fuels treatments; however, it retains the requirements in place for site-specific plans and analyses.

For both alternatives, this analysis makes the following assumptions:

- Past wildland fire history provides a reasonable basis upon which to predict future wildland fire activity.[2]
- Wildland fire will continue to occur at approximately the same level and in the same hydrological units that it has been occurring since the implementation of the interagency wildland fire management plans.[3]
- Wildland fire is an essential ecological process and natural change agent of the Alaskan ecosystems.
- Future fuel treatment projects will require a project plan and corresponding analyses. Each will be reviewed for compliance with State and federal regulations and policies.
- All fire and fuels management activities will follow procedures, restrictions and constraints listed in Sections 2.3.3 and 2.5.5.

3.1 Critical Elements

BLM requires the following Critical Elements be analyzed in all Environmental Assessments. Critical elements are subject to requirements specified in statue, regulations, or executive orders.

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[1] Map 5 displays the interagency fire planning units.

[2] Appendix E for Fire Occurrence Statistics

[3] Map 6, Alaska Hydrologic Units with Fire History for a graphic depiction of large fire occurrence. The map illustrates the fire history from 1950 to 1987 and post interagency fire plan implementation occurrence from1988 to 2002.

3.1.1 Air Quality

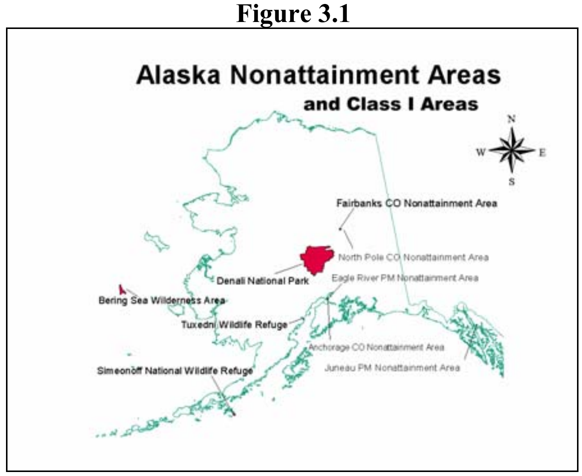
3.1.1a Affected Environment

The Clean Air Act (CAA) was enacted in 1970 (amended in 1990) to limit the emission of pollutants into the atmosphere to protect human health and the environment from the effect of airborne pollution. The CAA authorized the U.S. Environmental Protection Agency (EPA) to achieve this objective by setting air quality standards and regulating emissions of pollutants into the air. These controls are implemented in Alaska through EPA and the Alaska Department of Environmental Conservation (ADEC).

In undeveloped areas, ambient air pollutant levels are below measurable limits. Locations near population centers are most vulnerable to air quality impacts from emissions sources such as automotive exhaust and residential wood smoke. National Ambient Air Quality Standards (NAAQS) limit the amount of specific pollutants allowed in the atmosphere: carbon monoxide (CO), lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter (PM). The major pollutant of concern in smoke from fire is fine particulate matter, both PM10[4] and PM2.5.

Alaska has four Class I airsheds[5]. There are no BLM-managed lands near or adjacent to any Class I airsheds. Fire management activities on BLM-managed land may affect four Areas of Non-Attainment[6]: three with CO and one with particulate matter exceeding PM10 guidelines. The Northern Field Office has resource management responsibilities on lands near or adjacent to the Fairbanks and North Pole CO Non-Attainment Area. The Anchorage Field Office manages lands near or adjacent to the Anchorage CO and Eagle River PM10 Non-Attainment Areas. Figure 3.1 displays Alaska Class 1 Airsheds and Non-Attainment areas

Figure 3.1



ADEC is responsible for declaring air episodes and issuing air quality advisories, as appropriate, during periods of poor air quality or inadequate dispersion conditions. That agency is represented on the AWFCG. During periods of wildland fire activity the Multi-Agency Coordinating Group (MAC), a sub-group of the AWFCG, addresses air quality and smoke management issues. At the present, the ADEC has a Memorandum of Understanding and an Enhanced Smoke Management Plan (ESMP) circulating for signature among the State and federal agencies. The ESMP addresses ADEC procedures and requirements for managing smoke from prescribed fires. As ADEC develops its State Implementation Plan (SIP) for regional haze, changes may be necessary to address additional fire tracking and emission management needs based upon policies and guidelines developed by the Western Regional Air Partnership. Under State law all agencies, corporations and individuals that burn forty acres or more of land require written approval from ADEC. The ESMP outlines the process and items

[4] PM10 is particulate matter less than 10 microns in diameter; PM2.5 is less than 2.5 microns.

[5] Geographic areas designated under the Clean Air Act where only a very small amount or increment of air quality deterioration is permissible.

[6] An area considered to have an air quality attribute that does not meet the NAAQS as defined in the Clean Air Act.

which must be addressed by land management agencies to help ensure that prescribed fire activities minimize smoke and air quality problems. The ESMP addresses elements required by the EPA's Interim Air Quality Policy on Wildland and Prescribed Fire (April 23, 1998).

3.1.1b Environmental Consequences

The U.S. Dept. of Agriculture, U.S. Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-42-volume 5, December 2002, *Wildland Fire in Ecosystems, Effects of Fire on Air*[7], is incorporated here by reference. It includes chapters on air quality regulations, overview of air pollution from fire, emission characteristics, chemistry, impacts, consequences and recommendations for research.

Fires are a source of CO and PM air pollutant emissions. Fire affect on air quality and visibility depends on many factors including amount and duration of emissions, wind speed and direction, atmospheric stability, humidity, weather system patterns, the scope and severity of fires, terrain, and the type and quantity of fuels burned. Prevailing winds and atmospheric circulation during periods when there are active fires on BLM-managed land may result in impacts to the Class I airsheds or populated areas. Other impacts to air quality would include minimal increases in noise, dust, and combustion engine exhaust generated by manual and mechanical treatment methods or suppression actions. In general, impacts in an area are temporary.

Wildland fire occurrence and impacts from those fires vary widely from year to year. For example, in Alaska in 1989 just less than 60,000 acres burned and in 1990 just over 3 million acres burned. The CAA and State air quality regulations distinguish between impacts associated with wildland fire (natural events) and those of prescribed fires (planned events). Wildland fire emissions are not regulated under current EPA or State policy; prescribed fire emissions are regulated.

Site-specific treatment plans are reviewed for compliance with applicable laws and policies. Additional mitigation may be incorporated into specific project proposals to further reduce potential impacts. Prescribed burning activities must also comply with the BLM Manual Sections 9211.31 (E), Fire Planning, and 9214.33, Prescribed Fire Management, to minimize air quality impacts from resulting smoke. Prescribed burns are planned to be implemented under favorable atmospheric conditions for smoke dispersion; the impacts on air quality and visibility resulting from smoke emissions would be localized and limited to the time and duration of the prescribed fire.

By allowing wildland fire to function in its natural role, wildland fires burn more frequently and provide a natural mosaic of fuel conditions. The most effective means of controlling air pollutant emissions from wildland fire is to reduce the number of large fires through selective use of wildland fire and vegetation treatments to break up heavy, continuous fuels. Prescribed fires and manual and mechanical treatments on lands in the wildland urban interface and adjacent to populated areas would reduce fuels accumulation and the likelihood of wildland fire occurrence. By reducing the risk of wildland fire, the risk of significant air quality impacts is also reduced.

In summary, under both alternatives, impacts to air quality and visibility are anticipated due to wildland and prescribed fires. Optimal atmospheric conditions would minimize any adverse impacts. The Preferred Alternative authorizes more fuel treatment projects than the No Action Alternative. Proper implementation of prescribed fire would prevent increases in PM10 or CO concentrations sufficient to cause any change in the NAAQS attainment status.

Under both alternatives, effects on the human environment from wildland fire will

[7] The publication is available at http://www.fs.fed.us/rm/main/fire_res/fire_pubs.html.

vary yearly. The adverse impacts on quality and visibility will depend on the location and extent of activity that year. In general, air quality impacts would be greater from large wildland fires than from fuel treatments since wildland fires burn more acreage over an extended time period under varying atmospheric dispersion conditions. Compliance with local smoke management programs would minimize effects from prescribed fires.

Data documenting the cumulative effects on the health of firefighters with long-term exposure to smoke is lacking.

3.1.2 Aquatic Resources and Essential Fish Habitat

The 1996 Sustainable Fisheries Act enacted additional management measures to protect commercially harvested fish species. It reauthorized the Magnuson-Stevens Act (16 USC 1801 *et seq.*) which directs action to stop or reverse the continued loss of fish habitats and added measures to describe, identify and minimize adverse effects to essential fish habitat. Toward this end, Congress mandated the identification of habitats essential to managed species and measures to conserve and enhance this habitat. The Act requires federal agencies to consult with the Secretary of Commerce regarding any activity, or proposed activity, authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat (EFH).

For the purposes of this environmental assessment, essential fish habitat means those waters and substrate necessary for salmon for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by salmon and may include aquatic areas historically used by salmon where appropriate. Substrate includes sediment, hard bottom, structures underlying waters, and associated biological communities. Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Spawning, breeding, feeding, or growth to maturity covers a species' full life cycle.

The National Marine Fisheries Service recognizes waters cataloged under AS 16.05.870 (Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes) as essential fish habitat. An Environmental Impact Statement is being written by National Marine Fisheries Service which analyses several alternative descriptions of EFH; any new regulations concerning EFH are expected to be published no later than August 2006.

3.1.2a Affected Environment

The aquatic community consists of three main components: (1) aquatic plants (phytoplankton, periphyton, and rooted vascular macrophytes), which fix energy from sunlight; (2) bacteria and fungi, which decompose organic matter; and (3) consumers, both sedentary (invertebrates and fish, which use energy from plants, animals, bacteria, and fungi) and mobile (birds, mammals, amphibians). The habitat requirements for fish include a healthy, functioning aquatic ecosystem consisting of all three community components, as well as the proper physical and chemical attributes.

➢ ***Aquatic Habitat and the Fish It Supports***

In Alaska BLM manages 115,000 miles of fish-bearing stream habitat, which includes 15,145 miles of habitat used by anadromous species. In addition, BLM-Alaska manages an estimated 2.6 million surface acres of lake habitat. This habitat ranges from high mountain lakes to lowland and tidal influenced lakes and ponds and small first-order tributaries to large rivers.

Of the anadromous stream habitat under BLM management 98% (14,800 miles) is considered to be in natural or near-natural condition, and 2% (319 miles) is in fair to minimal condition (BLM 1996).

Fish species utilizing freshwater habitats include the following families: Salmonidae (salmon, trout, char, grayling, whitefish); Cottidae (slimy sculpin); Catostomidae (longnose sucker); Esocidae (northern pike); Petromyzontidae (lampreys); Gadidae (burbot); and Gasterosteidae (sticklebacks), and Umbridae (Alaska Blackfish). Much is known about the life history and habitat requirements of some of these species, and nothing is known about others. All of the species are important to the natural functioning of their associated ecosystems, and many species have social or economic value to humans.

➢ ***Habitat Factors That Influence Fish Abundance***

Habitat needs for fish vary with the species, season of the year, and life stage. A variety of chemical, physical, and biological parameters interact to provide the range of environmental conditions that allow the species to exist. Some of the more important parameters include water quality, lake/stream, depth, temperature, water velocity, streamflow, cover, substrate, and nutrient/energy (food) availability. These parameters are directly influenced by riparian function, but climate, geology, soils, topography, upland vegetation, hydrology, and land use within a watershed all play a role in defining the condition and quality of the aquatic environment. Fish respond to these parameters both physiologically (altered growth rates and health) and behaviorally (site selection and community interaction). Fish generally respond to these environmental factors in combination. Where fish can live and reproduce, the range of environmental conditions must be suitable throughout their lives. To show the complex and often narrow range of environmental conditions required by fish the following narrative [from Bjornn and Reiser (1991) unless otherwise cited] discusses the habitat requirements of salmonids (e.g. trout, salmon, and char), a group that represents many species found in streams within the study area.

- ***Water Quality:*** Salmonids require water that has a high concentration of dissolved oxygen (>75% saturation), is nearly neutral to slightly alkaline (pH 6.5-8.7), is free from toxic concentrations of heavy metals and other toxic chemicals, and has sediment levels (bedload and suspended) that approximate natural undisturbed conditions. In addition, water temperature plays a crucial role in defining suitable water quality for fish. Additional information is contained in Section 3.1.14 Water Quality.

- ***Water Temperature:*** The timing of salmonid spawning has evolved in response to water temperatures in each stream before, during, and after spawning. Water temperatures can influence the upstream migration of adult spawners and delay the entry of spawners into their natal streams. Temperature also determines the rate of embryo and alevin (newly hatched fish still attached to the egg yolk) development. Within the temperature range for successful spawning and incubation, 4-14°C (Bell 1986), warmer temperatures result in shorter development times. In many streams winter temperatures fall below the 4°C minimum recommended for incubation, but the eggs develop normally because the spawning and development occurred when temperatures are within the suitable range.

  Water temperature also determines the capacity of water to hold oxygen in solution. The relationship is an inverse one, with oxygen solubility lower in warmer water. Salmonids can survive relatively low concentrations of dissolved oxygen for short periods of time, but swimming performance, growth rate, and food conversion efficiency are adversely affected.

- ***Streamflow:*** Adequate streamflow is important for providing fish passage (both for upstream migrating adults and for the downstream migration of juveniles). Streamflow regulates the amount of spawning and rearing area by controlling the wetted perimeter, depth, and velocity of water. Streamflow also determines stream channel morphology, bed material particle size, and the sediment transport capacity of the stream. These parameters in turn determine the quality and distribution of aquatic habitat types.

- ***Water Velocity:*** Next to flow, water velocity is probably the most important variable in determining the amount of living space available for fish. If velocities are unsuitable, no fish will be present. Natural streams have a variety of velocities, some of which are suitable for fish. The velocities suitable for salmonids vary with life stage of the fish, the species, and the season of the year.

- ***Cover:*** In-stream cover provides fish with security from predation and displacement during high flows and allows fish to use portions of a stream they may not otherwise be able to use. Some of the more common cover elements include deep water, water turbulence, large-particle substrates, overhanging riparian vegetation, undercut streambanks, woody debris, and aquatic vegetation. The cover requirements of fish change diurnally, seasonally, and by species and life stage. Cover has been correlated to fish abundance and is an important aspect of quality habitat.

- ***Substrate:*** Streambed substrate provides juvenile fish cover from predators and adverse environmental conditions, serves as habitat for aquatic invertebrates that often provide a substantial component of the fish's diet, and contributes to the quality of spawning, incubation, and rearing habitat. In-stream cover is provided by the interstitial space (voids) between substrate particles. In many streams, large-particle substrate is the main cover type, along with water turbulence and depth. Small-particle substrates, such as silt and sand, are of no value as cover for fish. Small fish, such as newly emerged fry, can use substrates consisting of 2-5 cm diameter rocks, whereas larger fish require cobble- and boulder-size material.

  Aquatic invertebrates, which are a primary food for fish, are produced in the substrate. Some types of invertebrates are more suited to fine-particle substrates than others. But watershed disturbance and erosion can add fine sediments, which can reduce the abundance of many species of invertebrates, resulting in reduced fish production.

  When an adult salmonid selects a spawning site, it is also selecting the incubation environment. During redd (nest) construction, fine sediment and organic material are displaced from the redd, larger substrate material such as gravel and rubble are rearranged, and the site is as favorable to egg development as it will ever be. As the incubation period proceeds, redds may become less suitable to developing embryos if fine sediment and organic material are deposited in the interstitial space between particles. The fine sediment can impede the movement of water and alevins from the redd, and the organic matter can consume dissolved oxygen during decomposition. If the dissolved oxygen is consumed faster than the reduced intragravel water flow can replace it, the embryos or alevins will asphyxiate. The amount of fine sediment deposited and the depth to which it intrudes depends on the size of substrate in the redd, flow conditions in the stream, and the amount and size of sediment being carried.

- ***Energy Flow and Stream Productivity:*** Stream and terrestrial ecosystems are closely linked. The flow of water, sediment, nutrients, and organic matter from the surrounding watershed shapes the physical habitat and supplies energy and nutrients to the stream community. Activities of the numerous components of the stream community influence the flow of energy from primary production to decomposition. As predators, salmonids are influenced by energy-flow processes operating at all levels in the stream ecosystem (Murphy and Meehan 1991).

Streams vary in productivity, largely in response to the available nutrients and energy. Energy comes to the stream community from two main sources: photosynthesis by aquatic plants in the stream and decomposition of organic matter imported from upland and riparian areas outside the stream. Imported energy sources contribute organic matter to a stream by four main pathways: litter fall from streamside vegetation, ground water seepage, soil erosion, and fluvial transport from upstream. In addition, animals can contribute important amounts of organic matter and nutrients.

Streamside vegetation provides large amounts of organic matter when leaves, needles, and woody debris fall into the stream. Leaves and needles usually contribute most of the readily usable organic matter in woodland streams.

As much as one-quarter of a stream's total imported organic matter may enter dissolved in ground water. But the nutritional value of this dissolved organic matter is generally low, and this organic matter does not contribute much energy to the stream community (McDowell and Fisher 1976; Klotz and Matson 1978). As with ground water, most dissolved organic matter from soil erosion offers little nutritional value to the stream community.

Fluvial transport of organic material from upstream reaches becomes an energy input to downstream reaches. Upstream reaches can supply up to a third of the total organic input to small streams and nearly all the organic matter in large rivers (Vannote *et al.* 1980). The source of fluvial transport is generated in the stream itself by invertebrate processing of detritus (Webster and Golladay 1984 in Meehan 1991) and algal cells detached from the streambed (Swanson and Bachmann 1976).

Animals transport organic matter to streams in many ways. Terrestrial insects drop into streams and are eaten by fish. Drift of aquatic insects export matter downstream, and mature insects can move matter upstream by flying. Beavers carry woody debris to streams, and grazing and browsing mammals transfer matter by feeding in uplands and defecating in the floodplain. Annual spawning runs of anadromous salmon (and decay of carcasses) can contribute large amounts of organic matter and nutrients to some streams and historically contributed a substantial input of organic material and nutrients to streams.

- ***Influence of Riparian Vegetation:*** Additional information on riparian areas is contained in Section 3.1.15, Wetlands and Riparian Areas. Watershed and riparian community condition directly influences the condition, quality, and maintenance of aquatic habitat. Riparian plants filter sediments and nutrients, provide shade, stabilize streambanks, provide cover in the form of large and small woody debris, produce leaf litter energy inputs, and promote infiltration and recharge of the alluvial aquifer (Orth and White 1993; Wesche 1993). As a result of these functions, spawning beds for salmonids and microhabitats for macroinvertebrates remain relatively free of damaging fine sediment deposits. Riparian vegetation reduces sedimentation of pools, thereby maintaining water depths and structural diversity of the channel. Base flow levels are augmented throughout the year by the slow release of water stored in aquifers. Complex off-channel habitats, such as backwaters, eddies, and side channels, are often formed by the interaction of streamflow and riparian features such as living vegetation and large woody debris. These areas of slower water provide critical refuge during floods for a variety of aquatic species and serve as rearing areas for juvenile fish.

The bank stabilizing function of streamside vegetation not only helps reduce erosion and influence channel morphology but also acts to supplement in-stream cover by contributing to the development of undercut streambanks and by providing overhanging vegetation. Well-vegetated stream channels and stable streambanks help reduce turbidity and channel scouring resulting from high runoff events; they can also enhance primary production. In Alaska and other cold regions, well-vegetated stream channels help reduce the formation of aufeis (ice formed by the overflow of water onto existing ice). Aufeis can decrease primary productivity, delay riparian plant growth, increase erosion, tie up water in the form of ice during critical low-flow periods, and cause the formation of new stream channels due to channel blockage (Churchill 1990; Michel 1971; Slaughter 1990).

