# WILDLAND FIRE MANAGEMENT PLAN

## Turnbull National Wildlife Refuge

2001

# Turnbull National Wildlife Refuge Fire Management Plan
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## EXECUTIVE SUMMARY

Turnbull National Wildlife Refuge (NWR) was established in 1937 under presidential executive order #7681. The objective of protecting and preserving the area was to provide productive breeding and nesting ground for migratory waterfowl and other wildlife. Turnbull NWR is administered and managed by the U.S. Department of Interior, Fish and Wildlife Service with the primary management objective of providing quality breeding and migratory habitat for diving and dabbling ducks and Canada geese, with special emphasis on redhead and canvasback (diving duck species), and maintaining the rich diversity of plants and wildlife that are found within the refuge.

Turnbull NWR occupies approximately 16,000 acres of channeled scabland on the eastern edge of the Columbia River plateau. The ecosystem that predominates the refuge is unique within the National Wildlife Refuge System and has characteristics that distinguish it from natural reserves worldwide. Satellite imagery of eastern Washington depicts Turnbull NWR as a singular green island of forest, disconnected from the Rocky Mountains to the east and surrounded by the dry, agricultural wheat fields of the eastern edge of the Columbia Plateau. The powerful forces of volcanism, glaciation and the largest flood in geological history have combined to forge a distinct environment. The combination of basalt outcrops, channeled canyons, pine forest uplands and diversity of wetlands and lakes make Turnbull NWR an environment of aesthetic beauty as well as high quality wildlife habitat.

Refuge wetlands and the surrounding "channeled scabland" wetland complex fall within the Intermountain west waterfowl habitat area delineated by the North American Waterfowl Management Plan, one of several key continental areas of major concern in the United States and Canada. The 5000 acres of wetlands on Turnbull NWR represent some of the last quality breeding habitat available in eastern Washington for waterfowl. Since the early 1970's waterfowl populations of all species have declined nearly 40%. Loss of quality breeding habitat continues today at an alarming rate. More than 100 million acres of wetlands have been destroyed nationwide since the 1800's. The majority of wetlands in the vicinity of Turnbull NWR have been drained for purposes of agriculture, transportation networks and urban development. Turnbull NWR is intensively managing the available resources to obtain optimal waterfowl productivity.

One of the greatest threats to the resource integrity of Turnbull NWR is high intensity, uncontrolled wildland fires. A medium sized wildland fire (5,000 to 10,000 acres) could alter the refuge environment for decades to come, affecting the wildlife that inhabit the refuge, water quality, aesthetic value and potential economic value from commercial timber harvests conducted to meet refuge habitat objectives. Due to the success of local fire agencies in preventing and suppressing wildland fires on the refuge for many years, extreme levels of live and dead fuels now occupy the forest environment, creating conditions of high probability for a large devastating wildland fire within the next ten years. Implementation of mechanical hazardous fuel reduction followed by prescribed fire will reduce this probability.

Due to the hazardous levels of dead fuel residues within the forest environments of Turnbull NWR, a significant wildland fire occurring on the refuge threatens numerous private residences built throughout areas immediately adjacent to the refuge and on lands leased by the refuge for wildlife easements. Numerous historic and archeological resources are found within the refuge boundaries. Some of these historic sites are old homestead foundations, which could easily by consumed by fire. Two refuge buildings currently used as administrative sites and employee residences have been nominated for the National Historic Register having once been part of the historic Pine Creek Dairy Farm, one of the first and largest dairy operations in eastern Washington during the 1800's.

Several species of plants found on the refuge are listed by the state of Washington as rare and endangered. The list includes the yellow lady's slipper (*Cypridpedium calceolus* var. *parviflorum*), water howellia (*Howellia aquatilis*), Spaulding's silene (*Silene spauldingii*) and tufted hairgrass (*Deschampsia caespitosa*). On July 14, 1994 the U.S. Fish & Wildlife Service listed the water howellia as a threatened species in the Federal Register under the authority of the Endangered Species Act. A large percentage of the documented locations for water howellia in the state of Washington occur on Turnbull NWR. A severe wildland fire on the refuge could impact habitat critical to these species.

Refuge facilities that may be threatened by wildland fire include the refuge main office, three employee residences, two maintenance storage barns, a maintenance shop, hazardous fuel building, two well houses, an equipment barn, a public comfort station, three structures at the Goodwin tract and an environmental education classroom. The assessed real value of these facilities and the equipment in them is over 3 million dollars. Also within the refuge boundary is the Turnbull Lab for Ecological Studies which is owned and operated by Eastern Washington University. This facility houses offices and laboratories.

The forested private lands that surround Turnbull NWR are rapidly developing with numerous residential improvements, which are a reflection of the vigorous economy of the inland northwest. This trend will no doubt continue since the area surrounding the refuge is one of the last undeveloped and most appealing areas in the Spokane area to live. The expansion of the urban interface to the boundaries of the refuge will create a complex fire environment, which will constrain fire management options in both fire suppression and prescribed fire. Currently, there are hundreds of homes in the ponderosa pine forests surrounding the refuge creating a contiguous fuel bed from the refuge through the urban interface. The potential for a large wildland fire originating within the refuge to burn into the adjacent residential areas causing significant structural loss and damage is presumable.

This document will replace the 1998 Fire Management Plan for Turnbull NWR. Proposed actions in this FMP do not differ significantly from the 1998 FMP, but have been updated to meet fire policy changes addressed in the Fire Management Handbook (2000).

# INTRODUCTION

Fire is a natural phenomenon and has played a critical role in the ecosystem dynamics of natural communities represented within Turnbull National Wildlife Refuge (NWR). Before the advent of current wildland fire suppression capabilities, naturally caused lightning fires burned thousands of acres of upland and wetland vegetation in eastern Washington on an annual basis. These naturally caused fires occurred in return intervals estimated at 5 to 20 years. These frequent natural fires maintained vigorous, diverse upland and wetland plant communities in various stages of post-fire succession, providing a wide variety of habitat types and conditions for wildlife.

Due to the improvement of wildland fire suppression capabilities, the natural role of fire in sustaining dynamic ecosystem conditions within the vegetation communities of Turnbull NWR declined. Emergent vegetation in the many marshes within the refuge and downed trees have accumulated on forest floors creating hazardous wildland fire conditions. In the 1980's the U.S. Fish & Wildlife Service began a program of using controlled burning in marshes and forested areas within the refuge to re-introduce the influence of fire in maintaining habitat conditions favorable to waterfowl production and natural diversity.

Department of Interior policy requires that all refuges with vegetation capable of sustaining fire develop a fire management plan that details wildland fire suppression policies, the use of prescribed fire for attaining resource management objectives and fire program operational procedures. The FMP is an extension of the refuge Habitat Management Plan. It describes in detail fire management programs, activities and methods that will be undertaken by the U.S. Fish & Wildlife Service in meeting the wildland fire suppression objectives and fire management strategies which utilize prescribed fire to attain the habitat management goals established for Turnbull NWR. The plan also assesses the potential environmental effects of the proposed fire management program in relation to refuge resources, the local environment as well as impacts to the public, adjacent landowners and surrounding communities. Consideration of these issues is required by the mandates of the *National Environmental Policy Act of 1972 (NEPA)* and other applicable federal laws and regulations.

It is the intention of the U.S. Fish & Wildlife Service to continue to suppress all wildland fires occurring within Turnbull NWR, including natural lightning ignitions. Prescribed fire will be utilized under controlled conditions and defined weather variables to mimic the natural role of fire in sustaining ecosystem functions, improve habitat conditions for wildlife and reduce hazardous accumulations of dead fuels for fire prevention.

## COMPLIANCE WITH USFWS POLICY

Service Fire Management Policy is based on the Departmental Manual, (910 DM 1-3).

1. Every fire is either a wildland fire or a prescribed fire (and will be managed accordingly). The Service will employ fire whenever it is an appropriate tool for managing refuge resources, and to protect against whenever it threatens human health, private property, or refuge resources.

2. The safety of personnel involved in wildland fire suppression and prescribed fire on refuge lands is of paramount concern. With the possible exception of instances where the life of another is threatened, no Service employee, contractor or cooperator will be purposely exposed to life-threatening conditions or situations.

3. Only trained and qualified people will be assigned to fire management duties. Personnel will be issued personal protective equipment and will be trained in its proper use.

Other federal laws, regulations, and authorities affecting the fire program include:

Protection Act of September 20, 1922 (42 Stat. 857; 16 U.S.C.594).
Authorizes the Secretary of the Interior to protect from fire, lands under the jurisdiction of the Department directly or in cooperation with other Federal agencies, states, or owners of timber.

Economy Act of June 30, 1932 Authorizes contracts for services with other Federal agencies.

Reciprocal Fire Protection Act of May 27, 1955 (69 Stat. 66, 67; 42 U.S.C. 1856,1856a and b). Authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of agency lands in suppressing fires when no agreement exists.

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

National Wildlife Refuge System Administrative Act of 1966 as amended (80 Stat. 927; 16 U.S.C. 1601) 668dd-668ee). Defines the National Wildlife Refuge System as including wildlife refuges, areas for the protection and conservation of fish and wildlife which are threatened with extinction, wildlife ranges, game ranges, wildlife management areas and waterfowl production areas.

Federal Fire Prevention and Control Act of October 29, 1974 (88 Stat.1535; 15 U.S.C. 2201). Provides for reimbursement to state or local fire services for costs of firefighting on federal property.

Wildfire Suppression Assistance Act of 1989, (Pub. L. 100-428, as amended by Pub. L. 101-11, April 7, 1989).

Departmental Manual (Interior), Part 910 DM, Chapter 1, Wildland Fire Suppression Management (March 29, 1990). Defines Department of Interior Fire Management Policies.

National Environmental Policy Act of 1969

Clean Air Act (42 United States (USO) 7401 et seq.).

The mission of the National Wildlife Refuge System is "to preserve a national network of lands and waters for the conservation and management of fish, wildlife, and plant resources of the United States for the benefit of present and future generations" (Executive Order 1996).

Turnbull National Wildlife Refuge was established by President Franklin Roosevelt in 1937 by executive order. He stated that the refuge shall be managed "to serve as a refuge and breeding ground for migratory birds and other wildlife."

The Refuge Manual (USFWS 3/2000) provides policies and guidelines for managing National Wildlife Refuges and lists the specific goals for refuges ( RM 620 DM 1-2, A-D).

a) To preserve, restore and enhance in their natural ecosystem (when practicable) all species of animals and plants that are endangered, or threatened with becoming endangered.

b) To perpetuate the migratory bird resource

c) To preserve a natural diversity and abundance of fauna and flora on refuge lands.

d) To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible for the purposes for which the refuge was established.

## FIRE MANAGEMENT OBJECTIVES

The mission of Turnbull NWR is to restore and maintain ecosystem processes that provide for a natural diversity of flora and fauna native to the wetland, steppe and ponderosa pine communities of Eastern Washington. Refuge goals include:

1. Provide habitat conditions essential to the conservation of migratory birds and other wildlife within a variety of wetland complexes.
2. Protect and restore water quality and quantity sufficient to maintain native wetland flora and fauna.
3. Restore refuge forests to a range of structural and successional stages.
4. Protect and restore the natural distribution and diversity of grassland and shrub steppe habitats to benefit indigenous wildlife.
5. Support the conservation of threatened and endangered species in their natural habitats.
6. Support the maintenance of biologically effective landscape linkages and corridors between the refuge and other intact areas of vegetation zones representative of this Ecoregion.
7. Provide quality environmental education, interpretation, research and wildlife oriented recreation opportunities compatible with the refuge purposes.

It is the intention of the fire management program to support the mission, management objectives and operational goals of the refuge by protecting refuge resources and habitats from the undesirable effects of wildland fire. The fire management program will include the use of prescribed fire to restore and enhance refuge habitats, promote natural diversity and manipulate wetlands to promote operational goals of increasing the production of diving ducks.

The Habitat Management Plan, which was completed in 1999, describes specific actions and techniques that will be undertaken by the U.S. Fish & Wildlife Service to manage the various habitat types found within the refuge. Prescribed fire is one of many techniques for manipulating vegetation within the refuge to meet habitat management objectives.

The specific objectives of the wildland fire management program are to:

1. Protect human life and property both within and adjacent to refuge areas.
2. Perpetuate, restore, replace or replicate natural processes where appropriate.
3. Protect natural and cultural resources from unacceptable impacts due to fire and fire management activities.
4. Promote an interagency approach to managing fires on an ecosystem basis.
5. Develop and implement a process to ensure the collection, analysis and application of high quality fire management information needed for sound management decisions.
6. Employ strategies to suppress all wildland fires, which minimize costs and resource damage, consistent with values at risk.
7. Prevent unplanned human-caused ignitions.
8. Restore and rehabilitate facilities lost in or damaged by fire or suppression activities.
9. Minimize and mitigate human-induced impacts to resources or natural processes.
10. Promote public understanding of fire management programs and objectives.
11. Conduct fire activities in a manner consistent with applicable laws, policies and regulations.
12. Organize and maintain a fire management capability which consistently applies the highest standards of professional and technical expertise.
13. Encourage research to advance understanding of fire behavior, effects, and ecology.
14. Integrate fire management with all other aspects of refuge management.

## DESCRIPTION OF REFUGE

Turnbull NWR is located in eastern Washington approximately 20 miles southwest of the city of Spokane ( Figure 1). The Refuge lies between the Cascade Mountains and the western edge of the Rocky Mountains. The environment is dominated by the Columbia River Basin, and the refuge is situated on a 2,000 ft plateau within the "channeled scablands", which were carved by a series of gigantic glacial floods during the last ice age. Refuge ecosystems represent an ecological transition area between the dry, sagebrush dotted grasslands of the Columbia Basins and the forested mountains that rise up to the east. The geological forces of volcanism and glaciation combined to create a distinctive ecosystem, unduplicated anywhere in the world. The flood carved ravines (called Coulees), potholes and rugged rock outcrops, which distinguish the local topography, providing diverse niches for a unique combination of habitat types. Meadows, marshes and lakes are surrounded by pine forest, grasslands, riparian woodlands and groves of aspen.

The refuge was established in 1937 by Executive Order for the purpose of providing "...refuge and breeding ground for migratory birds and other wildlife....". Prior to establishment of the refuge, wetlands were drained by homesteaders in an attempt to farm the land, but the rocky basalt and thin soils proved to be more persistent than the efforts of the settlers. After the refuge was established the wetlands were restored with the installation of a network of water control structures. Farms and ranches still surround the refuge on more suitable sites, while residential development, the largest growth industry of the inland northwest, is rapidly becoming the dominate land use adjacent to the refuge boundaries.

### GEOLOGY

The physical environment of Turnbull NWR is a result of a unique set of geological events working in combination to create the "channeled scablands" that predominate the refuge and surrounding environments. The unique geological features of the "scablands" were the result of a series of gigantic floods, which occurred during the last Ice Age. These floods carved coulees through the dense basalt bedrock of the scablands. This basalt bedrock was deposited by lava flows originating in the vicinity of the present day Cascade Mountains between 25 and 12 million years ago, which covered thousands of square miles of eastern Washington.

The flooding which carved the scablands was caused by glaciers moving southward from the great icefields of British Columbia approximately 16,000 to 12,000 years ago. These glaciers formed ice dams in many of the great rivers, which drained the icefields as they progressed southward creating temporary lakes. The largest of these lakes was Glacial Lake Missoula which formed within the Purcell Trench, plugging the mouth of what is now the Clark Fork river valley near the inlet of present day Lake Pend Oreille. As the glacial ice dammed the river valley located within the Bitterroot Mountains, the water impounded behind the ice covered 3000 square miles, contained 500 cubic miles of water and reached depths of 2000 feet. The lake stretched from what is now Lake Pend Orielle to Missoula and the south end of Flathead Lake. Eventually the lake level reached the lip of the ice dam and began to overflow, cutting a huge breach in the dam. As the water roared through the cut, it widened very rapidly, undercutting the dam, causing it to collapse within a couple of days. The entire contents of Glacial Lake Missoula roared through the opening, carrying a vast wall of water and huge icebergs. The volume of water released by the lake created a flood of unprecedented proportions in geological history. The wall of water released reached 800 feet high and flowed at a rate of 400 million cubic feet per second.

Figure 1: Vicinity Map

The flood carried topsoil, huge boulders and icebergs. As the flood currents rushed in a southwest direction, the currents were so powerful that they carried huge blocks of basalt from the bedrock. In the vicinity of the refuge the flood crest reached over 200 ft., stripping away hundreds of feet of topsoil, while scouring deep gullies and washes into the basalt bedrock. The flood left a rough jumble of mesas and depressions so irregular that there are no through flowing streams for over 70 miles, creating the unique wetlands and sloughs of Turnbull NWR. As the flood progressed on its route to the Pacific Ocean it created unique geological features such as the Grand Coulee, the Drumheller Scablands and the Columbia River Gorge. It is estimated that the continual advance and retreat of the glaciers during the last Ice Age recreated these flood events of ice dam formation and release approximately 85 times, with the major flood events occurring 12,000 to 13,000 years ago (Weis and Newman, 1974).

**SOILS**

Most upland areas of the refuge have very shallow soil layers with basalt outcrops surfacing in many areas. Drainages and wetlands have deeper soil profiles, which are coarse to medium in texture and are underlain by gravel, cobble, sand and basalt. Deeper soils in drainage's and wetlands generally become saturated during winter and spring providing the wetland habitats that are important for waterfowl. The vast majority of soils within the refuge are classified as being in the "Hesseltine" soil series. Interpretation of soil properties show this series has low water holding capability, rapid permeability and low shrink-swell potential which indicates low clay and silt content (Soil Survey: Spokane County, USDA, Soil Conservation Service 1968).

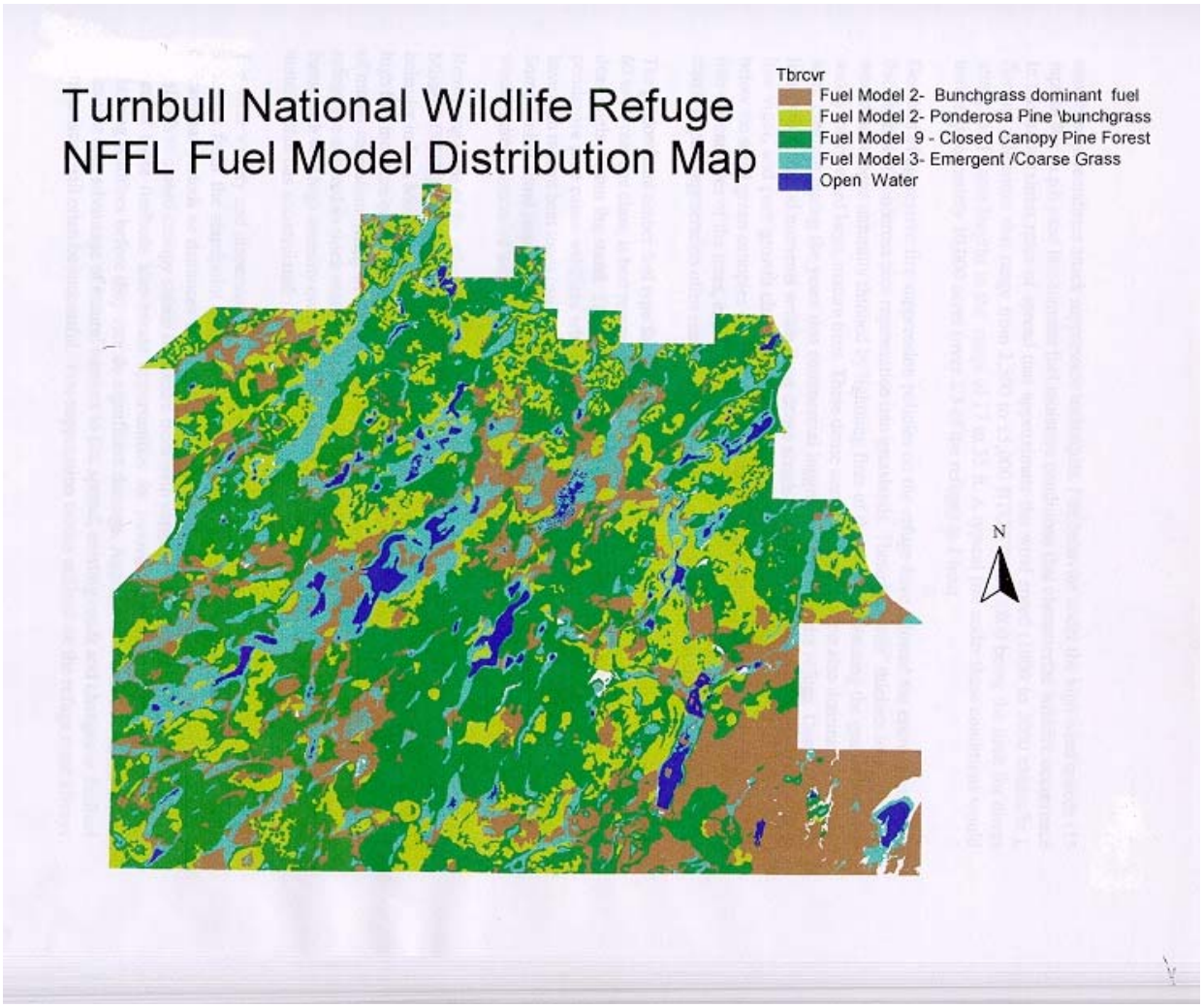
**VEGETATION**

Turnbull NWR is made up of four primary vegetation types: Pine forest, deciduous woodland and shrub communities, grasslands and shrub-steppe, and wetlands. The Turnbull NWR Vegetation Classification Map is located in figure 2.

**Pine Forest**

Ponderosa Pine (*Pinus ponderosa*) is the predominant forest type of Turnbull National Wildlife Refuge. Approximately 10,400 acres of the refuge is covered by ponderosa pine forest of various stand age classes and densities. Refuge forest management practices of timber harvest and fire exclusion have created forest distribution, structure and densities that no longer resemble the natural ponderosa pine forest of the past. Early explorers described the aboriginal ponderosa pine forest as consisting of very large trees, spaced widely apart (50 to 100 ft.), very little undergrowth (shrubs or pine regeneration), with a great diversity of wildflowers and grasses on the forest floor. Researchers (Biswell 1973, Weaver 1967) have described the natural stand structure of the ponderosa pine forest as consisting of uneven aged trees. Lightning caused fires frequently (8-25 year intervals) swept through these forests, reducing the litter of needles and dead branches on the forest floor, reducing the density of seedlings, removing centers of bug killed or overmature trees, ultimately creating a mosaic within the forest of trees clustered in varying age classes growing in densities that promoted forest health and optimal growth conditions.

Figure 2: Fuel Model Distribution



The ponderosa pine forests af Turnbull NWR are relatively slow-growing. The shallow, rocky basalt outcrops, which underlie forest sites, preclude superior growth characteristics due to the thin, nutrient poor soils. Because of the rock substrate the trees have virtually no taproot and root systems of the trees are very shallow. The shallow root systems predispose the trees to frequent windfall and fires easily burn out roots causing the trees to fall. Many of the poorer sites have short (30-40 ft.) stunted trees, which locals have labeled "Bull Pine". The fastest-growing ponderosa pine forests on the refuge grow on the perimeter of wetlands and lakes where soil development is deeper with good nutrient and moisture availability. Specimen trees in these areas have been found to exceed 60 inches in diameter and are up to 150 ft. tall and grow in fairly close proximity for the species. These specimen trees are approximately 150 years old and during optimal growth periods exceed 1 inch per year in diameter growth. These trees are somewhat rare due to commercial logging practices on the refuge.

Timber sales were discontinued on the refuge in 1973 and firewood gathering in 1976. An average of 250,000 board feet was removed annually on 10-year rotational cycles. Timber removal by clearcutting has resulted in many thickets of pole sized ponderosa pine growing in such dense proximity that proper stand form and growth characteristics is not achieved. Many of these small trees are infested with insect and fungal diseases. Mortality is high within these densely stocked stands resulting from competition for light, moisture and nutrients. Insect and disease infestations established within these stands provide the means for spread to mature, healthy trees. Dead fuels within the pole sized thickets present opportunities for low intensity fires to spread to the canopies of the fire adapted mature ponderosa pine.

Past management practices of fire exclusion and timber harvest on the refuge have resulted in extreme fuel loading in the more densely forested areas of the refuge. In locations, harvested unmerchantable timber was left on the forest floor along with logging slash. Dead fuel load calculations taken from forest surveys in 1990 indicate dead fuel loads up to 20 tons/acre in some locations, almost 100% higher than would be expected. The results of monitoring dead fuel loading reduction from prescribed fires conducted during the fall of 1990 and 1992 (MacDowell 90-1, AutoTour 92-1/2/3) indicate the potential for reducing fuel loading by approximately 75% in the 100 hr., 1000 hr. and 10,000 hr. fuel size classes (MacDowell Prescribed Fire Summary, 1991). Subsequent monitoring of prescribed fire objectives also indicates effective reduction in fuel loads by the use of prescribed fire as a management tool.