3.1.2b Environmental Consequences

Fish species and aquatic fauna adapted to the cold water in Interior Alaska streams have been exposed to indirect effects of wildland fire for thousand of years. Fire can indirectly influence fish populations or their prey through increased siltation, increased water temperature, altered water quality (dissolved oxygen, pH, suspended and dissolved solids, total hardness, turbidity), changes in nutrient input to water system, and changes in permafrost status that can lead to altered hydrology. The extent of surface erosion after a fire largely depends on the topography and soil types of the immediate area, and the amount of ice-rich frozen ground within the active layer. Stream siltation is usually negligible from surface erosion on burned sites in interior Alaska due to its gentle topographical features. Siltation may be a factor where severe burns occur on steep slopes or even shallow slopes with ice-rich active layers, where fire has severely damaged riparian protection of bank soils' integrity, or where heavy equipment is used in suppression activities. Lakes are also potentially vulnerable to fire effects of concentration of nutrients, sedimentation, and erosion of riparian protected shorelines from wave and wind action. Response of deciduous riparian foliage after a fire is related to already existing riparian vegetation; the impact of a fire is a change in age structure and short term productivity.

Data on how fires affect stream temperatures and productivity are currently inadequate to accurately assess the effects of fire on anadromous or resident fish habitats. Much of the published work has focused on changes in lake systems (McEachern *et al*. 2000, St-Onge and Magnan 2000). Analyses of long-term fire effects on stream ecology are currently underway as part of FROSTFIRE[8], a landscape-scale prescribed research burn in the boreal forest of interior Alaska conducted in July 1999. Future research may be able to clarify anecdotal information collected in some systems that seems to suggest higher abundance of juvenile salmonids in systems where land use or fire modifications in canopy cover have led to increased water temperatures.

Fish populations have generally shown a positive response during the initial five-year period after wildland fire where populations exhibit good connectivity with key refugia throughout the watershed (Gresswell 1999; Minshall *et al.* 1989). Fish will generally reinvade fire-affected areas rapidly where movement is not limited by barriers. These new colonists generally come from areas upstream of the affected area, from surrounding watersheds and from main-stem rivers where migration is not limited. Fish population recovery generally tracks the increase in primary and secondary production that occurs in the early post-fire period. Where sediment is continually delivered into the main-stem, there could be short-term negative effects on fish and macro-invertebrate communities.

[8] http://www.fs.fed.us/pnw/fera/frostfire/news.html

Fuels projects are designed and implemented in a "non-emergency" manner that minimizes impacts to aquatic resources. Although wildland fires may still occur in areas where hazardous fuel loads have been reduced, fires which may occur are expected to be predominately ground fires rather than crown fires. Ground fires are easier to control with lower-impact suppression methods (such as hand-built fire line) that are less likely to adversely affect aquatic resources. In contrast, the crown fires associated with heavier fuel loads often require suppression techniques likely to have greater adverse impacts to aquatic habitats and species.

Competent planning and implementation will minimize the effects of fuels treatments. Some projects involve multiple treatments of the same area. Prescribed fires conducted in the spring (when drainage-bottoms are still snow covered) help to protect riparian vegetation and soils. The primary goal of these projects is to reduce the occurrence, risk, and impacts of wildland fires, not restore the natural capacity of aquatic species to withstand the effects of natural fires.

Removal of vegetation to reduce future fuel loading may be accomplished with minimal impacts in some areas, but in others, sensitivity to ground disturbance from loss of vegetation can cause increased erosion, compacted soils, and a loss of nutrients (USDA 2000, Beschta *et al*. 1995).

To protect water quality and the diversity of habitats for fish, amphibians and other aquatic organisms, standard operating procedures (Section 2.3.3 and 2.5.5) are in place to protect the proper functioning condition of riparian area and stream characteristics. When the primary objective is to protect life, these techniques may not be followed since species and habitat protection is logically placed below protection of human life; in Alaska, these occasions would be unusual and rare.

As a result of this analysis, the Preferred Alternative includes the formation of Riparian Buffer Zones (RBZ) around riparian, streamside, lakeside, and wetland areas (Section 2.5.5). In RBZs, the effects of wildland fire are not considered adverse impacts and fire will be allowed to function in its natural ecological role. Configuration recommendations are found in widely accepted riparian and aquatic protection strategies: PACFISH 1995 and INFISH 1995[9]. These buffer zones help preserve ecological processes by creating a vegetation filter that removes sediment before it reaches water bodies (Montana State University 1991). Properly maintained RBZs protect salmon fry and other young fish; maintain water temperatures necessary for spawning and rearing; introduce insects and other fish food to the water from streamside vegetation; stabilize stream banks and floodplains; and protect bird habitat and wildlife travel corridors associated with riparian areas. To minimize erosion and the amount of sediment that reaches waterways, RBZs should be adjusted to appropriate width depending on the volume of the stream. The width necessary to protect stream and riparian area structure and function will be determined on a case-by-case basis and from site-specific analysis.

Under both alternatives, the occurrence of wildland fire and impacts associated with those would be the same. The preferred alternative authorizes fuel treatments, prioritized to protect human life and property, on all BLM-managed lands. Each project would be planned based on site characteristics. Properly planned and implemented treatment projects would result in minimal impacts to aquatic resources and EFH.

3.1.2c Essential Fish Habitat Compliance

Standard operating procedures (Section 2.3.3 and 2.5.5) applicable to wildland fire and fuels management are in place to protect the proper functioning condition of riparian areas, streams characteristics and EFH.

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9 http://www.fs.fed.us/r6/fish/#_DOCUMENTS_(in_original

Examples of mitigation measures included in those procedures to avoid or minimize impacts to EFH and water quality are:

- ★ Create Riparian Buffer Zones (RBZ) for all fire management activities for all perennial water bodies.
- ★ Use minimum impact suppression tactics.
- ★ Use of aerial fire retardant near lakes, wetlands, streams, rivers, sources of human water consumption, and areas adjacent to water sources should be avoided to protect fish habitat and water quality. If feasible in these areas, the use of water rather than retardant is preferred. When the use of retardant is necessary, avoid aerial or ground application of retardant or foam within 300 feet of a waterway; application beyond 500 feet is preferred. Examples of when use of retardant is authorized are for the protection of :
  - Human life.
  - Permanent year-around residences.
  - National Historic land marks.
  - Structures on or eligible for the National Register of Historic Places.
  - Government Facilities.
  - Sites or structures designated by Field Office resource specialists to be protected.
  - High value resources on BLM-managed lands and those of adjacent land owners.
  - Threatened, endangered and sensitive species habitats as identified by resource specialist.
- ★ Procedures for heavy equipment use.

In addition, stabilization or restoration activities after a wildland fire are planned in conjunction with a resource specialist. (Section 2.5.4)

3.1.3 Areas of Critical Environmental Concern (ACEC)

BLM manages 42 ACECs. ACEC designations highlight areas where special management attention is needed to protect and prevent irreparable damage to important cultural, historic, and scenic values; fish or wildlife resources; natural systems or processes; or to protect human life and safety from natural hazards. On-the-ground suppression actions on wildland fires are necessary only to protect resource values at sites specifically identified by staff specialists. Fuel treatments are only likely in areas requiring maximum protection from wildland fire, such as high value cultural or historic sites or structures, or to meet a specific management objective for resources for which the ACEC was established. Under both alternatives, projects require site-specific consideration and planning.

3.1.4 Cultural Resources

Cultural, archeological, historical, and paleontological resources are addressed in this section since impacts are similar.

3.1.4a Affected Environment

BLM-managed lands contain a variety of known cultural and related resources, including prehistoric, historic, and archeological sites, Native cemeteries, former community sites, and travel routes associated with Native heritage. Evidence of more recent human settlers includes cabins, roadhouse sites, mines, trails, and tools and equipment associated with European explorers and settlers.

Although some surveys have been done and others are ongoing, only a relatively small portion of BLM-managed lands have been extensively investigated for cultural resources. Site-specific designations (Section 2.3.3e) and procedures for newly discovered structures (Section 2.5.5b) are in place to preserve and protect cultural resources to the extent possible from wildland fire and associated activities. BLM also manages cultural resources under its internal manual procedures, the ***1997***

National Programmatic Agreement for Section 106 Compliance and its ***1998 Implementing Protocol with the Alaska State Historic Preservation Officer***.

3.1.4b Environmental Consequences

Nearly 25 years ago the Fairbanks District Office prepared an Environmental Assessment for a fire plan. As part of the analysis of impacts, that EA contained the following statement:

> "Information concerning the effects of fire and fire suppression activities on cultural resources is scanty at best. Some information has been gathered concerning fire effects in the lower 48 states, but any attempt to generalize from this data to radically different conditions in Alaska would not be justifiable."

While the concluding statement is perhaps no longer true, the rest of the paragraph still applies. Despite our best efforts, we have not managed to achieve any appreciable expansion of our knowledge of fire effects on cultural resources in Alaska. Experience with fire and cultural resources has improved in the Lower 48 states, however, and the following general discussion, based largely on an EA prepared in Montana, may be useful.

In general, the effect of wildland fire and prescribed burning on cultural resources depends on the location of the resource with respect to the ground surface, the proximity to fuels that could provide a source of heat, the material from which artifacts are made, and the temperatures to which artifacts are exposed. Threshold temperatures for damage to cultural artifacts manufactured from different materials, such as ceramic or stone, vary significantly.

Surface or near-surface cultural materials may be damaged, destroyed, or remain essentially unaffected by fires, depending on the temperatures reached and the duration of exposure to that temperature. Wooden structures or wooden parts of stone structures are susceptible to fire and potential damage from suppression activities. Combustible artifacts lying directly on the ground surface could be damaged or destroyed. The ability to date noncombustible surface artifacts may be adversely affected if exposed to specific high temperatures. Subsurface resources are much less likely to be significantly affected by fire; however, they may be affected if excessive amounts of soil heating occur.

Much of interior Alaska is known to have burned in the past. Evidence of such burning has been observed on several archaeological sites that have been excavated, apparently with no evidence of severe impacts from the fires. Hence the resources most susceptible to damage usually are the most recent ones which have not been burned previously, such as standing cabins.

Prescribed fires in areas of cultural significance would not be ignited under conditions dry enough to cause significant subsurface heating. Subsurface cultural resources are generally more subject to harm from construction of fire lines around planned fire boundaries than from the fire itself.

The heat, smoke and soot from fires can also damage cultural resources, especially prehistoric rock art, by causing spalling, which physically destroys the resource, or by obscuring the surface of the resource with smoke and soot. Smoke and soot can damage cultural resources by either increasing chemical deterioration or obscuring carvings and painted motifs.

In general, damage to cultural resources, prehistoric and historic, also may result from fire suppression-related activities. Cultural resources may be more at risk from activities such as blading fire lines, setting camps and staging areas, or using vehicles off road, than by the fire.

Impacts from smoke, heat, or soot are not believed to produce measurable effects on fossil resources unless those elements are in close proximity to the resources.

The effect of fire on fossil resources is directly related to the location of the resource with respect to the ground surface, the proximity of the fuels that provide the source of heat, and the location and use of hand tools, motorized vehicles, fossil collecting activities, and heavy equipment. Fossils lying at or near the surface would likely be located in an area lacking vegetation or fuel.

Wildland fire and prescribed burns make sites both cultural and paleontological more susceptible to the effects of erosion and it also results in a more visible resource. Illegal collecting may increase on burned areas, especially along access routes.

The greatest risk for these resources would likely come from the equipment and activities associated with fire management activities. This includes any surface disturbing activities such as camp preparation, fire line construction, motorized vehicle use, and heavy equipment operation. If these activities are isolated from the fossil producing formations and the selected areas are judged unlikely to contain significant cultural resources, the impacts to these resources should be negligible.

For fuel reduction projects where mechanical or manual treatments are proposed, a Class III cultural resource inventory is required. If any cultural resources are located, the planning and mitigation measures for the project are directed toward avoiding any damage to the resources. Given these procedures, impacts to significant cultural resources are not anticipated from mechanical or manual treatments.

During wildland fires, impacts to significant cabins would be minimized by use of BLM's ***Policy for Cabin/Structure Protection*** (Appendix L).

In areas where fossil resources are known or anticipated, mechanical or manual treatments will include provisions to avoid areas containing sensitive fossil producing formations. If those areas cannot be avoided by the treatments or associated activities, a qualified paleontologist will be retained to recover specimens subject to direct impact. In conclusion, the anticipated impacts under both alternatives are the same. Using the standard operating procedures associated with site-specific designations and procedures in place for newly discovered sites including the statewide wildland fire cabin policy, the effects of both suppression activities and fuels treatment activities should be minimal.

3.1.4c National Historic Preservation Act Section 106 Compliance

Impacts to cultural resources by naturally-ignited fires without human intervention are not Undertakings. BLM emergency suppression actions and planned fuel reduction projects (both mechanical and manual treatments) are Undertakings. Potential impacts to significant cultural resources from both emergency and planned fire-related actions taken by BLM will be avoided or minimized to the maximum extent possible through application of existing BLM policies and procedures. These include following procedures for Section 106 compliance in BLM's 1997 National Programmatic Agreement for Section 106 compliance which is implemented in Alaska by BLM's 1998 Protocol with the Alaska State Historic Preservation Office. BLM would also use its ***Policy for Cabin/Structure Protection*** (Appendix L) to further proactively help identify and protect significant standing structures in rural parts of the state.

3.1.5 Environmental Justice

Executive Order 12898 directs federal agencies to review the effects of proposed projects on minority or low income populations. This includes native corporations and villages. Under both alternatives, Native representation and equal participation in fire management issues statewide continue through the Alaska Interagency Wildland Fire Coordinating Group. Neither alternative would result in unique effects or issues specific to any minority or low-income population or community other than those discussed under Section 3.1.11 Subsistence.

3.1.6 Farm Lands (Prime or Unique)

The Farmland Protection Policy Act of 1985 and 1995 requires identification of proposed actions that would affect any lands classified as prime and unique farmlands. No BLM-managed lands in Alaska are identified as such.

3.1.7 Floodplains

Executive Order 11988 was enacted to "avoid to the extent possible the long-term and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative." Standard operating procedures (Section 2.3.3 and 2.5.5) have been developed to avoid damage to riparian area and wetlands during all fire management activities. No developments or effects of development by the BLM in conjunction with wildland fire or fuels management activities are anticipated in a floodplain with either alternative.

3.1.8 Migratory Birds

Executive Order 13186 issued January 10, 2001 directs federal agencies to protect migratory birds. Alaska is home to over 445 species of birds. Most of these are migratory birds for which the Fish and Wildlife Service is responsible under international treaties and the Migratory Bird Treaty Act. Some of the birds stay in Alaska year-round. Most migrate to Canada, Central America, South America, Asia, or the lower 48 United States. In fact, birds from Alaska pass through virtually every other state in the Union (even Hawaii) on the way to their wintering grounds. Maintaining migratory birds and their habitats in Alaska is clearly a matter of national and international significance.[10] The environmental consequences of wildland fire on birds are contained in Section 3.1.12 Threatened and Endangered Species, 3.2.4 Special Status Species and 3.2.7 Wildlife.

3.1.9 Noxious and Invasive Plants

3.1.9a Affected Environment

Noxious and invasive plants (weeds) are an increasing problem on BLM-managed lands nationally. Alaska BLM-managed lands are less impacted by noxious and invasive plants than other lands in the west but many vectors for weed spread onto AK BLM-managed lands exist and are presenting an increasing threat. Noxious and invasive plants can rapidly displace desirable plants that provide habitat for wildlife. Such weeds can cause drastic changes in the composition, structure and productivity of vegetation communities. Some weeds documented in Alaska are noxious to wildlife, humans and pets.

Invasive plants can be native or non-native plants. Most invasive plants in Alaska are non-native, having been introduced accidentally or intentionally. Most occur on disturbed areas but many can invade natural landscapes. Most commonly they have been introduced and spread unintentionally through hay, feed or straw contaminated with weed seed, by hitchhiking on vehicles, domestic animals (horses, dogs) or humans, via waterways, and contaminated agricultural seeds and equipment. Intentional introductions of the invasive plants in Alaska have occurred commonly through re-vegetation of disturbed areas, such as highway or other rights-of-way, and horticulture.

Noxious plants are listed by state and federal law and are generally considered those that are exotics and negatively impact agriculture, navigation, fish, wildlife or public health. Figure 3.2 lists the noxious weeds regulated through seed laws by the State of Alaska, 11AAC 34.020.

The Committee for Noxious and Invasive Plants Management in Alaska (CNIPM)[11] is developing a ranked list of problematic weeds that will expand on the state noxious weed lists. Invasive plants known to occur in

[10] From US Fish and Wildlife Service website http://www.r7.fws.gov/mbm/introduction.html

[11] For more information see http://cnipm.org/

Figure 3.2
Alaska Regulated and Restricted Noxious Weeds

Species	Scientific Name	State Designation
Field Bindweed	*Convolvulus arvensis*	Prohibited
Austrian Fieldcress	*Rorippa austriaca*	Prohibited
Galensoga	*Galensoga parviflora*	Prohibited
Hempnettle	*Galeopsis tetrahit*	Prohibited
Horsenettle	*Solanum carolinense*	Prohibited
Russian Knapweed	*Acroptilon repens*	Prohibited
Blue-flowering Lettuce	*Lactuca pulchella*	Prohibited
Quackgrass	*Elymus repens*	Prohibited
Perennial Sowthistle	*Sonchus arvensis*	Prohibited
Leafy Spurge	*Euphorbia esula*	Prohibited
Canada Thistle	*Cirsium arvense*	Prohibited
Whitetops and varieties, pepperweed	*Cardaria drabe, C. pubescens, Lepidium latifolium*	Prohibited
Annual bluegrass	*Poa annua*	Restricted
Blue burr	*Lappula echinata*	Restricted
Mustard	*Brassica kaber, juncea*	Restricted
Wild Oats	*Avena fatua*	Restricted
Buckhorn Plantain	*Plantago sp.*	Restricted
Radish	*Rahpanus raphanistrum*	Restricted
Yellow Toadflax	*Linaria vulgaris*	Restricted
Tufted Vetch	*Vicia cracca*	Restricted
Wild Buckwheat	*Polygonum convolvulus*	Restricted

Alaska are not likely to contribute to changes in fire frequency or intensity; however, they may provide an unwanted seed source adjacent to natural or prescribed fires or other fire fuels treatments. New invasive plants are arriving in Alaska and some may impact fire intensity and occurrence.

The control of noxious and invasive plants on BLM-managed lands is being evaluated in the *Environmental Impact Statement for Vegetation Treatments, Watersheds and Wildlife Habitats on Public Lands Administered by the BLM in the Western United States, Including Alaska* (Vegetation EIS). [12]

3.1.9b Environmental Consequences

No new impacts would occur under either alternative. The No-Action Alternative represents continuation of current invasive or noxious weed management. The primary impacts from continuing the current fire management practices are from noxious and invasive plants (weeds) becoming established as a direct result of fire or fire suppression activities. Seeds or plant parts may be transported into relatively remote and undisturbed areas by fire crews, equipment aircraft, and dozers.