Timber harvest practices on the refuge have created forest stands of two primary age classes. Pole sized trees in regeneration thickets are approximately 20 to 40 years in age, averaging 15 to 25 feet in height, stocked at approximately 1000 to 2000 trees/acre. Second growth, intermediate size class trees range from 40 to 60 feet in height and average 15 to 20 inches in diameter. Approximately 80 to 90% of mature trees on the refuge are within this size class. Mature pine on good sites (deep soils on wetland perimeters) are within the 60 to 90 year range, averaging 75-100 to 50 feet in height, predominantly within the 25 to 35 inch diameter size class, stocked at an average of 20-40 trees/acre. 10% of the trees surveyed were in the 20 to 30 inch diameter class and 60 to 90 feet in height. These trees were probably not large enough for harvest during initial cuts or were left as seed trees.

Ponderosa pine understory communities contain a wide variety of shrubs, grasses and forbs providing a wide variety of browse, cover and nesting habitat for woodland wildlife species. The predominant grass types, Idaho fescue (*Festuca idahoensis*) and Bluebunch wheatgrass (*Agropyron spicatum)* grow well where the canopy of the ponderosa pine overstory is less dense, allowing good sunlight penetration to the forest floor.

Closed canopy stands of ponderosa pine are associated with understory components of snowberry (*Symphocarpus alba)* and pinegrass (*Calamogrostis rubescens*).

**Deciduous Woodland and Shrub Communities**
Deciduous woodland and shrub communities cover approximately 200 acres of the refuge, mostly in small isolated stands of less than one acre. Many of the deciduous communities grow along the perimeter of wetlands and drainages and include species such as aspen (*Populus tremuloides),* willow (*Salix* sp.), black hawthorne (*Crataegus douglasii)* chokecherry (*Prunus virginiania),* water birch (*Betula occidentalis*), red-osier dogwood (*Cornus stolonifera*) and black cottonwood (*Populus tricocarpa)*. These species are among the most important vegetation types to wildlife on the refuge. They provide nesting and feeding sites for birds, browse for elk and deer and winter food and shelter for small mammals. The current condition of woodland and shrub communities on the refuge demonstrates evidence of diminished vigor and abundance.

Fire exclusion policies in the fire dependent ecosystems of the refuge have allowed ponderosa pine to dominate sites once occupied by deciduous trees and shrubs. Many of these deciduous species are short lived, requiring fire or other disturbance factors to allow regeneration from root sprouts to rejuvenate the stock. Management techniques such a prescribed fire and timber stand improvement will open the canopy of many of these sites improving conditions for deciduous species and the wildlife that utilize this habitat type.

**Grasslands and Shrub-steppe**
Turnbull NWR has approximately 6500 acres of grassland habitat types. The grassland communities exist in various plant associations including ponderosa pine/bunchgrass, pure grassland communities or as shrub-steppe communities, which are associations of various grasses, shrubs and deciduous tree species. Prominent upland native grass species found on the refuge include Idaho fescue (*Festuca idahoensis),* Bluebunch wheatgrass (*Agropyron spicatum),* sandberg bluegrass (*Poa sandbergii*) and needlegrass (*Stipa* sp.). These species can be found occurring in prairie grassland associations or in association with ponderosa pine/bunchgrass communities.

Another grassland type found within the refuge is the shrub-steppe community type (dwarf sage) where the above grass species are found in association with shrub species such as sage (*Artemesia* sp.), rabbitbrush (*Chrysothamnus* sp.) and buckwheat (*Eriogonum* sp.). This community type is found on drier sites with shallow soils and exposed basalt substrates.

Significant invasion of non-native grass species such as cheatgrass (*Bromus tectorum*), and Japanese brome (*Bromus japonicus)* are evident in areas disturbed by past agricultural practices and/or grazing.

**Wetlands**
Turnbull NWR contains approximately 939 acres of permanent and semi-permanent marshes and 2132 acres of seasonal/wet meadow habitats. These wetland areas are very productive habitats for a variety of wildlife including waterfowl and marsh dwelling mammals such as beaver, otter and muskrat. The wetlands were the primary resource feature, which influenced the inclusion of Turnbull NWR into the National Wildlife Refuge System. Wetlands range from wide open large marsh systems of hundreds of acres such as Turnbull slough to small pothole marshes surrounded by forest of less than an acre in size. One large playa lake, Stubblefield Lake, dominates the southeast portion of the refuge and is an important resting and feeding area for migratory waterfowl. Many wetlands are surrounded by forest cover types, which make excellent nesting habitats for cavity nesting waterfowl such as buffleheads, mergansers and wood ducks as well as providing excellent residual upland nesting cover for mallards and other upland nesting ducks.

Wetland water levelsmat, at times, be extremely low due to the combined effects of drought, post water management practices and dropping surface water tables. Water levels in some wetlands may be also impacted by extensive forest development in the riparian zone adjacent to the wetland. Fire exclusion policies have allowed ponderosa pine to encroach into riparian zones and grow into dense, large diameter stands of trees in the moist deep soils surrounding the wetlands. The moisture requirements of the large trees in maintaining moisture equilibrium in relation to their evapotranspiration rates may have significant effect on water levels, particularly in smaller wetland/watershed areas.

**WILDLIFE**

Turnbull NWR was established to provide quality breeding habitat for diving ducks, primarily canvasback *(Aythya americana)* and redhead *(Aythya valisineria*) ducks, along with other species of waterfowl. Wildlife management emphasis is also placed upon supporting waterfowl during migration and supporting a diversity of wildlife and associated habitats on the refuge. In recent years, increasing emphasis has been placed upon the refuges role in supporting biodiversity in the Columbia River Basin through ecosystem management practices and principles.

The diversity and distribution of vegetation communities on the refuge provide a wide range of habitats and ecotones, which support a variety of wildlife species. Approximately 17 different species of waterfowl use the refuge for breeding and about 27 species utilize the refuge during periods of migration. Other species of birds dependent on Turnbull wetlands include great blue heron (*Ardea herodias*) which nest in colonies in the Turnbull slough area, eared grebes (*Podoceps nigricollis*), black terns (*Childonias niger)* and approximately 25 species of shorebirds (*Calidris* sp. and others) which migrate through the refuge.

Upland forest, meadows and riparian areas are utilized by approximately 80 species of landbirds which include 53 species of neotropical migrants (migrate between northern and southern latitudes). Approximately 20 different species of raptors utilize the refuge either for nesting, hunting or during migration. Notable species include osprey, bald eagle, goshawk, cooper's hawk and prairie falcons. Five species of owls nest on the refuge including great horned owl (*Bubo virginianus*), short-eared owl (*Asio flammenus*), long eared owl (*Asio otus*), northern pygmy owl (*Glaucidium brasilianum*) and northern saw-whet owl (*Aegolius acadicus*). Other nesting raptors include red tailed hawk (*Buteo jamaicencis*) and kestrel (*Falco sparverius*).

In recent years elk (*Cervus canadensis*) have utilized the refuge throughout the year and has grown to an estimated 80-100 animals. Both white-tailed (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus*) have been observed on the refuge with white- tailed deer being more significant in terms of refuge populations.

Other refuge mammals of significance include coyote (*Canis latrans*), badger ( *Taxidea taxus*), porcupine (*Erethizon dorsatum*), river otter (*Lutra canadensis*), beaver (*Castor canadensis*), long tailed weasal (*Mustela frenata*), yellow-bellied marmots (*Marmota flaviventris* sp.), and Columbia ground squirrels (*Citellus* sp.). Other small mammals of significance are, Red squirrel (*Tamiascriurus hudsonicus*), Yellow pine chipmunk (*Eutamias amoenus*), Northern pocket gopher (*Thomomys talopoides*), Harvest mice (*Reithrodontomys* sp. )and bats (*Vespertilionidae*). Unusual mammal sightings in the area include black bear, cougar, bobcat and moose.

**ENDANGERED SPECIES**

The bald Eagle (*Haliaetus leucocephalus)* is the most recognizable of the endangered species found on the refuge although the water howellia (*Howellia aquatilus)* is also important.

**Water Howellia**
The water howellia was officially listed as a threatened species by the Fish and Wildlife Service on July 14, 1994. The Federal Register describes water howellia as an aquatic annual plant that grows from 4 to 24 inches in height and is extensively branched. It has narrow leaves with submerged or floating stems. It produces two types of flowers, small inconspicuous flowers below the surface and small emergent white flowers. On Turnbull NWR, the plant seems to prefer the edges of small (<1 acre) semi-permanent wetlands surrounded by aspen or some other deciduous tree or shrub (full study of habitat requirements and preferences have yet to be undertaken).

At one time the plant ranged in freshwater wetlands throughout the Pacific Northwest from California to Montana. Current populations of the plant are located in the Swan River valley in Montana, one small population in Idaho, a population at Ridgefield NWR, and those found in Spokane County (Turnbull NWR). Conversion of small freshwater wetlands for agriculture, invasion of exotic species (particularly reed canarygrass), grazing and loss of riparian vegetation have all contributed to the decline of critical habitat for the howellia. Populations of the water howellia have been found within two units that were treated with prescribed fire. These units include the McDowell Unit burned in 1990 and the Auto Tour unit #1 burned in 1992. Both fires were fall burns and burned the area of the howellia populations completely with moderate intensity fire. Most plants that have evolved in an environment of frequent natural fire, develop strategies, mechanisms or reproductive capabilities adapted to survive at an individual or population level. Fire may play some role in reducing competition from other plants in the wetlands inhabited by howellia. Intensive study of specific population recovery from prescribed fire is required if fire is to be used as a management technique in wetlands populated with howellia. Under the requirements of the Endangered Species Act, any activity, which may affect the water howellia and involves federal action, will require consultation with the Fish & Wildlife Service under Section 7 of the Act.

**Other plant species**
Two other plant species has special status afforded by federal and state law. The yellow lady's slipper (*Cypripedium calceolus* var. *parviflorum)* is listed as Endangered in Washington by the state Natural Heritage Program. It primarily occurs in bogs, wet meadows and moist forest areas in association with red-osier dogwood and aspen. The plant is in the Orchid family and is approximately 16-20 inches tall with a distinct yellow flower. There are only 15 know occurrences of the plant in the state of Washington with 7 of those sites located within Turnbull NWR.
Spaulding's silene (*Silene spauldingii*)is a Federally proposed threatened species that grows in the Palouse prairie/steppe habitat in and around the Refuge. The plant is slender and of medium height and not showy. It belongs in the Pink family and there are six known occurrences documented on the Refuge.

**Bald Eagle**
Bald eagle use of Turnbull NWR is seasonal and coincides with waterfowl migration in the spring and fall. There do not appear to be any specific roost trees or preferred areas of the refuge that Bald eagle sightings occur. The eagles appear to be hunting for weak or injured waterfowl among the migrating waterfowl. On average 5.2 bald eagle sightings occur on the refuge annually (Habitat Management Plan).

**CULTURAL RESOURCES**
Several cultural resource surveys have been conducted on Turnbull NWR over the last decade, which have identified and recorded eight archaeological and 56 historic sites. These surveys have covered only 16 percent of the land base of the refuge. The archaeological sites consist primarily of rockshelters and talus pits. These sites were used by pre-historic native cultures for shelter and food storage. It is believed

that although no permanent sites of occupation occurred on the refuge, the area was important to native people for hunting and food gathering purposes.

The 56 historic sites on the refuge are related to early settlement of the area during the late 1800's by subsistence farmers. These farmers drained the wetlands for agricultural purposes. Most of the historic sites have little remains of the original structures that occupied the sites, having been removed or destroyed after the refuge was established. Some old rock foundations remain, along with root cellars and rusted pieces of farm implements. The most historically significant buildings on the refuge are part of the existing refuge headquarters complex and consist of quarters #50 and the old barn that is used as a storage area. These buildings were part of the Pine Creek Dairy the first and largest dairy farm in Spokane County at the turn of the century.

Other significant historic sites include three rock ovens which were presumably constructed and used by railroad workers building the railroad Northern Pacific Railroad at the turn of the century. Additional historic sites include ditches constructed by early settlers to drain wetlands and some old barrel hoop fence posts.

All refuge fire management activities require compliance with the federal Historic Preservation Act. All prescribed fire plans are required to be reviewed by the Regional Cultural Resource Specialist for compliance with state and federal historic preservation acts. A map of the known cultural and historic sites can be found in A Study of Cultural Resources on Turnbull National Wildlife Refuge, Spokane County, Washington by Craig Holstine, Jerry R. Galm, and Robin Bruce on file at refuge headquarters.

**AIR QUALITY**

Air quality and it's relationship to the fire management program and smoke management is a very sensitive issue within the local communities surrounding Spokane. Portions of Spokane County have been designated as non-attainment areas for particulate matter (PM-10: particulates 10 microns or less in size) under the provisions of the Clean Air Act (Public Law 95-95). The Clean Air Act established "National Ambient Air Quality Standards and provides the States with the primary jurisdiction in air quality management. Under the act, States are required to identify areas, which have air pollutant levels, which do not meet national standards.

Agriculture is a vital component of the local economy. Agricultural practices in Spokane and surrounding counties include burning of grass and wheat stubble to prepare for fall plowing and increase yield. These practices contribute a major portion of the particulates produced within the local airshed during the summer and fall months. Under the new agricultural burning rules and court cases agricultural field burning is being phased out in Spokane County and the growers are looking into alternate methods of residue disposal.

High winds (20-40 m.p.h.) that often occur during the fall carry tremendous amounts of soil into the atmosphere. These dirt laden winds darken the sky over all of eastern Washington, frequently causing highway closures. During the winter, the cities many residential wood stoves cause particulates in amounts which reach unhealthful levels. Frequent wood stove burning bans are implemented by the Spokane County Air Pollution Control District (SCAPCA) during the winter months. The local air pollution control districts also allow spring and fall yard refuse burn periods. These periods which last from several weeks to a month allow local residents/home owners to burn yard waste such as grass clippings and tree trimmings.

The inland northwest has historically had periods when large wildland fires burning in forested areas have

created significant episodes of poor air quality. During the historic summer of 1994 large wildland fires burning in the Cascade mountains and Rocky Mountains darkened the skies over Spokane for weeks and impacted local air quality for months as the fires burned from late July into October.

## WILDLAND FIRE MANAGEMENT SITUATION

### FIRE HISTORY

Turnbull NWR is part of what is known as the wildland/urban interface. These areas are characterized by residential development occurring adjacent to public wildlands where forest fuels are contiguous with the fuels that surrounds the residential developments. These areas present difficult fire suppression problems for firefighters, as well as attendant constraints on the use of prescribed fire due to the possibility of escaped fires and smoke management considerations. The areas east of Turnbull NWR contain some of the most attractive real estate in the local area for those seeking to build homes in a more rural setting. Thousands of homes currently occupy the wildland urban interface area between Turnbull NWR and the city of Spokane. Unfortunately, the fuel types surrounding these homes are the same as and are contiguous with the fuels that predominate Turnbull NWR. Extreme fire weather in the local fire environment are punctuated by hot, dry winds blowing from the southwest off the "Palouse". The potential for a fire originating on, or burning through Turnbull NWR, attaining extreme size and extreme fire behavior in the process and continuing across refuge boundaries into residential areas, is highly probable in the near future.

As the human population continues to increase around the refuge boundaries, the potential for human caused fires increases proportionally. The combination of natural ignition potential coupled with the human caused fire risk of more residential development, traffic, visitors and human activity around the refuge, creates an extremely high fire potential for Turnbull NWR. Large amounts of dead fuels that have accumulated in the pine forest areas, both within and surrounding the refuge in residential areas, increase the risk. Wildland fires occurring within the refuge under extreme weather conditions, in particular the frequent southwest winds which occur during the fall with speeds of 30 to 40 mph, will spread rapidly through grasslands and timber, spreading spotfires over a wide area, causing a multi-front fire which will be extremely difficult to control. The result may be a 5,000 to 10,000 acre fire which will do extensive damage to refuge resources and with high potential for destroying numerous residential and farm structures that lie downwind of the refuge.

The existence of the wildland/urban interface surrounding the refuge presents significant constraints on the use of prescribed fire in relation to potential liabilities resulting from escaped fires. An escaped fire resulting from a refuge habitat management prescribed fire that burns into private property will cause severe constraints to be placed upon the use of prescribed fire by the refuge. Due to the importance of using prescribed fire in the management of the refuge, extreme caution should be used when implementing prescribed fires. The refuge should maintain a significant initial attack capability of engines, crews, dozers and water tenders to deal with this risk. Cooperative agreements and/or funding should be allocated to provide for remuneration to local fire agencies to assist refuge staff in the implementation of the prescribed fire program. The values at risk from an escaped prescribed fire are too great to allow escapes to occur into areas surrounding the refuge. This constraint will continue to increase as areas adjacent to the refuge continue to develop. Refuge management should become involved with local planning agencies to communicate the magnitude of the wildland fire problem on the refuge and the potential for development adjacent to the refuge to constrain refuge management options in relation to prescribed fire.

**Pre-settlement Fires**

The area that the refuge now occupies was a traditional use area of the Spokane Nation prior to settlement. In discussions with the Tribe it was very likely that they frequently burned the area to enhance hunting and gathering.

**Post-settlement Fire History**

The historic record of wildland fire occurrence within Turnbull NWR (Table 1) has been reconstructed using refuge narratives dating back to 1940 and Department of Interior "Fire Reports" which were first utilized to report wildland fires in 1956. Much information is missing in relation to the exact location or boundaries of these fires. Location information provided within Table 1. is approximated according to the information available unless specifically mapped on an individual fire report.

As can be seen from the data in Table 1., lightning plays a significant role in causing fires on the refuge. As in other areas most lightning fires are small (less than 1 acre), but the season of lightning occurrence (June through September) provides ample opportunity for a lightning caused fire to attain significant size when coupled with low fuel moistures, extreme fuel loading and the frequently occurring high winds that accompany storm fronts.

Many fires occurring on Turnbull NWR in the past were started by trains passing through the refuge on the Burlington Northern right of way. Some of these fires were quite intense, and although suppressed rapidly, they did significant damage to forest resources. This rail route was abandoned in 1989, and deeded to the state of Washington for the development of a "Rails to Trails" program for recreational use. The presence of a major recreational trail passing through the refuge presents additional potential for wildland fire starts caused by users of the trail. Two major railroad lines remain on the northern boundary of the refuge and are extensively used at this time presenting the potential for fires caused by sparks from passing trains. Many of the mutual aid fires that refuge crews are called to assist on are caused by passing trains in the area.

Although only one large fire (1000 acres or greater) has occurred within the refuge in the last 52 years (1590 acres burned west of Long Lake in 1960), the potential for a large, devastating wildland fire occurring on the refuge exists. Evidence for this type of wildland fire can be found in wildland fires that have occurred in the vicinity, both in the past and more recently. In October of 1991, 60 mph winds blew across the Columbia Basin through Spokane County. These winds caused numerous fires to start throughout the area from downed power lines. Within the immediate vicinity of the refuge (mutual aid response zone), three fires approximately 1000 acres each occurred destroying many of residences and farm buildings.

Table 1: Historic Fires of Record: Turnbull NWR

| Date | Size (acres) | Cause | Location |
|---|---|---|---|
| 06/??/40 | 0.25 | Lightning | unknown |
| ??/??/41 | 2.0 | unknown | " |
| 07/14/43 | 25.0 | Train | along tracks |
| 08/23/43 | 4.0 | " | " |
| 08/31/43 | 15.0 | " | " |
| 09/08/43 | 4.5 | " | " |
| 09/18/43 | 6.5 | " | " |
| 09/26/43 | 3.0 | " | " |
| 10/01/43 | 0.25 | " | " |
| 10/04/43 | 260.0 | " | " |
| 10/08/43 | 1.0 | " | " |
| 05/??/44 | 0.25 | Lightning | unknown |
| 08/21/51 | 3.0 | unknown | " |
| 07/18/52 | 0.25 | Lightning | " |
| 08/10/53 | 0.25 | " | " |
| ??/??/54 | 0.25 | " | " |
| 07/24/55 | 1.5 | " | " |
| 08/19/57 | 0.25 | " | " |

| | | | | | |
|---|---|---|---|---|---|
| 05/28/58 | | 4.0 | " | " | |
| 08/26/58 | 60.0 | | " | " | |
| 10/13/58 | | 8.0 | accidental | " | |
| 07/07/60 | | 2085.0 | Train | Long Lake | |
| 07/17/60 | 15.0 | | Lightning | unknown | |
| 07/27/60 | | 8500.0 | unknown | s. boundary | |
| 08/13/61 | | 0.5 | rain | unknown | |
| 07/07/62 | | 0.25 | " | " | |
| 07/17/62 | | 0.25 | " | " | |
| 07/26/62 | | 0.25 | Lightning | " | |
| ??/??/63 | 0.25 | | " | " | |
| ??/??/63 | 0.25 | | Train | " | |
| ??/??/64 | 0.25 | | unknown | " | |
| 07/18/68 | 35.0 | | Train L. | Turnbull | |
| 11/20/69 | 12.0 | | Slash Burn | N. boundary | |
| 07/18/70 | | 0.25 | Arson | Cheney Plaza | |
| 08/13/70 | | 0.25 | Train | unknown | |
| 10/12/70 | | 7.0 | Hunter Fire | Long Lake | |
| 08/30/71 | | 1.0 | Lightning | Long Lake | |
| 08/18/72 | | 6.0 | Lightning | Turnbull crossing | |
| 08/05/73 | | 2.0 | unknown | unknown | |
| 08/08/79 | 10.0 | | Train | Long Lake | |
| 09/02/79 | | 2.5 | Lightning | Cossalman Lk. | |
| 10/06/80 | | 1.0 | unknown | Long Lake | |
| 07/10/82 | | 2.0 | unknown | Campbell Crossing | |
| 09/26/83 | | 2.0 | Train | along tracks | |
| 09/03/84 | 11.0 | | Welding | Wheeler pool | |
| 05/14/86 | | 0.25 | unknown | Kepple Lake | |
| 06/29/86 | 40.0 | | Train | Long Lake & tracks | |
| 06/29/86 | 4.0 | | " | Balliger Lk.(south) | |
| 08/12/86 | | 5.0 | Equipment | Reeves Lk. | |
| 08/27/86 | | 1.0 | Visitors | Smith rd. entrance | |
| 06/16/87 | | 7.0 | Lightning | Cheney plaza s. | |
| 06/29/87 | | 0.5 | Reburn | " | |
| 07/13/91 | 10.0 | | Lightning | Wheeler | |
| 07/05/92 | | 5.3 | " | South Boundary | |
| 10/08/92 | | 9.0 | escape PB | Auto Tour | |
| 06/15/93 | | 0.25 | Lightning | Long Lake | |
| 06/29/93 | | 0.25 | Lightning | Pine Creek | |
| 07/10/93 | | 0.25 | Lightning | Peterson Tract | |
| 08/08/94 | | 8.0 | Lightning | Finley Lake (s.) | |
| 05/26/95 | | 2.0 | Debris | Refuge H.Q. | |
| 06/25/95 | | 2.0 | Debris | N.W. Boundary | |
| 08/19/95 | 30.0 | | Debris | Indian Camp P.B. | |
| 09/09/95 | | 3.0 | Lightning | Palmer Meadow | |
| 08/14/96 | | .1 | Lightning | Snag | |
| 08/14/96 | | 0.1 | Lightning | Helms | |
| 08/14/96 | 0.5 | | Lightning | Lone tree | |
| 08/14/96 | 7.0 | | Lightning | Sterling | |
| 10/03/97 | | 5.0 | Escaped slash burn | Red gate | |
| 10/03/97 | 5.0 | | Escaped slash burn | Powerline | |
| 07/15/98 | 4.0 | | Human | 30 Acre lake | |
| 11/05/99 | 0.1 | | Human | Gate 19 | |
| 08/13/00 | 12 | | Human | Campbell/Lasher | |
| 08/14/01 | | 0.25 | Human | Mullinix Road | |

**Prescribed Fire History**

Table 2 shows prescribed fire history for the Refuge since 1985.

Table 2: Prescribed Fire History

| | | |
|---|---|---|
| 1985 | Overpass | 40 acres |
| | Stubble S | 70 acres |
| | Stubble N | 37 acres |
| | Headquarters | 5 acres |
| 1986 | W Tritt | 52 acres |
| | E McDowell | 15 acres |
| 1987 | Cossalman | 13 acres |
| | E McDowell | 80 acres |
| 1988 | N. Winslow | 10 acres |
| | Northwest | 85 acres |
| | Northwest2 | 305 acres |
| 1989 | Smith Rd | 240 acres |
| 1990 | Upperturnbull | 526 acres |
| | McDowell | 300 acres |
| 1992 | Auto tour1 | 88 acres |
| | Auto tour2 | 202 acres |
| | Auto tour3 | 118 acres |
| | Long Lake | 9 acres |
| 1993 | Indian camp | 96 acres |
| | Palmer | 90 acres |
| 1995 | Helms Meadow | 85 acres |
| 1996 | L. Turnbull | 349 acres |
| | N. Indian | 118 acres |
| | Fence Trail | 20 acres |
| 1997 | W. Tritt450 acres | |
| | Fence Trail | 70 acres |
| 1998 | Blackhorse | 450 acres |
| | Campbell | 200 acres |
| 1999 | SW Boundary | 125 acres |
| | SW Boundary2 | 100 acres |
| 2000 | Upper Turnbull | 250 acres |
| | Aspen piles | 40acres |

**RESPONSIBILITIES**

Turnbull NWR has had a dedicated fire management staff since 1990 when a Fire Management Officer and four seasonal firefighters were added to the refuge staff. The primary responsibilities of the fire management staff are to provide initial attack fire suppression capability on the refuge, conduct hazard fuel reduction / fire prevention programs, provide interagency support in fire suppression and conduct prescribed fire activities in support of refuge habitat management programs.

Current suppression capability on the refuge consists of a 500 gallon 4 wheel drive quick attack engine (ICS type V), a 900 gallon extended operations engine (ICS type IV), a 300 gallon engine unit (ICS type VI) and a 3000 gallon water tender (ICS type II). All initial attack engines are "Class A" foam equipped to increase effectiveness in all aspects of fire operations. The refuge also maintains a 20 person fire cache consisting of hand tools, chainsaws, personal protective equipment, field pack meals and first aid supplies. Various equipment such as porta-tanks and a "Mark III" porta-pump support fire suppression and prescribed fire activities (Appendix C).

**Refuge Manager**
The Refuge Manager of Turnbull NWR is the primary line officer responsible for all aspects of the refuge fire management program. The Refuge Manager or designee approves the annual fire management budget requests, authorizes all purchases of fire equipment, supervises the fire management officer, reviews and approves prescribed burn plans and ensures that the fire management program is carried out in accordance with FWS policies, regulations and guidelines.

Currently the refuge fire staff consists of a Zone Fire Management Officer (FMO; located at Little Pend Oreille NWR), Assistant FMO (AFMO), Engine Crew Supervisor, Assistant Engine Crew Supervisor, and four seasonal Engine Operators/crew. The Regional Prescribed fire crew is hosted at the refuge and consists of a Supervisor, Lead Forestry Technician, and four Forestry Technicians.

**Zone Fire Management Officer**
The Zone Fire Management Officer, through consultation with the Refuge Manager, is responsible for all aspects of the implementation of the refuge fire management program in accordance with the policies, procedures and guidelines established by the Department of Interior and the National Wildfire Coordinating Group. Fire Management Program implementation includes development of annual budgets for fire management operations, determination of fire equipment needs and initiating procurement requests, determination of staffing levels, development of seasonal fire crew duties, initiation of personnel actions and selection of seasonal fire staff. The Zone FMO is responsible for the training of all fire staff to the standards established for fire positions according to the standards established for "red card" qualification by the National Wildfire Coordinating Group (PM 310-1). The Zone FMO conducts training for staff , as requested. The Zone FMO is responsible for overseeing all aspects of fire management planning on the refuge including the development of the refuge Fire Management Plan, Pre-Attack Plans, Escaped Fire Contingency Plans, Prescribed Burn Plans and other required fire planning documents.

The Zone Fire Management Officer is responsible for the development of interagency agreements with local, state and federal agencies to insure cost effective shared use of fire suppression resources for large incidents as requested through the interagency dispatch system.

Prescribed fire planning and implementation is also the responsibility of the zone fire management officer. Objectives for prescribed fire implementation for habitat management purposes are developed in conjunction with refuge biological staff. Fire behavior predictions, implementation strategies, control tactics, smoke management and safety considerations are all the responsibility of the fire management officer in prescribed fire planning.

The Zone FMO is also responsible for the refuge fire prevention program. Fire prevention involves public awareness of fire danger levels within the refuge and using various media to make the visiting public aware of fire danger levels. Fire danger rating levels are determined through a comprehensive program monitoring fire weather and fuel moisture variables, input of the data into the appropriate computer system for analysis, obtaining outputs and responding with appropriate pre-suppression strategies. Pre-suppression strategies can involve prepositioning equipment, maintaining maximum staffing levels or using crews to remove accumulations of hazardous forest fuels from areas with values at risk. Other responsibilities include development and oversight of project work assignments for the seasonal fire crew.

The Zone FMO should be a thoroughly trained, experienced and qualified individual in both fire suppression and prescribed fire. The individual should have training in fire suppression tactics, wildland fire engine operations, fire behavior, fireline safety and supervision in the fire service. The Zone FMO should be a qualified instructor for basic fire suppression training courses by completing the Facilitative

Instructor course (M-410) and have appropriate fire management administrative training.

**Assistant Fire Management Officer**
The Assistant Fire Management Officer is responsible for the training of all fire staff to the standards established. The Assistant Fire Management Officer may also conduct training, as requested. The AFMO is responsible for assisting the Zone FMO with all aspects of fire management planning on the refuge including the development of the refuge Fire Management Plan, Pre-Attack Plans, Escaped Fire Contingency Plans, Prescribed Burn Plans and other required fire planning documents. The Assistant Fire Management Officer is responsible for the overall supervision of the fire program at Turnbull NWR including the fire and the prescribed fire programs. The AFMO develops budget, work plans and projects for the Zone Fire Management officer and Refuge staff. The AFMO is responsible for the refuge fire prevention program. Fire prevention involves public awareness of fire danger levels within the refuge and using various media to make the visiting public aware of fire danger levels. Fire danger rating levels are determined through a comprehensive program monitoring fire weather and fuel moisture variables, input of the data into the appropriate computer system for analysis, obtaining outputs and responding with appropriate pre-suppression strategies. Pre-suppression strategies can involve pre-positioning equipment, maintaining maximum staffing levels or using crews to remove accumulations of hazardous forest fuels from areas with values at risk. Other responsibilities include development and oversight of project work assignments for the fire crew.

The AFMO should be a thoroughly trained, experienced and qualified individual in both fire suppression and prescribed fire. At a minimum the Assistant Fire Management Officer should have ICS "red card" qualifications of Initial Attack Incident Commander (ITC4). The individual should have training in fire suppression tactics, wildland fire engine operations, fire behavior, fireline safety and supervision in the fire service. Along with these qualifications the Assistant Fire Management Officer should be rated as a Prescribed Burn Boss Type 2 (RXB2). The Assistant Fire Management Officer should also be a qualified instructor for basic fire suppression training courses by completing the Facilitative Instructor course (M-410) and have appropriate fire management administrative training.

**Supervisory Forest Technician (Engine Crew Supervisor)**
The Engine Crew Supervisor is responsible for the direct supervision of daily activities for the fire crew on wildland fire activities and project work assignments. The engine crew supervisor receives assignments and instructions directly from the AFMO or, in the case of wildland fires, through the Incident Commander. The primary responsibility of the crew supervisor is ensuring the safe operations of fire crew personnel in all aspects of fire management operations. The Engine Crew supervisor is responsible for making sure that the daily safety inspections of all refuge suppression equipment are conducted. It is the crew supervisor is responsibility to ensure that all refuge fire equipment is ready to respond to a wildland fire at all times and to perform necessary maintenance activities to insure this level of readiness. The crew supervisor is responsible for assisting the assistant AFMO in training fire crew personnel in all aspects of fire operations. The crew supervisor is responsible to ensure that all fire crew personnel are thoroughly trained in the operation and use of all the various units of refuge fire suppression equipment.

The crew supervisor is responsible for coordinating the activities of refuge fire equipment and personnel during wildland fire suppression operations. The supervisor is responsible for preparing required fire reports, crew time reports, equipment logs, equipment procurement documents and conducting annual fire suppression equipment inventories. The crew supervisor is responsible for documentation of all crew activities on all On- and off-refuge fire assignments including unit logs, meal and lodging receipts and utilization of purchase orders. Daily project work activities of fire crew personnel are supervised by the

crew supervisor under direction of the AFMO. Project work supervision includes suppression equipment repair and maintenance, hazard fuel reduction activities, timber stand improvement, hazard tree removal, fire weather data collection, prescribed burn unit preparation and assisting refuge staff in biological monitoring activities.

The engine crew supervisor should have extensive experience in wildland fire suppression and the supervision of fire personnel in actual fireline situations. Knowledge in fire engine operations and maintenance, engine tactics and strategies, fireline safety, water handling systems, Class A Foam use and delivery systems, prescribed fire, firing techniques and chainsaw use are required skills and abilities for the engine crew supervisor. Minimum training and qualifications include Initial Attack Incident Commander (ICT5), Crew Boss, and formal training in fireline safety, fire suppression tactics, fire behavior, engine operations and water handling systems. Current Department of Interior policy requires that all operators of fire equipment exceeding 26,000 lbs. acquires the equivalent of a Commercial Vehicle Operators license.

**Forestry Technician (Assistant Engine Supervisor)**
The Assistant engine crew supervisor is responsible for the direct supervision of daily activities for the seasonal fire crew both on wildland fire suppression activities and project work assignments. The assistant engine crew supervisor receives assignments and instructions directly from the engine crew supervisor or, in the case of wildland fires, through the Incident Commander. The primary responsibility of the assistant crew supervisor is ensuring the safe operations of fire crew personnel in all aspects of fire management operations. The assistant engine crew supervisor is responsible for making sure that the daily safety inspections of all refuge suppression equipment are conducted. It is the assistant crew supervisor's responsibility to ensure that all refuge fire equipment is ready to respond to a wildland fire at all times and to perform necessary maintenance activities to insure this level of readiness. The assistant crew supervisor is responsible for assisting the Fire Management staff in training fire crew personnel in all aspects of fire operations. All daily project work activities of the fire crew personnel are supervised by the assistant crew supervisor under direction of the engine crew supervisor. Project work supervision includes; suppression equipment repair and maintenance, hazard fuel reduction activities, timber stand improvement, hazard tree removal, fire weather data collection, prescribed burn unit preparation and assisting refuge staff in biological monitoring activities.

The assistant engine crew supervisor should have extensive experience in wildland fire suppression and the supervision of fire personnel in actual fireline situations. Knowledge in fire engine operations and maintenance, engine tactics and strategies, fireline safety, water handling systems, class A foam use and delivery systems, prescribed fire, firing techniques and chainsaw use are required skills and abilities for the engine crew supervisor. Minimum training and qualifications include, single resource boss, and formal training in fireline safety, fire suppression tactics, fire behavior, engine operations and water handling systems. Current Department of Interior policy requires that all operators of fire equipment exceeding 26,000 lbs. acquires the equivalent of a Commercial Vehicle Operators license.

**Range / Forest Technician (Engine Operators)**
Engine Operator positions work under the direct supervision of the Engine Crew Supervisor in fire suppression, prescribed fire, hazard fuel reduction and project activities. The Engine operators often function as Engine Boss (when qualified) and supervise the operations of the fire engine and crew assigned to him/her during a particular operational period. Responsibilities include ensuring the safety of the crew in fireline assignments, directing engine tactics upon direction from the line supervisor and overseeing pump and hoselay operations. Daily work activities include performing fire engine safety and maintenance checks, participating in hazard fuel reduction activities, timber stand improvement projects,

hazard tree removal, prescribed fire preparation, maintaining the refuge fire cache and conducting fire weather monitoring activities.

Persons functioning in this position must have prior experience in fireline supervision, safety and engine operations. Qualifications and training required of the position include Single Resource Boss (Engines) and formal training in fire behavior and fireline safety. A Commercial Drivers license or the equivalent is required.

**Prescribed Fire Crew Supervisor**
The Prescribed Fire Crew Supervisor is responsible for the supervision and administration of this regional resource hosted at Turnbull NWR. This person is responsible for the overall operations of this crew both at the refuge and while away at others stations. This person must provide leadership in operations, administration and supervisory details. Being a Regional resource, the Crew Supervisor is responsible to train, equip, and prepare the crew for host refuge projects and regional projects. This person is responsible for keeping time, reporting time, submitting travel vouchers, and making travel logistics happen in a timely manner. This person is responsible for the safe operation of task assigned and the safety of the entire crew during all operations. This person is responsible for the maintenance and repair of the vehicles assigned to this crew. The crew supervisor is responsible for assisting the AFMO in training fire crew personnel in all aspects of fire operations. The crew supervisor is responsible to ensure that all fire crew personnel are thoroughly trained in the operation and use of all the various units of refuge fire suppression equipment.

The crew supervisor is responsible for coordinating the activities of refuge fire equipment and personnel during wildland fire suppression operations. This includes coordination with other local, state and federal firefighting organizations during suppression operations where the Incident Command System has been implemented. The supervisor is responsible for preparing required fire reports, crew time reports, equipment logs, equipment procurement documents and conducting annual fire suppression equipment inventories. On off refuge fire assignments the crew supervisor is responsible for documentation of all crew activities including unit logs, meal and lodging receipts and utilization of purchase orders.

The Prescribed fire crew supervisor should have extensive experience in wildland fire suppression/ Prescribed fire operations and the supervision of fire personnel in fireline situations. Knowledge in fire engine operations and maintenance, engine tactics and strategies, fireline safety, water handling systems, class A foam use and delivery systems, prescribed fire, firing techniques and chainsaw use are required skills and abilities for the prescribed fire crew supervisor. Minimum training and qualifications include Initial Attack Incident Commander (ICT5), Crew Boss, and formal training in fireline safety, fire suppression tactics, fire behavior, engine operations, burn boss type 2, and water handling systems.

**Assistant Prescribed Fire Crew Supervisor**
The assistant crew supervisor is responsible for the daily operations and coordination of the crew. He/ she will direct the crew in assigning work, equipment to be used, setting production standards, and defining timeliness of work. The assistant supervisor will assume the duties of the supervisor in their absence, when qualified. The assistant supervisor will be responsible for daily equipment check and reporting any deficiencies to the supervisor for action. The assistant supervisor will maintain an inventory of all parts and equipment under their control and report any needs to the supervisor for action.

The assistant Prescribed fire crew supervisor should have extensive experience in wildland fire suppression/Prescribed fire operations and the supervision of fire personnel in actual fireline situations. Knowledge in fire engine operations and maintenance, engine tactics and strategies, fireline safety, water

handling systems, class A foam use and delivery systems, prescribed fire, firing techniques and chainsaw use are required skills and abilities. Minimum training and qualifications include Initial Attack Incident Commander (ICT5), squad boss, and formal training in fireline safety, fire suppression tactics, fire behavior, engine operations, chainsaw use and maintenance and water handling systems.

**Prescribed Fire Crew Member**
Prescribed Fire Crew member positions work under the direct supervision of the Prescribed fire Crew Supervisor in fire suppression prescribed fire, hazard fuel reduction and project activities throughout the Region. The crew member may function as Engine Boss. Responsibilities include ensuring the safety of the crew in fireline assignments, directing engine tactics upon direction from the line supervisor and overseeing pump and hose-lay operations. Daily work activities include performing fire engine safety and maintenance checks, participating in hazard fuel reduction activities, timber stand improvement projects, hazard tree removal, prescribed fire preparation, maintaining the refuge fire cache and conducting fire weather monitoring activities.

Persons functioning in this position must have prior experience in supervision of a small squad, safety and engine operations.

**Collateral Duty Firefighters**
At various times as conditions require, particularly during severe wildland fire seasons, during refuge fires and prescribed burns, members of the refuge staff will be asked to function as firefighters on refuge engines or as members of Incident Management Teams in overhead positions. Responsibilities include operation/driving of the refuge fire engines and water tender, operation of all pumping units, constructing hose lays and foam wet-lines, completing required operational and safety maintenance on fire suppression equipment, manual and mechanical hazard fuel reduction activities and assist in prescribed fire preparation and implementation.

Persons functioning in these positions are required to have the basic firefighter training required by the FWS and the National Wildfire Coordinating Group. This training includes basic fire-fighting techniques (S-130), basic fire behavior (S-190), introduction to the Incident Command System (I-220) and annual refresher training in fireline safety (Standards for Survival) and the use of fire shelters.

## INTERAGENCY OPERATIONS

Interagency cooperation is vital to the full realization of refuge fire management program objectives. The ability of a single agency to implement a fire management program of any complexity is limited without coordination with and assistance from other organizations. Wildland fires escaping initial attack, project fires, and wildland fires of regional or national magnitude require the combined firefighting resources of all federal agencies. Interagency cooperation and the coordination of shared resources are imperative at all levels of the U.S. Fish & Wildlife fire management organization, from the refuge level to the regional and national offices. The Service often depends upon the resources and expertise of other Federal firefighting agencies to assist us in containing escaped prescribed fires, wildland fire suppression and providing formal fire training for our fire personnel. Conversely, the Service and Turnbull NWR have a responsibility to assist other agencies when requested. Fire staff and equipment is funded out of national fire emergency funding distributed by Congress to the Bureau of Land Management, which in turn distributes shares to each of the federal land management agencies based upon identified program needs. Turnbull NWR fire crews, engines and qualified incident management personnel are national resources and will be fully utilized to respond to requests for assistance from other agencies. The Interagency Fire Agreement (No. 83-SIE) provides the basis for cooperation between the agencies of the Departments of

the Interior and Agriculture on all aspects of wildland fire management and to facilitate the cooperative use of fire related resources during national or regional non-fire emergencies. It has been proven that it is most cost effective and in the public interest to provide specifically coordinated action between federal agencies by sharing their firefighting resources. The agreement specifically states in section VI.(11) "Upon request, any authorized agency shall render assistance in fire suppression to another, both within and outside zones of mutual interest, with its regular firefighting personnel and fire suppression facilities (equipment), when assistance is available and when such action shall not leave areas in its own protection unit unduly exposed to fire danger." Recently a *Master Cooperative Fire Protection Agreement* was developed between the states of Oregon and Washington and all Federal Land Management agencies in the Pacific Northwest. This agreement provides the foundation for cooperation in all fire management activities between states and the federal government under the direction of the Pacific Northwest Wildfire Coordinating Group (PNWCG).

In addition to the interagency agreements between federal firefighting agencies, Turnbull NWR has entered into specific mutual aid agreements with local and state and refuge fire suppression agencies. These agreements are with Spokane County Fire District #3 and the State of Washington Department of Natural Resources. The mutual aid agreements are contained in the file at the office and contain the covenants by which the U.S. Fish & Wildlife Service shares and obtains fire suppression crews and equipment on a cooperative basis with these agencies. The basic concept of these agreements is that no single agency has the suppression capability to control large and devastating wildland fires within local area and that it is more cost effective to enlist the support of other agencies within the region. These agreements are generally executed without exchange of funds between the agencies, with the understanding that unusual amounts or types of resources, (such as air tankers) or in extended attack situations will require some reimbursement. The agreements specify that each agency involved will retain autonomy in the command of it's individual resources through the implementation of the "Unified Command System" in which agency representatives of each agency involved in the suppression effort will be included within the command organization of the incident.

Turnbull NWR is located within the functional area of the Pacific Northwest Interagency Coordination Center located in Portland, Oregon. This coordination center manages the combined fire suppression resources of federal agencies in the PNW in developing the most effective means of combining these resources during periods of major wildland fire activity. All FWS and refuge fire equipment and personnel are maintained on status boards in this coordination center. Requests for refuge resources to assist another federal agency in fire suppression would come through the PNW coordination center to the Colville Inter Agency Dispatch Center (CIADC) located in Colville, Washington, which would then contact the refuge manager with a specific resource request for assistance to another agency.

Local assistance within Spokane County to local fire districts and the Department of Natural Resources is dispatched through "Fire Central", located in Spokane, Washington. The specific provisions of these dispatch procedures are contained within the cooperative agreements between the FWS/Turnbull NWR, Spokane County Fire District #3 and the Washington Department of Natural Resources. These agreements are provided in the file at the office. Requests for assistance in fire suppression come as radio requests through "Fire Central" to participating agencies.

**PROTECTION OF SENSITIVE RESOURCES**

The Regional Archaeologist and/or his/her staff will work with fire staff, project leaders, and incident commanders to ensure that cultural resources are protected from fire and fire management activities. The “Request For Cultural Resource Compliance” form (RCRC, Appendix H) will be used to inform the Regional Archaeologist of impending activities, thereby meeting the regulations and directions governing

the protection of cultural resources as outlined in Departmental Manual Part 519, National Historic Preservation Act (NHPA) of 1966, Code of Federal Regulations (36CFR800), the Archaeological Resources Protection Act of 1979, as amended, and the Archaeological and Historic Preservation Act of 1974. The NHPA Section 106 clearance will be followed for any fire management activity that may affect historic properties (cultural resources eligible to the National Register of Historic Places).

Impacts to archaeological resources by fire resources vary. The four basic sources of damage are (1) fire intensity, (2) duration of heat, (3) heat penetration into soil, and (4) suppression actions. Of the four, the most significant threat is from equipment during line construction for prescribed fires or wildfire holding actions (Anderson 1983).

The following actions will be taken to protect archaeological and cultural resources:

Wildland Fires

-- Minimum impact fire suppression tactics will be used to the fullest extent possible.
-- Resource Advisors will inform Fire Suppression personnel of any areas with cultural resources. The Resource advisor should contact the Regional Archaeologist and/or his/her staff for more detailed information.
-- Foam use will be limited in areas known to harbor surface artifacts.
-- Mechanized equipment should not be used in areas of known cultural significance.
-- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.
-- Rehabilitation plans will address cultural resources impacts and will be submitted to the Regional Archaeologist using the RCRC.

Prescribed Fires

-- The Refuge Fire staff will submit a completed RCRC to the Regional Archaeologist and/or his/her staff as soon as the burn area is identified ( i.e., as soon as feasible).
-- Upon receipt of the RCRC, the Regional Archaeologist and/or his/her staff will be responsible for consulting with the FMO and evaluating the potential for adverse impacts to cultural resources.
-- When necessary, the Regional Archaeologist and/or his/her staff will coordinate with the State Historic Preservation Officer (SHPO). The SHPO has 30 days to respond. The Refuge will consider all SHPO recommendations.
-- Mechanized equipment should not be used in areas of know cultural significance.
-- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.

## WILDLAND FIRE ACTIVITIES

Fire program management describes the operational procedures necessary to implement fire management at Turnbull NWR. Program management includes: fire prevention, preparedness, emergency preparedness, fire behavior predictions, step-up staffing plan, fire detection, fire suppression, minimum impact suppression, minimum impact rehabilitation, monitoring, and documentation.

Records show that fire season is typically from July 4th until October 31st. Depending on the specific weather of any particular year the seasons may be shorter or longer and, therefore, may start earlier or last longer.

### FIRE MANAGEMENT STRATEGIES

Fire suppression strategies for Turnbull NWR will place primary emphasis on the development of a fire suppression program that is capable of suppressing wildland fires quickly, before significant resource damage can occur. Meeting this objective will require a refuge fire management program with a significant initial attack capability of equipment and personnel. Fire suppression capabilities will be augmented by fire prevention programs and hazard fuel reduction projects. Hazard fuel reduction will involve both mechanical removal of fuels in critical areas by contractors and fire crew and the systematic application of prescribed fire to gradually reduce accumulations of dead fuels in timber stands with low intensity prescribed burns under carefully controlled conditions. Due to the hazardous levels of dead fuel residues within the forest environments of Turnbull NWR, a significant wildland fire occurring on the refuge not only threatens refuge resources, but threatens numerous private residences built immediately adjacent to the refuge and on lands leased by the refuge for wildlife easements. The communities surrounding Turnbull NWR are rapidly developing which will create a complex fire environment and limit management alternatives in the future.

Due to the small geographical area of Turnbull NWR, extreme fuel loading, proximity to urban-interface improvements and property, potential for resource damage and air quality considerations within local communities, all wildland fires will be suppressed utilizing the closest available resources. Tactical fire suppression operations will include both direct and indirect attack based upon considerations of firefighter safety, minimum impact to refuge resource values, and cost effectiveness.

The purpose of the wildland fire suppression program at Turnbull NWR is to provide the equipment and personnel necessary to suppress wildland fires that occur within or near the refuges boundaries that threaten life, property and refuge resources. It is also the intention of the U.S. Fish & Wildlife Service to provide cooperative wildland fire suppression assistance to local, state and other federal firefighting agencies in the suppression of wildland fires when requested through the provisions of various mutual-aid agreements, cooperative agreements, and as mandated by federal law.

As part of Turnbull NWR's wildland fire pre-suppression program fire staff at the refuge will identify areas of hazardous accumulations of woodland and range fuels and attempt to reduce wildland fire potential and effect by using various means of fuel reduction including; manual fuel reduction by crews, mechanical fuel reduction and hazard fuel reduction prescribed burns. The U.S. Fish & Wildlife Service will also participate and provide fire prevention activities and awareness programs within and around the refuge in cooperation with other local and state fire agencies.