Rehabilitation of fire lines (hand, dozer or other) or burn areas may be a source of noxious and invasive plant introduction. There is little evidence of invasive, non-native vegetation becoming established on burned areas on BLM-managed lands in Alaska where fire suppression activity did not occur (for example, on lands designated Limited Management Options.) In some of the contiguous western states, noxious and invasive plant spread does occur after wildland fire and contributes to hazardous fuel loads and alteration of burn intervals (USDI/BLM Arizona 2003).

The Preferred Alternative, Land Use Plan Amendment, includes how management

[12] http://www.blm.gov/weeds/VegEIS/index.htm

objectives drive fire management on BLM-managed lands in Alaska. Objectives for noxious and invasive plant management emphasize prevention and control. These objectives were in place prior to this amendment through other documents and agreements. Under both alternatives, these objectives are met, by allowing fire to occur on the landscape, except where public health and safety issues warrant fire exclusion, or in the few cases where fire may now or in the future need to be deferred from an area for specific resource protection.
Under the Preferred Alternative, the following standard operating procedures have been added and will hinder noxious weed spread when suppression actions or rehabilitation of areas impacted by suppression activities are necessary:

- ★ Use original soil and vegetation to rehabilitate fire and dozer lines.
- ★ Use native vegetation and seed (when available) when seeding or plugging is necessary.
- ★ Develop rehabilitation plan by working with BLM wildlife biologists and botanists.

3.1.10 Native American Religious Concerns

See Sec. 3.1.3 Cultural Resources.

3.1.11 Subsistence

3.1.11a Affected Environment

In Alaska, the term subsistence refers to contemporary hunting, fishing, trapping, and gathering practices, providing food, fuel, and other products on which many households rely for a significant portion of their livelihood. Under Title VIII of the Alaska National Interests Lands Conservation Act (ANILCA 1980), the subsistence uses of rural Alaskans are granted a priority in the management of fish and wildlife on Federal public lands. The statute equally protects the subsistence practices of rural Alaska Natives and non-Natives, but it is important to note that Alaska Native societies have a particularly long history and richly elaborated social and cultural practices associated with the subsistence way of life. Subsistence represents a productive and highly valued component of the rural economy, where participation in the monetized economy is uneven, due to limited employment and income, along with high costs for imported goods.

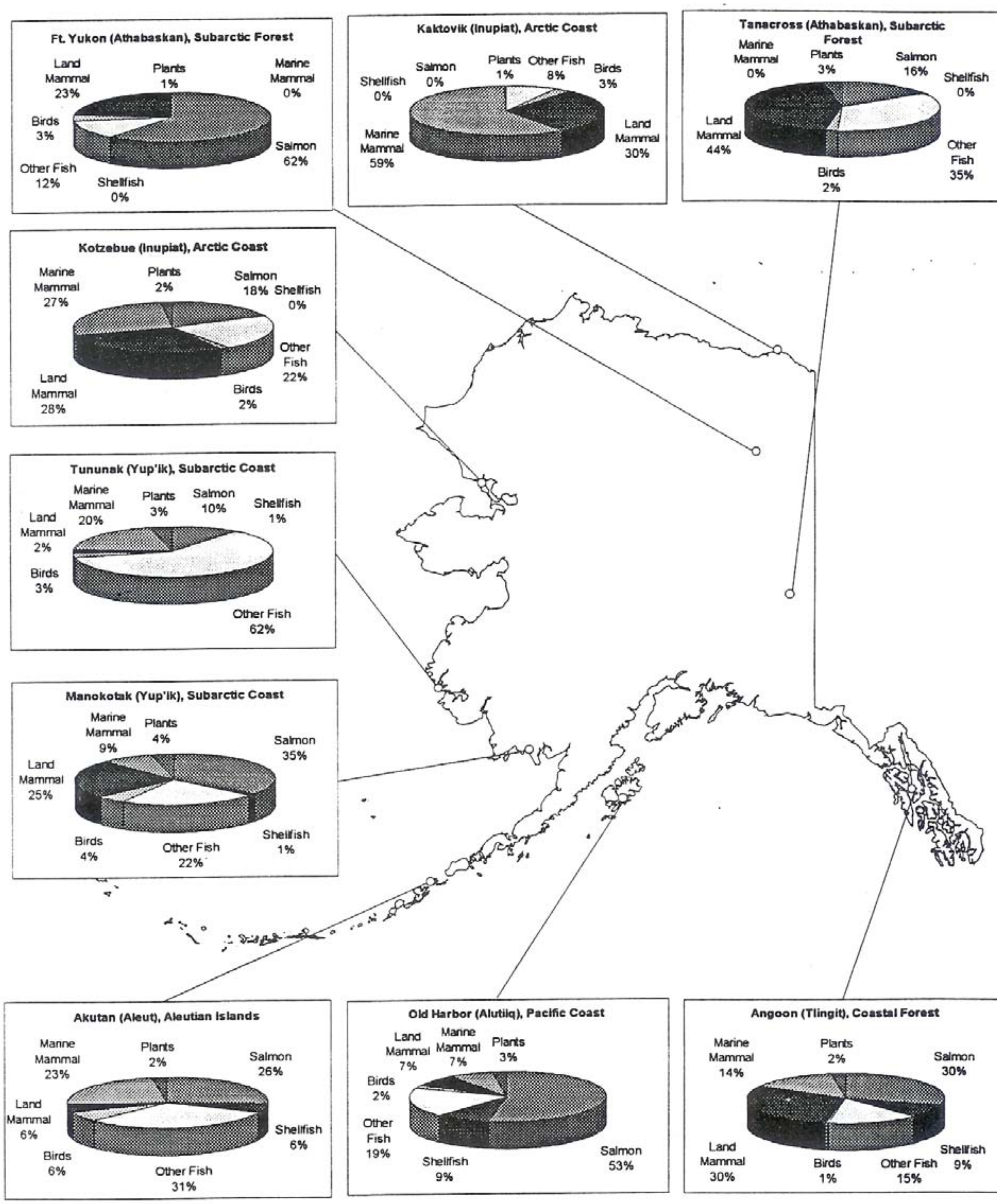
The vitality of contemporary subsistence activities is closely tied to healthy ecosystem processes. Productive hunting, fishing, and trapping depend upon healthy fish and wildlife populations, and these in turn require intact, productive habitats. Ecosystems are dynamic, changing over time, and fire is a natural ecological process, to which flora and fauna have adapted. The subsistence way of life in rural Alaska, particularly as practiced by Alaska Natives, incorporates a detailed knowledge of local climate, habitat, and fish and wildlife, including adaptive harvest strategies to respond to habitat change and resource population dynamics.

The demographic scale and economic productivity of contemporary subsistence production may be seen in the estimate that, as of the late 1990s, 120,000 rural residents harvest nearly 44 million pounds of wild food per year, or about 375 pounds per person per year.[13] Rural Alaskans live in 270, generally small, relatively isolated, communities. The rural population is about equally Alaska Native and non-Native. The high level of production is paralleled by high rates of participation: nearly 83% of rural households harvest fish, and about 60% harvest wildlife. When sharing and redistribution are taken into account, about 95% of rural households consume fish, and 86% consume wildlife. Assuming costs replacement costs of $3 - $5 per pound, these subsistence foods represent a monetary value of between $131 million and $215 million per year.

One of the most important ecological dimensions of subsistence production is

[13] Figures in this section taken from Wolfe 2000, unless otherwise noted.

3.3 Wild Food Harvest Species Composition[14]



[14] Source: Alaska Department of Fish and Game, Division of Subsistence

found in the species composition and seasonal cycle of subsistence harvests. These vary enormously from one region in Alaska to another, as a result of the diverse ecosystems involved. Arctic and Western coastal regions, for example, have access to marine mammals, but lower reliance on land mammals. Many coastal and riverine communities, from the Norton Sound south, have access to rich salmon resources, which make up a large component of total subsistence harvest. In more remote Interior communities, salmon are more limited or absent, so freshwater fish species are more important, as are the large mammals, including moose, caribou and bear. Several examples of the diversity in subsistence species composition across the state are shown in Figure 3.3. Taking the rural Alaska as a whole, fish make up 60% of subsistence harvests, while land mammals constitute 20%, marine mammals 14%, birds 2%, shellfish 2% and plants 2%.

The other significant ecological dimension of subsistence practices is the traditional subsistence use areas associated with each community. Over generations, each community has established a traditional range for its hunting, fishing and trapping activities. Effective and efficient subsistence harvest strategies are based on intimate knowledge of this range, including familiarity with a variety of ecological factors. In the cumulative stories developed over several generations and shared widely throughout a community, hunters can draw upon an intricate body of knowledge concerning weather and hydrological conditions, productive habitat zones, and animal natural history. Traditional place names provide a shared, highly detailed map of important locations throughout this range. Thus, hunters have a repertoire of probabilities about where animals will be concentrated at key times of the year, varying with changes in the weather, such as prevailing winds on the coasts, high water, early or late freeze-up and breakup, high snow depth, etc. The stories also provide examples of adapting harvest activities to these conditions. Included in this body of intensive ecological knowledge of the traditional use area are accounts of fire events and their impacts on habitat and wildlife. In the central Kuskokwim River area, for example, elders talk of a fire early in this century, after which moose became more common, and caribou declined as a key species (Brelsford, field notes, 1983-1986).

Maps of traditional subsistence use areas have been prepared for most rural Alaska communities as part baseline research by the Alaska Department of Fish and Game Subsistence Division (Fall 1990). For many areas, researchers documented the lifetime use areas of elders in the community, extending back to the early part of the 20th century. Prior to the 1950s, in most parts of rural Alaska, Alaska Natives exploited their range through a series of seasonal settlements, including fish camps, trapping camps, and spring camps, with the specific pattern varying with the ecological zone. But by the 1950s and 1960s, government policies emphasized the importance of school attendance and pressured families to remain year-round in the primary settlement. Generally, the advent of new transportation technology, including more reliable outboard motors and widespread use of snowmobiles, counteracted the effects of sedentarization, and people continued to exploit nearly the entire traditional range from the central community.

Traditional socio-territorial patterns are diverse among Alaska Native societies, responding to ecological and social factors. Some species are available in high concentration near the communities, so the use area for fish, for example, is relatively compact. Other species are widely dispersed, and the traditional use area may extend more than a hundred miles from the community, typically along river or coastline transportation corridors. Depending on the overall concentration of resources, communities may be densely settled in an area, such as the Yukon-Kuskokwim Delta, or in Southeast Alaska. In these cases, traditional use areas may have portions that are perceived as reserved for the exclusive use of a community, and overlapping portions shared with adjacent communities. Alternatively, where resources are more sparsely distributed, communities may be more isolated with larger exclusive use zones.

3.1.11b Environmental Consequences

In the first instance, the effect of fire cycles and fire management initiatives upon subsistence derive from the impacts on plant community successional cycles and associated wildlife communities. Vulnerability to, and impacts of, fire differ between tundra and boreal forest communities. Intermittent fire frequency, with low intensity, would have moderate impacts, leaving patchy habitats and resetting successional cycles. Moose populations grow when fire displaces climax stage forests and willow thickets emerge with better browse. However, tundra fires can damage lichen, which takes many decades before returning to a stage of productive browse for caribou.

Traditional use areas are also adapted to take into account localized declines or displacements in key species. These traditional ranges were large enough that community members would not hunt all portions in a year, so if some portion was subject to short-term impacts from fire, alternative zones were available within the overall traditional use area.

Subsistence harvest practices were adapted to ecological dynamics, including fire. So long as fire management does not over-suppress natural fire frequencies to the extent that fuel loads accumulate resulting in fewer, but significantly more intense fire, fire management initiatives should not have significant impacts on subsistence harvest practices.

3.1.11c ANILCA 810 Evaluation

The evaluation concluded no significant restrictions. Appendix M contains the full evaluation.

3.1.12 Threatened and Endangered Species

An endangered species is defined as species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as a species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Also see Section 3.2.6 Special Status Species.

3.1.12a Affected Environment

There are four threatened species and three endangered species found in Alaska (Figures 3.4 & 3.5).

Figure 3.4
Alaska's Threatened and Endangered Species
Vertebrate

Common Name	Scientific Name	Status	Range In Alaska
Aleutian Canada Goose	*Branta canadensis leucoparea*	Threatened	Aleutian Is., Semidi Is.
Spectacled Eider	*Somateria fischeri*	Threatened	Western & Northern AK
Steller's Eider	*Polysticta stelleri*	Threatened	So. Western, Western, & Northern AK
Eskimo Curlew	*Numenius borealis*	Endangered	No longer occurs in AK
Short-Tailed Albatross	*Phoebastria albrarus*	Endangered	US territorial waters, Gulf of Alaska, Aleutian Is., Bering Sea Coast
Stellers Sea Lion	*Eumetopias jubatus*	Threatened & Endangered	Coastal

Figure 3.5
Alaska's Threatened and Endangered Species
Botanical

Common Name	Scientific Name	Status	Range In Alaska
Shield Fern	*Polystichum aleuticum*	Endangered	Adak Is.

Of the threatened and endangered vertebrate and botanical species known to occur in Alaska, only the spectacled and Steller's eiders have designated critical habitat that may be affected by fuels treatments and fire suppression activities. Therefore, no further analysis of other species is included in this document.

- **Spectacled Eider (*Somateria fischeri*) (Threatened)**

The spectacled eider was listed as a threatened species under the Endangered Species Act in May 1993 (58 Federal Register [FR] 27474). The primary reasons for listing spectacled eiders were their rapid and continuing decline on the Yukon-Kuskokwim Delta (YKD) breeding grounds (Stehn et al. 1993) and indications that they may have declined on Alaska's North Slope (Warnock and Troy 1992). Population estimates in the YKD prior to 1972 ranged from 48,000 nesting pairs in an average year to as many as 70,000 pairs in a year with high productivity (Dau and Kistchinski 1977). Declines in numbers of spectacled eiders of between 79-96% have been reported for the 20 year period between the mid 1970's and the mid 1990's on the YKD (Dau and Kistchinski 1977, Ely et al. 1994). Surveys of nesting populations in the Prudhoe Bay area suggest that this population has also declined (Warnock and Troy 1992).

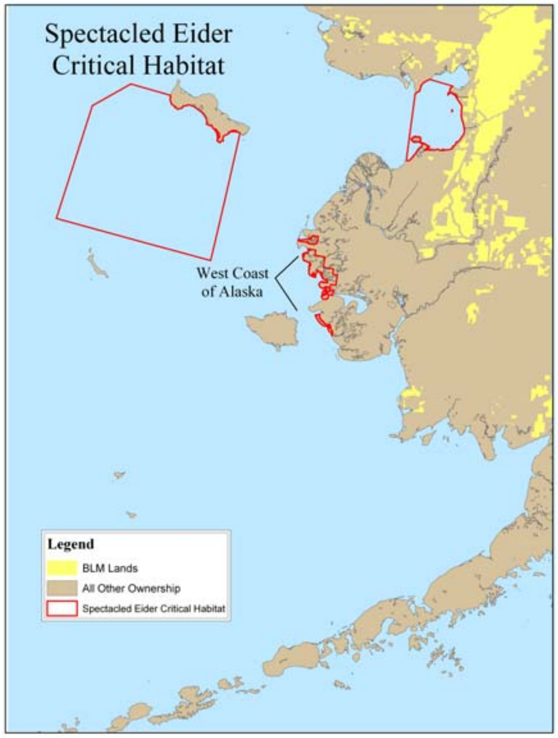
Spectacled eiders' summer breeding habitat is along the northern coastal areas of Alaska, most notably Alaska's National Petroleum Reserve (NPR-A). Their primary nesting grounds on the Arctic Coastal Plain are west of the Sagavanirktok River, and nesting locations appear to be most abundant in the western portions of the coastal plain (Cape Simpson to the Sagavanirktok River). In the NPR-A, spectacled eiders select breeding habitat areas that are large emergent wetlands with high shoreline development, vegetated islands and islets (Balogh 1997).

Critical habitat for the spectacled eider has been designated in molting areas in Norton Sound and Ledyard Bay, breeding areas in central and southern YKD, and wintering area in waters south of St. Lawrence Island. A total of 38,991 mi^2 has been designated as critical habitat for spectacled eiders. (Figure 3.6).

Spectacled eiders are diving ducks that spend most of the year in marine waters predominately feeding on clams and small amounts of snails, amphipods, and other bivalves (Lovvorn et. al. 2003). On the nesting grounds, spectacled eiders feed by dabbling in shallow freshwater or brackish ponds, or on flooded tundra (Kistchinski and Flint 1974). Food items include mollusks, insect larvae, trichopterans, and chironomids; small crustaceans, and plants or seeds (Cottam 1939, Dau 1974, Kistchinski and Flint 1974, Kondratev and Zadorina 1992).

Causes of declines in populations of spectacled eiders are not well understood. Threats to spectacled eiders may be due to increased human presence and activity in summer and wintering grounds. Lead poisoning (caused by consumption of lead shot that has been deposited into the environment) has been documented as a direct cause of mortality on the YKD (Flint et al. 1997) and as a factor affecting over-winter survival (Grand et al. 1998). Subsistence harvest of eggs and adults is also potential factor in the decline of the population. Subsistence hunting, predation by foxes, gulls, jaegers, and ravens on the breeding grounds, commercial fishing, environmental contaminants, disease and regime shifts in the Bering Sea ecosystem

Figure 3.6
Spectacled Eiders Critical Habitat



are all possible causes of decline in this species. Trash dumps and reduced trapping support increased populations of predators like the arctic fox, and building structures and power poles aid as perches for avian predators. Other factors that may affect spectacled eider survival but have not been fully investigated are: bioaccumulation of contaminants in the marine environment, accidental strikes, harvest of eiders outside breeding grounds, disease, and parasites.

Satellite-tagged post-breeding birds from the North Slope have been relocated in Ledyard Bay, a primary Alaskan molting area, and in several other coastal areas from the Beaufort Sea to the Yukon-Kuskokwim Delta and Russian Far East and scattered localities near Saint Lawrence Island. Subsequent aerial surveys have revealed large molting concentrations of birds in Ledyard Bay and Norton Sound in Alaska and in Mechigmenskiya in the Russian Far East (Larned *et al*. 1993, 1994, and 1995). In March 1995, the U.S. Fish and Wildlife Service located a large proportion of the world's spectacled eider population (an estimated 140,000 birds) wintering in leads in the pack ice in the central Bering Sea, about halfway between Saint Matthew and Saint Lawrence islands. (Larned et al. 1997, Petersen et al. 1999)

- **Steller's Eider *(Polysticta stelleri)* (Threatened)**

In 1994, the U.S. Fish and Wildlife Service proposed to list the Alaska breeding population of the Steller's eider as threatened (59 FR 35896). In the 1960s, the worldwide population of Steller's eiders was estimated at 400,000 to 500,000. The Steller's eider population, estimated at 150,000 to 200,000 individuals rangewide, has declined by about 50 percent since the early 1970s (59 FR 35896). The Alaska breeding population of Steller's eiders was designated as threatened under the Endangered Species Act on June 11, 1997, due to a substantial decrease in the species nesting range (62 FR 31748). Historically, Steller's eiders nesting in Alaska were found in western Alaska and on the North Slope. In western Alaska, Steller's eiders were primarily found in the coastal areas of the YKD where they were thought to be a common breeding species in the 1920s, to the 1960s but not recorded as breeding between 1976 and 1994 (Kertell 1991). In 1994, 1996-1998, and 2002, one to two nests of Steller's eiders have been found on the YKD (Flint and Herzog 1999) indicating that the population has not been expatriated from the area but that nesting birds are extremely rare. On the North Slope the species has historically been documented nesting in the area between Wainwright and Cape Halkett (Quakenbush et al. 2002). The highest concentrations of Steller's eiders on the North Slope are found near Barrow (Quakenbush et al. 2002).