Fire suppression strategies employed at Turnbull NWR will include a range of suppression techniques in order to provide for protection of values at risk, natural resources, and cost efficiency with firefighter safety always being the first operational priority. Suppression strategies and tactics will be unique to each

wildland fire, predicated by weather parameters, fuel conditions, safety considerations, resources and threats to improvements. Determination of strategies and tactics will be made by the Incident Commander on scene utilizing guidance from pre-attack plans (see *Fire Management Units* section) for individual areas of the refuge, knowledge of refuge fire management objectives, and input from refuge resource advisors if available.

The primary suppression strategy employed at Turnbull NWR will be aggressive but safe perimeter control utilizing direct attack tactics. Numerous justifications for this strategy have been enumerated elsewhere in this document. Turnbull NWR contains numerous lakes, wetlands, rock outcrops and roads that provide excellent barriers to fire spread and safe areas for control efforts. Situations in which direct attack on a high intensity, rapidly spreading wildland fire would jeopardize firefighter safety, the Incident Commander should consider use of indirect attack tactics taking advantage of natural barriers as part of the fire perimeter control plan. Burnout's, blacklines and backfires can and will be utilized to augment the control capabilities of natural and manmade barriers to contain wildland fires. Indirect attack tactics may be employed when resource values are compromised more by suppression actions than by the wildland fire. Examples include areas of archeological resources or endangered plant populations within the fire perimeter. The use of heavy equipment such as bulldozers will cleared by the Refuge Manager or Wildlife Biologist prior to use, the consideration here being threat to life or private structures.

All fires occurring on the refuge will be manned with all refuge resources until mopped-up and declared out. No fire occurring on the refuge will be left unmanned during daylight hours. Refuge fires will be declared out after 100% mop-up has been achieved.

As discussed previously in this document, Turnbull NWR is located within one of the most rapidly developing wildland/urban interface areas in the west. This area is dominated by ponderosa pine/bunchgrass fuel types (NFFL 2) with extreme fuel loading resulting from fire exclusion policies practiced by local fire agencies. Fuels within residential areas are contiguous with those on the refuge boundaries. Turnbull NWR lies downwind of these areas during the most extreme wind occurrences experienced. Suppression costs will always be subordinate to values at risk for fires that escape refuge boundaries and threaten residences, ranches, farms and private timber resources.

**PREPAREDNESS**

Preparedness is the work accomplished prior to fire occurrence to ensure that the appropriate response, as directed by the Fire Management Plan, can be carried out. Preparedness activities include: budget planning, equipment acquisition, equipment maintenance, dispatch (Initial attack, extended, and expanded), equipment inventory, personnel qualifications, and training. The preparedness objective is to have a well trained and equipped fire management organization to manage all fire situations within the Refuge. Preparedness efforts are to be accomplished in the time frames outside the normal fire season dates.

Wildland Fire Preparedness activities refer to those actions taken by the fire staff to prepare for and prevent wildland fires. These activities include conducting fire suppression training courses, preparation and maintenance of fire suppression equipment, physical fitness training, fire weather monitoring, fire danger rating, extra staffing during high fire danger, hazard fuel reduction activities (manual fuel reduction and prescribed fire), practice drills with refuge fire suppression equipment and public education in fire prevention in coordination with other local fire agencies.

Turnbull NWR lies within the "rain shadow" of the Cascade Mountain Range in the flat rolling country immediately west of the Rocky Mountain Range in Idaho. Most of the precipitation coming in from the

Pacific Ocean is deposited on the west side of the Cascades in Washington. The result is that the intermountain region has a climate that is described as "semi-arid". Annual precipitation at Turnbull NWR is approximately 16 inches with most of the precipitation occurring during the winter as snow. Summers are normally very dry with average high temperatures in the low 80's and maximum temperatures that can get over 100 degrees. The fire season begins in May when the grasses begin to dry out. Fires at this time of the year are usually small and do not carry into the pine woodlands due to the high fuel moisture still present in the larger dead fuel classes and live fuels. The large number of wetlands and wet meadows on the refuge would preclude wildland fires from attaining significant size (over 1000 acres) during normal years. However, recent drought years and forest conditions of extreme fuel loading with contiguous forest canopy throughout the refuge have created conditions that could promote large wildland fires at any time of year with the right conditions of fuel moisture and wind. Relative humidity readings have been recorded below 10% on the refuge and 10 hr. fuel sticks have been recorded as low as 3%, which occurs quite frequently during late summer and early fall. Lightning caused fires occur with regularity in the Spokane County area during the summer months, however fuel moisture conditions and rain which often accompanies these events prevents these fires from attaining significant size before local suppression forces are on scene.
The primary progenitors of large wildland fires in the local fire environment are the "Palouse Winds" which occur during late summer and fall with regular frequency. These westerly winds are typically associated with changing weather conditions when cooler low pressure systems sweep in from the Pacific, accelerated by the "gravity wind" effect of cool air coming down the east slope of the Cascades and meeting little resistance as they sweep across the flat, rolling terrain of the Columbia River Basin. Wind speeds under these conditions can reach 40 to 60+ miles per hour. These winds occur in conjunction with the lowest levels of fuel moisture in all size classes and can cause relative humidity levels to drop below 15%. Wildland fires occurring under these conditions are virtually uncontrollable unless contained with rapid and capable initial attack forces. In 1991, a series of wildland fires ignited by 60 mph winds in the vicinity of Turnbull NWR burned over 100,000 acres and destroyed 110 homes in a single day of devastation that became known as "Firestorm 91". This was the largest wildland/urban interface fire in the history of the inland northwest. It can be expected that due to local forest health, fuel loading and weather conditions the situation will occur again in the near future.

The Annual Refuge Fire Management Activities table is attached in Appendix E.

**Historical weather analysis**
The weather station used for the historical weather was the Spokane Airport, station number 453505. A data set from 1973 to 2000 exists for this station. KCFAST was used to download the data onto a PC and the FIREFAMILY Plus was used to analyze the data.

A cumulative frequency distribution on the burning index yields staffing classes. The 97$^{th}$ percentile establishes staffing class 5, the 90$^{th}$ percentile establishes staffing class 4. Staffing classes 2 and 3 are based upon 1/4 and ½ of the 90$^{th}$ percentile value respectively (Appendix F).
The break points of the burning index for fuel model C were used in the step-up plan and were:

Staffing class 1 = 0-11
Staffing class 2 =12-22
Staffing class 3 = 23-46
Staffing class 4 = 47-54
Staffing class 5 = 55 and greater

**Staffing**
Daily Staffing Levels will be developed using the FTS200 weather software and FTS weather station

daily at or about 1500 hours. The AFMO or designee will down load the daily observations and find the BI. Using that BI and forecast for the next day will set the staffing level. This then will be posted in the crew quarters and passed on to the Refuge Manager. Document process for determining daily fire danger BI (what weather station, who processes WIMS and NFDRS data, staffing class break points). Included in Appendix F are the weather station catalog with fuel model with 90th and 97th percentile breakpoints.

In conjunction with Refuge, Regional and National Preparedness Levels, the Refuge Manager may limit the following activities in the public use area or on the entire refuge. When a staffing level 1 or 2 exists there will be no limitations on any refuge activities. When a staffing level 3 is reached all chainsaw use will cease at 1300 and a 1 hour fire watch will be maintained. In a staffing level 4 No chainsaw use may occur on the refuge. If a staffing level 5 occurs all public use areas may be closed and no smoking outside of vehicles may occur.

The refuge step up plan identifies the process and procedures for determining the level of preparedness activities by refuge fire staff and fire suppression equipment on an incremental basis in response to increasing fire danger. As the fire season progresses, the temperatures get higher, vegetation gets drier and the potential for wildland fires increases proportionally. The Step-up plan uses the Burning Index calculated by the National Fire Danger Rating System (NFDRS) for determining the level of fire danger. As the level of fire danger increases within and around the refuge, fire staff will respond by working their normal days off, increasing the level of readiness of all refuge fire equipment. Step-up plan will also determine the number of engines and crews that the refuge will respond with to inter-agency requests for assistance.

Table 3: Step-up Plan

| Staffing Level | Burning Index (Fire Danger Level) | Step-up Activity |
|---|---|---|
| SL-1 | BI = 0-11 (Low Fire Danger) | Normal tours of duty and numbers of engine personnel<br>Single engine initial attack response (E-TB-1) |
| SL-2 | BI = 12-22 (Moderate Fire Danger) | Normal tours of duty and numbers of engine personnel<br>Single engine initial attack response (E-TB-1) |
| SL-3 | BI = 23-46 (High Fire Danger) | Normal tours of duty and numbers of engine personnel<br>Tandem engine initial attack (Engine TB-1 and TB-2) |
| SL-4 | BI = 47-54 (Very High Fire Danger) | Tours of duty for engine crews expanded to 6th day<br>Tandem engine initial attack (Engine TB-1 and TB-2) |
| SL-5 | BI = 55+ (Extreme Fire Danger) | Tours of duty for engine crews expanded to 7th day.<br>Tandem engine initial attack (Engine TB-1 and TB-2) |

*Note: At staffing level 3 (High Fire Danger) and above, Initial Attack Incident Commander will automatically request mutual-aid assistance from Fire District #3.

*Lightning or steady winds in excess of 19 MPH predicted for the next burning period will automatically adjust the calculated fire danger level into the next highest Staffing Index level.

Extreme fire weather conditions (BI>55), either predicted or current may require the Refuge Manager (or

designee) to close the refuge to public use activities both in the interest of public safety and to protect refuge natural resources from potential wildland fire ignition sources. These areas include the refuge public use area, the auto-tour route and the State of Washington's Columbia Plateau trail that crosses the northwest portion of the refuge.

In the event of extreme fire weather conditions, or in the case of an ongoing wildland fire emergency the Refuge Manager will order a fire closure and all staff not involved in fire suppression activities will assist with the evacuation of public use areas. In the event that Smith Rd. is impassable due to safety considerations (fire threatening the road) or fire equipment is blocking access, public and staff will take shelter in green belts at refuge headquarters away from powerlines and fuel facilities. The refuge will also explore the possibility of alternative egress routes for public evacuation, such as Luke Road or out through gate 19 on the auto tour route, or even out through the SE corner of the refuge through the Stubblefield Lake area.

The Refuge Manager may also close the refuge to public use at the request of local fire officials in order to prevent potential refuge fires from burning off refuge into surrounding residential areas. This is a discretionary closure and will be undertaken as a courtesy to local fire agencies.

Fire closure of public use areas may also be required during periods when prescribed burns are conducted within public use areas. Public notification will be provided via local media outlets or signs posted on the entrance road prior to the proposed burn date.

**Fire Prevention**
An active fire prevention program will be conducted in conjunction with other agencies to protect human life and property, and prevent damage to cultural resources or physical facilities.

A program of internal and external education regarding potential fire danger will be implemented. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and neighbor awareness of fire hazards. Trained employees need to relate to the public the beneficial effects of prescribed fires as opposed to unwanted human-caused fires, with emphasis on information, essential to understanding the potential severity of human-caused wildland fires and how to prevent them.

It is essential that employees be well informed about fire prevention and the objectives of the refuge's fire management program. Further, employees must be kept informed about changes in existing conditions throughout the fire season.

During periods of extreme or prolonged fire danger emergency restrictions regarding refuge operations, or area closures may become necessary. Such restrictions, when imposed, will usually be consistent with those implemented by cooperators. The Assistant Fire Management officer will recommend when such restrictions are necessary. Any recommended closures will be authorized by the Refuge Manager or their designee.

An important part of the refuge preparedness program, hazard fuel reduction refers to the removal of dead vegetation (grasses, pine needles, branches, logs) and the thinning of forested areas where tree densities prevent healthy forest conditions and present significant wildland fire hazards. Hazard fuel reduction is a fire prevention activity and can be accomplished through a variety of means and methods. The primary techniques to be used at Turnbull NWR in hazard fuel reduction will include manual reduction of fuel accumulation by fire crews in critical areas, mechanical reduction of fuels using refuge equipment, mechanical reduction of fuels during commercial timber sales and large scale hazard fuel reduction using

prescribed fire.

As part of the primary work activities of fire crews at Turnbull NWR, annual hazard fuel reduction work will be accomplished in critical areas of the refuge using hand tools, chain-saws, and weed whips. Work elements include the cutting, raking, clean-up and removal of dead vegetation from areas adjacent to refuge facilities, residences and other improvements. This work is undertaken after grasses have cured to prevent re-growth and accomplished before the high fire danger season begins. Areas that will be given priority attention for manual hazard fuel reduction work will include:

1. Refuge Headquarters, Buildings, Shops and Equipment Storage Areas
2. Refuge Residences at headquarters and the bunkhouse on Mullinix Road
3. Refuge Roads and Auto-tour Route Mowing
3. Visitor Use Facilities, Parking Areas, and Handicapped Boardwalk and Refuge Signs.
4. Fuel Facilities
5. Power Supply Poles
6. Turnbull Lab for Ecological Studies
7. Goodwin tract buildings

These areas have been identified as priorities due to high potential for fire ignitions resulting from human activity or values at risk to damage and loss from a wildland fire.

As discussed previously in this document, fire exclusion from fire dependent ecosystems and timber harvest management practices on the refuge has created conditions within refuge forest habitats of unnatural tree densities, extreme fuel loading (dead branches and logs), ladder fuels on living trees (these provide the impetus for running crown fires) and unhealthy trees susceptible to insect and disease pathogens. Existing trees and stands exhibit loss of vigor and growth under the intense competition, with very little green living canopy, stunted diameter growth and elongated vertical growth resulting from competition for light by the shade-intolerant pine. In the dry environment of eastern Washington forests, pine needles, branches and other forest detritus are not decomposed sufficiently by soil fungi and bacteria for effective nutrient cycling. As in most xeric vegetation systems, fire is the primary mechanism of nutrient cycling and plays a significant role in the regeneration of new trees. Unfortunately, most of the trees that need to be removed from forest stands within the refuge to promote healthy, natural forest densities have reached a size sufficient to prevent low intensity prescribed fires from removing their competitive influence on stand dynamics. If these stands are not managed with a combination of mechanical reduction and prescribed fire they will provide the fuel for extreme wildland fires and the potential for insect and disease infestations.

In order to restore more natural and healthy density to refuge pine forests, refuge fire staff will undertake a program to identify forest stands that need intensive management and initiate mechanical thinning. An intensive forest stand inventory will be conducted within the refuge utilizing air photos, ground surveys and computer analysis of individual stands using Geographic Information Systems. Once a stand has been identified for treatment, trees will be marked for removal and cut by refuge crews or commercial contractors. Fallen trees will be piled or scattered throughout the stand and be allowed to cure for several months. Prescribed fire will then be applied to the site either as individual pile burns or as broadcast under-burns. Prescribed fire will allow uniform and natural distribution of fire released nutrients within the stand. Combinations of the above techniques may also be employed depending on site characteristics and management strategies required.

In cooperation with local agencies Turnbull NWR will provide fire prevention programs on the refuge in accordance with FWS guidelines. These activities will include daily maintenance of the refuge fire danger sign, which is located at the entrance to the refuge. It's purpose is to notify the public on a daily basis of

the current fire danger level in the surrounding area (extreme, very high, high, moderate and low) and caution them to be careful with the use of fire. Additional fire prevention activities will include public contact by refuge staff during periods of extreme fire danger to make them aware of the hazard potential and media contacts through printed media, television and radio. When requested, refuge fire staff will provide interpretive programs on fire prevention for school groups and well as any other aspect of the fire management program on the refuge.

Levels of fire staffing and fire danger rating levels at Turnbull NWR are determined by recording daily measurements of weather and fuel moisture variables. The measurements are recorded automatically at an Automatic Weather Station (AWS) located at Turnbull NWR headquarters. This computer controlled weather station continuously records information on air temperature, humidity levels, wind speed / direction, precipitation and fuel moisture. The recorded weather data is downloaded to the refuge fire management computer system as well as the national Weather Information and Management System (WIMS). Data from the Turnbull NWR weather station is used to calculate National Fire Danger Rating System (NFDRS) indices, which utilize weather, and fuel moisture data to determine fire danger levels for the next operational period. The refuge fire management computer system accesses the programs through telephone modem connections. The NFDRS system is programmed with specific information about Turnbull NWR including the station identifier, fuel types, location, climate class, topography, human and lightning caused risk factors. This information is integrated with the daily weather and fuel moisture inputs to determine levels of operation preparedness (staffing levels) based upon predicted fire danger. Outputs of the NFDRS include predictions of potential fire behavior (spread component, flame lengths, ignition component) lightning activity levels, human caused fire risk levels, and the burning index. This information is combined to give a fire danger rating, which ranges through low, moderate, high, very high and extreme. The fire danger level is used in the fire prevention program to make the public aware of the potential for wildland fires through the use of a Fire Danger Level sign at the entrance to the public use area of the refuge. The information gathered by the Turnbull NWR weather station is also provided to local cooperating fire agencies, (Spokane County, Bureau of Land Management, Department of Natural Resources) either through the Weather Information Management System National Computer or through direct FAX. Direct FAX data also includes the status of refuge fire equipment and staff regarding operational levels and locations .

One of the most important uses of the daily fire weather data is in calculating the staffing levels for daily fire preparedness. This information is used to calculate the Burning Index(BI)in the National Fire Danger Rating System (NFDRS). The Burning Index is the primary input of the refuge "Step-Up Plan" which is described in the following section.

**Structure Protection**

Annually, the fire crew constructs defensible space around Refuge buildings and improvements. These firebreaks allow structure protection in the event that a fire burns in, around or near any building. These fire breaks are 30 to 40 feet wide and all burnable material is removed, trees limbed up, and debris removed.

Congress approved monies to help prevent large fires from damaging or destroying communities at risk, Turnbull NWR lies just south of Cheney, WA and during FY 01 the refuge proposed treating 500 acres of these Wild land Urban Interface areas. Private structures adjacent to the Refuge (on the northern and eastern edges of the Refuge) need additional protection from wildland fire; 280 acres along these boundaries have been treated to limit potential fire threats to these structures.

**Training**

Departmental policy requires that all personnel engaged in suppression and prescribed fire duties meet the standards set by the National Wildfire Coordinating Group (NWCG). Employees at Turnbull NWR will conform strictly to the requirements of the wildland fire management qualification and certification system and USFWS guidelines.

Basic wildland fire training refreshers are offered annually for red-carded firefighters and records kept in a centralized database. Additional training is available from surrounding agencies in pump and engine operation, power saws, firefighter safety, fire weather and fire behavior, helicopter safety and prescribed fire objectives and activities. On-the job training is encouraged and will be conducted at the field level. Whenever appropriate, the use of fire qualification task books will be used to document fire experience of trainees. The AFMO will coordinate fire training needs with those of other nearby refuges, cooperating agencies, and the RO.

The Refuge supports the development of individual Incident Command System (ICS) overhead personnel from among qualified and experienced refuge staff for assignment to overhead teams at the local, regional, and national level. The Refuge Manager may authorize on-duty physical fitness training for fire personnel.

Fire suppression is an arduous duty. On prescribed fires, personnel may be required to shift from implementation/monitoring activities to suppression. Poor physical condition of crew members can endanger safety and lives during critical situations.

Personnel performing fire management duties will maintain a high level of physical fitness. This requires successful completion of a fitness pack test. Personnel must complete a three mile hike with a 45 pound pack in less than 45 minutes.

Fish and Wildlife Service policy requires that only trained and qualified people will be assigned to fire management duties. Minimum qualification standards are required for participation in fire suppression and prescribed fire assignments. These standards specify knowledge and skills gained through formal training, job related experience and physical fitness requirements for each specific position. The level of training and experience required for a specific position is determined and defined in the National Interagency Incident Management System (NIIMS) Wildland Qualifications Guide as developed by the National Wildfire Coordinating Group (NWCG).

Specific qualifications and training for various fire suppression and prescribed fire positions can be found in the FWS Fire Management Handbook (621 FW: exhibit 49).

A performance based training system has been established by the National Wildfire Coordination Group in recognition that all of the skills, knowledge and experience needed to be qualified for a specific fireline position can not be obtained in formal training. Performance based training utilizes on the job training as the basis for qualification. A "task book" for each fireline position is utilized as a checklist of specific functions that the employee designated as the trainee must complete on an actual fireline assignment or other qualified incident. The task books include a full range of duties that must be performed in a position, from supervision, to planning and administration. Each trainee is assigned a facilitator who verifies the completion of each assigned task, oversees actual performance and finally certifies that individual is qualified for the position. Only individuals qualified within the position may certify another for the position. Tasks books for prescribed fire positions are currently in use.

Annual fireline safety re-training is required for all personnel involved in fireline operations, including

prescribed fire. The training consists of the "Standards for Survival" course which includes a situational review of the "13 Standard Firefighting Orders", the "Watch Out Situations" and re-certification in the use and deployment of a fire shelter. All fireline personnel are required to be able to deploy a fire shelter within 25 seconds during annual safety training exercises.
All fireline personnel are required to have an annual physical exam by a qualified physician. Upon completion of the physical, firefighters are required to pass an aerobic fitness test prior to being assigned to fireline duties. The aerobic fitness test shall consist of the "Pack-test".

The primary operational priority for all activities undertaken in fire management is SAFETY. The safety of all personnel involved in fire management activities on Turnbull NWR, regardless of position, agency affiliation or function, will be the primary operational objective. All operational plans will ensure that safety procedures are implemented and understood by all individuals involved in the fire management activity. Fireline supervisors will be responsible for communication of operational safety imperatives to those individuals functioning under their supervision. Fireline supervisors will ensure that all personnel under their responsibility wear all required personal protective equipment (PPE) when working in fireline or work project situations. Required personal protective equipment will be utilized according to National Wildfire Coordinating Group Standards, Departmental Guidelines and OSHA (Occupational Safety and Health Act).

Departmental policy requires that all personnel assigned to specific functions within the fire management organization will have completed the required minimum training (defined in the NWCG 310-1, Wildland Fire Qualification Guide) for the assigned position. Fire staff supervisors will provide required basic fire training as applicable or provide access and funding to training opportunities for more advanced fire training courses as they become available. Individuals in position training assignments will be closely supervised.

Safety procedures for fireline situations will follow those defined in the Fireline Handbook (NWCG 410-1). Fire supervisors will ensure that along with personal protective equipment, all "STANDARDS FOR SURVIVAL" are met during all incidents, including the provision of clear operational instructions, established safety zones and escape routes, maintaining lines of communication with all firefighters and command functions and posting lookouts.

Since much of the refuges fire management operation involves the use of fire suppression equipment, i.e. fire engines, water tenders, pumps and chainsaws etc., training and certification in the use of this equipment is required. In addition this equipment must be serviced to maintain a level of instantaneous response for initial attack purposes. Turnbull NWR fire crews are thoroughly trained in the operation and maintenance of all the various components of the refuge fire equipment capability. Any member of the crew should be able to perform any task required or requested on the equipment for purposes of safety. A standardized daily maintenance check sheet for initial attack readiness is utilized for the daily equipment inspections which are performed as the very first duty of the day during fire season (see Maintenance Check sheet Appendix G.)

Daily Operations Schedule:
1. Maintaining INITIAL ATTACK READINESS is the primary responsibility of all fire staff. All fire staff personnel and equipment must remain initial attack capable at all times.

2. Crews will remain with their assigned engine at all times. Engine Crews will not be split from engines for specific project assignments. All project work assignments will be accomplished as an engine crew.

3. Fire suppression, including interagency requests for assistance takes priority over all project work assignments.

**Supplies and Equipment**
The secure cache is located in the old dairy barn on the Refuge. The engine captain is in charge of the inventory and issue of the equipment. The engine captain is also in charge of acquiring the normal unit strength equipment through the GSA purchasing protocol. This refuge maintains a 20 person fire cache in Appendix D is a list of the required equipment.

Additional equipment and supplies are available through cooperators and the interagency cache system. Requests for additional personnel and equipment are made through the servicing Dispatch Center for the refuge is contained in the Refuge dispatch plan in appendix C. In the event of a fire that requires more equipment than is available in the cache at the refuge the IC can order additional equipment through Colville dispatch and they will send the request onto the area cache in Wenatchee.

Table 4: Fire Equipment Type Specifications
Engine TB-1 ICS type V 500 gal. water capacity / Crew of 3
Class A Foam with 22 gal. aux. foam tank
1000 ft. 1 1/2" hose
1000 ft. 1" hose
Handtools and Chainsaw
Engine TB-2 ICS Type IV 900 gal. water capacity / Crew of 3
Class A Foam with 22 gal. aux. foam tank 2000 ft. 1 1/2" hose
1800 ft. 1" hose
Handtools and Chainsaw
Engine TB-3 ICS ICS Type VI 300 gallon / Slip on unit
Class A Foam
used as a backup unit for prescribed fire
IA when primary engines are off-refuge
Water Tender ICS Type II 3000 gallon capacity
300gpm volume pump
Refuge Fire Cache: 20 person capability for Handtools and personal protective gear (20 person)
2 Mark III portable pumps, porta tanks, hose, fittings, chainsaws, first aid gear, and MRE. A detailed list is attached in Appendix D.

**DETECTION**
Due to proximity to the urban interface and three major travel corridors most Refuge fires are reported through the 911 system. Duty officers carry the county alert pagers during fire season . When the fire danger is at high or better the Refuge is included on the response cards for the local district. During lightning events the fire management staff may post resources around the refuge to observe any starts.

The Fire Management Plan does not discriminate between human-caused and lightning caused fire. All wildland fires will be suppressed. However, detection shall include a determination of fire cause. Moreover, human-caused fires will require an investigation and report by law enforcement personnel. For serious human-caused fires, including those involving loss of life or property, a qualified arson investigator will be requested.

**COMMUNICATIONS**
Turnbull NWR Has a refuge base station and various vehicle and handheld mobile radios. Current MOU’s

can be found in office file. A radio log is located in the office for fire traffic. Dispatching is done through our cooperator in Spokane at Fire Central. Fire central tapes the conversations and can provide written transcripts upon request. Interagency dispatching is done over the phone and fax. records are kept in the fire office.

**FIRE MANAGEMENT UNITS**

Due to staff limitations, relatively small land management parcels, long response times, valuable resources, and values at risk on neighboring lands, this plan does not recommend wildland fire managed for resource benefit as an option for any of the units. Wildland fires will be suppressed using the appropriate suppression response. Prescribed fires will be used to reduce hazardous fuels and to meet resource management objectives.

Fire Management Units (FMUs) are areas on a refuge which have common wildland fire management objectives and strategies, are manageable units from a wildland fire standpoint, and can be based on natural or manmade fuel breaks. An FMU may coincide with a prescribed fire burn block or treatment area or unit, but this is not always the case.

Turnbull NWR has been divided into four fire management planning units based upon logical wildland fire control boundaries that utilize natural and manmade fuel breaks (wetlands and roads) as well as refuge boundaries. These fire management planning units (designated hereafter as FMU1, FMU2, FMU3, and FMU4) essentially divide the refuge into quadrants of similar size (Appendix H). Each FMU will have a pre-attack fire suppression plan developed for it which contain and specify the following information:

1. A detailed map of the unit showing roads, improvements, structures, fuel/vegetation types, hydrography, threatened or endangered species locations, cultural or historical sites and the best locations for containing a running wildland fire within the unit.
2. Fire suppression objectives of the unit.
3. Primary control strategies and tactics to be utilized within the unit.
4. Identification/description of the best suppression containment/control points within the unit.

The fuel types, fire history and fire behavior characteristics of refuge fire management planning units are consistent in the regard that each unit has a variety of fuel types and conditions. The geologic formation of the channeled scablands created many shallow ravines, potholes, lakes that affect vegetation/fuel types. This variety of topography creates great differences in soil and moisture characteristics within short distances and small areas. The result is a "patchwork quilt" of habitats and consequently fuel types. There are upland meadows, grasslands dotted with pine, dense stands of pine forests, marshes, riparian woodlands populated with deciduous trees and shrubs. The diversity and distribution of these varied fuel types within the refuge create significant complexity in fire suppression strategies and solutions. Wildland fires occurring in these varied fuel types will exhibit very different fire behaviors depending on which fuel type the fire front are burning in at a paticular time. A firefighter may find himself facing a running grassfire at one location, while only a short distance away, extreme fuel loading in a stand of ponderosa pine may be spotting up to one half mile downwind. All suppression strategies employed must recognize the disparate nature of refuge fuels types and utilize tactics, which will address the potential for very inconsistent and erratic fire fronts.

Figure 3 depicts the locations of Refuge Fire Management Units. Associated with each FMU map is a Pre-Attack Plan that details the wildland fire control objectives for each unit and provides information for use in developing suppression strategies and techniques. Control objectives range from general safety procedures to identifying specific locations for establishing primary and contingency control perimeters

within each unit. Major wetlands (locations for potential natural fuel breaks) and existing road locations are identified and named within each FMU map. These pre-attack plans are based upon control alternatives defined in the Wildland Fire Situation Analysis prepared for Turnbull NWR, which is located within the appendices of this document. Pre-attack plans are intended for use in developing control/containment strategies for wildland fires that escape initial attack and begin to attain significant size (100 acres and moving) and require some level of indirect attack particularly at the head of the fire where direct attack may not be possible or compromise firefighter safety. The pre-attack plans identify sub-unit containment perimeters where initial indirect attack efforts can be immediately implemented based upon existing natural or man made fuel breaks. Secondary containment perimeters are also identified for use on fires, which escape initial control efforts and require contingency implementation. All containment perimeters are located in areas that have good ingress/egress for fire suppression equipment, where fuels loads are generally less dense than surrounding areas and provide potential escape routes and safety zones.

**Vegetation Type**

The Refuge is composed primarily of Fuel Models 2 and 9. Fuel model 2 is a grass fuel model under an overstory of pine. This fuel model occupies about 60% of the refuge area, and has characteristics of high rates of spread. Fuel model 9 is a timber fuel model and generates a lot of heat and fire brands but is generally not a fast spreading fuel model. Fire in this fuel model poses the problem of spotting. A component of both fuel models are the roses and Snowberries. These shrubs when cured have the ability to generate heat and flame lengths that would complicate suppression efforts.

Figure 3: Fire Management Units

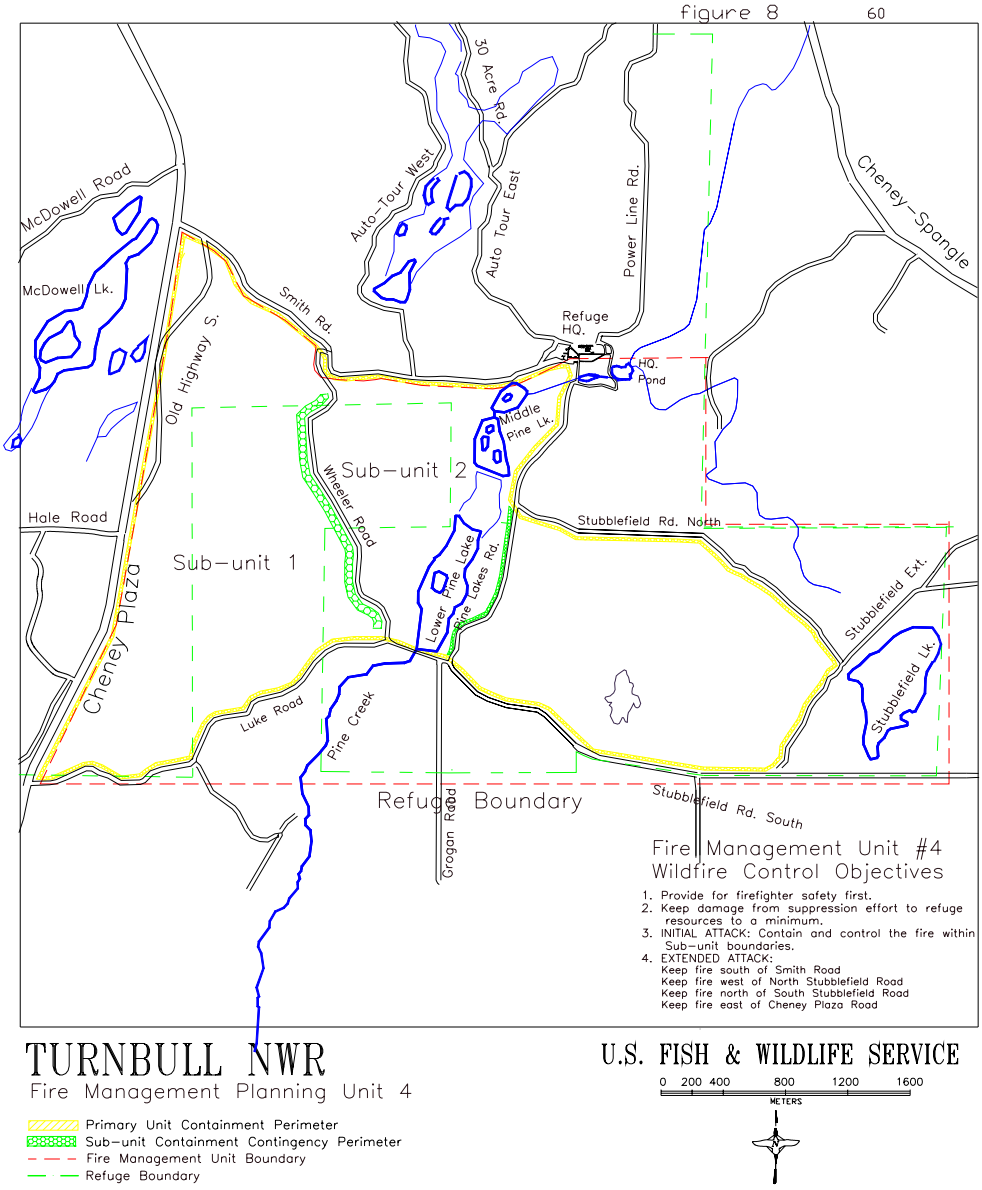


Figure 4: Fire Management Units

Figure 5: Fire Management Units

Figure 6: Fire Management Units

Figure 7: Fire Management Units

**Fuel Types and Fire Behavior**

The primary, dominant fuel type of Turnbull NWR, the Ponderosa pine/bunchgrass vegetation association (Fuel Model 2/NFFL), is one of the most volatile vegetation types in the west. Approximately 40% or 6,000 acres of the refuge is covered with this vegetation/ fuel type (Figure 2). Fuel loading in this fuel type ranges from 3 to 8 tons/acre. Fires in this fuel type are fast moving, due to the grass dominated fuel bed, have high fireline intensity and usually require indirect attack suppression techniques. Fire behavior under the high wind speeds (15 mph to 40+ m.p.h.) and late summer fuel moisture conditions that characterize wildland fire occurrence in this area exhibit rates of spread that approximate the wind speed (1000 to 2000 chains/hr.), fireline intensities (range from 2,500 to 15,000 BTU/FT/SEC) and flame lengths in the range of 17 to 35 ft. A typical fire under these conditions would burn approximately 10,000 acres (over 2/3 of the refuge) in 1 hour.

Decades of aggressive fire suppression policies on the refuge have allowed the encroachment of thick stands of ponderosa pine regeneration into grasslands. These "doghair" thickets of young pine would have been naturally thinned by lightning fires of the past, maintaining the grasslands with widely interspersed large, mature trees. These dense stands of regeneration also dominate areas that were clearcut. Competition for light, moisture and nutrients within these dense stands (300-600+ trees/acre) causes conditions of low vigor, and poor growth characteristics of individual trees. Large amounts of dead branches below the small green canopies of these stands create excellent "ladders" for ground fires to move into the canopies of the trees, causing crown fires and long range spotting. Fire behavior in these stands of pine regeneration often resembles that which occurs within some of the brush fuel models.

The predominant timber fuel type found on the refuge, closed canopy ponderosa pine stands in the 60 to 80 year age class, is best represented by NFFL fuel model 9, depending on the amount of large dead fuels within the stand. The presence of these large amounts of dead fuels within stands of ponderosa pine cause wildland fires which have lower rates of spread than the grass fuel models but, have high radiant heat loads causing high potential for long range spotting and running crown fires. Some timber stand improvement is proposed for forest and habitat management purposes, which would indicate extensive use of fuel model 10 (logging slash) in modeling prescribed fire behavior.

Remaining areas of the refuge include emergent and transitional areas of wetlands and marshes. Fuel Model 3 (NFFL) best characterizes the fire behavior characteristics of these vegetation types. Fire behavior in Fuel Model 3 is characterized by fast moving, high intensity fires that burn even under high fuel moisture conditions due to large accumulations of dead material within emergent stands of marsh vegetation. Many of the seasonal wetland/meadows that are interspersed throughout the refuge are covered in thick mats of reed canary grass. During the dry fire season, this exotic grass burns with very high intensity due to large amounts of dead material that has accumulated.

The wide variety and dispersion of fuel types within the refuge creates complex fire suppression solutions from the standpoint of potential strategies. Tactics often must change within short operational periods or distances in order to adapt to the varying nature of the fuels, from open grasslands to closed canopy stands of mature trees with extreme levels of dead fuels. The varying nature of these fuel beds also creates opportunities for innovative techniques to be applied in containing wildland fires before they can do significant damage. Aggressive and skilled initial attack tactics that take advantage of natural barriers to fire spread, existing roads and changes in fuel bed characteristics will often be successful. Fire suppression tactics utilized on the refuge must always be mindful that flashy fuels (grasses) are the predominant fuel types on the refuge and that more firefighters are killed or injured in these fuel types than any other. Figure 2 depicts the distribution of refuge vegetation/ fuel types.

**Fire Ecology**
The natural vegetation communities of Turnbull NWR are dominated in upland areas by ponderosa pine/bunchgrass and closed canopy ponderosa pine stands (fuel models 2 and 9 N.F.F.L.). These upland ponderosa pine communities are represented by even aged stands of age classes varying from 30 to 80 years in age. These even aged stands are primarily the result of commercial logging on the refuge.

Prior to the advent of significant fire suppression capabilities in the early third of this century, fires within the area now represented by Turnbull NWR were ignited primarily by lightning and aboriginal burning practices. Lightning is a frequent phenomenon in eastern Washington during summer and fall. Lightning activity coincides with fuel moisture conditions conducive to natural ignitions causing fires of significant size. Aboriginal use of fire, although not well documented within the local area, was probably used by the local native populations, since empirical observations of the benefits of lightning caused fires in the ponderosa pine forests were both evident and frequent. It is well documented within the literature that the deliberate burning of forests and range vegetation communities was extensively practiced by most aboriginal cultures of western north America, including those indigenous to the Pacific Northwest (Boyd 1986, Aschmann 1977).

Natural disturbance is one of the primary progenitors in the maintenance and succession of natural vegetation communities. Fire is one of the most significant and frequent mechanisms for natural disturbance in the forest and range vegetation communities in western North America (Ahlgren & Ahlgren 1960). Extensive research has been conducted into the role of natural fire in the development and extent of the ponderosa pine/bunchgrass vegetation type, which predominates the upland communities of Turnbull NWR. Weaver (1955), Kinateder (1998) studied fire scarred ponderosa pine stump sections in in the vicinity of Turnbull NWR and found an average fire frequency of one fire every 8 years between the middle 1700's to the early 1900's. Other researchers have noted frequent fire return intervals ranging from 4 to 25 years in the ponderosa pine forest type throughout it's distribution from the southern montane forests of Arizona and New Mexico, to the northernmost extent of it's range in Washington and British Columbia (Daubenmire & Daubenmire 1968, Keene 1940, Biswell 1963, Wagner 1961). The frequency of fire in ponderosa pine communities is a function of the climatic conditions found within the habitats occupied by the species. Ponderosa pine generally prefers dryer site soil conditions and requires full sunlight for successful reproduction without the competition of overstory canopy. Aboriginal ponderosa pine forests were described as forests consisting of large trees of even-age classes widely spaced apart, giving the appearance of a well managed park. Tree reproduction in these primal forests was in small even-aged groups growing in open clearings. These forest openings were generated by a variety of processes including windfall, insect attacks or mortality from old age. The accumulations of dead material within these areas of tree mortality created conditions conducive to intense fires which produced forest openings suitable for regeneration of the shade intolerant ponderosa pine seedlings (Biswell 1963, Weaver 1955).

The frequent fire return interval in ponderosa pine forests functioned to keep the levels of dead material from accumulating to amounts in which the subsequent fire would be of sufficient intensity to cause mortality to the mature trees which are protected by a thick layer of bark. These frequent low intensity fires also kept shade-tolerant trees and shrubs out of the forest understory, which insured the perpetuation of the ponderosa pine forest type. The fire caused openings in the forest provided excellent regeneration sites for ponderosa pine seedlings; exposure to full sunlight, good penetration of the forest canopy of the available moisture, and high levels of available nutrients through pyrolytic decomposition of dead forest biomass.

As the ponderosa pine regeneration reached the sapling stage, heavy drops of pine needles, which are a

characteristic of ponderosa pine which make the community type inherently more flammable, would accumulate to a degree sufficient to support a low intensity fire which would serve to thin the stand of young trees. The surviving trees, growing under less competition, would subsequently become more vigorous and more resistant to future fires. Trees reaching maturity would obviously be those with the best adaptive traits to survive fire and through time genetic selection favored ponderosa pine with the genetic characteristics that made them even more resistant to fire. In summary, the genetic evolution of ponderosa pine was influenced by the selective forces of fire. Due to the role of fire in the reproductive cycle of the species, the ponderosa pine became both fire tolerant from an individual tree standpoint, while the forest type became more flammable with characteristics of heavy needle drop that contained high levels of flammable resins (Biswell 1963, Weaver 1955). In this way, the ponderosa pine forest type can be described as fire dependent, in much the same way as lodgepole pine, giant Sequoia or chaparral vegetation communities (Mutch 1970). The ponderosa pine forest type under natural fire regimes has been described by researchers as one dominated by large, widely spaced trees in mature stands, with a mix of stands of various age classes in which the trees that comprise the stand are of the same age class.

Natural fires occurring within the channeled scabland ecosystem that comprises Turnbull NWR probably ranged in size from small single tree fires caused by lightning strikes, to fires that under the right conditions of fuel moisture and wind, burned thousands of acres over a period of several weeks to months. These larger fires, which occurred less frequently than the more common low intensity lightning caused fire, burned not only the upland ponderosa pine communities, but the adjacent wetland communities as well. These larger fires occurred when conditions were very dry, allowing them to burn into the wetland basins from the surrounding uplands, burning off the accumulations of dead material in the emergent bulrush and cattail that bordered the wetlands. In very dry years, these fires had the capability to burn into the marsh basins, removing the dead biomass (peat) that accumulated in the marsh bottoms and in the process, deepen the wetland basin.

The frequent fire regime of the upland ponderosa pine forest functioned in helping to renew the successional status of the wetlands within the channeled scabland through fires that burned over large areas, spotting or backing into the wetland basins, and removing the accumulations of dead biomass, infusing nutrients and increasing overall productivity.

This same pre-historic scenario of frequent small fires, and infrequent large fires served in the maintenance of the other vegetation communities that are found within Turnbull NWR including the annual grasslands, perennial grasslands, shrub and riparian communities. The riparian communities probably burned with less frequency (40 to 80 year intervals) and intensity due to the moisture content of the vegetation present. Long fire return intervals of large intense wildland fires probably played the most important role in the renewal of riparian communities due to the time periods required for sufficient fuel buildup and drought conditions sufficient to allow fire to carry through the usually moist riparian vegetation. A description of fire effects on the flora and fauna for the Refuge is found in Appendix N.

**PRE-ATTACK PLAN**

Upon discovery of a fire, all subsequent actions will be based on the following:

1. The Incident Commander (IC) will locate, size-up, and coordinate suppression actions. The IC will complete the pre-attack planning checklist (Appendix I).
2. Provide for public safety.
3. Considering the current and predicted fire conditions, the Incident Commander will assess the need for additional suppression resources and estimate the final size of the fire. The potential for spread outside of the refuge should be predicted, as well as the total suppression force required to initiate effective containment action at the beginning of each burning period.

4. The Incident Commander will assess the need for law enforcement personnel for traffic control, investigations, evacuations, etc. and make the request to the FMO.
5. Contact the Refuge Manager or Acting Refuge Manager
6. Document decisions and complete the fire report (DI-1202).
7. Should a wildland fire move into an extended attack a Delegation of Authority will be invoked. Once a Delegation of Authority has been authorized the Incident Commander will make the final decisions pertaining to the fire. A copy of Delegation of Authority is in Appendix J.

**SUPPRESSION TACTICS**

Wildland fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce fast, efficient action with minimum damage to resources. Suppression involves a range of possible actions from initial attack to final suppression. All wildland fires will be suppressed.

Personnel and equipment must be efficiently organized to suppress fire effectively and safely. To this end, the FMO assumes the command function on major or multiple fire situations, setting priorities for the use of available resources and establishing a suppression organization.

There will be only one Incident Commander responsible through the FMO to the Refuge Manager. The Incident Commander will designate all overhead positions on fires requiring extended attack. Reference should be made to a Delegation of Authority (Appendix J).

Fire suppression techniques should be of "low impact" when possible, utilizing the many natural and man-made features for wildland fire containment. "Low impact" suppression should be given high priority when fire intensity and spread is minimal. These same natural man-made features should also be used during large, fast moving fires in the Ponderosa Pine/bunchgrass fuel type (NFFL Model 2) or crown fires in dense canopy forest cover (NFFL Model 9) when firefighter **SAFETY** is a primary strategic objective. These same natural and man-made features provide excellent access to fires on the Refuge as well as anchor points, safety zones and escape routes.

Suppression Strategies and techniques:

1. Utilize existing roads, wetlands and other features as primary control lines, anchor points, escape routes and safety zones.
2. Use burnout's/blackline techniques to stabilize and strengthen primary control lines.
3. If mechanical equipment must be used, construct control lines on existing roads where possible.

Unit #1 Wildland fire Control Objectives:

1. Provide for firefighter and public safety first.
2. Keep damage from suppression effort to refuge resources to a minimum.
3. Initial Attack: Contain and control the fire within sub-unit boundaries.
   Extended Attack:
4. Keep the fire north of Upper Turnbull road (dirt).
5. Keep the fire west of Cheney Plaza road (blacktop).
6. Keep the fire south of the north Refuge boundary.
7. Use Mullinx road (blacktop) as control line depending on fire origin and direction of spread.

Unit #2 Wildland fire Control Objectives:

1. Provide for firefighter and public safety first.
2. Keep damage from suppression effort to refuge resources to a minimum.

3. Initial Attack: Contain and control the fire within sub-unit boundaries.
4. Keep the fire south of north Refuge boundary (utilize Findley/Ice Skate road as primary containment line).
5. Keep the fire west of Power line road (dirt with power line clearance).
6. Keep the fire north of Smith road (dirt).
7. Keep the fire east of Cheney Plaza road (blacktop).

Unit #3 Wildland fire Control Objectives:

1. Provide for firefighter and public safety first.
2. Keep damage from suppression effort to refuge resources to a minimum.
3. Initial Attack: Contain and control the fire within sub-unit boundaries.
4. Keep the fire south of Upper Turnbull road (dirt).
5. Keep the fire west of Cheney Plaza road (blacktop).
6. Keep the fire north of the south Refuge boundary.
7. Use Columbia Plateau trail for control depending on fire origin an spread.

Unit #4 Wildland fire Control Objectives:

1. Provide for firefighter and public safety first.
2. Keep damage from suppression effort to refuge resources to a minimum.
3. Initial Attack: Contain and control the fire within sub-unit boundaries.
4. Keep the fire south of Smith/North Stubblefield roads (dirt).
5. Keep the fire east of Cheney Plaza road (blacktop).
6. Keep the fire north of the south Refuge boundary (utilize Luke/Stubblefield roads as primary containment lines).
7. Keep the fire west of Stubblefield Lake (utilize North Stubblefield and Stubblefield ext. as control lines).

**Wildland Fire Situation Analysis**

For fires that cannot be contained in one burning period, a WFSA must be prepared. In the case of a wildland fire, the Incident Commander, in conjunction with the FMO or in his absence the Refuge Manager or Deputy Refuge Manager, will prepare the WFSA. Approval of the WFSA resides with the Refuge Manger. A sample WFSA is located in Appendix K.

The purpose of the WFSA is to allow for a consideration of alternatives by which a fire may be controlled. Damages from the fire, suppression costs, safety, and the probable character of suppression actions are all important considerations.

Public safety will require coordination between all Refuge staff and the IC. Notices should be posted to warn visitors, trails may be closed, traffic control will be necessary where smoke crosses roads, etc. Where wildland fires cross roads, the burned area adjacent to the road should be mopped up and dangerous snags felled. Every attempt will be made to utilize natural and constructed barriers, including changing fuel complexes, in the control of wildland fire. Rehabilitation efforts will concentrate on the damages done by suppression activities rather than on the burned area itself.

**Aircraft Operations**

Aircraft may be used in all phases of fire management operations. All aircraft must be Office of Aircraft Services (OAS) or Forest Service approved. An OAS Aviation Policy Department Manual will be provided by OAS.

Helicopters may be used for reconnaissance, bucket drops and transportation of personnel and equipment. Natural helispots and parking lots are readily available in most cases. Clearing for new helispots should be avoided where possible. Improved helispots will be rehabilitated following the fire.

As in all fire management activities, safety is a primary consideration. Qualified aviation personnel will be assigned to all flight operations.

**REHABILITATION AND RESTORATION**

When suppression action is taken, rehabilitation is appropriate. The most effective rehabilitation measure is prevention of impacts through careful planning and the use of minimum impact suppression techniques.

Rehabilitation will be initiated by the Incident Commander, FMO, or Refuge Manager. Rehabilitation will be directed toward minimizing or eliminating the effects of the suppression effort and reducing the potential hazards caused by the fire. These actions may include:

-Backfill control lines, scarify, and seed.
-Install water bars and construct drain dips on control lines to prevent erosion.
-Install check dams to reduce erosion potential in drainages.
-Restore natural ground contours.
-Remove all flagging, equipment and litter.
-Completely restore camping areas and improved helispots.
-Plan more extensive rehabilitation or re-vegetation to restore sensitive impacted areas.