Critical habitat for the Alaska breeding population includes breeding habitat on the Yukon-Kuskokwim Delta and four units in the marine waters of southwest Alaska, including the Kuskokwim shoals in the northern Kuskokwim Bay, and Seal Island, Nelson Lagoon, and Izembek Lagoon on the north side of the Alaska Peninsula. A total of 2,830 mi^2 has been designated as critical habitat for Steller's eiders (Figure 3.7).

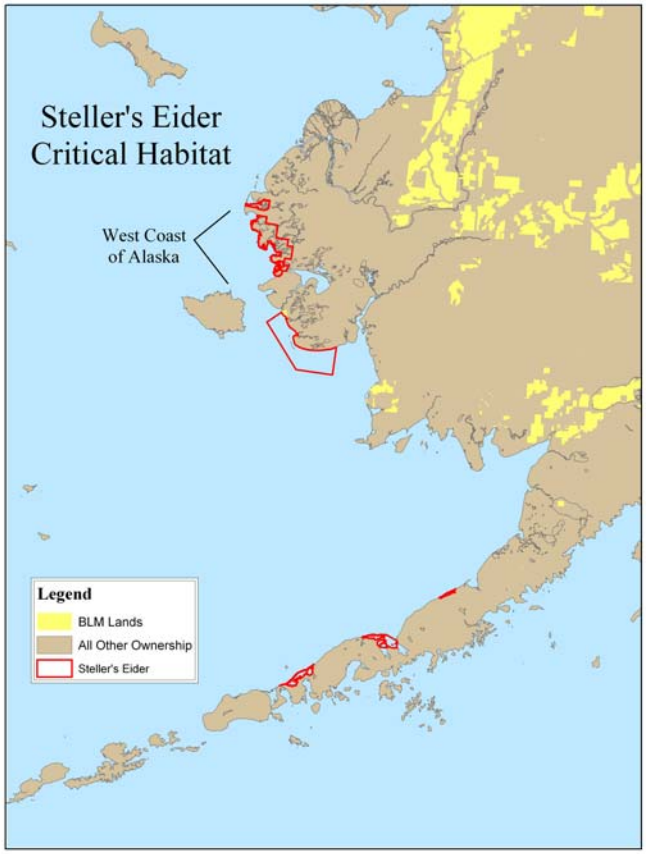
Steller's eider nesting habitat in northern Alaska is characterized by low relief tundra with numerous lakes and ponds (especially ponds with *Arctophila* and *Carex*), polygonized tundra, and small streams (Quakenbush *et al*. 1995). Steller's eiders near Barrow apparently do not nest every year (Quakenbush *et al*. 1995; Suydam, 1997). Current information indicates that nesting densities on the Arctic Coastal Plain are highest near Barrow, where eiders still occur regularly, though not annually. In some years, up to several dozen pairs may breed in approximately a one-mile area (62 FR 31748).

Steller's eiders are diving ducks that spend most of the year in marine habitats. During the winter, the majority of Steller's eiders have been found in near-shore marine waters concentrated along the Alaska Peninsula from the eastern Aleutian Islands to Cook Inlet (Jones 1965, Peterson 1980). Izembek Lagoon is one of the most important molting and wintering areas due to its extensive eelgrass beds and associated invertebrate fauna (Jones 1965, as cited in Quakenbush *et al*., 1995). They also have been found to occur in the western Aleutian Islands and along the Pacific coast of North America (Cramp et al. 1977). Prior to spring migration in 1992, an estimated 138,000 Steller's eiders concentrated in Bristol Bay (Larned et al. 1994) before sea ice conditions allowed northward movement of birds. Spring migration of Alaska breeding birds takes place along the offshore ice leads through the Bering Sea with birds reaching Barrow in early June. Fall migration begins with males leaving in mid-June with females and broods leaving nesting areas from late August to mid-September.

3.1.12b Environmental Consequences

Wildland fire suppression or treatment activities during early spring and summer months would have no direct or indirect affect on Steller's eiders and their critical wintering habitat and no adverse affects on the species. A human-caused summer fire near Barrow would be within the eiders' nesting range and could pose a negative affect on this breeding population. However, fire frequency in the northern wet tundra ecosystem around Barrow is very low and no known fires have occurred in the vicinity of Barrow since 1950. The threat of wildland fires to the breeding population of Steller's eiders and their habitat is negligible.

Figure 3.7
Steller's Eider Critical Habitat



Few fires have been known to occur in the NPR-A region over the past 20 years[15]. The most recent fires on record were over 100 miles south of the coast and not in any spectacled eider breeding habitat. The potential direct effects on spectacled eiders from wildland fires is anticipated to be negligible due to the infrequency of fire in this region. Wildland fire suppression activities during early spring and summer months would have no direct or indirect effects on spectacled eiders and their critical wintering habitat and no adverse effects on the species.

[15] Map 6. Alaska Hydrologic Units with Fire History.

Based on currently available information, neither the No Action nor the Preferred Alternative would affect any T&E species or their habitats. Since these habitats are neither located in the fire-dependent ecosystems of the Interior nor adjacent to populated areas, there is no potential for fuels management actions.

3.1.12c Endangered Species Act Section 7 Compliance

Section 7(a)(1) of the Endangered Species Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of threatened and endangered species. One of the conservation recommendations is to minimize or avoid adverse effects of a proposed action on listed species or critical habitat.

Both alternatives allow fire to perform its ecological role in the Alaskan environment. However, due to the location of these habitats in wetlands and riparian areas, the threat of wildland fire to spectacled eider or Steller's eider habitat or the surrounding lands is low. Fire occurrence in those ecosystems is rare. The high humidities of the marine climate zones during the summer months also minimize the potential for wildland fire. The remainder of Alaska's threatened and endangered (T&E) species and their habitats are outside fire management's area of influence. Neither alternative would promote fuels management activities in these areas. Therefore, there is no anticipated impact to listed species.

3.1.13 Wastes, Hazardous or Solid

Activities associated with either alternative would be conducted to be in compliance with the Resource Conservation and Recovery Act (RCRA), which provides "cradle to grave" control of hazardous waste and solid wastes by imposing management requirements on generators and transporters of the wastes. Spills of retardant, fuels, and other chemicals are subject to the spill reporting requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Clean Water Act. These reporting requirements are contained in the National Contingency Plan (40 CFR Part 300). In general, with "proper housekeeping procedures," compliance with these environmental laws and regulations would not be a significant concern for any of the activities associated with either alternatives.

3.1.14 Water Quality

The Safe Drinking Water Act of 1974 establishes protective measures for culinary water systems by providing standards that regulate allowable contaminant levels. This would not be affected by either fire management alternative. The Clean Water Act of 1977, as amended by the Water Quality Act of 1987, provides national policy and mandates the control of non-point pollution. Agencies are directed to develop and implement programs to meet the goals of this act through the control of both point and non-point source pollution. Also see Section 3.1.2 Aquatic Resources and Essential Fish Habitat, Section 3.1.15 Wetlands and Riparian Zones and Appendix N Retardant Composition and Use.

3.1.14a Affected Environment

BLM manages lands in the Anchorage, Eklutna and Ketchikan areas that are withdrawn for or adjacent to municipal water supplies.

3.1.14b Environmental Consequences

Fire may cause extensive changes in a watershed, including burning of vegetation and litter, which releases plant nutrients (such as Nitrogen, Phosphorus) and metals (such as Mercury, Manganese); heating of soils, which alters soil properties and flow paths; and post-fire erosion, which may increase turbidity and sediment loads. These changes can impact water quality and affect aquatic ecosystems, however, the nature and degree of the impact is highly variable depending on the watershed size, stream size and flow regime, fire size, and local fire intensity and severity.

Most of the important effects of fire on water quantity and quality ultimately result from destruction of vegetation and soil litter by fire. Destruction of vegetation and litter can affect water in several ways, including decreased soil stability, leading to increased erosion of upland soils during rainstorms or snowmelt, and to loss of bank stability along streams. The ultimate effect is increased loading of solutes, suspended solids and bed load to surface waters, adversely affecting water quality and aquatic flora and fauna. The suspended solids are eventually deposited, either within the stream channel, near the stream mouth in standing waters, or in adjacent bank and wetland/riparian areas. Loss of vegetation can also result in a temporary decrease in the infiltration capacity of soils, causing increased surface runoff and exacerbating erosion until the vegetation has been re-established in a burned area.

Erosion is a natural process occurring on landscapes at different rates and scales, depending on geology, topography, vegetation and climate. Natural erosion rates increase as annual precipitation increases. Landscape disturbing activities such as agriculture and road construction lead to the greatest erosion, which generally exceeds the upper limit of natural geologic erosion. Wildland fires and fuels management activities can also affect erosion. The timing and severity of erosion and sedimentation differ by geography, geology, precipitation regime and fire regime. Fire-related erosion and sedimentation can occur chronically and episodically. Chronic erosion tends to deliver fine sediment over long periods, typically in the absence of re-vegetation or from roads and fire lines. In contrast, pulses of sediment and large wood are delivered to streams by post-fire landslides and debris flows. Over time, wood and sediment are routed downstream by fluvial processes that form aquatic habitats (Reeves *et al.* 1995). Coarse sediment and wood are gradually depleted as they decay, break up and are transported downstream until replenished by new post-fire erosional episodes (Benda *et al.* “in press”).

After fires, suspended sediment concentrations in streamflow can increase due to the addition of ash and silt-to-clay sized soil particles in streamflow. High turbidity reduces municipal water quality and can adversely affect fish and other aquatic organisms. It is often the most easily visible water quality effect of fires. Less is known about turbidity than sedimentation in general because it is difficult to measure, highly transient, and extremely variable.

Depending on the size and severity of the fire, increases in streamflow after fire can result in substantial to little effect on the physical and chemical quality of streams and lakes. Higher stream flows and velocities result in additional transport of solid and dissolved materials that can adversely affect water quality for human use and damage aquatic habitat. The most obvious effects are produced by suspended and bed load sediments, but substantial changes in anion/cation chemistry can also occur (Robichaud 2000). Undisturbed forest, shrub, and range ecosystems usually have tight cycles for major cations and anions, resulting in low concentrations in streams. Disturbances such as cutting, fires and insect outbreaks interrupt or temporarily terminate uptake by vegetation and may affect mineralization, microbial activity, nitrification, and decomposition. These processes result in the increased concentration of inorganic ions in soil which can be leached to streams via subsurface flow. Nutrients carried to streams can increase growth of aquatic plants, reduce the potability of water supplies and produce toxic effects. Most attention relative to water quality after fire focuses on nitrate nitrogen (NO_3-N) because it is highly mobile. High NO_3-N levels, in conjunction with phosphorus, can cause eutrophication of lakes and streams. Most studies of forest disturbances show increases in NO_3-N, with herbicides causing the largest increases. Herbicides are not used in Alaska in either suppression operations or in fuels treatment projects.

A stable stream channel reflects a dynamic equilibrium between incoming and outgoing sediment and streamflow (Rosgen 1996). Increased erosion after fires can alter this equilibrium by transporting additional sediment into channels. However, increased peak flows that result from fires can also produce channel erosion (degradation). Sediment transported from burned areas as a result of increased peak flows can adversely affect aquatic habitat, roads, buildings, bridges, and culverts. Deposition of sediments alters habitat and can fill in lakes and reservoirs (Rinne 1996).

Mass wasting includes slope creep, rotational slumps, debris flows and debris avalanches. Slope creep is usually not a major post-fire source of sediment. Rotational slumps normally do not move any significant distance. Slumps are only major problems when they occur close to stream channels, but they do expose extensive areas of bare soil on slope surfaces. Debris flows and avalanches are the largest, most dramatic and main form of mass wasting that delivers sediment to streams (Benda and Cundy 1990). They can range from slow-moving earthflows to rapid avalanches of soil, rock, and woody debris. Debris avalanches occur when the mass of soil material and soil water exceed the shear strength needed to maintain the mass in place. Steep slopes, logging, road construction, heavy rainfall, and fires aggravate debris-avalanching potential. Most fire-associated mass failures are correlated with development of water repellency in soils which is not common to Alaska.

The effects of wildland fires on streams are generally viewed as "pulse" disturbances (Detenbeck *et al.* 1992) that may be initially severe but are generally short-lived depending on the extent and severity. Full recovery of aquatic communities is often dependent on the presence of intact communities that are juxtaposed to burned areas and the lack of additional disturbances that either retard recovery or pose additional stresses to the system. The response of aquatic ecosystems during a fire and immediately post-fire can be highly variable. Where fire intensity and severity is light to moderate, the initial effects of a fire are most likely minimal. Ephemeral and intermittent streams in a severe burn area will likely experience almost complete removal of streamside vegetation and the duff and litter layer of the surrounding watershed. The immediate post-fire effects include the movement of nutrients and sediments downstream into perennial streams.

Benthic macro-invertebrate communities could be affected in a fire area, depending on the severity within the immediate watershed and at the local site scale. Short-term effects during a fire may include local extirpations or a drift response where stream temperatures or water chemistry may reach sub-lethal to lethal levels. (Minshall, in review; Minshall *et al.* 1989; Spencer *et al.*, in review).

Immediate post-fire response of the invertebrate community could also be affected by the amount of sediment and debris transported into small streams from surface gravel and during initial runoff events. Lower 48 studies have documented a decline in both diversity and biomass in some streams affected by fires where channel sedimentation has occurred (Minshall *et al.* 1995, 2001a; Rinne 1996). Local effects related to sedimentation appeared to be highly variable. Where large woody debris was present in sufficient quantity or there were beaver dams present to trap sediment, it appeared that stream substrate immediately downstream was much more heterogeneous.

A variety of short-term responses in the Lower 48 have been noted for fish communities affected by wildland fire. Extirpation of fishes has been noted where fire intensity was severe, causing lethal increases in water temperature, and where short-term changes in water quality may have created unfavorable conditions for fish (Spencer *et al.*, in review). Certainly in cases where high fire intensity has severely affected water temperature, large-scale mortality can occur and can cause significant population losses (Rinne 1996).

In general, the five-year period after a major wildland fire is one of transition in aquatic ecosystems. Stream nutrient levels and suspended sediment increase within the first year post-fire and gradually decline within the first five years (Minshall *et al.* 1989; Spencer *et al.*, in review). The trajectory and the speed of this response are often dependent on the presence of major debris flows and/or floods. The initial pulse of sediment appears to be moving through the system, and a much more heterogeneous particle size distribution is apparent. The aggrading channels will take much longer to recover, as there has to be sufficient flow to scour out the channels without any substantial inputs of sediment (Moody and Martin 2001). Depending on the sequence of future storm events, this could take anywhere from decades to centuries.

Increased solar inputs from the opened canopy, combined with increased nutrient levels, often result in an increase in primary production and a shift in the aquatic invertebrate community from organisms that process leaf litter and debris to organisms that can scrape and graze attached algae from the substrate (Gresswell 1999; Minshall, in review; Minshall *et al.* 1989). The extent of this phenomenon will be dependent on the recovery of riparian vegetation and the extent that the canopy closes over the stream. In areas where little vegetation is present, temperature increases will be dependent on water quantity available and the recovery of riparian vegetation. Short-term increases in temperature are more likely to occur in smaller, perennial streams.

Other inputs from the riparian area show a variety of responses. Inputs of leaf and needle litter will often decline within the first five years if the canopy and surrounding riparian vegetation has been completely burned or removed. Large wood inputs often increase in the short-term as a result of wind-throw but generally remain stable during the first decade or more. Long-term replacement of large wood is affected by the rate of forest succession. Recruitment from the dead standing wood in the riparian areas within the fire will be critical to maintain in-stream large wood in the near future.

Fire suppression can also affect water resources, soils and vegetation. Riparian areas may be disturbed or damaged by heavy equipment traffic. Components of aerial retardants[16] can be toxic to aquatic fauna if released into or near surface waters. The aggregate effect of these processes is primarily as changes to water quality – minor to very significant increases in suspended solids, and sometimes increases in temperature, nutrient and metal concentrations. The degree and duration of change are influenced by several factors, including size and severity of the fire, proximity of the burned area to surface waters, slope, erodability of soils, and amount and intensity of precipitation. Changes to conditions in the water column are temporary, and would wane as vegetation is re-established and erosion is controlled, but deposition of sediments can lead to long-term changes in stream morphology and habitat.

Wildland fires and fuel treatments reduce vegetation cover that buffers raindrops before they hit the soil surface. The lack of vegetative cover on burned or treated areas allows raindrops to increase soil loss and sediment input to surface waters. Burned sites have lower soil-water infiltration rates, which increases surface runoff and decreases soil moisture available for plants. Increased runoff can stress the stability of receiving streams and the associated aquatic biota. The seasonal timing, size, duration, and intensity of fires and fuels treatments determine the magnitude of impacts. Intense wildland fires cause greater increases in water temperature, sedimentation, and turbidity by burning off vegetative cover, exposing mineral soil, and increasing runoff. Accelerated erosion also increases with surface disturbing activities such as the use of heavy equipment to blade fire lines, hand tool fire line construction, and off-road vehicle use. Sediment from accelerated soil erosion and elevated levels of nitrogen and phosphorous from ash are common in water after wildland fires.

Under both alternatives, water quality impacts related to wildland fire and disturbance depend on the amount of accelerated erosion. Often these impacts are short term and conditions return to pre-fire levels once vegetation is re-established. The Preferred Alternative includes mitigation measures to establish RBZs as discussed in Section 3.1.2b which would assist in mitigating impacts from wildland fire and fuels management activities and maintaining water quality. In addition, impacts from fuel treatments would be mitigated on case-by-case basis in project plans.

3.1.15 Wetlands and Riparian Areas

Management considerations must comply with Executive Order 11990, Protection of Wetlands, which requires federal agencies to minimize the destruction, loss, or degradation of wetlands while preserving and enhancing their natural and beneficial values on federal property. The order

[16] Information on retardant composition and use in Alaska is in Appendix N.

restricts most activities that could affect wetlands administered by the federal government. Activities mentioned in the EO include federal activities and programs affecting land use. (Also see Section 3.1.2 Aquatic Resources)

3.1.15a Affected Environment

Aquatic environments across the planning area are extremely variable, reflecting diverse geological settings, climates, disturbance histories, and past management. Aquatic habitat types range from small, high-gradient montane streams to low-gradient large rivers such as the Yukon. Lakes, ponds, wetlands, estuaries, tidal marshes, and springs are all present across the planning area. Riparian and aquatic areas comprise only a small portion of the total lands managed by the BLM nationwide; BLM-Alaska manages a large proportion of the national wetlands - approximately 12.5 million acres of BLM-managed lands are classified as wetlands (USDI/BLM FY2002). Their ecological significance is far greater than their limited physical scope as these systems form some of the most dynamic and ecologically rich portions of the landscape (Elmore and Beschta 1987).

Under natural conditions, riparian and aquatic ecosystems have a high degree of structural complexity, reflective of past disturbances such as floods, fire, ice floes, wind storms, grazing, disease and insect outbreaks. Historically, whether streamside or lakeside vegetative communities were substantially burned or not, fires altered watersheds and aquatic systems, primarily through changes in sediment and streamflow regimes. These effects, however, were extremely variable as noted in Sections 3.12 and 3.1.14. Watershed characteristics such as vegetation structure and seral stage, inherent geology, pattern of geomorphic processes, and local climate and weather combined to influence the trajectory and magnitude of post-fire change to aquatic systems. Humans have altered stream aquatic and riparian environments by direct modifications (channelization, wood removal, diversion, dam building, irrigation de-watering) and indirect impacts (from timber harvest, mineral exploration and development, grazing, and road building). These activities have altered channels by changing the rate at which sediment, water, and wood enter and are moved through streams. Anthropogenic activities have also affected the incidence, frequency, and magnitude of the natural disturbance events described above (McIntosh *et al*. 1994; Wissmar *et al*. 1994).