If re-vegetation or seeding is necessary, only native plant species will be used.

If emergency rehabilitation measures are needed or if rehabilitation is needed to reduce the effects of a wildland fire then the Refuge Manager can request appropriate funding through the Burned Area Emergency Rehabilitation (BAER) fund. The BAER fund is administered through the NPS representative at the National Interagency Fire Center and national BAER team leader.

Rehabilitation plans for each fire will be reviewed by the fire management staff. A final plan will be submitted to Region for establishing an account. Rehabilitation should be initiated prior to complete demobilization or early the following season.

**REQUIRED REPORTING**

The IC will be responsible for documenting decisions and completing the fire report (ICS-214, DI-1202). The ZFMO will be responsible for any additional required reports.

**FIRE INVESTIGATION**

Fire management personnel will attempt to locate and protect the probable point of origin and record pertinent information required to determine fire cause. They will be alert for possible evidence, protect the scene and report findings to the fireline supervisor.

Prompt and efficient investigation of all suspicious fires will be carried out. However, fire management personnel should not question suspects or pursue the fire investigation unless they are currently law enforcement commission qualified.

Personnel and services of other agencies may be utilized to investigate wildland fire arson or fire incidents involving structures. In the event an Investigator is needed and the Refuge law enforcement officer is not available or is not qualified then a fire warden from the DNR can be requested through

Dispatch.

# PRESCRIBED FIRE ACTIVITIES

**PRESCRIBED BURN PROGRAM OBJECTIVES**

Prescribed Fire is defined in the U.S. Fish & Wildlife Services Fire Management Handbook as "the controlled application of fire to wildland fuels in either their natural or modified state, under specified environmental conditions which allow the fire to be confined to a predetermined area and at the same time produce the fireline intensity and rate of spread required to attain planned resource management objectives."

The goals of prescribed fire within the U.S. Fish & Wildlife Service are to:

1. Conduct a vigorous prescribed fire program with the highest professional and technological standards using all means available to prevent escaped fires.
2. Identify the type of prescribed fire that is most appropriate to most situations and areas.
3. Efficiently accomplish resource management objectives through the application of prescribed fire.
4. Continually evaluate the prescribed fire program to better meet program goals by refining prescription treatments and monitoring methods, and by integrating applicable technical and scientific treatments.
5. Use prescribed fire in a manner, which meets the requirements of the Clean Air Act (PL 88-206, 42 USC 7401 revised 1990).
6. Effectively manage prescribed fire emissions using the most current technologies and techniques available.

Prescribed fire is a management technique, which will be used within Turnbull NWR to attain the following resource management objectives:

1. Enhance wildlife and plant species along with their associated habitats.
2. Eliminate hazardous accumulations of dead biomass within the Refuge to reduce the intensity and associated damage of uncontrolled wildland fires to natural habitat and values at risk.
3. Eliminate or reduce the abundance of exotic/alien species, which compete with species indigenous to the refuge.
4. Promote natural biodiversity among species inhabiting the Refuge.
5. Utilize management ignited prescribed fires to mimic the role once played by natural lightning ignitions within the fire dependent ecosystems of Turnbull NWR.

The use of fire to attain resource management objectives has inherent risks associated with it. The failure to use prescribed fire in the fire dependent vegetation types that predominate Turnbull NWR will ultimately lead to uncontrollable wildland fires which will threaten both refuge resources and the many homes and private lands which surround the refuge.

**Ponderosa Pine Forest Objectives**

a. Use management ignited prescribed fire to approximate the role of natural fire in Ponderosa pine forests.
b. Allow fire to function in the critical task of forest nutrient cycling.
c. Use prescribed fire to reduce hazardous accumulations of dead woody biomass, particularly in the 100 hr., 1000 hr. and 10,000 hr. size classes of forest fuels.
d. Use prescribed fire in combination with mechanical timber stand thinning to reduce the density of trees per acre throughout the Refuge.
e. Utilize prescribed fire effects to create forest habitat of varying age classes and densities to approximate the heterogenous composition of natural ponderosa pine stands and promote greater

biodiversity within forest habitats.
f. Improve forest health by utilizing fire to reduce stand density reducing competition for light, moisture and nutrients.
g. Remove pine encroachment from riparian, grassland, aspen and shrub habitats.
h. Increase water yield in wetland habitats by reducing pine density.

Prescription recommendations were developed based upon observations of prescribed fire behavior and fire effects over three years of prescribed fire implementation at Turnbull NWR and the research recommendations of prominent researchers in the use of prescribed fire in managing ponderosa pine forests.

**Wetland Habitat Prescribed Fire Objectives**

*Semi-permanent Marsh:*

1. Reduce the accumulation of litter and standing residual cover that impedes plant growth and restricts access to emergent vegetation by nesting hens and broods. Maintain litter depths below 40 cm within stands of emergent vegetation.
2. Utilize prescribed fire to rejuvenate decadent stands of emergent vegetation and promote nutrient cycling in semi-permanent marshes.

*Seasonal Wetlands:*

1. Remove accumulated dead plant litter from seasonal wetland basins to promote early season food production of plants and invertebrates through increased solar insolation of water surface area.
2. Prescribed fire in seasonal wetlands should consume at least 80% of the wetland surface area.
3. Prescribed fire should result in a 75% reduction of total dead biomass within the wetland basin, resulting in less than 10% of the basin being covered by litter, with a mean litter depth of less than 2 cm., and standing stubble height of less than 10 centimeters.
4. Increase water yield and available wetland habitat by reducing density of Ponderosa pine within wetland basins.
5. Initiate research into the effects of prescribed fire on the abundance, distribution and habitat of the endangered water howellia (*Howellia aquatillus).*

**Grasslands and Shrub Steppe Objectives**

1. Restore fire as an ecological influence within grassland and meadow habitats.
2. Prevent pine forest encroachment into grassland and meadow habitats.
3. Promote vigorous populations of native annual and perennial grasses.
4. Promote biodiversity in grassland/meadow habitats in both flora and faunal populations.

**Aspen and Shrub Habitat Objectives**

1. Restore fire as an ecological influence in Aspen and shrub habitats.
2. Increase the abundance and distribution of aspen and shrub stands by reducing pine encroachment into aspen and shrub stands.
3. Increase stem density, reduce dead biomass and improve the health and vigor of decadent aspen and shrub stands.

**FIRE MANAGEMENT STRATEGIES**

The overall objective in the use of prescribed fire in refuge resource management programs will be to re-introduce fire under controlled conditions to fire dependent habitat types. Refuge staff will carefully analyze the needs of each habitat management unit within the refuge in relation to treatment with prescribed fire. Variables to be considered in each proposed prescribed fire include habitat management

objectives, vegetation type, soil types, fire history, natural role of fire, hazard fuels, endangered species, cultural resources and previous treatments with prescribed fire. An overall strategy that sets priorities in each area of the refuge for treatment by prescribed fire will be developed. Methods for developing these priorities will be based on air photo analysis, survey data, habitat needs assessment and utilization of computerized Geographic Information Systems to correlate habitat variables and identify prescribed fire priorities.

The development of prescribed fire priorities will be an ongoing process, continually revised through subsequent revisions of this Fire Management Plan as a result of changing habitat conditions on the Refuge, changes in management objectives, management techniques or new information that is obtained through research conducted on previous prescribed fires.

It must be recognized that the effect of fire exclusion from the refuge environment during the20th Century, has created an "unnatural" forest environment within the Refuge. Current forest conditions are the result of local fire suppression policies and techniques, along with the effects of historic logging on stand structure. Fire exclusion policies have resulted in dead woody fuel loading within many forested areas of the refuge of 20-30 tons per acre, two or three times what should be found within the ponderosa pine fuel type. Clearcut logging, without subsequent timber management within regenerating stands, has resulted in extensive areas of "doghair thickets" of ponderosa pine where the trees grow in such abnormal densities (approximately 350 trees/acre or 1 tree/11 sq. ft.) that competition for light, moisture and nutrients prevents any of the trees from attaining normal growth characteristics. Growth analysis of trees growing under these conditions show that typical stands of pine regeneration 30 to 40 years in age, average 3" to 5" in diameter. These trees are typically loaded with dead branches (ladder fuels), very thin canopies and are bent over at the top, the result of vertical growth under intense competition exceeding diameter growth. Insect infestations and various fungus diseases are rampant within these low vigor stands. The stand density of the regenerating forest creates fuel load characteristics and fire behavior that closely approximates that of the brush or logging slash fuel models due to ladder fuels and high levels of dead biomass.

In addition to the "doghair thickets", are 60 to 80 years of accumulated large dead fuels in the 100 hr., 1000 hr., and 10,000 hr. size classes within forest stands that are in the 60+ year age class. Thick stands of brush and dense mats of litter on the forest floor add to the accumulations of dead branches and logs to create fuel loads many times beyond normal levels. This large amount of dead biomass sets the stage for large, uncontrollable wildland fires on the Refuge, which will do extensive damage to refuge resources beyond that which would be expected from a natural fire.

Many of the prescribed burns conducted will have specific hazard fuel reduction objectives in terms of reducing accumulations of large size class dead fuels or reducing tree densities in specific areas in order to attain more vigorous forest stands. These types of burns can only be conducted under specific conditions of weather and fuel moisture variables, which are most prevalent during late summer and fall burning seasons. Spring burning can achieve specific habitat management objectives in terms of burning fine fuels (one and ten hour), but high moisture levels in large fuel classes preclude significant hazard fuel reduction. Studies (Harrington, 1982) have also demonstrated high percentages of mortality to mature Ponderosa Pine resulting from spring burning. High moisture levels in cambial and apical meristematic tissue during this growth period conduct radiant heat from fires deep within cell layers causing mortality to exposed tissue. Although some mortality is desired in large diameter tree age classes from prescribed fire to reduce stand stocking levels, this effect can be more easily controlled under fall burning conditions when the ponderosa pine is more physiologically predisposed to surviving fire. The genetic adaptations of ponderosa pine to survive fire are synchronized to natural fire occurrence (summer and fall) when

seasonal growth is complete and moisture levels of living tissue are minimal. Experience in prescribed burning during the fall season has shown significant mortality levels resulting from the extreme fuel loading and the crowded conditions in forest stands that tend to accumulate lethal radiant heat levels at the base of the trees which causes root damage resulting in a higher probability of wind throw and insect attack.

Prescribed fires conducted under summer/fall burning periods, are more intense than spring burns. In the case of prescribed fire conducted at Turnbull NWR, fire exclusion policies have created unnatural fuel loadings and forest structure that no longer resembles the natural landscape of the past. The initial reintroduction of prescribed fires into the altered fire dependent ecosystems of Turnbull NWR will create fires of higher intensity than those that occurred naturally with less fuel loading. Low intensity spring or winter burns can be attempted to reduce some of the fuel loading prior to a fall broadcast underburn. In some instances manual collection of large fuels and pile burning can be conducted during the winter months to reduce some of the larger fuel classes present in the burn unit.

**PRESCRIBED FIRE PLANNING**

All prescribed fires, prior to implementation must have a written plan, compiled by a qualified burn boss, which is reviewed by the Zone Fire Management Officer and approved by the Refuge Manager. Prescribed burn plans will also be reviewed by appropriate permitting agencies for clearances regarding the protection of air quality, endangered species or cultural resources.

The Department of Interior, Departmental Manual, chapter on Wildland Fire Suppression and Management (910 DM 1), section 1.6B (2) states:

"No prescribed fire may be allowed to burn without suppression action unless a current and valid prescription has been approved by the responsible line officer. All prescriptions must address:

1. The land use objectives for the area.
2. Historical fire occurrence.
3. Natural role of fire.
4. Expected fire behavior.
5. Buffer and safety zones.
6. Energy release component.
7. Constraints which may be required due to regional and national fire activity.
8. Predetermined limit on the number of fires burning in the planning area at one time.
9. Perimeter and acreage burned limit.
10. Analysis of the cumulative effects of weather and drought on fire behavior.
11. Potential impacts upon visitors, users, and local communities, both on and off site.
12. Considerations of environmental, economic, and social effects, both on and off site.

**Annual Activities**

The ZFMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary, personnel utilized, and fire effects.

Prescribed Fire activities will be reviewed annually by the Refuge Management . Necessary updates or changes to the Fire Management Plan will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan. The annual activity chart is in Appendix L.

**Management Unit Objectives**

The objectives of prescribed burning Turnbull NWR are listed below. The purpose of fuels management is to complement the fire management program by reducing fire hazards, decreasing the potential damage to refuge resources, adjacent lands, and minimizing risks to employees, residents and visitors.

General prescribed fire objectives will be to:

1. Reduce fuel accumulations;
2. Reduce encroachment of Ponderosa pine into the wetlands and wet meadows;
3. Manage vegetation to promote the growth of native species and control encroachment of exotic species; and
4. Assist with the establishment and maintenance of the historic scene.

This plan calls for full suppression of all wildland fires, both natural and human-caused, for each of the units of the refuge. Any prescribed fire outside prescription will be designated a wildland fire and will be appropriately suppressed.

**Prescribed Burn Plan**

The Prescribed Burn Boss will conduct a field reconnaissance of the proposed burn location with members of the Refuge Management staff to discuss objectives, special concerns, and gather all necessary information to write the burn plan. After completing the reconnaissance, the Prescribed Burn Boss will write the prescribed burn plan.

All prescribed fires will have prescribed burn plans. The prescribed burn plan is a site specific action plan describing the purpose, objectives, prescription, and operational procedures needed to prepare and safely conduct the burn. The treatment area, objectives, constraints, and alternatives will be clearly outlined. No burn will be ignited unless all prescriptions of the plan are met. Fires not within those parameters will be suppressed. Prescribed Burn Plans will follow the format contained in Appendix M. The term “burn unit” refers to a specific tract of land to which a prescribed burn plan applies.

**Strategies and Personnel**

Execution of prescribed burns will only be by qualified personnel. The Prescribed Burn Boss will fill all required positions to conduct the burn with qualified personnel. All personnel listed in the burn plan must be available for the duration of the burn or the burn will not be initiated.

Weather and fuel moisture conditions must be monitored closely in planned burn units to determine when the prescription criteria are met. A belt weather kit may also be utilized to augment monitoring. Fuel moisture samples of 10-, 100-, and 1000-hour down and dead logs (where applicable) and of live plants may be monitored each week and percent moisture contents figured to help determine when the prescription criteria are met.

When all prescription criteria are within the acceptable range, the Prescribed Burn Boss will select an ignition time based on current and predicted weather forecasts. A thorough briefing will be given by the Prescribed Burn Boss and specific assignments and placement of personnel will be discussed. An updated spot weather forecast will be obtained on the day of ignition and all prescription elements will be rechecked to determine if all elements are still within the approved ranges. If all prescription elements are met, a test fire will be ignited to determine on-site fire behavior conditions as affected by current weather. If conditions are not satisfactory, the test fire will be suppressed and the burn will be rescheduled. If conditions are satisfactory the burn will continue as planned.

If the prescribed burn escapes the predetermined burn area, all further ignition will be halted except as needed for suppression efforts. Suppression efforts will be initiated, as discussed in the pre-burn briefing.

The ZFMO will be notified immediately of any control actions on a prescribed burn. If the burn exceeds the initial suppression efforts, the burn will be declared a wildland fire and suppressed using guidelines established in this plan. A WFSA (Appendix K) will be completed and additional personnel and resources ordered as determined by the Incident Commander. If the fire continues to burn out of control, additional resources will be called from the local cooperating agencies via the servicing dispatch. A management overhead team may be requested to assume command of the fire.

Upon approval of the prescribed burn plan, preparation of the prescribed burn unit for implementation of the burn is initiated. Prescribed fire preparation activities include identifying and positioning containment lines around the burn unit perimeter. In many cases, these containment lines will be located along existing management roads on the Refuge and require only superficial removal of fine surface fuels to mineral soil for effectiveness. This will be accomplished by refuge equipment operators using the road grader. Construction of new roads or control lines with mechanical equipment for prescribed burn purposes will be avoided if at all possible. Another alternative is to develop cooperative agreements with adjacent landowners and responsible local fire agencies to do prescribed burns within units that encompass both refuge and other federal, state, and/or private lands. In any case where construction of control lines for prescribed fire is involved, a request for cultural resources compliance (RCRC) must be completed (Appendix H).

Other actions that will be implemented to prepare prescribed burn units include reduction of heavy fuel accumulations next to control perimeters to prevent excessive radiant heat buildup in these areas which can cause tree canopies to torch and spots over the control lines. The potential problem fuel buildup areas will be identified by fire staff prior to the burn. Fire crews will then use chainsaws, handtools and manual labor to thin, separate and scatter these fuel accumulations over a wide area within the burn unit. In some cases this work will be undertaken within the "doghair thickets" of ponderosa pine regeneration, which have extreme amounts of ladder fuels and can cause torching of mature trees. These thickets will be manually thinned by fire crews. Trees removed will be piled within the burn unit in areas of sparse fuels, away from control lines, and burned during the unit burn or when piles are sufficiently dry for burning.

Snags will be left in place and protected during prescribed burns when possible to provide nest sites for the many species of birds and mammals that utilize them for nesting sites, food storage and hunting perches.

Important cultural, historical, biological sites and physical improvements within the burn unit will be identified and protected prior to, or during the burn with hand constructed fuelbreaks or "Class A" Foam wetlines. These features within Turnbull NWR include historical homestead sites, rock pile "fenceposts", existing fencelines and gates, power and telephone transmission poles, public use facilities, refuge signs, refuge operation facilities (water control structures, shops, offices, classrooms and residences), endangered species locations or important nest sites or constructed nest boxes.

Prior to implementation of the burn all Refuge suppression equipment will be checked to insure readiness for the prescribed burn. Specialized equipment for the burn such a portable pumps and porta-tanks will be checked and put on place on the burn site along with any required pre-layed hose lines and laterals. All drip torches will be checked for safety and operational effectiveness. All fire staff, refuge personnel, cooperators and casual firefighters participating in the prescribed burn implementation will be informed of specific responsibilities and assignments in a briefing held at least one hour prior to the burn.

**Mechanical Treatments**

As detailed in previous sections of this document, many forested areas of Turnbull NWR presently have

extreme fuel loadings, overstocked stands of trees and "doghair" thickets of regeneration. The utilization of prescribed fire in many of these types of areas will not be effective, or meet habitat objectives without some level of mechanical manipulation of forest conditions prior to the application of prescribed fire. In addition, forested areas on the boundary of the refuge present complex prescribed fire control problems in relation to adjacent private lands with structures and other values at risk. Prescribed fire planning at Turnbull NWR must also recognize the limitations imposed by recent changes in air quality regulations within the State of Washington. Habitat management and hazard fuel reduction activities will have to utilize a broad range of alternative forest and range management techniques in order to meet program goals and objectives.

Silvicultural techniques utilized to meet habitat management and hazard fuel reduction objectives will include:

**1. Non-Commercial Thinning:** Also known as timber stand improvement (TSI), this technique involves utilizing refuge staff or contract crews to mechanically remove dense thickets of small diameter trees that have suppressed growth characteristics due to intense competition within the stand for light, moisture and nutrients. Determination of which trees are to be removed and final stand basal area configuration will depend upon the specific habitat objectives desired for the unit. Trees that are removed will be hand piled and burned on site as part of the prescribed fire plan for the unit. In some cases, the fallen trees may be sold through special use permits allocated on a competitive bid basis to commercial operators, or removed through a firewood permit process.

**2. Commercial Thinning and Logging:** This silvicultural pre-treatment would involve the same principles of forest management described previously. The thinning operation would be conducted by commercial operators awarded special use permits on a competitive bid basis. The special use permit would specify the following information relating to the implementation of the commercial harvest:

1. Specific harvest targets will be establish in the Special Use Permit at the direction of the Refuge Manager. This will be based on a specific timber stand inventory/habitat analysis for the unit.

2. Timber harvest removal techniques (tractor skidding, high lead logging, skyline logging, low impact skidding with stock or whole tree harvest machines) and equipment.

3. Site access specifications (i.e. utilize existing roads, build temporary or permanent roads, log landing area specifications and types of equipment allowed on site) will be detailed in the SUP.

4. Special considerations will also be listed in the SUP(i.e., no skid zones in sensitive soils, wetlands or habitats, cultural site protection, rare plant protection, maximum skid distances, minimal snag densities, seed tree/shelterwood protection, timber harvest dates, permit duration and contract quality assurance).

5. Post-harvest rehabilitation of the site (re-seeding skid trails and landings, piling of slash, rehabilitation of damaged roads, seedbed preparation, and prescribed fire application) will be detailed in the SUP.

Timber harvest planning and implementation is based upon specific habitat management objectives designated in the Turnbull NWR Habitat Management Plan. This plan is based upon

detailed forest stand examinations and inventories which document current habitat and forest stand conditions within the refuge and set priorities for long term management strategies and treatments to achieve habitat and forest management objectives.

**3. Timber Stand Management For Hazard Fuel Reduction**

Forest Management Units on the boundary of Turnbull NWR have high levels of dead fuel loading. In many cases there are no natural or man-made barriers along refuge boundaries upon which prescribed fire units can be defined and used as containment zones. These units will require some level of mechanical manipulation to reduce hazard fuel levels or install firebreaks so that prescribed fire for hazard fuel reduction and habitat management can be conducted in these areas. Forest management units along the boundary of the refuge which are adjacent to the city of Cheney and the eastern boundary of the Refuge where many homes are interspersed within a contiguous forest canopy with the refuge are the most critical for this type of treatment. Techniques to be considered for the management of these areas will include non-commercial thinning, commercial timber harvest and various prescribed fire techniques. A possible alternative of less impact would be to develop cooperative agreements or contracts with adjacent landowners to thin and remove fuel accumulations that overlap private land and Refuge habitat. These projects are authorized as part of the 2001 National Fire Plan under the Wildland Urban Interface project. Congress has authorized funding for the Refuge to treat additional acres with in and adjacent to the Refuge to prevent dangerous fire that might affect the surrounding communities.

Another important consideration in the use of prescribed fire near refuge boundaries is the existence of two Research Natural Areas (RNA) within the refuge that are adjacent to the refuge boundary line. The Turnbull Pine RNA (200 acres) on the north boundary and the Pine Creek Natural Area (160 acres) on the east boundary were established to provide examples of undisturbed natural areas for study of natural processes and protect gene pool preserves of natural biota, particularly rare and endangered species. Existing fuel load conditions within these natural areas due to the exclusion of natural or prescribed fire and lack of alternative manual fuel / stand density reduction activities, threaten the biotic integrity of these RNA's. Fire exclusion not only threatens the RNA biota from the standpoint of the potential for the occurrence of an extreme stand replacement wildland fire, but also the competitive effects of increasing ponderosa pine stand density and canopy closure on other species. The dense pine stand canopies within the RNA's are causing significant impacts to important shade intolerant tree species such as aspen, alder, dogwood and willow in terms of reduced density and vigor in stands of these deciduous trees.

Shading also affects the distribution of grass and forb species, which are important components of RNA habitats. Included in this strata of vegetation are rare and threatened plant species including the yellow lady's- slipper (*Cypripedium calceolus*) and tufted hairgrass (*Deschampsia caespitosa*). The Pine Creek RNA also includes several locations of the semi-aquatic water howellia (*Howellia aquatilis*) which is also affected by ponderosa pine invasion of riparian habitat due to increased evapotranspiration of available water in critical seasonal wetland habitats by the dense stands of mature pine. These changes in RNA habitat structure, composition and temporal states induced by fire exclusion are impacting the very resources and natural processes for which the research areas were established. In addition, dead and live fuel loading in the RNA's threatens private property and residential values in areas nearby. The objectives of RNA management that preclude certain forest management activities such as timber harvest or the use of landscape level prescribed fire are in the long run destroying the very values that the RNA program intended to protect. RNA’s are "natural" areas where habitat management techniques

should be tested with in depth monitoring and research for application to other areas of the refuge and similar habitats.

**Monitoring and Evaluation**

Monitoring of prescribed fires is intended to provide information for quantifying and predicting fire behavior and its ecological effects on refuge resources while building a historical record. Monitoring measures the parameters common to all fires: fuels, topography, weather and fire behavior. In addition, ecological changes such as species composition and structural changes will be monitored after a fire. This information will be very useful in fine-tuning the prescribed burn program.

All wildland fires will be appropriately suppressed. However, monitoring wildland fires may be appropriate and potentially valuable in mapping and documenting the growth of the fire, measuring on-site weather and fuel loading to provide the fire staff with present and expected fire behavior and effects. During prescribed burns, monitoring can serve as a precursor to invoking suppression action by determining if the fire is in prescription, assessing its overall potential, and determining the effects of the prescribed burn.

During prescribed burning, monitoring should include mapping, weather, site and fuel measurements and direct observation of fire characteristics such as flame length, rate of spread and fire intensity. Operational monitoring provides a check to insure that the fire remains in prescription and serves as a basis for evaluation and comparison of management actions in response to measured, changing fire conditions, and changes such as fuel conditions and species composition.

All fires may be monitored regardless of size. The FMO will establish specific fire information guidelines for each fire to update intelligence about the fire. Highest priority for monitoring will be assigned to large fires or fires which threaten to leave the refuge.

**Required Reports**

All prescribed burn forms will be completed as outlined by the Prescribed Burn Boss. A monitor will be assigned to collect all predetermined information and complete all necessary forms prior to, during, and after the burn. All records will be archived in the refuge's fire records for future use and reference.

The Prescribed Burn Boss will prepare a final report on the prescribed burn for the file. Information will include a narrative of the burn operation, a determination of whether objectives were met, weather and fire behavior data, map of the burn area, photographs of the burn, number of work hours, and final cost of the burn.

**Prescribed Burn Critique**

The Burn Boss will critique each prescribed burn. A report detailing the actual burn will accompany any recommendations or changes deemed necessary in the program. This report will be submitted to the Refuge Project Leader. A post-season critique of the fire management program, including the prescribed burn program, will be held each year by the Refuge Management staff at the conclusion of the fall fire season.

## AIR QUALITY/ SMOKE MANAGEMENT GUIDELINES

According to Fish & Wildlife Service Fire Management Policies " ... fire management activities which result in the discharge of air pollutants are subject to, and must comply with, all applicable Federal, state, interstate, and local air pollution control requirements as specified by Section 118 of the Clean Air Act."

Prescribed fire program implementation at Turnbull NWR, must be sensitive to potential smoke impacts to the local communities and residential areas that could be affected by smoke from refuge fires. In addition to the local communities of Cheney and Spokane, the refuge is located within 10 miles of Spokane International Airport and Interstate 90. Smoke generated by refuge prescribed fires could cause serious visibility impairment to these areas with resulting threats to operational safety.

Portions of Spokane County have been designated as non-attainment areas for particulate matter (PM-10: particulates 10 microns or less in size) under the provisions of the Clean Air Act (Public Law 95-95). The Clear Air Act established "National Ambient Air Quality Standards and provides the States with the primary jurisdiction in air quality management. Under the act, States are required to identify areas, which have air pollutant levels, which do not meet national standards. Once identified, States must develop plans, called State Implementation Plans (SIP) which identify specific actions to bring non-attainment areas into compliance. The state of Washington has developed the *Washington Clean Air Act RCW 70.94* . Under the provisions of this act the Department of Natural Resources has been given the authority to issue burn permits for "abating or prevention of forest fire hazards, management of ecosystems ....and silvicultural operations". Negotiated agreements between the U.S. Department of Agriculture, and the Department of Interior have placed all prescribed fire conducted for the purpose of silviculture or ecological restoration in the state of Washington under the direct regulatory authority of the Department of Natural Resources in relation to smoke management coordination and permitting.

As part of this plan, Turnbull NWR is required to obtain burn clearance from the Department of Natural Resources prior to implementation of the burn. The clearance procedure is used to ensure that weather conditions on the day of the planned burn are conducive to good smoke dispersal conditions (no inversions and wind directions which will carry the smoke away from populated areas). It also allows coordination of burns between agencies and private interests to prevent too many burns from being conducted simultaneously within the same airshed. Clearance is obtained by placing a phone call to the local Department of Natural Resources Dispatch and requesting clearance for a specific date and time. The request must be made by 1500 hrs. on the day prior to the burn. Permission to burn is determined by DNR forecasters by 0900 hrs. the following day and communicated to the burn boss by phone. Once DNR smoke management approval is obtained, Turnbull NWR will advise / notify Spokane County Air Pollution Control Authority (SCAPCA) by phone of the intention to proceed with the permitted burn.

As part of an agreement between the Department of Natural Resources (DNR) and the Spokane County Air Pollution Control Authority (SCAPCA), DNR will communicate and coordinate all silvicultural burns within Spokane County with SCAPCA. If SCAPA has specific concerns about silvicultural burning on a particular day due to weather conditions or poor ambient air quality, SCAPA may request the DNR curtail or prohibit all burning in the county.

Annual smoke management allocations to each agency identified in the plan (total amount of allowable emissions per agency) are based upon an average based upon the total amount of forest residues (dead forest fuels) consumed during a five year period prior to implementation of the plan. Allocations are made on an agency basis, with the agency determining which burns should have priority within its individual management units.

In order to reduce these localized impacts the following restrictions and procedures will be part of the prescribed burn planning and implementation process for Turnbull NWR.

Guidelines, Procedures and Prescriptions for Effective Smoke Management in Prescribed Fire Implementation at Turnbull NWR:

1. **Interagency Coordination:** Smoke management approval will be obtained from the Washington Department of Natural Resources. As prescribed weather and fuel moisture conditions become conducive to burn implementation, requests for smoke management clearance will be made to the DNR by 1500 hrs. on the day prior to ignition. Permission to burn will be given by 0900 hrs. the following morning. Once DNR smoke management approval is obtained, Spokane County Air Pollution Control Authority will be given a notification call of the intention to proceed with the burn.

2. **Critical Impact Areas:** Burns will be conducted under weather and fuel moisture conditions which generally provide good smoke dispersal characteristics and low impacts to surrounding communities and identified "Critical Impact Areas". Critical Impact Areas are locations within a 30 mile radius of the burn unit that smoke from the burn must not affect human health or safety. Identified Critical Impact Areas for Turnbull NWR include:

Table 5: Communities

| AREA | TYPE | DISTANCE and DIRECTION |
|---|---|---|
| Cheney (city) | Residential/Commercial | 6 miles/ north |
| Spokane (city) | Residential/Commercial | 20 miles/northeast |
| Spokane Intl. | Airport Commercial Aviation | 15 miles/northeast |
| Interstate 90 | Transportation corridor | 10-15 miles/NW/NE |

3. **Recommended Weather Conditions for Effective Smoke Management:**

Wind Direction: North, Northeast, East to Southeast
Wind Speed: Surface (20 ft. windspeed): Min. 2 mph.
Transport (windspeed @ 1500 ft.): Min. 9 mph.

Mixing Height: Min. 1640 ft.
Relative Humidity: Maximum of 60% during ignition.
Fuel Moistures: 1 hr. max 10% 10 hr. max 13%

All burning operations will cease if conditions of weather and fuel moisture do not meet those desired within the smoke management portion of the prescribed burn plan.

Prior the burn (24 hrs.): Obtain Spot Weather forecast from National Weather Service Fire Weather Office in Spokane.

Morning of the burn (0800 hrs.): Obtain Smoke Management Forecast from DNR Northeast Region or DNR Smoke Management Office in Olympia.

4. **Recommended Ignition Techniques for Effective Smoke Management:** Research has demonstrated that by maintaining the flaming stage of combustion during prescribed fires particulate output is decreased by 50%. Maintaining the flaming stage of combustion is attained by developing prescriptions

which utilized low fuel moistures in all size classes, and using firing techniques which have low rates of spread allowing the flaming stage of combustion to maintain itself for the longest period of time within a fuelbed. The best season for prescribed fire at Turnbull NWR in relation to good smoke management conditions (low fuel moistures) are during the late summer and fall, which as discussed in the fire effects portion of this plan, is the time of year in which natural fire occurred within the Channeled Scabland Environment.

5. **Notification Procedures:** Local communities and residents will be notified of the proposed burn program through local media sources (newspapers, television and radio) with official news releases at least two weeks prior to the burn implementation. In addition, potentially affected agencies and individuals will be notified prior to implementation by telephone on the day of the proposed burn. Specific notification via phone under this guideline include; Spokane Fire District #3, Department of Natural Resources Northeast District Fire Dispatch, Spokane County Air Pollution Control Authority, Spokane County 911 emergency dispatch center and landowners adjacent to the refuge potentially affected by drift smoke.

6. **Human Health and Safety:** Roads potentially affected by surface smoke will be signed with visibility hazard notifications and patrolled during and after the burn until visibility is safe for traffic. If poor smoke dispersal characteristics cause safety hazards on State or County Roads near the burn site, all ignition operations will cease, appropriate law enforcement authorities will be notified and checkpoints to channel traffic safely through smoke affected areas will be established. Roads affected by smoke will be periodically patrolled and monitored through the duration of the burn.

Minimum Visibility Standards for vehicle safety on roads potentially affected by the Turnbull NWR prescribed fire program:

Cheney Plaza: 400 ft.
Cheney Spangle: 400 ft.
Mullinix Rd.: 400 ft.
SR-904: 400 ft.
I-90: 600 ft.
Smith Rd.: 110 ft.

*Note: If smoke is on the roadway during the night the distances for minimum visibility standards must be doubled.

7. **Develop Predictions of Smoke Plume Dispersal and Fuel Consumption Using Available Technology:** The level of current technology available to model and predict smoke dispersal characteristics, fuel consumption and subsequent particulate output provides the prescribed fire manager with excellent tools for determining the potential impacts of smoke from any single prescribed fire. Several computer programs are now available to model smoke plume dispersal (PUFF, SASEM) as well as a standard Forest Service Fuel Consumption Model (CONSUME). According to the requirements of the 1990 Clean Air Act, the Best Available Control Methods (BACM) must be used to reduce air pollution. Use of the smoke management computer software meets the requirements of the clean air act.

8. Develop and Implement a Standardized Smoke Management Monitoring Program: In order to determine the effectiveness of the smoke management techniques used in implementing the prescribed fire program at Turnbull NWR a monitoring program which documents all aspects of the prescribed fire in relation to reducing smoke impacts must be implemented. The purposes of the monitoring program are

twofold; first to provide real time input to the prescribed fire manager about the smoke produced from the fire in relation to the smoke plumes direction, height, dispersal, potential encroachments on Critical Impact Areas and hazards created from smoke incursions on surrounding highways or Spokane International Airport; second to provide input to the prescribed fire manager on the effectiveness of the techniques used to mitigate smoke impacts. This information can be used to refine various prescription variables such as wind speed and direction, mixing height, fuel moistures and firing techniques to obtain more desirable results in smoke management. Smoke management monitoring should take place both within the burn unit and from long range to view the smoke plume in relation to dispersal and potential impacts to target areas. Highway visibility should be monitored periodically throughout the burn.

In addition to monitoring the smoke dispersal characteristics of the prescribed fire, determinations of pre-burn fuel loading can be made for input into fuel consumption models (CONSUME) for purposes of calculating the amount of particulate smoke produced in relation to the fuel consumed. The CONSUME model uses standardized techniques for determining pre-burn fuel loads from various photo-series (photographs of dead fuels from similar habitats upon which detailed analysis of fuel loading has been measured), along with actual weather data taken on site during the burn to calculate prescribed fire emissions. This information is used for determining if the requirements of the State Implementation Plan (SIP) are being met on an agency basis and for determining baseline emission allocations for each agency. This emissions data is also used for determining how much each agency must pay for program administration (the current rate is approximately $50.00 per 500 tons of fuel consumed).

## FIRE RESEARCH

The refuge in cooperation with Eastern Washington University and Washington State University initiated an adaptive management research project to study the effects of the refuge Hazardous Fuel Reduction projects on refuge resources. Protocols were established to monitor first order fire effects including, tree mortality, fuel consumption of all size classes, and understory plant density and species composition. In addition, protocols were established to monitor small mammal, forest amphibian and songbird populations. Pre-treatment sampling has been completed on 3 treatment units and 3 control units. Funding is provided through Prescribed Fire Dollars, a research grant from Washington State in 1998 , refuge operational funds, and 2000 volunteer hours annually. Monitoring is also undertaken on all prescribed fire and thinning projects and includes at minimum, permanent photo plots and belt transects covering 10% of the unit to monitor tree mortality and snag gains/losses, fuel consumption (>1,000 hours), and changes in shrub, forb and grass densities and composition

## PUBLIC SAFETY

Turnbull NWR is dedicated to ensuring the safety of each visitor and to all residents and property adjacent to the refuge's boundary. In the interest of public safety any wildland fire or prescribed fire that threatens the public use areas or the upper Columbia plateau trail may be closed by the refuge manager or their designee.

Areas of fire activity will be clearly signed at visitor centers and bulletin boards. Residents adjacent to the refuge will be notified in advance of any prescribed burn and if any fire poses a threat to burn outside the refuge boundaries.

During prescribed burns at least one burn team member will have first aid training. A first aid kit will be on-site for prescribed burns as well as wildland fires. The local police, fire, and emergency medical services will be notified prior to the ignition of any prescribed burn. They will also be notified of the location of any wildland fires.

## PUBLIC INFORMATION AND EDUCATION

Educating the public on the value of fire as a natural process is important to increasing public understanding and support for the fire management program. The Refuge shall use the most appropriate and effective means to explain the overall fire and smoke management program. This may include supplemental handouts, signing, personal contacts, auto tour routes, or media releases. When deemed necessary, interpretive presentations will address the fire management program and explain the role of fire in the environment.

The public information program will be developed as follows:

1. Concepts of the prescribed burn program will be incorporated, as appropriate, in publications, brochures, and handouts.
2. The fire management program may be incorporated into visitor contacts. Particular attention will be given when fires are conspicuous from roads or visitor use areas.
3. News releases will be distributed to the media as appropriate.
4. The public information outlets of neighboring and cooperating agencies and the regional office will be provided with all fire management information.
5. The fire management program will be discussed in informal talks with all employees , volunteers, residents, and neighbors.

As outlined in the prevention section, emergency closures or restrictions may become necessary during periods of extreme or extended fire danger.

# FIRE CRITIQUES AND ANNUAL PLAN REVIEW

## FIRE CRITIQUES

Fire reviews will be documented and filed with the final fire report. The AFMO will retain a copy for the Refuge files.

## ANNUAL FIRE SUMMARY REPORT

The AFMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary (prescribed burns and wildland fires), personnel utilized, and fire effects.

## ANNUAL FIRE MANAGEMENT PLAN REVIEW

The Fire Management Plan will be reviewed annually. Necessary updates or changes will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan.

## CONSULTATION AND COORDINATION

The following agencies, organizations and/or individuals were consulted in preparing this plan.

Roddy Baumann, Prescribed Fire Specialist, Pacific Region, USFWS, Portland, OR.

Doug Frederick, Assistant Fire Management Officer, Turnbull NWR, Cheney, WA.

Dennis Macomber, Fire Management Consultant, Portland, OR.

Amanda McAdams, Fire Planner, Pacific Region, USFWS, Portland, OR.

Michael Rule, Refuge Biologist, Turnbull NWR, Cheney WA.

Robert Plantrich, Assistance Regional Fire Management Officer, Bureau of Indian Affairs, Pheonix, AZ.

Tom Romanello, Assistant Fire Management Officer, Sheldon-Hart NWR, Lakeview, OR.

Don Voros, Refuge Supervisor, USFWS, Portland, OR.

# APPENDICES

## APPENDIX A: REFERENCES CITED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**APPENDIX B: DEFINITIONS**

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices or services of the Department.

Class of Fire (as to size of wildland fires):
Class A - ¼ acre or less.
Class B - more than ¼ but less than 10 acres.
Class C - 10 acres to 100 acres.
Class D - 100 to 300 acres.
Class E - 300 to 1,000 acres.
Class F - 1,000 to 5,000 acres.
Class G - 5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC) A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.

Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.
Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.
Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.
Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.
Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.
Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.
Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.
Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.
Natural fire. A fire of natural origin, caused by lightning or volcanic activity.
NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.
NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.
Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to realize maximize net benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.
Prevention Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation (1) Actions to limit the adverse effects of suppression on soils, watershed, or other values, or (2) actions to mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.
Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.
Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildfire. An unwanted wildland fire.

Wildland Fire. Any non-structure fire, other than prescribed fire that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.
Wildland/urban interface fire A wildland fire that threatens or involves structures.

## APPENDIX C: TURNBULL NWR FIRE DISPATCH PLAN

The Fire Dispatch Plan provides guidelines and operational procedures for refuge personnel and fire staff to follow in the event of a wildland fire occurring within refuge boundaries or threatening to move into Turnbull NWR. The Dispatch Plan also provides information for mutual-aid dispatch to cooperating state and local fire agencies as well as procedures for inter-agency dispatch to assist other federal firefighting efforts.

### 1. Refuge Fire Dispatch:

If a wildland fire is reported to the refuge office, discovered by refuge staff or reported through Spokane County Fire Central Radio Dispatch the following actions will be taken:

1. If the fire report is received by phone, the individual receiving the fire report will obtain as much information as possible about the fire i.e. location (be specific) size, fire type (grass, timber) and any information ( car license numbers, descriptions of individuals) about suspicious activity around the fire scene that may indicate arson. ** DO NOT DELAY IN REPORTING FIRE TO FIRE STAFF ** Initial attack must begin immediately, get information required after contacting fire staff by radio, phone or in person.

2. If the report is received by phone or from an individual, call 911 to report the fire to Spokane County Fire Central Dispatch in order to get mutual-aid support from Spokane Fire District #3 rolling to the scene as soon as possible.

3. If the fire report comes in the form of a radio call-out tone from Spokane County Fire Central and the location of the fire is possibly within, adjacent or threatening refuge resources, fire staff and equipment automatically roll to the scene without delay. **IMMEDIATE RESPONSE IS REQUIRED ON FIRES REPORTED IN THE VICINITY OF THE REFUGE**. All refuge engines TB-1,2, and available refuge fire staff will provide initial attack to fires within refuge. Additional fire staff not on duty, will be called back to report to the fire.

4. Notify the Refuge Manager of the fire situation and what action is being taken. Post someone near a phone and refuge radio base station to take calls, provide information or place resource orders with central dispatch. Person posted should keep a written log of all calls and radio transmissions along with the time monitored.

5. Fire command will take actions necessary to notify adjacent landowners/homeowners of the fire situation and initiate evacuation procedures if necessary.

### 2. Mutual Aid Dispatch Requests:

Under the terms of a cooperative fire agreement with Spokane County Fire District #3, the District may request the assistance of refuge fire resources to suppress fires occurring within District #3 jurisdiction. Requests for assistance will be made by radio or a phone call to the refuge. Upon receiving the request, engines and respond according to the pre-determined response levels defined within the refuge Step-up Plan. Response levels are based upon fire weather conditions and predicted fire behavior (Refer to Turnbull NWR Step-up Plan). Fires that are within the boundaries of the refuge or in the vicinity of the refuge (with a high possibility of burning into the refuge), will require a full response initial attack by all refuge engines and available fire personnel.

**3. Interagency Dispatch Requests:**
The interagency agreement established between all federal agencies involved in wildland fire suppression activities provides for the cooperative use and assistance of fire equipment and personnel of the various agencies in the suppression of wildland fires of regional or national magnitude. Turnbull NWR will support requests for assistance from other federal agencies in fire suppression activities with refuge fire equipment and personnel. Interagency requests for the assistance of Turnbull NWR fire resources will be made through the Colville Dispatch Center (CDC). Turnbull NWR fire personnel and equipment available for Interagency dispatch will be provided to CDC annually along with appropriate request procedures. Requests from CDC for Turnbull NWR resources will be made by phone or Fax to the Refuge Manager (designee)or the Assistant fire Management officer.

**4. Refuge Fire Suppression Equipment (Normal Unit Strength)**

Equipment ID Type Specifications

Engine TB-1 ICS type V 500 gal. water capacity / Crew of 3
Class A Foam with 22 gal. aux. foam tank
1000 ft. 1 1/2" hose
1000 ft. 1" hose
Handtools and Chainsaw
Engine TB-2 ICS Type IV 900 gal. water capacity / Crew of 3
Class A Foam with 22 gal. aux. foam tank 2000 ft. 1 1/2" hose
1800 ft. 1" hose
Handtools and Chainsaw
Engine TB-3 ICS ICS Type III 300 gallon / Crew of three
20 gallon Class A Foam
used as a backup unit for prescribed fire
IA when primary engines are off-refuge

Water Tender ICS Type II 3000 gallon capacity
300gpm volume pump
Refuge Fire Cache: 20 person capability for Handtools and personal protective gear (20 person)
2 Mark III portable pumps, porta tanks, hose, fittings, chainsaws, first aid gear, and MRE.

**Fire Emergency Contacts and Dispatch Centers**

U.S. Fish & Wildlife Service
**Portland Regional Office (R1)**
Pam Ensley (Regional Fire Coordinator) (503) 231-6174
Andy Anderson (Regional Fire Management Officer) (503) 231-6175
**Boise Interagency Fire Center**
Rodger Erb (Service Fire Management Coord.) (208) 387-5595
**Turnbull NWR Headquarters** (509) 235-4723
Local Fire Agencies and Emergency Services
**Spokane County Fire District #3** 911 or (509) 235-6645
**Spokane County Sheriff** 911 or (509) 456-2233
**Washington Department of Natural Resources** (509) 684-7474
(**Air tankers and Interagency Fire Suppression Support)**
Colville Dispatch Center (CDC) (509) 684-7194
Northwest Interagency Coordination Center (503) 326-7405

| Name and Title | Home Phone (Pager) | Qualifications |
|---|---|---|
| (area code 509) | | |
| Nancy Curry / Refuge Manager | 235-4469 | Agency Rep. |
| Ronnie Sanchez/ Assistant Refuge Manager | 235-6690 | Agency rep. |
| Mike Rule / Biologist | 235-5240 | Resource/Rehab. Spec. |
| Sandy Rancort/Biologist | 235-5240 | Resource/FFT2 |
| Doug Frederick AFMO | 455-5397 (979-0005) | IAIC/TFLD. |
| Ken Mienhart/Forest Tech. | 235-4766 | ENGB/FFT1 |
| Kyle Merrit /Forest Tech. | | FFT1 |
| Forest Tech . | | FFT2 |
| Tom Merritt/Forest Tech. | 235-4766 | FFT2 |
| Glen Warner / Sup Forest Tech | | CRWB. |
| Scott Ebel / Engine Captain | 928-5634 | IAIC/ STEN |
| Justin Hughes / Forest Tech | 448-9105 509-768-2333cp | ENGB |
| Tom Merrit/Forest Tech. | 235-4766 | ENGB/FFT1 |
| Rebbecca Goosman | | FFT2 |
| Gary Beal / Maintenance | 235-2983 | EMT/FFT2 |

**APPENDIX D: EQUIPMENT**

| PPE | Amount | Unit |
|---|---|---|
| Hard hats | 40 | EA |
| Shelters | 38 | EA |
| P Shelters | 20 | EA |
| Fire Shirts | 70 | EA |
| Fire pants | 70 | EA |
| Shrouds | 20 | EA |
| Line Packs | 27 | EA |
| Red Packs | 16 | EA |
| Headlamps | 40 | EA |
| Fusees | 4 | CS |
| Goggles | 35 | EA |
| Hotshields | 12 | EA |
| Webbelts | 20 | EA |
| Flagging | 5 | CS |
| Reppelant | 5 | CS |
| Foot powder | 2 | CS |
| Brush Jackets | 21 | EA |
| Jacket Liners | 10 | EA |
| Gloves | 40 | PR |
| Chin Straps | 20 | EA |
| MK3 Pump | 2 | Kits |
| Volume Pumps | 5 | Kits |
| Hose 1 1/2 | 200 | LNG |
| Hose 1 | 300 | LNG |
| Fittings | 500 | EA |
| Back Pumps | 25 | EA |
| Pulaski's | 25 | EA |
| Shovels | 25 | EA |
| McCloeds | 15 | EA |
| Rakes | 10 | EA |
| Combi tool | 15 | EA |
| MRE'S | 15 | CS |
| Canteens 1 gal | 10 | EA |
| Canteens 1 qt | 80 | EA |
| Drip Torches | 15 | EA |
| Chainsaws | 5 | Kits |
| Plans Kit | 1 | Kits |
| Lantern | 2 | EA |
| Cubies | 20 | EA |
| Hose Roller | 1 | EA |
| Foam 5 gal | 10 | EA |
| Foldatanks | 3 | EA |

## APPENDIX E: FIRE MANAGEMENT ACTIVITIES

Month Activity

January Planning budgets, Work plans, Recruitment.

February Reviewing Fire Base inputs, Recruitment, Planning.

March Ordering supplies, Inventorying Engines, preparing for spring burns.

April Supporting Refuge Rx.
May Training, Supporting Rx, Inventory of PPE and Cache.

June Yearly Re-Certification, Readiness drills.

July Project work, Hazard fuel reduction, Suppression activities.

August Supporting suppression efforts in region. Project work at refuge.

September Preparing Fall Rx projects, Suppression support in region.