3.1.15b Environmental Consequences

Wetlands and riparian areas in Alaska are generally more resistant to fire than the surrounding wildlands and, therefore, the effects of fire in those areas are often more limited. Wetlands and riparian areas can and do burn, especially when high to extreme burning conditions exist, but the more pronounced disturbance effects can come from suppression efforts. Large mechanized equipment and/or excessive use of smaller motorized vehicles can cause damage to wetland and riparian zones and underlying permafrost, but since riparian areas are often utilized by suppression resources as natural barriers to fire spread, heavy equipment use is usually quite limited. The use of retardant in riparian areas, although not allowed by standard operating procedures, also can have detrimental effects.

RBZs as discussed in section 3.1.2b would be incorporated into fuels management projects, where riparian resources receive primary management emphasis, and require analysis of project-related impacts to specific elements of riparian and aquatic function. These RBZs are designed to protect a comprehensive suite of ecological processes, and would protect wetlands, riparian areas, amphibians and fish.

There is little difference in impacts between the alternatives. Suppression activities and fuels treatment activities are relatively infrequent in riparian areas. Most fuels treatments occur in areas that have high flammability fuels near the wildland urban interface, or in areas that are at greater risk from wildland fire. Since riparian areas are generally composed of less flammable fuels and because these areas pose little threat to the wildland urban interface, fuels treatments in riparian areas are unlikely to occur.

3.1.16 Wild and Scenic Rivers

BLM-Alaska manages six rivers identified in the National Wild and Scenic River System: All were established by the Alaska National Interest Lands Conservation Act of December 2, 1980. The National Wild and Scenic River System allows a river to qualify in three classification areas: wild, scenic, and recreational. All six of the rivers managed by the BLM are classified as wild; two are also classified as scenic and recreational. The Wild and Scenic Rivers Act states that selected rivers "shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."

Under both alternatives, management option designations along the river corridors are consistent with the intent of Wild and Scenic River designations and wildland fire occurrence is not considered an adverse impact on the physical environment. Safety concerns due to fire activity may result in restricted access or temporary closure to the public. This impact would be short-term and affect recreational and subsistence users.

Fuels treatments may be conducted on adjacent land and affect viewsheds. Projects will be evaluated in a site-specific NEPA process before action.

3.1.17 Wilderness

BLM manages no designated wilderness areas in Alaska, but does manage one wilderness study area. The Alaska National Interest Lands Conservation Act of 1980 directed a wilderness study of the Central Arctic Management Area (CAMA) in north-central Alaska. Congress later designated the CAMA Wilderness Study Area (WSA). Congress has yet to decide its long-term designation. CAMA is designated Limited Management Option.

Under both alternatives, the appropriate management response for a wildland fire is to allow fire to function in its natural ecological role while conducting routine surveillance to observe fire activity and to determine if site-specific values or adjacent higher priority management areas are compromised. This is consistent with the intent of wilderness areas. Safety concerns due to fire activity may result in restricted access or temporary closure. That would result in a short-term impact to users.

3.2 Other Elements Analyzed

Due to the potential impacts, the following additional elements were analyzed.

3.2.1 Recreation

BLM-managed lands in Alaska provide a wide variety of summer and winter recreational opportunities. That includes 14 campground/waysides, 12 public use cabins, a visitor center, a visitor contact station and 10 areas that are part of the National Landscape Conservation System.

Under both alternatives, site-specific designations provide protection priority based on values at risk. Short-term effects from large wildland fires may adversely affect recreational use of BLM-managed lands. Large fires may displace recreational users and may even cause areas to be evacuated, access-restricted or closed to recreational use. In addition, heavy smoke associated with large fires will limit sightseeing and wildlife viewing opportunities and could prevent aircraft flights into remote areas. Firelines and burned areas may provide additional access to the public and Off-Highway-Vehicles (OHV) to areas adjacent to existing routes.

Fire has a positive impact by promoting vegetation and wildlife diversity, which can enhance recreation opportunities. Fuels management will have additional benefits to recreation by promoting public safety while benefiting ecosystem health, increasing wildlife populations and diversity of species.

3.2.2 Socio-Economics

BLM-managed land in Alaska is predominantly remote and removed from human developments. Except for BLM-managed lands withdrawn for military use near population centers, population densities are very low. This is well accounted for by the predominance of BLM-managed land where the appropriate management response is to allow fire to function in its natural ecological role while conducting routine surveillance to observe fire activity and to determine if site-specific values or adjacent higher priority management areas are compromised. Ninety-two percent of BLM-managed land will continue to be open to wildland fire. This is a continuation of the historic situation, where wildland fire has been largely allowed to occur as a natural process.

Eight percent of BLM-managed land is classified as Critical and Full Management Options (complete protection from wildland fire). This includes BLM-managed land near the population centers of Anchorage, Fairbanks, Kodiak, Delta Junction, and others. The current level of protection, where less than 0.023% of BLM acreage sustains fire annually, will continue. The level of fire suppression will not change in the proposed action. The net effect resulting from these BLM activities will remain the same.

The amendment allows vegetation and fuels management on a broader scale than current management. The objectives are designed to enhance and protect resources, while lowering human risk. Control of wildfire where appropriate is therefore an enhancement to the social and economic system. Similarly, manipulation of resources to prevent fire, or to benefit habitat, is also an enhancement to the social and economic system. It should be noted that individual projects to manipulate fuels or habitat will be undertaken only after a separate NEPA process.

3.2.3 Soils

3.2.3a Affected Environment

Soils vary across the state of Alaska based on location on the landscape and geomorphic process. Physical characteristics such as depth and texture; and different chemical properties such as reaction (pH) and nutrient content vary considerably over short distances. These characteristics are influenced by parent material, regional and local climate, slope, aspect, vegetation and surface stability. A broad statewide description of this variability is provided in the Exploratory Soil Survey of Alaska (Reger, *et al*. 1979). This document, as well as more detailed descriptions of smaller areas, are provided in published soil surveys and electronic data files provided on the U.S. Department of Agriculture web sites.

Soils located on BLM-managed lands in Alaska have formed in a variety of climates and environments. Bailey *et al.* (1994) describe two sub-continental climates or Ecoregion Domains for Alaska, including a Humid-Temperate and Polar Domain. The Humid-Temperate climate is found along the coastal regions including Southeast and Southcentral Alaska where coastal rainforests and coastal boreal forests occur as a narrow band at elevations below about 2,000 feet and subalpine and alpine biomes common at higher elevations. Also included within this climate are the extensive grasslands of the Aleutian Islands and Alaska Peninsula. Wildland fire appears to only be common to boreal portions within the Cook Inlet Lowlands portion where conditions are significantly drier.

The sub-continental Polar Domain climate includes Interior Alaska between the summits of the Alaska and Brooks Ranges, the North Slope of the Brooks Range and coastal areas that are locked in pack ice during much of the winter months or have significant areas of permafrost. Within the more interior portion, boreal biomes dominate landscapes below about 2,500 feet with the alpine biome at higher elevations and non-vegetated rock and ice dominating mountains above about 4,500 feet. The Western Alaska portion includes a mixture of boreal, alpine and tundra biomes with tundra biomes dominating the remaining Coast Plain portion of the North Slope. Wildland fires are common to the boreal portions within this climatic domain, and infrequent within the tundra and alpine biomes.

3.2.3b Environmental Consequences

Wildland fires are common to the boreal biomes of the State, especially the Interior portion, and to a lesser degree, Southcentral and Western Alaska. The most widespread impacts of fire, both wildland and prescribed, and other fuel treatments are on landscapes underlain by permafrost within the Interior portion where plant communities consist of stunted black spruce (*Picea mariana*) and larch (*Larix laricina)* woodlands on soils that are typically classified within the Typic Historthels and Typic Histoturbels soil taxonomic Subgroups of the Gelisol Order. This naturally occurring phenomenon of fire and post-fire succession is best described as a cycle of events on the landscape. The short-term impact following most wildland fires is thawing of the permafrost and an increase in the thickness of the active layer, the surface layer that thaws during summer. As permafrost thaws, a large volume of water is liberated and either accumulates in depressions or runs off through surface or subsurface drainage outlets. Differential subsidence of the soil surface and slumping on steeper slopes can occur, depending on the ice content of the permafrost and the rate of thawing. Gradually, in the absence of additional fires or disturbances, the moss-organic layer reestablishes and permafrost level returns to the pre-fire condition (Foote 1976; Viereck 1973). Return to the pre-burn state depends, in part, on the depth of the organic layer consumed by the fire and the rate of re-vegetation (Viereck and Dyrness 1979). The pre-burn state returns as post-fire vegetation succession progresses and the organic mat reestablishes. Dyrness (1982) reported that, four years after burning in the black spruce type, thaw layer thickness increased threefold when one-half of the organic mat was consumed by the fire and fivefold when the entire surface was consumed and mineral soil exposed. Foote (1976) and Viereck (1973) agree that, in the black spruce type in Interior Alaska, the forest canopy, forest floor, and active layer thickness return to their original state within 50 to 70 years following fire. Fuels treatments not involving fire will not affect the vegetative mat directly, and consequently allow partial insulation of soil, resulting in less change in the ice layer.

Specific soil processes are associated with each part of this cycle. The saturation or accumulation of basic soil metals and nutrients, such as calcium, magnesium, potassium, sodium, and nitrates, in surface soil layers originates from the ash residue left behind after fire. The ash layer typically effervesces when dilute hydrochloric acid is added; this reaction can often be observed in the remaining surface organic layer of soils for a year or more following fire. Associated with effervescence is a soil reaction (pH) of 8 to 8.2. Other changes in nutrient status following fire, such as improved phosphorus and nitrate status of soils, are usually related to this increase in pH (Heilman 1966). Heilman reports that the removal of low-density and low-nitrogen containing layers of moss by fire maximizes nitrogen content of soils at the surface. This restoration of the bulk of the soil nitrogen to the warmest portion of the soil profile explains the substantial improvement in productivity and nitrogen availability following burning. Acidification is associated with the aerobic, well drained, permafrost-free portion of this cycle. As conditions become more acid and organic mats thicken, rates of biological decomposition slow and litter and moss tend to accumulate on the soil surface. Nutrients for plant growth become less available. Thickening of the organic mat is important in terms of nutrient cycling. Without a corresponding increase in the quantity of available nutrients, the quantity of available nutrients in the upper portion of the soil is considerably diminished. As succession proceeds, elements that are at low levels and potentially limited, such as Nitrogen, Phosphorus, and Potassium, are cycled by the vegetation and dispersed throughout the increasingly thick organic layer (Heilman 1966, 1968). This gradual thickening of the surface organic mat is accompanied by a lowering of soil temperatures in underlying soils and eventually the reformation of permafrost.

Fire influenced communities without permafrost are also present throughout Interior and Western Alaska; however, these are less extensive. Riparian white spruce *(Picea glauca)* forests along rivers support some of the most productive forests in Interior Alaska. Major soils are occasionally flooded and moderately well or well drained with slight acid to moderately alkaline reaction. Parent materials consist of stratified loamy alluvium of various depths over sand and gravel. Moderate amounts of nitrogen and phosphorus associated with moderate organic matter decay and nitrification (Van Cleve, *et al*., 1993) and relatively high levels of calcium, magnesium and potassium from relatively young alluvial deposits contributes significantly to the overall high forest productivity of these soils. These are classified within the Cryofluvents Soil Great Group. The high initial calcium, Subalpine woodlands of white spruce (*Picea glauca*) and dense stands of shrub birch scrub (*Betula glandulosa and Betula nana*) are found along the upper limits of tree growth at about 3,000 feet elevation on seasonally wet and well drained soils. Major soil taxa included are Cryaquepts, Eutrocryepts, and Dystrocryepts Soil Great Groups. Little is known regarding nutrient cycling within this subalpine zone.

Within the Humid-Temperate climatic domain, wildland fire is primarily restricted to the boreal portion in lowlands below about 2,000 feet within the Cook Inlet Lowlands of Southcentral Alaska. Wildland fire within this region is most common where either well-drained or poorly drained soil conditions favor the establishment of dwarf black spruce woodland and forest. Well-drained soils are primarily Haplocryods and poorly drained soils that are classified within the Cryaquepts, Cryaquands, Cryohemists, and Cryosaprists taxonomic Subgroups. Site conditions responsible for the establishment of black spruce forests on some well-drained soils is not entirely clear. However, the thin loamy surface layer that mantles many of these soils has a high percentage of nutrient poor volcanic ash as well as very acidic soil conditions with surface mineral soil pH levels commonly 4.5 to 5.5. These conditions favor the establishment of this more acid tolerant tree species. Regardless of the site conditions, fire releases significant nutrients and bases to the surface. Resultant processes are similar to those described previously, with the exception of permafrost that does not form in these soils due to warm mean annual air temperatures. A gradual decrease in nutrient availability occurs on the forest floor with time following fire as nitrogen, phosphorus, and potassium are cycled by the vegetation and dispersed throughout the increasing biomass.

Since some of the existing land use plans indicated varied levels of wildland fire and fuels management, the effect on soils is considered similar for both alternatives.

3.2.4 Special Status Species

BLM Manual 6840 provides policy and direction for the conservation of special status species of plants and animals, and the ecosystems upon which they depend.

Categories of Special Status Species include:

- Federally Listed Threatened and Endangered Species and Designated Critical Habitats. (Section 3.1.12)
- Federally Proposed Species and Proposed Critical Habitats.
- Candidate Species.
- State Listed Species.
- BLM Sensitive Species. (Figures 3.8 and 3.9)

Sensitive Species are those plants or animals that are known or suspected to occur on federal lands and do not meet either the threatened or endangered criteria but have been determined to be rare or sensitive. They will be provided the same protection as that of a candidate species under the Endangered Species Act.

Figure 3.8
BLM's Sensitive Species
Vertebrate

Common Name- Birds	**Scientific Name**
Northern Goshawk (Queen Charlotte)	*Accipiter gentilis laingi*
Tule White-Fronted Goose	*Anser albifrons elgasi*
Marbled Murrelet	*Brachyramphus marmoratus*
Dusky Canada Goose	*Branta canadensis occidentalis*
Gray-Cheeked Thrush	*Catharus minimus*
Olive-Sided Flycatcher	*Contopus cooperi*
Trumpeter Swan	*Cygnus Buccinator*
Blackpoll Warbler	*Dendroica striata*
Townsend's Warbler	*Dendroica townsendi*
Harlequin Duck	*Histrionicus histrionicus*
Bristle-Thighed Curlew	*Numenius tahitiensis*
Buff-Breasted Sandpiper	*Tryngites subruficollis*
Kittlitz's Murrelet	*Brachyramphus brevirostris*
King Eider	*Somateria spectabilis*
Long-tailed Duck	*Clangula hyemalis*
Black Scoter	*Melanitta nigra*
Black Guillemot	*Cepphus grille*
Dovekie	*Alle alle*
Red Throated Loon	*Gavia stellata*
Black Brant	*Branta bernicla nigricans*
Red Knot	*Calidris canutus*
Black-tailed Godwit	*Limosa limosa*
Surf Scoter	*Melanitta perspicillata*
Mckays Bunting	*Plectrophenax hyperboreus*
Marbled Godwit	*Limosa fedoa*
Common Name –Animals	Scientific Name
Canada Lynx	*Lynx Canadensis*
Harbor Seal	*Phoca vitulina*
Common Name- Fish	Scientific Name
Angayukaksurak Char	*Salvelinus anaktuvukensis*
Western Brook Lamprey	*Lampetra richardsoni*
Gulkana Steelhead	*Oncorhyachus mykiss*
Kigliak Char	*Salvelinus alpinus*
Clear Creek Chum Salmon	*Onconhynchus keta*
Beaver Creek Chinook Salmon	*Onconhynchus tshawytscha*

Figure 3.9
BLM's Sensitive Species
Botanical

Common Name- Plants	Scientific Name
Aleutian Wormwood	*Artemisia aleutica*
Purple Wormwood	*Artemisia globularia var. lutea*
Yellow-Ball Wormwood	*Artemisia senjavinensis*
Alaskan Glacier Buttercup	*Beckwithia glacialis spp. Alaskansis*
Moonwort	*Botrychium ascendens*
Ogilvie Mountains Springbeauty	*Claytonia ogilviensis*

Sessile-Leaved Scurvy Grass	*Cochlearia sessilifolia*
Shacklette's Catseye	*Cryptantha shacletteana*
Bering Dwarf Primrose	*Douglasia beringensis*
Aleutian Whitlow-Grass	*Draba aleutica*
Tundra Whitlow-Grass	*Draba kananaskis*
Murray's Whitlow-Grass	*Draba murrayi*
Ogilvie Mountains Whitlow-Grass	*Draba ogilviensis*
Muir's Fleabane	*Erigeron muirii*
Yukon Wild Buckwheat	*Eriogonum flavum var. aquilinum*
Narrow-Leaved Prairie Rocket	*Erysimum asperum var. angustatum*
Calder's Bladderpod	*Lesquerella calderi*
Calder's Licorice-Root	*Ligusticum calderi*
Drummond's Bluebell	*Mertensia drummondii*
Arctic Locoweed	*Oxytropis arctica var. barnedyana*
Kobuk Locoweed	*Oxytropis kobukensis*
Alaska Bluegrass	*Poa hartzii alaskana*
Yukon Podistera	*Podistera yukonensis*
Willow	*Salix reticulata spp. glabellicarpa*
Aleutian Saxifrage	*Saxifraga aleutica*
Mountain Avens	*Senecio moresbiensis*
Pear-Shaped Candytuft	*Smelowskia pyriformis*
	Draba micropetala
Stipulated Cinquefoil	*Potentilla stipularis*
Nodding Semaphoregrass	*Pleuropogon sabinei*
Pygmy Aster	*Aster pygmaeus*
Hairy Lousewort	*Pedicularis hirsuta*

3.2.4a Affected Environment

A BLM-Alaska sensitive species list (Figures 3.8 and 3.9) has been developed using guidance provided in the BLM 6840 Manual. It was derived using information gathered from the Alaska Natural Heritage Program, the Nature Conservancy, Alaska Department of Fish and Game, U.S. Fish and Wildlife Service and the National Park Service. The list includes only those species that have been determined to likely occur on BLM-managed lands in Alaska. Many of the species on this list are there because of a general lack of inventory; this list may be modified to exclude or add species in the future, as inventories are completed.

3.2.4b Environmental Consequences

Some sensitive species would benefit from continued aggressive fire suppression activities that minimize loss of individuals, populations, or habitats. Conversely, fire suppression activities can also affect sensitive species through mortality, disturbance, displacement, damage or alteration of key habitat components. Impacts to sensitive species would vary depending upon a variety of factors including range and distribution, life history and preferred habitats.

The following are the potential direct and indirect effects to sensitive species from fire suppression:

- ***Terrestrial Wildlife Species***

    - Mortality or injury of adults, young, or eggs from smoke inhalation or crushing by vehicles or equipment used during fire management operations.
    - Disturbance or displacement of individuals from smoke, noise, and other human activities associated with the operations affecting foraging, roosting or reproductive behavior.
    - Nest abandonment or mortality of young, resulting in the loss of one year's recruitment.
    - Loss or conversion of key habitat components for nesting, foraging, roosting or cover.
    - Increased risk of predation from removal of cover.
    - Changes in food quality and quantity or foraging habitats.
    - Long-term changes in habitat quality or quantity for nesting, roosting, foraging, or cover affecting the ability of a species to continue occupying a site or facilitating the return of a species to its historic range.

- ***Fish and Other Aquatic Species***

    - Mortality of adults, young, or larvae from using occupied water resources during fire suppression or proposed fire management activities.
    - Loss of habitat (water quality).
    - Chemical contamination of individuals or aquatic habitats from fire retardant drops.
    - Damage or loss of riparian or upland vegetation resulting in decreased channel stability, increased erosion and sedimentation, increased water temperature, reduced instream cover and altered water velocities.

- ***Plant Species***

    - Heat stress from prescribed fire or wildland fire.
    - Mortality from prescribed fire or wildland fire.
    - Crushing from vehicles during suppression activities.
    - Crushing from human foot traffic during suppression activities.
    - Damage to seed bank due to fire severity or mechanical disturbance.
    - Change in vegetation composition and/ or structure of the habitat as a result of wildland fire or treatments.
    - Increase in invasive species in the habitat which may outcompete special status species.

Sensitive species may be adversely or positively impacted by habitat changes or vegetation removal associated with wildland fire. Under both alternatives, the assignment of the landscape scale management options and use of site-specific designations consistent with the conservation needs of special status species and based on BLM resource specialists recommendations would minimize any adverse impacts and maximize potential habitat enhancements through the use of wildland fire. Little or no impact would occur to sensitive species from fuel treatments since sites are inventoried for species of concern and mitigation measures are incorporated into project plans.

3.2.5 Vegetation Resources

Northern boreal ecosystems evolved with fire as a natural occurrence (Shugart, *et al*. 1992), and future disturbance by naturally occurring wildland fires is assured, regardless of management alternatives chosen. Fires clearly have a direct impact on vegetation. The direct, indirect, and cumulative impacts of alternatives presented here will differ primarily based on anticipated levels and timing of fire activity and fuels treatments, but it is understood that complete exclusion of fire from this landscape is neither feasible nor desirable.

The only single land cover classification covering all BLM-managed lands in Alaska to date is the 1-km resolution *Vegetation map of Alaska*, developed by Michael Fleming of USGS (Map 7, Alaska Vegetation Cover). This classification contains 19 vegetated classes, and was developed using the phenology of a vegetation index (AVHRR/NDVI) collected during the 1991 growing season[17]. A more detailed regional land cover classification developed from satellite imagery by a collaboration of BLM and Ducks Unlimited covers over 90 percent of BLM-managed lands in Alaska at a resolution of 30 meters per pixel. The _Alaska Vegetation Classification_ by Viereck, *et al*. (1992) has been the basis for these and all other land cover classifications referred to in this document. Viereck described 888 known plant communities. However, only general classes will be addressed in this analysis, along with knowledge and firsthand experience of resource specialists. Three general classes will be analyzed: forestlands, shrublands and herbaceous communities.[18]

Species-specific fire effects on northern vegetation, including Alaska, have been compiled and summarized into the electronic Northern Rockies Interagency Fire and Aviation Management Fire Effects Information System.[19] Information on fire effects in Alaska vegetation types has been summarized in _Wildland Fire in Ecosystems: Effects of Fire on Flora,_ (USFS 2000), and reviewed by the in _Effects of Fire in Alaska and Adjacent Canada: A literature review_ (Viereck and Schandelmeier, 1980). This information on individual species effects is incorporated by reference into this analysis. Stand-level effects will be reviewed here only briefly.

[17] Map 7 and Map 8 are products derived from AVHRR satellite imagery collected in 1990-91. Both show fires from the 1990 and 1991 due to timeframe of collections.

[18] Appendix O Fuel Models and Fire Behavior relates these vegetative communities to expected fire behavior.

[19] http://www.fs.fed.us/database/feis/welcome.htm

3.2.5a Forestlands, Affected Environment

Viereck's (1992) classification considers areas with tree species comprising more than 10 percent of the canopy cover as forestlands. Forestlands account for 39 percent, or approximately 33.5 million acres, of BLM-managed lands. Forestlands are a composite of coniferous, hardwood, and mixed deciduous-conifer, with the primary conifer in interior Alaska being spruce (*Picea*, sp.). Four representative forestland types are very common throughout the non-coastal forested areas of the state:

- ***Black Spruce Woodland*****:** Black spruce forests with a canopy closure of less than 25 percent, but greater than 10 percent, typically occur on poorly-drained permafrost sites. The understory is dominated by sphagnum moss on wetter sites and feathermoss/lichens on drier sites. Ericaceous shrubs, resin birch, and cottongrass are also important. The trees are often very stunted due to the harshness of the site. These black spruce communities often have a thick organic mat: 15-30 cm. Moss and lichen on the surface wets and dries out quickly in response to changes in relative humidity. This, along with the continuity of fuel over larger areas, allows this vegetation type to burn readily when ignited during dry conditions. Generally ground fuels such as moss, grass, or shrub carry the fire, with later "torching" trees and consumption of the tree canopy.

- ***Open/Closed Black Spruce Forest:*** Black spruce stands with canopy cover greater than 25 percent occur throughout the planning area. Paper birch, aspen clones and tamarack are occasional components. These stands are usually located on slightly drier sites than are woodland black spruce communities, and the trees are often taller. The understory is usually dominated by feathermosses, although lichens may form a nearly continuous mat in some stands. Ericaceous shrubs, dwarf arctic birch, and low willows make up most of the shrub layer. Fire in these forests burn similarly to the woodland type (above) but crown fires, where high intensity fire is carried through and consumes the treetops ahead of the ground fire, are not uncommon in this fuel type.

- ***Open/Closed White Spruce Forest:*** This forest type is widespread throughout interior, northwest, southwest, and south-central Alaska, representing the most productive of taiga forests, often occupying alluvial fans, river terraces, and other well drained soils. Some stands, although slow-growing compared to temperate forest species, have commercial value as individuals may reach over two feet in diameter. Stand development may occur for 300 years or more before fire reinitiates succession (Foote 1983). Around 150 years post-fire, shrub/hardwood forest yields canopy dominance to white spruce. White spruce also commonly forms "stringers" along smaller streams and around lakes. Paper birch and balsam poplar often comprise a significant part of the tree canopy in these stands. In open stands, a wide variety of shrubs and herbs dominate the understory, along with horsetail and feathermoss. Alder, tall willow, prickly rose, buffaloberry, dwarf dogwood, twinflower, and ericaceous shrubs are common.

- ***Open/Closed Deciduous Forests:*** Pure stands of birch, aspen, or mixtures of the two species are common on upland sites in the Interior. Aspen are most common on warm, well-drained sites, and grade into birch on colder, wetter sites. Aspen is an intermediate stage leading to white spruce, while paper birch sites may later be dominated by white or black spruce. A well developed understory of alder, willow, highbush cranberry, and low shrubs is usually present, as well as herbaceous vegetation, mosses and lichens. Fires are infrequent in deciduous forests and generally are low intensity when they do occur. When they do occur, these fires often kill the thin-barked overstory, after which a new hardwood stand will quickly reestablish. Understory tall shrubs vary widely in occurrence and distribution throughout Alaska. Rocky Mountain maple occurs in the Haines area; red dogwood also occurs in several regions.

  Mixed coniferous/deciduous forests are also very common. Many represent a stage of development which generally moves toward coniferous dominance in the absence of a disturbance, such as fire, logging, flooding, or insect outbreaks.

  In the southeast panhandle of Alaska, the forestlands are a temperate rainforest, which will be referred to as “coastal forest.” Very little of BLM-managed lands falls within this forest type. The forest which characterizes the Matanuska Valley, Kenai Peninsula, Cook Inlet, and Copper Delta regions have been termed a “coastal-boreal transition” type. Dominant overstory vegetation includes white spruce, Sitka spruce, Lutz spruce (a hybrid of white and Sitka spruce), and inclusions of mountain and western hemlock. Widespread mortality in the spruce component has recently occurred in this type related to spruce bark beetle (*Dendroctonus rufipennis*) infestations. Since 1989, about three million acres of spruce forest on the Kenai Peninsula have been impacted by beetles, resulting in the death of most mature spruce trees in these localities (Berg 1998). In a natural setting, fire visits these forests infrequently - about every 200-600 years.

Fire regimes in forested types vary greatly between coastal and interior forest types, but in general they are characterized by low frequency/high intensity fire events. Open/closed black spruce forests burn with a frequency similar to that of black spruce woodlands. Stands can be ready to burn as early as 40 years, once a moss/lichen layer has developed, but average fire return interval for both woodland and closed spruce stands is estimated to be 80 years. The range of reported fire cycles from black spruce forests is roughly 40 to 120 years (Viereck 1983). However, much older stands are not uncommon. The floodplain white spruce forest type is characterized by longer fire cycles, estimated at 110 years, with a range of 80-150 years. Under the U.S. Forest Service scheme of classification (Hardy *et al*. 1998) both have been classed into fire regime group 4 - moderate frequency, stand replacement.

Northern boreal forests are adapted to fire. Vegetation recovers by sprouting or from seed stored in the forest soil organic layer (duff) after fire. The exact response varies by fire prescription, season, moisture condition and plant species. The amount of organic forest floor material consumed is particularly important in dictating revegetation because the roots and propagules of species are located at different depths, and some species have light, windblown seed, which can readily colonize exposed mineral soil seedbeds. Some later successional species, especially "reindeer" and beard lichens, will be scarce in post-fire stands for long periods. Lichens, especially the *Cladina* sp., which are important as winter forage for reindeer and caribou, typically require over 100 years to re-establish on some sites (Thomas, *et al*. 1996, Joly, *et al*. 2002). Post-fire recovery of white spruce stands after fire depends on stage of seed production, and the rate of reinvasion depends on distance to seed source, the size of the burned area, and the presence of dispersal agents.

3.2.5b Forestlands, Environmental Consequences

Increased forest fuel hazard and/or declined forest health would be the expected manifestations of inappropriate fire management of forestlands. BLM-managed forestlands in Alaska are generally considered "healthy" in terms of few non-native species, low incidence of disease, and natural fire allowed to occur in most (>70%) of these forestlands since the inception of statewide fire management plans that direct levels of fire suppression in the early 1980s (USDI 1996). Coastal/boreal transition forest types, which historically had low frequencies of fire, have experienced periodic irruptions of bark beetles, which increase the proportion of dead trees. These irruptions are believed to be the result of climate signal (temperature and drought). Accumulations of understory dead woody fuels, the standard of "fire hazard" in the conterminous United States, can occur in Alaskan forests as a result of windfall, flooding, disease, or low intensity fire, but is a rare condition. On the other hand, black spruce forests in their natural state are among the most hazardous of forest fuel due to their dry, resinous fine needles and growth form with branches to the ground creating a ladder between the surface fuels and the tree crowns. Stand replacing fires are typical. It is rare to find trees that have survived a surface fire in spruce forests. This is very unlike the conditions in the western United States where many forests have had fire excluded for 50 to 75 years, and some fires in recent years are attributed to the accumulation of fuels and insect activity.

The concept of Fire Regime Condition Class (FRCC)[20] (Appendix G) was developed to measure the degree to which fire has been excluded from the forest. In the western United States, where this concept was developed, fire exclusion correlates well with the degree to which fire hazard characteristics, such as ladder fuels, flammable understory species, and dense stocking rates, may be present. This correlation breaks down in Alaska, because natural spruce forests have high fire hazard. However, fire exclusion on forests with long stand replacement cycles results in increased fire hazard at the landscape level because of greater contiguous areas of flammable mature forest and fewer young, less flammable patches of herbaceous, shrub, or deciduous forest.

At the time of this analysis, Condition Class assessments have not been systematically employed on forestlands in Alaska. Small project areas, comprising acres to hundreds of acres have been classified by estimate of local resource specialists. Efforts are underway to develop FRCC as a standardized assessment tool for the use of all state and federal land managers. It is anticipated that most Alaska forestlands should classify as Condition Class 1 due to their relatively long fire cycles and short history of suppression activities. In areas where aggressive suppression of fires is mandated for the protection of human life, property, or natural resources, prescribed fires and other fuel treatments may be required to maintain healthy forests.

[20] More information is available on U.S. Forest Service website: http://www.frcc.gov

Mechanical or manual treatments and prescribed burning can be effective management tools in forested vegetative communities in Alaska. Fire can sometimes be used to:

- reduce surface fuels in the understories of fire resistant trees,
- return forest stands to less hazardous early regenerative stages,
- create seedbed especially for post-logging white spruce stands,
- enhance forage values for wildlife,
- maintain and improve browse quality and quantity; and
- rejuvenate old stands of deciduous trees.

Prescribed fire can produce favorable conditions for conifers, or for deciduous forest, depending on prescription and initial condition. Burning spruce forests increases grasses and forbs and top-kills shrubs, such as willow, shrub birch, and alder, which often resprout the next year (Zasada 1971).

After mechanical or manual treatments, slash can be piled and burned to reduce fire hazard without harming the residual trees in these communities. Timely removal of woody slash residue also precludes colonization and enhancement of insects, such as bark beetle and northern engraver beetle, which in sufficient numbers can invade adjacent healthy stands.

Under both alternatives, the choice of Limited and, to an extent, Modified suppression management options help maintain a mosaic of forested and non-forested vegetative successional stages that reflect natural processes and maintain or improve ecosystem health. One consequence of the proposed action would be allowing consideration of mechanical or manual treatments and prescribed burning as options in managing BLM-managed lands where they are not currently addressed in management plans.

Without the benefits of wildland fire, mechanical or manual treatments or prescribed fires, the ultimate result would be a loss of stand diversity and more contiguous areas of flammable spruce fuels. This would decrease the value of habitat for some wildlife species, such as moose, and risk forest health due to insect outbreaks. In addition, the risk of wildland fire to adjacent communities, private land inholdings, and public land users would be increased due to an accumulation of fuels.

3.2.5c Shrublands, Affected Environment

The *Alaska Vegetation Classification* (Viereck 1992) classifies shrublands as areas with more than 25 percent shrub cover and less than 10 percent forest cover. Shrublands account for about 30.1 million acres and approximately 35 percent of BLM-managed lands. Shrublands are common as post-fire seres on boreal forestlands, where they dominate post-fire sites from roughly 5-30 years after burning (Foote 1983). However, there are sites in Alaska where shrub communities are considered the potential natural vegetation. Mesic shrubland communities are noted on river terraces, deltas, lake margins, colluvial deposits, flood plains, and south-facing slopes. Alder and shrub birch form dense stands near altitudinal treeline in the foothills of the Alaska Range and willow/alder complexes dominate the western Alaska tall shrub belt in headwater drainage basins and below high elevation tundra types. Dense tall willows (especially feltleaf willow) are common in riparian zones, and medium willow (such as diamondleaf willow) line drainages in tundra areas, especially in the northern and western parts of the state. The understory varies considerably, consisting of dense grasses and herbs, or mosses and lichens. Vast shrub bog communities, dominated by ericaceous shrubs, are found on wet cold sites, generally underlain by permafrost, and have a thick organic mat. Stunted black spruce and dwarf arctic birch are often scattered throughout. This community grades almost imperceptibly into black spruce woodland and low shrub tundra. On very wet sites, all shrubs disappear and a bog characterized by sphagnum dominates. These areas are often left unburned when large fires burn surrounding, drier areas.

The fire history of shrublands has not been firmly established, but fire return intervals are speculated to be around 100-150 years, similar to adjacent forestlands, where they often originate. Typically fires burn slowly and with low intensity when they occur in this vegetation type, due to moisture, shading, and lack of fine ground fuel in dense shrub stands. Exceptions, however, are noted and under severe drought conditions and low relative humidity, shrub stands can burn with higher intensity. Shrub birch (*Betula glandulosa*) is recognized by firefighters for burning intensely once ignited due to its resinous leaves and twigs. Since fire occurrence is rare, and many of these communities are characterized by other types of disturbance (riparian willow communities, for example, are maintained by flooding and ice-scouring), fire regimes are likely to be within historical range and the risk of losing key ecosystem components is low (Condition Class 1) on most BLM-managed shrublands.

Post-fire revegetation in shrublands and bogs is primarily by resprouting of shrubs, grasses, sedges, and low-growing herbaceous plants. Because these vegetation types are fairly wet, fires rarely burn severely enough to burn all roots and rhizomes, and resprouting by shrubs is normally rapid following fire. After the rare event that a fire burns deeply into the organic layers, seed reproduction will assume greater importance, and recovery of the pre-fire vegetation will initially be slower.

3.2.5d Shrublands, Environmental Consequences

Appendix H describes potential treatments anticipated on shrublands. Shrublands designated Full Management Option will tend to result in progression to older, and possibly less productive sites without an active fuels management program. In tundra areas, willow in drainage eventually become decadent and do not grow as tall, as the organic duff layer thickens over time, resulting in cooler soils (Viereck *et al*. 1992). Under the Preferred Alternative, treatment of shrubland communities for purposes of enhancing wildlife habitat and precluding succession to more hazardous forest fuels near the urban and rural/wildland interface would tend to slightly increase shrubland vegetation on BLM-managed lands. The extent of such treatments would certainly account for a difference of less than 1% in shrubland vegetation between alternatives, due to practical considerations and per-acre cost. Fires in tundra transitional zones have been shown to facilitate colonization by shrubs, and increasing fire use in these areas will have the effect of converting some tundra areas to shrub dominated communities. It is expected that these areas would be small in extent and ultimately succeed back to tundra. However, they could be maintained and expand as shrublands by additional impact of warming climatic conditions (Rupp *et al*. 2000).

3.2.5e Herbaceous Communities (Tundra and Grasslands), Affected Environment

Vegetation dominated by grasses, sedges, forbs, or aquatic vegetation - either submerged or floating - with less than 25 percent shrub cover and less than 10 percent forest cover is classified as "herbaceous" (Viereck *et al*. 1992). Grasslands account for about 6.2 million acres and approximately 7 percent of BLM-managed lands. True grasslands communities are important ecosystems in the western United States but are relatively rare in Alaska. Grassy meadows are commonly found at lake margins, in recently drained lake beds, recently disturbed areas, and on old lacustrine and glacial deposits. They are frequently dominated by bluejoint grass (*Calamagrostis canadensis*), coastal ryegrass (*Elymus* spp.) or native fescues (*Festuca* spp.).

On the other hand, tundra herbaceous communities, including low shrub tundra and tussock tundra cover immense areas above treeline, in western Alaska, and north of the Arctic Circle. Tussock tundra is dominated by cottongrass (*Eriophorum vaginatum*). Other important species include ericaceous shrubs — such as Labrador tea, lingonberry, blueberry, and Kamchatka rhododendron — dwarf birch (*Betula nana*), dwarf willows (*Salix* spp.), mosses, lichens, sedges, and cloudberry. Shrub tundra is dominated by dwarf birch, blueberry, labrador tea, dryas, bearberry, cassiope, and dwarf willow. Tussock tundra will replace shrub tundra communities or lichen tundra communities for a variable period following fire, depending on burn severity and moisture regime (Jandt and Meyers 2000).

Mat-and-cushion tundra communities are located where harsh environmental conditions limit the development of vegetative cover, particularly in exposed, rocky and montane areas. Discontinuous low growing mats of vegetation, primarily of Dryas and prostrate willow, are found, along with ericaceous shrubs, forbs, sedges, grasses, and lichens. Fire occurrence is very low because fuels are sparse and discontinuous.

It is estimated that fire regimes in tundra and grasslands are within an historical range and the risk of losing key ecosystem components is low on most BLM-administered units (Condition Class 1). Vegetation attributes (species composition and structure) are intact and functioning within an historical range but information is still being collected on rare and relict plant species (which include some grasses and tundra forbs), and plants with limited distribution. To date, no adverse effects on rare plant species in Alaska from fire or fire exclusion have been documented.

3.2.5f Herbaceous Communities Environmental Consequences

Based on the conditions created by fire exclusion in grasslands in other states and Canadian provinces (i.e., encroachment of conifers), prescribed fire would be the primary tool used to achieve hazardous fuels reduction and function of natural processes in fire-dependent grassland ecosystems. Therefore, this analysis of effects focuses on the impacts associated with prescribed and wildland fires on grasslands. Mechanical treatments of grasslands (such as mowing) could also be used in combination with prescribed fire to control conifer encroachment. In planning any surface-disturbing activity, local factors are considered.

In general, the effect of fire on grasslands or tundra depends on the growth form, age of the stand, weather, and soil moisture. Many of the grass species are fairly fire resistant after green current annual growth appears. Following low-to-medium severity burns, grasses can produce new shoot growth within a week or two of the fire extinguishment. Fires in tussock tundra have been noted to burn with high intensity during very dry summers (Racine *et al.* 1987), but can sustain a ground fire whenever the relative humidity and fuel moistures are low due to the accumulations of grass litter. Typically tundra fires consume only the surface organic layer and are fought by "beating" the dry surface down to moist lower layer of vegetation and organic duff. However, in extreme drought (10-15 year events), fires can burn very deeply into the organic mat. Rapid melting of permafrost results which can produce mass wasting, subsidence, erosion and sediment deposition into drainages.

Prescribed burn projects are planned to allow for recovery of key plant species, and typically are scheduled during periods of higher soil and fuel moisture, higher relative humidity, and lower temperature. Prescribed fires to maintain grasslands are often conducted just after snowmelt in spring, while forest fire danger is still very low. Native vegetation re-establishes rapidly (without rehabilitation) following fires under these conditions, and the burn scar may not be apparent to an untrained observer by the end of growing season. Naturally-ignited wildland fires typically occur during June and July, when summer convective storms occur. Under these conditions, soil and fuel moisture and relative humidity are lower, and temperatures are higher. In general, artificial restoration (rehabilitation) would be necessary more often following wildland fire than following prescribed fire.

In some cases, short-term reductions in desirable species/uses may be necessary to achieve long-term benefits such as increased plant productivity. For example, burning lichen tussock tundra may reduce winter forage lichens for caribou or reindeer for 50-100 years, but may be necessary in tundra transitional areas to reduce conifer encroachment into these ranges.

In conclusion, by allowing wildland fire to perform its ecological role, most BLM-managed lands will remain in a proper functioning condition. Similarly, protection of particular habitats through fire management may be prioritized in future land use planning. Fuel treatments would help sustain the ecological health and function of fire-adapted grasslands, shrublands, and forestlands where, due to current land use, the objective is to exclude or minimize naturally occurring fires. Under the Preferred Alternative, fuel treatments by prescribed fire, manual methods or mechanical means are anticipated on approximately 20,000 acres annually. Treatments are prioritized in areas where the objective is to increase protection of human life and property, but are an option to protect, maintain, or enhance habitat as well. On areas with Condition Class 2 and 3 attributes that are not treated, and where the appropriate management response is to exclude or minimize wildland fires for protection of private property or fire-sensitive resources, trends (conditions) created by fire exclusion would continue, including:

- Large, continuous expanses of flammable fuel in fire-adapted forests that are beyond their natural fire return intervals. These stands may be more vulnerable to insects and disease.
- Loss of some grassland and shrubland habitats to conifer encroachment.
- Moderate to high potential for wildland fire.

These potential impacts are more likely under the No Action than the Preferred Alternative.

3.2.6 Visual Resource Management

Visual Resource Management classifications are incomplete for BLM-managed lands. Wildland fire is an integral part of the ecological process that maintains or enhances natural visual diversity. No adverse impacts from wildland fires are anticipated. The visual impacts of fuels treatment projects will need to be evaluated on a project-by-project basis.

3.2.7 Wildlife

3.2.7a Affected Environment

Fire is a natural disturbance affecting a large portion of upland areas within mainland Alaskan, particularly the northern boreal forest or taiga (Viereck 1973). Fire is the primary agent of change in the boreal forest and is responsible for maintaining habitat heterogeneity in the large portion of mainland Alaska that is covered by a mosaic of coniferous and deciduous forest, shrub, meadow, and bog habitats. Higher elevations throughout the boreal forest contain dry tundra, whereas large coastal regions of western and northern Alaska are dominated by wet tussock tundra and wetlands. Natural fire is rare in coastal areas of the Alaska Peninsula, Gulf of Alaska, and Southeast Alaska. The few accidental human-caused fires near the southern coast are usually contained within small areas by natural barriers such as water bodies and rocky outcroppings near ridge tops, so fire is a minor influence on wildlife habitat in that region. Wildlife communities are various and responsive to the heterogeneity, size variation and juxtaposition of habitats. There are key life stage periods where wildlife may be particularly vulnerable to negative effects. These would be nesting and brooding periods for many bird species. for example. Fire enhancement of post fire insect populations and increased woodpecker productivity around the edges of large burns is another of a myriad of potential affects of fire on the environment that affects wildlife abundance and distribution.

Fire is rare on the Arctic Slope, and areas burned tend to be small. The role of fire in the tundra ecosystem is less conspicuous than in the northern boreal forest but nonetheless contributes to habitat heterogeneity. Most wildlife species inhabiting tundra and wetlands of the Arctic Slope are widely dispersed and occur at low densities, with large mammals generally ranging over wide areas. Loss of relatively small burned areas within their range has little effect, although some species may take advantage of increased forage and seed production in recent burns. The infrequent, small fires on the Arctic Slope will not meet all yearly habitat requirements of large species, and population responses will be less pronounced than in Interior ecosystems. Fires may have a significant effect on the habitat of localized populations of small, sedentary species.

3.2.7b Environmental Consequences

Generally, the effects of fire on habitat are more significant than the effects on existing animals (Viereck and Schandelmeier 1980). Habitat changes determine the suitability of the environment for future generations of animals. Fires may have a short-term negative impact on existing animals by displacing or sometimes killing them or by disrupting critical reproductive activities. However, populations recover quickly if suitable habitat is provided. Fire maintains the mosaic of vegetation types and age classes that provide habitat for a wide variety of species. The adverse effects that the immediate generation of wildlife may experience are usually greatly offset by the benefits accrued to future generations. Herbivores are directly affected by changes in vegetative cover and forage associated with fire, whereas predators respond indirectly to changes in both cover and abundance of their primary prey.

Boreal forest wildlife has adapted to the presence of fire, so maintenance of a natural fire regime should be viewed as positive for maintaining habitat and wildlife diversity at the landscape scale. Even those species normally associated with mature stages of vegetation are able to accommodate and benefit from some level of disturbance by fire.

The grasses, sedges, and herbaceous plants that quickly re-establish on burned areas provide forage and cover for small mammals, several species of grassland or steppe birds, and grazing species such as bison (*Bison* spp.) and muskox (*Ovibos moschatus*). A change in species composition and abundance of small mammals usually occurs following a fire. This abundance of small prey animals in turn makes the recently burned area an important foraging area for predatory mammals and birds. However, the size of the fire and the subsequent proximity to cover and denning or nesting sites affects the degree of use by these larger animals (Magoun and Vernam 1986, Johnson *et al*. 1995).

Fire severity and frequency greatly influence the length of time that this grass and herbaceous plant stage will persist. Severe burning delays the re-establishment of shrubs, a benefit to grazing animals and seed-eating birds. Frequent re-burning of a site further retards generation of shrubs and seedlings and prolongs the grassland environment.

Browsers such as ptarmigan (*Lagopus* spp.), snowshoe hares (*Lepus americanus*), and moose (*Alces alces*) can benefit from the fire as soon as shrubs and tree seedlings begin to reestablish. If a fire leaves most of the shrub root and rhizome systems intact, sprouting will occur very soon after burning. In the case of early season fires, some forage may be available by the end of the growing season, and use by browsing animals is dependent upon the local populations of wildlife on or near the fire area at the time of the fire. Post fire use may range from be very high to very low. Forage quality is improved, with higher digestibility, protein, and mineral content for a few years after fire (McCracken and Viereck 1990). As tall shrubs and tree saplings begin to dominate, the site becomes increasingly able to provide shelter and forage for a greater variety of wildlife. Although the rate of regrowth varies among burned areas and is dependent on many factors discussed earlier, this productive stage can persist for as long as 30 years after fire.

The greatest diversity of wildlife typically will be found during the tall shrub-sapling stage. Many species, which up to that point have frequented the burned area only to hunt or forage, begin to find that it provides edge effect complexes, shelter and denning or nesting sites. This abundance and diversity of wildlife, in turn, makes these burned areas extremely important to people, whether it be to hunt and trap or to view and photograph. Fire may enhance human accessibility to wildlife when burned areas or firelines are used as transportation corridors.

On most sites the young trees outgrow the shrubs and begin to dominate the canopy after 25-30 years. At this point the shrub component thins out and changes, as more shade-tolerant species replace the willows. Subsequently, use by browsing animals declines. On mesic sites that are developing into black spruce forest, lichens become important during this period and increase in abundance for 50 to 60 years. As the forest canopy develops and the understory species disappear, a burned site becomes progressively more unproductive. Relatively few animal species can find the requirements necessary for their survival in the mature black spruce that will eventually develop in the absence of further fire. Lichens are slowly replaced by feather and sphagnum mosses. On valley bottoms where a muskeg bog situation exists, lichen cover also develops but, contrary to the upland sites, lichens may persist as succession advances.

Large, severe fires are generally not as beneficial to wildlife as are more moderate fires. Fires of low severity and intensity quickly benefit browsing animals and their predators by opening the canopy, recycling nutrients, and stimulating sprouting of shrubs. In addition, the mature trees that are killed but not consumed by the fire provide perches and sites for cavity nesting by several raptors and passerine birds. A severe fire that burns off the aboveground biomass and kills root systems can result in site conversion to different plant species via seed dispersal, which is a slower process to regenerate browse and cover than sprouting from existing rootstock. However, in the long term it improves carrying capacity for browsing species by converting conifer stands to shrubs and deciduous-dominated forest for several decades.

Some sites have progressed so far toward a spruce forest community that very little shrub understory exists from which re-vegetation of the site may occur. Some sites are so cold and poorly drained that black spruce or tamarack has a competitive edge over the less cold-tolerant shrub species. In these situations, a light fire simply results in more spruce. Severe or frequently recurring fires are necessary to kill the seeds in the spruce cones and prepare a suitable seedbed for other species. Then the value of the site to most species of wildlife is enhanced.

The following species accounts largely focus on game species because of their importance as food for humans and the extent of effort by state and federal agencies to manage their habitats and sustainable harvest. The list of species was compiled from the 13 regional fire plans written in Alaska during 1982-88. This brief review is not a complete account of the various limiting factors on wildlife populations (food quantity and quality, thermal cover, predation, disease, etc.).

The review focuses primarily on habitat relationships with respect to fire effects and is not a prescriptive guideline to increase wildlife abundance. A positive response in species abundance after fire should be expected only when fire enhances a limiting factor, such as food or cover. Carnivores tend to respond to fire in a manner similar to that of their primary prey, although specialized denning or nesting structures may be important also. Whereas larger mammals and adult birds can typically disperse from burning forest in boreal regions, fire may occasionally kill small mammals (if it burns deeply into the organic layer where they take shelter) or nestling birds. Critical reproductive activities can be disrupted the year of the fire, but subsequent improvement in vegetative productivity and habitat diversity usually cause populations to exceed pre-fire abundance within a few years after burning.

An overview of effects on large mammals, small mammals, furbearers, and birds follows:

➢ **Large Mammals**

- ***Black bears (Ursus americanus) and grizzly bears (U. arctos):*** Bears are omnivorous, and fires often increase the availability of both plant and animal foods in some habitats and decrease preferred foods on others. Blueberries, cranberries, and soapberries often increase following fire, particularly in upland areas (Johnson *et al*. 1995), and fires quickly rejuvenate a variety of grasses and forbs consumed by bears in spring and summer. Devil's club fruits are favored by black bears on the Kenai Peninsula; fire eliminates that species for many years.

  Moose calves are important in the diets of both the black and grizzly bears in the springtime. Early stages of plant succession tend to increase moose production; therefore, more calves are available as prey. Because grizzly bears are wide-ranging and tundra fires are small, fire has relatively little direct affect on grizzly populations. Fire has no effect on *polar bears (U. maritimus)* that are only found inland when they den during winter along some of the rivers of the arctic slope in northeastern Alaska

- ***Plains bison (Bison bison bison):*** Currently about 900 *plains bison* (*Bison bison bison*) exist in four wild herds in Alaska. Additionally, several hundred plains bison exist in domestic herds in interior and southcentral Alaska (Steve Trickett and Ed Arobio, Alaska Dept. Natural Resources, Division of Agriculture, in litt. to Tom Paragi, Alaska Department of Fish & Game (ADF&G). This species was first introduced to the Delta Junction area from Montana in the 1920s, and this founder stock was subsequently used for introductions of free-ranging herds to Farewell, Copper River, and Chitna. Dated skeletal remains and historic accounts demonstrate that *wood bison (B. b. athabascae)* were native to Alaska for thousands of years but disappeared during the last few hundred years, likely because of changes in habitat distribution combined with the effects of hunting. About 3,000 free-ranging wood bison remain in northwest Canada, and ADF&G is working with a coalition of interested groups to restore wood bison to a suitable range in Alaska where they could exist in isolation from existing herds of plains bison. Bison are principally a grazing species that utilizes windswept floodplains, recent burns, and natural meadows in boreal forests to obtain grass, sedges, and herbaceous plants as forage (Campbell and Hinkes 1983, Waggoner and Hinkes 1989, Berger 1996). Herds may also forage on the leaves and twigs of woody shrubs such as willow for short periods in early summer. Wildland fires are typically beneficial to bison by removing woody cover to allow soil warming and rejuvenation of grasses and forbs. Severe burns that kill rootstock of trees and shrubs may prolong the grass and forb stage after fire. Repeated fires in a short return interval can have the same result by killing trees and shrubs before they mature enough to produce seeds. The August 1977 fire in the Farewell area stimulated forage that was utilized by bison during the summer, fall, and winter (Campbell and Hinkes 1983, Waggoner and Hinkes 1989). Where bison are present, a management program that entails periodic burning to preclude invasion by shrubs and trees can supplement the rangeland that is naturally available along the braided river courses. The Farewell plains bison herd occupies a mix of State and BLM-managed lands south of McGrath. ADF&G has led an effort for prescribed burning on State land occupied by the Farewell herd and is working with BLM on fire management options and prescribed fire planning on adjacent federal lands. ADF&G is also currently identifying potential habitat for wood bison (large meadow complexes in woodland black spruce) in the Interior, some of which may occur partly on BLM-managed lands. Key criteria for potential release sites include adequate forage of preferred species, snow conditions that allow forage access, and suitable logistics for transporting bison to a fenced enclosure for a gradual release program.

- ***Barren ground caribou (Rangifer tarandus granti) and woodland caribou (R.t. caribou):*** Caribou have definitive summer and winter ranges, the latter often occurring in taiga (Russell *et al*. 1993). Lichens are the major forage for caribou in winter and typically take 80 years after fire disturbance to achieve biomass suitable for caribou winter range (Klein 1982). Forage lichen biomass in the Fortymile region was greatest in 80-220 year-old stands but virtually absent from stands less than 60 years old (Joly *et al*. 2003). Fire reduces immediate forage quantity by removing vegetation, but it can also reduce availability of winter forage to caribou if deadfall inhibits travel and snow interception by conifers no longer occurs. Deeper snow inhibits forage detection by smell and increases energy spent on digging to forage. Fire can produce short-term positive responses in sedges and other winter-green plants (Viereck 1973, Racine *et al*. 1987, Saperstein 1993). Caribou may be better characterized as influenced by fire rather than adapted to fire. Fire intervals $\geq$100 years maintain the ecological diversity of caribou range, and short-term effects of fire on parts of a winter range are not detrimental if the herd is below the range carrying capacity (Klein 1982). Caribou are nomadic, and each herd has historically utilized a range much larger than necessary to meet its short-term food needs. Light fires may rejuvenate stands of lichens with declining production, and fire replaces old forest stands where lichens have been replaced by mosses. Periodic fire creates a mosaic of fuel types and fire conditions that naturally preclude large, extensive burns. However, even light fires recurring on a short rotation may result in forests being replaced by grasslands or shrub-dominated communities, thus reducing range available for caribou. A natural fire regime is generally desired for maintaining wildlife habitat, but there may be instances where recovery efforts for specific herds (e.g., Fortymile and Chisana herds in eastern Alaska) may benefit from occasional fire suppression within a larger area of a Limited Management Option designation. Where winter range is well defined for the smaller caribou herds, managers might plan for an acceptable rate of range replacement by fire. For example, allowing no more than 5% of the range to burn per decade gives complete range replacement (turnover by fire) in 200 years. Assuming you start with good quality range ($\geq$60 years old) over the entire area, allowing $\leq$5% of the range to burn per decade without spatial overlap (reburn of young range) would maintain $\geq$70% of the range in the 60-200 year age class over the long run. If >5% burns in an extreme fire year, greater suppression vigilance in the next decade within the defined area can get replacement rate back on schedule.

- ***Dall sheep (Ovis dalli dalli):*** Sheep are usually adapted to climax vegetation communities because fire is relatively rare on subalpine sites (Hoefs 1979). Winter range, lambing areas, and mineral licks are critical elements of Dall sheep habitat. In some circumstances, fire may enhance sheep range by reducing spruce and shrub encroachment into subalpine habitat. Renewal of more open habitat can increase the amount or short-term quality of herbaceous or gramminoid forage and reduce ambush cover used by bears and wolves, particularly near licks and along lower-elevation migration routes among seasonal ranges. The sheep winter and spring ranges along Cook Inlet south of Anchorage is an example of an area that fire could potentially benefit sheep. Seip and Bunnell (1985) studied the effect of prescribed fire on summer and winter ranges of stone sheep in northern British Columbia. Although spring forage quantity was increased in the burned areas, forage quality (crude protein and acid detergent fiber) was not. Similar intake rates on burned and unburned range demonstrated that spring range was not a limiting factor. However, winter range was effectively limited to windswept areas (<30 cm snow), in which instance the burned range provided far more forage than unburned range. Higher lamb production and lower counts of lungworm larvae (*Protostrongulus* spp.) in feces were subsequently observed in the population using burned subalpine range as compared to a population on unburned alpine range (Seip and Bunnell 1985). For population-level benefits to sheep, burning should be focused on areas of winter range where snowfall typically is removed by wind. However, in the Chugach and much of the Alaska Range, this may not be beneficial. Research on Alaska Dall sheep is limited and not specific to different mountain complexes or habitat differences; little is known about Dall sheep winter and spring habitat use and distribution.

- ***Moose (Alces alces):*** Fire benefits moose populations primarily by increasing quantity (availability) of forage for two to three decades and improving quality (nutritional value) of forage for a few years following disturbance (MacCracken and Viereck 1990, Peek 1997). Moose respond to disturbance at two scales. At the stand scale, local herds can be affected by individual fires or habitat alterations (such as timber harvest sites), whereas several herds may respond to regional habitat changes at the landscape scale of thousands of square miles (Thompson and Stewart 1997). Fire management options are germane to habitat at the landscape scale. Fire suppression activities have interrupted the natural fire regime near larger communities (Chapin *et al*. 2003), which overall is detrimental to moose and other species dependent on early forest seral stages. Moose are relatively philopatric to seasonal ranges and migration routes, so colonization of a specific burn may take several years through dispersal if it was not utilized as range prior to the burn (Gasaway *et al*. 1985). Allowing wildland fires to spread will increase opportunities for moose to encounter enhanced forage on seasonal ranges or in migration corridors. Large fires often contain numerous unburned inclusions that provide concealment from predators and may allow better utilization by cows (Weixelman *et al*. 1998). Numerical response by moose to burns may occur most rapidly where range enhancement improves body condition and overwinter survival of cows. Thus, sites for prescribed burning to enhance moose populations should be chosen based on knowledge of important range already occupied by moose, particularly upland ranges adjacent to floodplain willow communities maintained by fluvial action (flooding, ice scouring) or early-successional habitats maintained by human activity near settlements (logging, land clearing). If a moose population is being limited by factors other than poor habitat (e.g. predation), moose may be slow to effectively utilize new habitat created by burning, and moose numbers may not increase dramatically.

- ***Muskoxen (Ovibos moschatus):*** Muskox are restricted to treeless habitats because they rely on visual detection of predators to form their defensive grouping. Their principal forage includes forbs, graminoids, and willow leaves in summer and sedges in winter. Similar to caribou, they require a high quality diet during the brief arctic summer to enhance nutritional reserves necessary for winter survival, and snow dynamics play an important role in access to forage (Klein 2000). Fire is relatively rare in arctic tundra. Fire effects on muskoxen range is likely positive because it maintains herbaceous forage and willows, reduces encroachment of spruce forest into tundra, increases habitat heterogeneity, and rejuvenates decadent or over-browsed riparian communities. Habitat selection and distribution of muskox relative to fire has not been studied in depth.

- ***Roosevelt elk (Cervus elaphus canadensis):*** Herds on Raspberry and Afognak Islands were transplanted from Washington in 1928, and herds have subsequently been established in southeast Alaska. Fire is not a common natural feature in coastal spruce-hemlock forest. Mature Sitka spruce in coastal winter ranges is important for cover and to provide food in periods with deep snow conditions. Occasional burning of areas dominated by grass/shrub and patchy spruce would probably result in improving summer range by stimulating new growth of herbaceous vegetation. Wildland fire in mature coastal spruce could be a serious detriment to elk. Considering that much of the elk winter range on Afognak Island has been logged, there is little need for additional clearing through wildland fire.

- ***Mountain goats (Oreamnos americanus):*** Goats are found in alpine and subalpine areas, typically with steep bedrock outcroppings as escape terrain. Goats in Alaska generally inhabit coastal mountains where deep snowfall forces animals to winter in adjacent late-seral coniferous forest that intercepts snowfall and allows access to forage (Fox *et al*. 1989). Winter food habits are quite varied for goats and they utilize a wide range of woody browse, evergreen foliage as well as cured herbaceous matter. In more inland areas in the Talkeetna and Chugach mountains and, in low snowfall winters, in the Haines region, windblown alpine and subalpine habitats become important winter habitat. Summer habitat is predominantly herbaceous growth at higher elevations, thus has low fire potential. Most of the nanny-kid groups utilize highly productive subalpine meadows to meet nutritional needs of lactation. Fire in subalpine areas might improve forage condition by stimulating early growth of herbaceous vegetation and reducing ambush cover for predators. Loss of bordering old growth forest habitat would likely be detrimental to the goat's winter cover and food needs.

- ***Sitka Black-Tailed Deer (Odocoileus hemionus):*** Deer select herbaceous forages whenever available but often resort to browse during winter (Hanley *et al*. 1989). The infrequent and often small wildland fires in coastal spruce-hemlock forest typically have little effect on Sitka black-tailed deer populations. Stimulation of herbaceous growth by fires will enhance summer range, and small fires in dense stands of younger spruce might enhance range conditions. Extensive burning of mature Sitka spruce in coastal winter range are detrimental to deer, which depend on old-growth forest for cover and accessible forage during periods of deep snow accumulations (Kirchhoff and Schoen 1987). Limited burning of logging slash has been done in coastal Alaska as a silvicultural practice and may remove post-logging barriers to wildlife movement, but low ambient temperatures and high fuel moisture content makes burning difficult.

➢ ***Small Mammals***

- ***Yellow-cheeked voles (Microtus xanthognathus):*** Small mammals (particularly voles and lemmings) are the primary prey base of many small and medium-sized carnivores in boreal forest. Fires benefit most small mammals in the long run but may cause temporary declines in their populations for one to two years following fire. The grasses, sedges, and fireweed that recover following fire are the primary foods of voles, which begin to occupy areas soon after fire (Magoun and Vernam 1986, Johnson *et al*. 1995). The yellow-cheeked voles occur primarily in early-successional habitats, often those created by fire (Lehmkuhl 2000). Yellow-cheeked voles require burns that do not remove all the litter layers. These voles are only found after fires in the thick duff or organic islands; they are the key prey base for dispersing young pine martin that move onto burned areas from the occupied territories of their parents.

- ***Red squirrels (Tamiasciurus hudsonicus) and northern flying squirrels (Glacomys sabrinus):*** Squirrels are adapted to late-seral coniferous forests. These squirrels are dependent on white spruce seed, fungi, lichens, and berries for food and may be adversely affected by fire in the short term.

- ***Snowshoe hares (Lepus americanus):***These hares are a browsing species that undergoes dramatic population cycles of abundance and scarcity over 8-11 year periods that are driven by predation (Krebs *et al*. 2001). During population lows, hares prefer refugia that provide cover from terrestrial and avian predators (Keith 1990, Wolff 1980) but use a variety of habitats during population highs, including even severely burned areas. Summer diet consists largely of herbaceous plants and leaves from low shrubs, which are more abundant and nutritious on recently burned sites. Snowshoe hares are most abundant in willow, birch, and aspen stands with typically high browse production 5-25 years after fire (Paragi *et al*. 1997) and may use older stands of black spruce and thick alder tangles during lows in their 10-year cycles. Small fires or large fires with numerous unburned inclusions of black spruce or other heavy cover should provide optimal habitat for hares.

- ***Tundra hares*** (***L. othus***)**:** Shrubland and tundra of northern and western Alaska to the margin of boreal forest are the habitats of the tundra hares. Fire is relatively less frequent in this region than in boreal forest and serves to reduce encroachment of forest.

- ***Furbearers***:

- ***Muskrats (Ondatra zibethica):*** Semi-aquatic species such as muskrats have flexible habitat requirements beyond access to permanent water and protected sites for shelter and rearing of young (Boutin and Birkenholz 1987). Fire rejuvenates herbaceous forage, and fire in dry herbaceous vegetation such as cattails serves to maintain open marshes where vegetative succession is progressing toward shrubland or forest.

- ***Beavers (Castor Canadensis):*** These are a keystone species in northern aquatic ecosystems, maintaining habitat for waterfowl and fish, and they are important to subsistence users as pelts and food. Beavers benefit from the abundance of shrubs and deciduous saplings maintained by fluvial processes along streams, and forage can be enhanced along wetlands and lake shores by fire because roots remain intact in moist soil when fires sweep over the surface. Beaver populations can be depressed by severe fires until forage species recolonize. However, beavers can persist by utilizing large roots of aquatic plants that proliferate in lakes surrounded by severe burns, possibly as a result of ash fertilization (Stephen Attla, Huslia, pers. comm. to Tom Paragi, ADF&G). Furbearers other than beaver and muskrat are carnivorous and tend to respond to fire in a manner similar to that of their primary prey (Stephenson 1984).

- ***Wolves (Canis lupus):*** Wolves have fairly large pack territories and prey upon a variety of mammals. The abundance of wolves is largely dependent on prey availability, and wolves benefit from fires that develop habitat conditions favoring prey species. Large fires in caribou winter range may displace herds (Joly *et al*. 2003) but improve habitat for moose. In this instance, wolves may cease to use the caribou range or switch to alternate prey species encountered more frequently.

- ***Red fox (Vulpes vulpes)*** and ***coyote (Canis latrans):*** These species subsist primarily on rodents and hares, thus benefit from fires that produce openings within the boreal forest or result in replacement of forest with grassland. Depending upon the numerical response of prey, the first couple of decades following fire should benefit the smaller canids (Stephenson 1984).

- ***Arctic fox (Alopex lagopus)*****:** The Arctic fox inhabit predominantly coastal areas and islands, feeding largely on nesting birds, rodents, and beach carrion. Because of the damp climate, fires seldom occur in coastal areas and often have minimal effects.

- ***Lynx (Lynx canadensis):*** Lynx prefer the same habitat types as snowshoe hares, their primary prey, which are often most abundant in mid-successional forest and shrubland (Paragi *et al*. 1997). Fires that benefit hares by increasing browse production in association with adequate cover will also benefit lynx. Fires with numerous unburned inclusions should create optimal conditions for hares and lynx because large debris typically found in old burns and mature forest is used for maternal denning sites by lynx (Slough 1999).

- ***Marten (Martes americana):*** Marten can be abundant in recent burns, foraging beneath the snow surface and using burned trees as escape cover from terrestrial predators (Paragi *et al*. 1996). Voles make up the majority of the marten's diet and they do especially well in burned areas where grasses, sedges, and fireweed are abundant soon after the fire occurs (Magoun and Vernam 1986, Johnson *et al*. 1995). Birds and berries can also compose a large part of the marten's diet in some years. Mature forest on the burn periphery and unburned inclusions may be important for maternal denning in martens (Paragi *et al*. 1996).

- ***Others:*** The ***least weasel (Mustela nivalis)*** and **muskrats (*Ondatra zibethica*)** also benefit from the increased vole abundance that usually follows burning. Fire has little effect on ***wolverines (Gulo gulo)*** because they are wide-ranging, use a variety of habitats and prey, and often den above treeline. Wolverine are primarily scavengers that indirectly benefit from fires that enhance populations of their prey species.

- ***Birds***

- ***Waterfowl:*** Fire near wetlands and riparian areas can consume dead grass, sedges, and shrubs, thus opening up dense marsh vegetation to a degree that maintains habitat for waterfowl. Burning also stimulates the growth of new shoots that are of greater forage quality and nesting value. In dry summers, peat marshes can burn down to the point where new bodies of water are created. Burning removes old marsh vegetation and allows soil warming where permafrost or ice lenses are prevalent. Without fire, some ponds may be filled in by marsh vegetation. Organic matter accumulation will then favor the establishment of shrubs and trees. Fire can have a short-term negative effect on waterfowl when it occurs during nesting or molting periods, and reduction of woody vegetation may reduce suitability to some species requiring overhead cover during nesting.

- ***Gallinaceous birds:*** Grouse and ptarmigan generally benefit from the increased forage and cover diversity created by fires in the boreal forest. ***Sharp-tailed grouse (Tympanuchus phasianellus)*** are a steppe species that prefers the open, shrubby areas created by fire and found in muskeg bogs. Insects and berries are a common summer-autumn forage for these birds, and dwarf birch (*Betula nana/glandulosa*) is a primary winter forage (Raymond 1999). Sharp-tailed grouse extensively utilize open areas of young burns for foraging and for essential reproductive activities such as "lekking" (male display). ***Ruffed grouse (Bonasa umbellus)*** numbers may be initially depressed by the occurrence of a fire; however, they begin using the burned areas extensively as summer foraging and brood rearing sites when the sapling stage develops. Aspen buds are an important winter forage for grouse. Fire is important to ruffed grouse because it maintains aspen clones in the boreal forest. Despite a preference for mature coniferous forest, ***spruce grouse (Falcipennis canadensis)*** may benefit indirectly from patchy fires that maintain dense stems for brood rearing cover and foraging sites for insects and berries in early-successional forest. Alaska is inhabited by ***rock ptarmigan (Lagopus mutus), white-tailed ptarmigan (L. leucurus)***, and ***willow ptarmigan (L. lagopus)***. Ptarmigan breed in the alpine areas at higher elevations and frequently segregate by age and sex during winter, with males remaining in higher elevations. Ptarmigan forage on forbs and berries during summer (with young consuming insects for protein) and switch primarily to buds of shrubs and deciduous trees during winter. Fires near treeline could increase ptarmigan nesting and brooding habitat by removing spruce trees that are encroaching on alpine tundra sites, and fire in boreal forest often increases availability of winter forage and cover. Fire or the lack thereof is not a limiting factor relative to ptarmigan habitat in Alaska.

- ***Passerine Birds:*** The habitat requirements for passerine birds vary greatly with their nesting and foraging requirements. ***White-winged crossbills (Loxia leucoptera)*** and ***pine grosbeaks (Pinicola enucleeator)*** are specialized in feeding on seeds, buds, or fruits and prefer spruce forest, whereas others like ***yellow warblers (Dendroica petechia)*** are insect gleaners found primarily in shrubs and young broadleaf forest. ***Black-backed woodpeckers (Picoides arcticus)*** and ***three-toed woodpeckers (P. tridactylus)*** move immediately into burned areas (Murphy and Lehnhausen 1998), and others, such as ***olive-sided flycatchers (Contopus cooperi)***, take advantage of forest openings and edge effects created by fire. Many species frequent younger seral stages of vegetation and are most abundant in areas of greatest plant diversity. Shrub and sapling seral stages often support the greatest diversity and abundance of passerine species (Spindler and Kessel 1980, Kessel 1998, Johnson 1999). Ground, shrub and timber nesting birds are particularly vulnerable to fire in nesting and brooding periods in wet and dry tundra and gramminoid dominated habitats and regions.

- ***Raptors:*** Hawks, owls, eagles, and falcons may benefit from fire. Small raptors that feed on voles and mice benefit most rapidly by rejuvenation of herbaceous vegetation that is preferred by some rodents and birds. These species include ***American kestrel (Falco sparverius), boreal owl (Aegolius funereus),*** and ***northern hawk owl (Surnia ulula)***. Raptors that specialize in preying on hares and grouse benefit the most when shrubs and sapling trees invade the burned site. These larger raptors include ***northern goshawk (Accipiter gentilis), red-tailed hawk (Buteo jamaicensis),*** and ***great horned owl (Bubo virginianus)***. Fires produce standing dead trees (snags) that are excavated for primary cavity nesting by woodpeckers and great gray owls for hunting perches and nest sites. Short eared owls, snowy owls and northern harriers inhabit open tundra habitats and burns create short term vulnerability of prey species and high productive post burn prey populations. Merlins prefer tall shrub communities that provide abundant passerine prey populations. Some raptors (American kestrel and boreal owl) and passerines (*tree swallow [Tachycineta bicolor], mountain bluebird [Sialia currucoides], some chickadees* [*Poecile* spp.]) practice secondary cavity nesting. Regardless of perimeter size, fires with many unburned inclusions of mature forest provide foraging habitat interspersed with nesting structures. ***Sharp-shinned hawks (Accipter striatus)*** prefer dense young stands of conifers or mixed conifer-deciduous forest. In interior Alaska, wildland fires may be the most important factor influencing sharp-shinned hawk distribution and abundance (Clarke 1984).

There is anecdotal and oral-history evidence of indigenous burning in Alaska (Lutz 1959, Roessler 1997) and boreal Canada (Lewis and Ferguson 1988) to maintain open areas and early-successional habitat for game prior to the influx of Europeans. More recently, cattle ranchers practiced spring burning of grassland-shrub vegetation for many years on northeastern Kodiak Island. The ranch fires stimulate green-up of grasses and other herbaceous vegetation by removing heavy accumulations of leaf litter, thereby fertilizing and warming the soils. However, repeated burning allows grasses, salmonberry, and other herbaceous vegetation to replace the normally dominant woody species such as alder, elderberry, birch, and cottonwood. This change benefits wildlife species adapted to a grassland environment, but browsing animals are largely displaced.

Suppression guidance from the Alaska Interagency Wildland Fire Management Plan, driven by increasing fiscal constraints and a growing realization of the ecological role of fire, has resulted in a largely natural fire regime outside of developed areas (commonly referred to as the Wildland-Urban Interface). However, fire suppression has effectively reduced fire size and amount of area burned near population centers (Chapin *et al*. 2003), which reduces the amount of early-successional habitat in these areas. The reduced extent and frequency of disturbance near forested communities allows spruce to dominate the canopy over time, which increases risk of spreading future fires.

Fuels management at the stand scale in developed areas can be compatible with habitat enhancement objectives because maintenance of early-successional broadleaf forest and shrubs creates a relatively low-risk fuel type that provides cover and forage for many species of boreal wildlife. Following a fuels assessment by fire professionals, stand-scale vegetative treatments can be judiciously located to help protect communities from fires originating in wildlands and in turn provide subsistence resources (game, berries, mushrooms) adjacent to communities. Subsequent disturbance on a relatively short rotation schedule (30-60 years) through prescribed fire or mechanical or manual treatment will prevent establishment of a continuous spruce understory capable of spreading fire beneath the hardwood overstory. However, adequate late-seral features (snags, cavity trees, woody debris, old growth) and islands with various successional seral stages must be retained during fuel treatment activities to provide denning or nesting habitat for wildlife species that otherwise favor early-seral forest.

3.3 Cumulative Effects

Wildland fire is an historic and vital component of Alaskan ecosystems, an essential ecological process and natural change agent. Modern (post 1988) fire management on BLM-managed land in Alaska has allowed natural processes to continue. 92% (78 million acres) of BLM-managed land has been under Limited and Modified suppression options set by interagency agreement. This is proposed to continue with the Amendment. On the remaining 8% (7 million acres) of BLM-managed land, fire is suppressed with high proficiency. Fire consumes approximately 0.023% (22,000 acres) annually.

The effect of designating land Limited Management Option is considered nil, since this is equivalent to the baseline condition of natural ecosystems in Alaska.

Suppression of wildland fires on the remaining 8% of BLM-managed land may cause long term departure from the natural process. It also introduces effects of fire management activities such as retardant[21].

Exclusion of fire itself raises its risk, intensity, and severity. Exclusion also favors late seral stage vegetation, which is desirable for some species and not desirable for others.

Suppression activity on the ground may cause local changes, but lasting changes must result from other decisions, such as maintenance of new trails and roads. Firelines may be attractive avenues for OHV use, and become travelways.

Retardant will change in formula in upcoming years, and probably will have little environmental effect in the future. The pattern of retardant use diminishes potential effect as it is excluded from use within at least 300 feet of waterways, a primary site of chemical effect and vector for the spread of effects. By following national guidelines and the additional mitigation measures that have been added in Section 2.5.5a, negative impacts of retardant should be minimized.

Prescribed fire and fuels reduction also introduce effects, although similar to the natural process. Historic and even prehistoric human use of fire and igniting wildfires in Alaska is documented.

With practices of prescribed fire and fuels reduction continued consistently, benefits will accrue. Both practices will prevent disastrous wildfires affecting human safety and property, as well as ecosystems. Ecosystems will benefit by both control of wildfire intensity and severity, but also by rotation of seral stage in a manner consistent with natural processes or to attain a desired future condition for a specific objective, such as bison range. These practices may benefit land in any fire management option. Fuel management may be paramount in critical and full suppression areas, yet bestow benefits of habitat diversification and renewal as well. Fuel management activities will be more localized on modified and limited option land, but prescribed fire may be used to benefit local ecosystems on a small scale of up to 20,000 acres each year. Controlling the size of fire, its intensity, and severity will cumulatively benefit subsistence species and species with specific habitat requirements. It is important to note that specific prescribed fire and fuels reduction projects will be either discussed in future land use plans or, at minimum, documented with their own NEPA process addressing site specific proposals, before action is taken.

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[21] Issues regarding the composition and use of retardant are addressed in Appendix N.