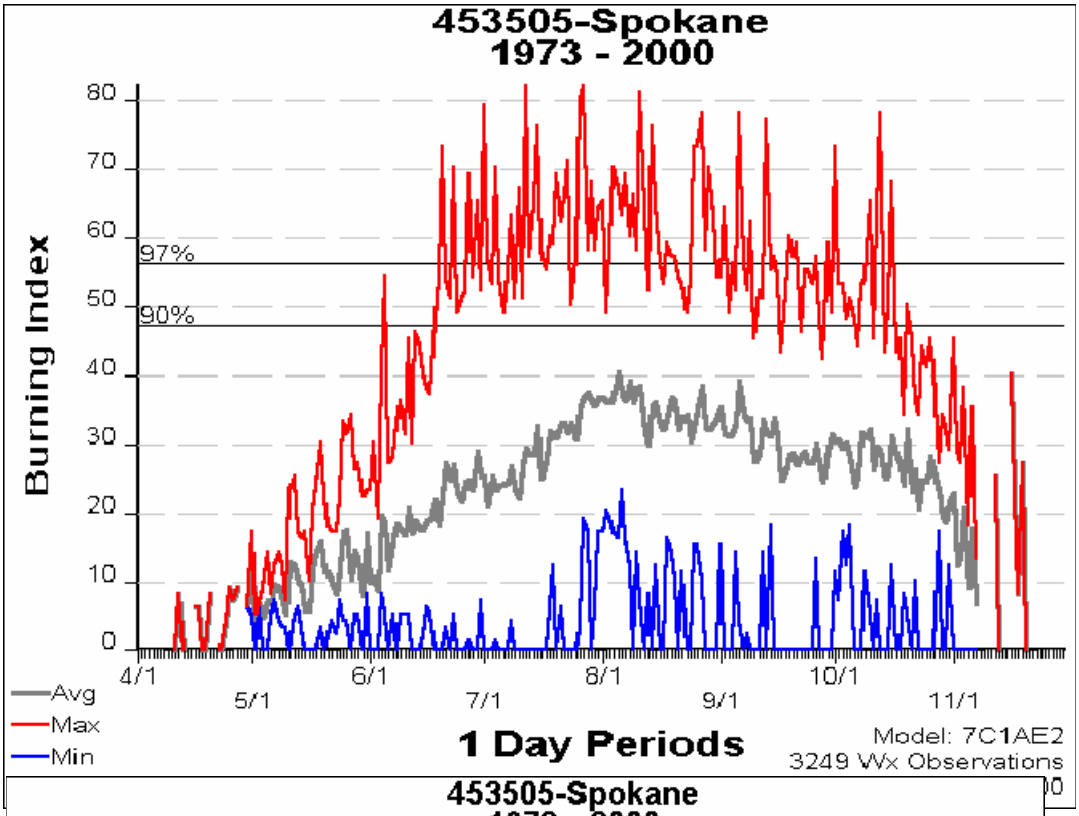
October Supporting Rx in R-1, Suppression of wildland fires.

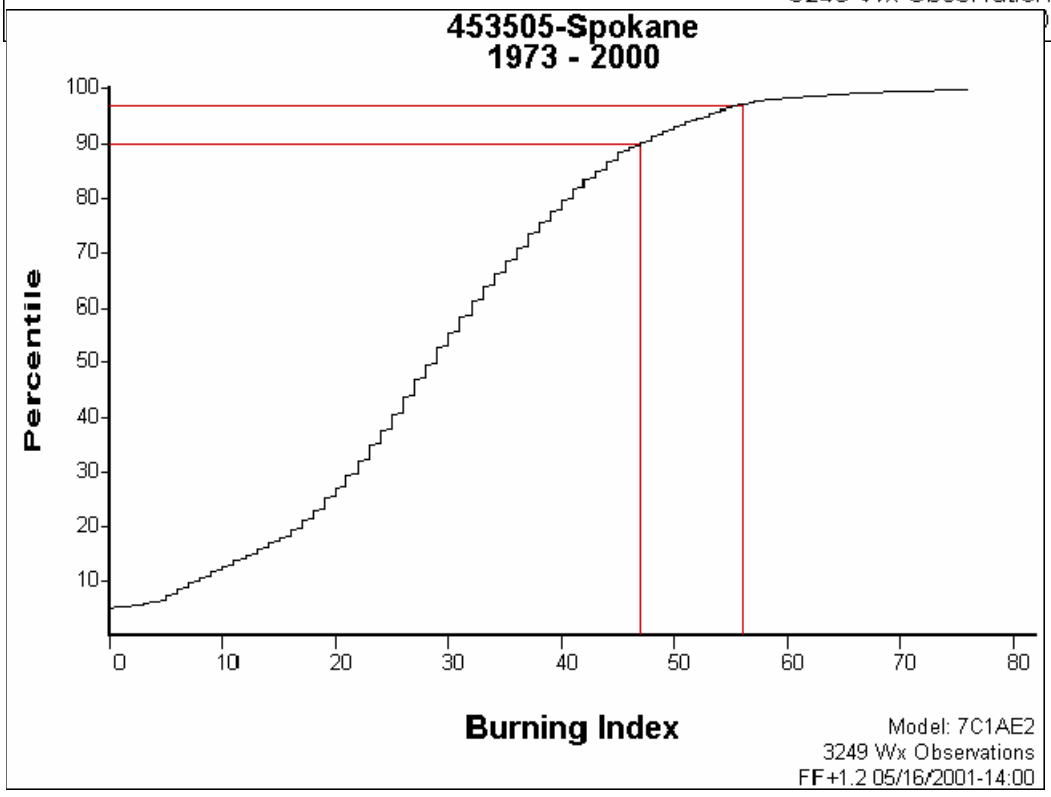
November Supporting Rx in R-1, Preparing reports.

December Planning, Reviews, Budget in put into Firebase.

**APPENDIX F: WEATHER DATA**

Weather station used for weather analysis was the Spokane Airport #453505 for the years 1973-2000. The graphs below show the burning index for this data set.



**APPENDIX G: DAILY CHECKLIST**

Turnbull NWR Fire Apparatus Daily Safety Inspection checklist.

Vehicle ID_____. Date:_____. Initials:_____. Odometer:_____

Engine:
Radiator full, cap secure, hoses tight no leaks. Yes____. No_____. Action.
Batteries snug, clean, fluid adequate. Yes____. No_____ Action.
Engine oil clean and at operating level. Yes____. No_____. Action.
Hydraulic fluids clean and full, no leaks. Yes____. No_____. Action.
Belts tight and in good condition. Yes____. No_____. Action.
Air filter clean. Yes____. No_____. Action.
Engine starts easily. Yes____. No_____. Action.
Instrument gauges operational. Yes____. No_____. Action.
Vehicle controls operational. Yes____. No_____. Action.
Gas/Diesel tank(s) full. Yes____. No_____. Action.
Tires inflated to recommended pressure. Yes____. No_____. Action.
Daily/Weekly/Monthly vehicle log book updated.Yes____. No_____. Action.

Passenger Cabin.

1. Windows clean and wiper operational. Yes____. No____. Action.
2. Mirrors clean, tight and adjusted. Yes____. No____. Action.
3. Turn indicators and backup light/alarms working. Yes____. No____. Action.
4. Emergency warning system operational. Yes____. No____. Action.
5. Cab clean, Floor clear, Seatbelts working. Yes____. No____. Action.
6. Steering and brake system operational. Yes____. No____. Action.
7. Water canteens fresh and full. Yes____. No____. Action.

Fire Apparatus.

1. Pump engine operates correctly. Yes____. No_____. Action.
2. Pump controls operate correctly. Yes____. No_____. Action.
3. Pump gauges operate correctly. Yes____. No____. Action.
4. Main water reservoir full. Yes____. No____. Action.
5. Pump gas tank full, no leaks. Yes____. No.____. Action.
6. Spare gas can full. Yes____. No_____. Action.
7. Foam tanks full and full extra on board. Yes____. No_____. Action.
8. Valves operating correctly, no leaks. Yes____. No____. Action.
9. Tools and equipment on and secured. Yes____. No____. Action.
10. Hose reels operational. Yes____. No____. Action.
11. Hose beds clean and ready. Yes____. No____. Action.
12. Hose packs clean and ready. Yes____. No____. Action.
13. Chainsaw operational and kit ready. Yes____. No____. Action.
14. Drip torches full, no leaks. Yes____ No_____. Action.

Notes and repairs made.

Signature of Engine Captain_____ Date:_____.

**APPENDIX H : REQUEST FOR CULTURAL RESOURCE COMPLIANCE**

# REQUEST FOR CULTURAL RESOURCE COMPLIANCE

**U.S. Fish and Wildlife Service, Region 1**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Project Name:** | | | | | **Program:** (Partners, Refuges, JITW, WSECP, etc.) | |
| **State:** CA, ID, HI, NV, OR, WA | | **EcoRegion:** CBE, IPE,KCE, NCE | | | **FWS Unit:** **Org Code:** | |
| **Project Location:** | **County** | **Township** | **Range** | **Section** | **FWS Contact:** Name, Tel#, Address | |
| | | | | | | |
| **USGS Quad:** | | | | | **Date of Request:** | |
| **Total project acres/linear ft/m:** | | **APE Acres / linear ft/m (if different)** | | | **Proposed Project Start Date:** | |

| **MAPS Attached** | **Check below** | | |
|---|---|---|---|
| Copy of portion of USGS Quad with project area marked clearly **(required)** | | | Project (sketch) map showing Area of Potential Effect with locations of specific ground altering activities **(required)** |
| Photocopy of aerial photo showing location **(if available)** | | | Any other project plans, photographs, or drawings that may help CRT in making determination **(if available)** |

| | |
|---|---|
| **Directions to Project:** (if not obvious) | |
| **Description of Undertaking:** | Describe proposed project and means to facilitate (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25' of 3' high check dam)? |
| | |

| | |
|---|---|
| **Area of Potential Effects (APE):** | Describe where disturbance of the ground will occur. What are the dimensions of the area to be disturbed? How deep will you excavate? How far apart are fenceposts? What method are you using to plant vegetation? Where will fill be obtained? Where will soil be dumped? What tools or equipment will be used? Are you replacing or repairing a structure? Will you be moving dirt in a relatively undisturbed area? Will the project reach below or beyond the limits of prior land disturbance? Differentiate between areas slated for earth movement vs. areas to be inundated only. Is the area to be inundated different from the area inundated today, in the recent past, or under natural conditions? Provide acres and/or linear ft/m for all elements of the project. |
| | |
| | |
| **Environmental and Cultural Setting:** | Briefly describe the environmental setting of the APE. **A)** What was the natural habitat prior to modifications, reclamation, agriculture, settlement? **B)** What is land-use history? When was it first settled, modified? How deep has it been cultivated, grazed, etc.? **C)** What is land use and habitat today? What natural agents (e.g., sedimentation, vegetation, inundation) or cultural agents (e.g., cultivation) might affect the ability to discover cultural resources? **D)** Do you (or does anybody else) know of cultural resources in or near the project area? |
| | |
| | |

## APPENDIX I: PRE-ATTACK CHECKLIST

Pre Attack Plan for Turnbull NWR

Refuge Base Map: This is located in the GIS computer in the Fire Office.

Topographic Maps: A complete set is located in the fire shop.

Vegetation/fuels map: This database is located in the GIS computer in the fire office.

Hazard Location map: There are no ground hazards for aircraft. There is an approach pattern for SIA well above 3000 AGL near the refuge.

Archeological/Cultural base map: The arch study is in the AFMO's office and the base map is in the GIS computer.

Endangered Species Critical Habitat Map: This is located in the Biologists office.

Sensitive Plant map: This is located in the Biologists office.

Special use visitor's area: The 2000-acre public use area is in the NE corner of the refuge and it includes

the Auto tour route and several satellite trails, which can be easily checked and evacuated. Gates control both ends of the auto tour route.

Operations:
Due to the open nature of the Refuge and the many wetlands and water control structures there are many possible helospot and water sources and safety zones that can be identified by the IC or the Team.

Logistics:
The Refuge has a 20-person cache on site. Any other logistical need the staff can coordinate with Colville Dispatch

## APPENDIX J: DELEGATION OF AUTHORITY

Draft Delegation of Authority for Turnbull NWR

Date_____

Time_____

Fire Name_____

I (Refuge Manager or Designee) delegate my authority to manage the _____ fire, on Turnbull NWR to (Incident Commander)_____, and their team/organization.

This fire was started by _____ occurring on this date, and is burning in the (FMU or DRAINAGE/Area)_____, my considerations for managing this fire are;

Provide for fire fighter and public safety.
I would like to manage this fire under a control strategy with suppression actions done with as little as possible environmental, cultural and resource damage.
Key cultural resources are;(List)_____.
Key resources considerations are;(list)_____
Restrictions for suppressions actions are;(list)_____
Managing the fire cost effectively for the values at risk is a significant concern.
Providing training to Refuge staff as requested to strengthen our organization is important.
My agency resource advisor(s) will be_____
Minimum disruption of visitor access of the entrance road and visitor area consistent with public safety is very important.

/s/ _____ Refuge Manager Date:_____

/s/_____Incident Commander Date:_____

# WILDLAND FIRE SITUATION ANALYSIS

**Incident Name:**
**Jurisdiction:**

**Date and Time Completed:**

***This page is completed by the Agency Administrator(s).***

**Section I, WFSA Information Page**

A. Jurisdiction(s): Assign the agency or agencies that have or could have fire protection responsibility, e.g., USFWS, BLM, etc.

B. Geographic Area: Assign the recognized "Geographic Coordination Area" the fire is located in, e.g., Northwest, Northern Rockies, etc.

C. Unit(s): Designate the local administrative unit(s), e.g., Hart Mountain Refuge Area, Flathead Indian Reservation, etc.

D. WFSA #: Identify the number assigned to the most recent WFSA for this fire.

E. Fire Name: Self-explanatory.

F. Incident #: Identify the incident number assigned to the fire.

G. Accounting Code: Insert the local unit's accounting code.

H. Date/Time Prepared: Self-explanatory.

I. Attachments: Check here to designate items used to complete the WFSA. "Other could include data or models used in the development of the WFSA. Briefly describe the "other" items used.

| I. | Wildland Fire Situation Analysis |
|---|---|
| To be completed by the Agency Administrator(s) | |
| **A. Jurisdiction(s)** | **B. Geographic Area** |
| **C. Unit(s)** | **D. WFSA #** |
| **E. Fire Name** | **F. Incident #** |
| **G. Accounting Code:** | |
| **H. Date/Time Prepared** _____@_____ | |
| **I. Attachments** | |

| | | |
|---|---|---|
| - Complexity Matrix/Analysis * | _____ | |
| - Risk Assessment/Analysis * | _____ | |
| Probability of Success * | _____ | |
| Consequences of Failure * | _____ | |
| - Maps * | _____ | |
| - Decision Tree ** | _____ | |
| - Fire Behavior Projections * | _____ | |
| - Calculations of Resource Requirements * | _____ | |

| | | |
|---|---|---|
| - Other (specify)<br><br>* Required<br><br>** Required by FWS | _____ | |

***This page is completed by the Agency Administrator(s).***

**Section II. Objectives and Constraints**

A. Objectives: Specify objectives that must be considered in the development of alternatives. Safety objectives for firefighter, aviation, and public must receive the highest priority. Suppression objectives must relate to resource management objectives in the unit resource management plan.

Economic objectives could include closure of all or portions of an area, thus impacting the public, or impacts to transportation, communication, and resource values.

Environmental objectives could include management objectives for airshed, water quality, wildlife, etc.

Social objectives could include any local attitudes toward fire or smoke that might affect decisions on the fire.

Other objectives might include legal or administrative constraints which would have to be considered in the analysis of the fire situation, such as the need to keep the fire off other agency lands, etc.

B. Constraints: List constraints on wildland fire action. These could include constraints to designated wilderness, wilderness study areas, environmentally or culturally sensitive areas, irreparable damage to resources or smoke management/air quality concerns. Economic constraints, such as public and agency cost, could be considered here.

## II. Objectives and Constraints

To be Completed by the Agency Administrator(s)

**A. Objectives** (Must be specific and measurable)

1. *Safety*

   - Public

   - Firefighter

2. *Economic*

3. *Environmental*

4. *Social*

5. *Other*

**B. Constraints**

***This page is completed by the Fire Manager and/or Incident Commander.***

**Section III. Alternatives**

A. Wildland Fire Management Strategy: Briefly describe the general wildland fire strategies for each alternative. Alternatives must meet resource management plan objectives.

B. Narrative: Briefly describe each alternative with geographic names, locations, etc., that would be used when implementing a wildland fire strategy. For example: "Contain within the Starvation Meadows' watershed by the first burning period."

C. Resources Needed: Resources described must be reasonable to accomplish the tasks described in Section III.B. It is critical to also look at the reality of the availability of these needed resources.

D. Final Fire Size: Estimated final fire size for each alternative at time of containment.

E. Estimated Contain/Control Date: Estimates of each alternative shall be made based on predicted weather, fire behavior, resource availability, and the effects of suppression efforts.

F. Cost: Estimate all incident costs for each alternative. Consider mop-up, rehabilitation, and other costs as necessary.

G. Risk Assessment - Probability of Success/Consequences of Failure: Describe probability as a percentage and list associated consequences for success and failure. Develop this information from models, practical experience, or other acceptable means. Consequences described will include fire size, days to contain, days to control, costs, and other information such as park closures and effect on critical habitat. Include fire behavior and long-term fire weather forecasts to derive this information.

H. Complexity: Assign the complexity rating calculated in "Fire Complexity Analysis" for each alternative, e.g., Type II, Type I.

I. A map for each alternative should be prepared. The map will be based on the "Probability of Success/Consequences of Failure" and include other relative information.

## III. Alternatives (To be completed by FMO / IC)

| | A | B | C |
|---|---|---|---|
| **A. Wildland Fire Strategy** | | | |
| **B. Narrative** | | | |
| **C. Resources needed**<br>Handcrews<br>Engines<br>Dozers<br>Airtankers<br>Helicopters | | | |
| **D. Final Size** | | | |
| **E. Est. Contain/ Control Date** | | | |
| **F. Costs** | | | |

| | | | |
|---|---|---|---|
| **G. Risk Assessment**<br><br>**- Probability of success**<br><br>**- Consequence of failure** | _____<br><br>_____ | _____<br><br>_____ | _____<br><br>_____ |
| **H. Complexity** | | | |
| **I.** | **Attach maps for each alternative** | | |

***This page is completed by the Agency Administrator(s), FMO and/or Incident Commander.***

**Section IV. Evaluation of Alternatives**

A. Evaluation Process: Conduct an analysis for each element of each objective and each alternative. Objectives shall match those identified in Section II.A. Use the best estimates available and quantify whenever possible. Provide ratings for each alternative and corresponding objective element. Fire effects may be negative, cause no change, or may be positive. Examples are: 1) a system which employs a "-" for negative effect, a "0" for no change, and a "+" for positive effect; 2) a system which uses a numeric factor for importance of the consideration (soils, watershed, political, etc.) and assigns values (such as -1 to +1, - 100 to +100, etc.) to each consideration, then arrives at a weighted average. If you have the ability to estimate dollar amounts for natural resource and cultural values, this data is preferred. Use those methods which are most useful to managers and most appropriate for the situation and agency. To be able to evaluate positive fire effects, the area must be included in the resource management plan and consistent with prescriptions and objectives of the fire management plan.

Sum of Economic Values: Calculate for each element the net effect of the rating system used for each alternative. This could include the balance of: pluses (+) and minuses (-), numerical rating (-3 and +3), or natural and cultural resource values in dollar amounts. (Again, resource benefits may be used as part of the analysis process when the wildland fire is within a prescription consistent with approved Fire Management Plans and in support of the unit's Resource Management Plan.)

| IV. | Evaluation of Alternatives |
|---|---|

| To be Completed by the Agency Administrator(s) and Fire Manager / Incident Commander | | | |
|---|---|---|---|
| **A. Evaluation Process** | **A** | **B** | **C** |
| ***Safety***<br>Firefighter<br>Aviation<br>Public | | | |
| *Sum of Safety Values* | | | |
| ***Economic***<br>Forage<br>Improvements<br>Recreation<br>Timber<br>Water<br>Wilderness<br>Wildlife<br>Other (specify) | | | |
| *Sum of Economic Values* | | | |
| ***Environmental***<br>Air<br>Visual<br>Fuels<br>T & E Species<br>Other (specify) | | | |
| *Sum of Environmental Values* | | | |

| | | | |
|---|---|---|---|
| ***Social***<br>Employment<br>Public Concern<br>Cultural<br>Other (Specify) | | | |
| *Sum of Social Values* | | | |
| ***Other*** | | | |

***This page is completed by the Agency Administrator(s) and Fire Manager and/or Incident Commander.***

**Section V. Analysis Summary**

A. Compliance with Objectives: Prepare narratives that summarize each alternative's effectiveness in meeting each objective. Alternatives that do not comply with objectives are not acceptable. Narrative could be based on effectiveness and efficiency. For example: "most effective and least efficient," "least effective and most efficient," or "effective and efficient." Or answers could be based on a two-tiered rating system such as "complies with objective" and "fully complies with or exceeds objective." Use a system that best fits the manager's needs.

B. Pertinent Data: Data for this Section has already been presented, and is duplicated here to help the Agency Administrator(s) confirm their selection of an alternative. Final Fire Size is displayed in Section III.D. Complexity is calculated in the attachments and displayed in Section III.H. Costs are displayed on page 4. Probability of Success/Consequences of Failure is calculated in the attachments and displayed in Section III.G.

C. External and Internal Influences: Assign information and data occurring at the time the WFSA is signed. Identify the Preparedness Index (1 through 5) for the National and Geographic levels. If available, indicate the Incident Priority assigned by the MAC Group. Designate the Resource Availability status. This information is available at the Geographic Coordination Center, and is needed to select a viable alternative. Designate "yes," indicating an up-to-date weather forecast has been provided to, and used by, the Agency Administrator(s) to evaluate each alternative. Assign information to the "Other" category as needed by the Agency Administrator(s).

Section IV. Decision

Identify the alternative selected. Must have clear and concise rationale for the decision, and a signature with date and time. Agency Administrator(s) is mandatory.

| V. | Analysis Summary | | |
|---|---|---|---|
| To be Completed by the Agency Administrator(s) and Fire Manager / Incident Commander | | | |
| **Alternatives** | **A** | **B** | **C** |
| **A. Compliance with Objectives**<br>Safety<br>Economic<br>Environmental<br>Social<br>Other | | | |
| **B. Pertinent Data**<br>Final Fire Size<br>Complexity<br>Suppression Cost<br>Resource Values<br>Probability of Success<br>Consequences of Failure | | | |

C. External / Internal Influences

National & Geographic Preparedness Level _____

Incident Priority _____

Resource Availability _____

Weather Forecast (long-range) _____

Fire Behavior Projections _____

## VI. Decision

**The Selected Alternative is:** _____

**Rationale:**

_____ _____
Agency Administrator's Signature Date/Time

***This Section is completed by the Agency Administrator(s) or designate.***

**Section VII. Daily Review**

The date, time, and signature of reviewing officials are reported in each column for each day of the incident. The status of Preparedness Level, Incident Priority, Resource Availability, Weather Forecast, and WFSA validity is completed for each day reviewed. Ratings for the Preparedness Level, Incident Priority, Resource Availability, Fire Behavior, and Weather Forecast are addressed in Section V.C. Assign a "yes" under "WFSA Valid" to continue use of this WFSA. A "no" indicates this WFSA is no longer valid and another WFSA must be prepared or the original revised.

**Section VIII. Final Review**

This Section is completed by the Agency Administrator(s). A signature, date, and time are provided once all conditions of the WFSA are met.

| **VIII.** | **Daily Review** |
|---|---|
| To be completed by the Agency Administrator(s) or Designate | |
| Selected to be reviewed daily to determine if still valid until containment or control | |

| | | | PREPAREDNESS LEVEL | INCIDENT PRIORITY | RESOURCE AVAILABILITY | WEATHER FORECAST | FIRE BEHAVIOR PROJECTIONS | WFSA VALID |
|---|---|---|---|---|---|---|---|---|
| **Date** | **Time** | **By** | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**If WFSA is no longer valid, a new WFSA will be completed!**

## VIII. Objectives Final Review

The elements of the selected alternative were met on: _____ _____
Date Time

By:_____
(Agency Administrator(s)

**A GUIDE FOR ASSESSING FIRE COMPLEXITY**

The following questions are presented as a guide to assist the Agency Administrator(s) and staff in analyzing the complexity or predicted complexity of a wildland fire situation. Because of the time required to assemble or move an Incident Management Team to wildland fire, this checklist should be completed when a wildland fire escapes initial attack and be kept as a part of the fire records. This document is prepared concurrently with the preparation of (and attached to) a new or revised Wildland Fire Situation Analysis. It must be emphasized this analysis should, where possible, be based on predictions to allow adequate time for assembling and transporting the ordered resources.

**Use of the Guide:**

1. Analyze each element and check the response "yes" or "no."

2. If positive responses exceed, or are equal to, negative responses within any primary factor (A through G), the primary factor should be considered as a positive response.

3. If any three of the primary factors (A through G) are positive responses, this indicates the fire situation is, or is predicted to be, Type I.

4. Factor H should be considered after all the above steps. If more than two of these items are answered "yes," and three or more of the other primary factors are positive responses, a Type I team should be considered. If the composites of H are negative, and there are fewer than three positive responses in the primary factors (A-G), a Type II team should be considered. If the answers to all questions in H are negative, it may be advisable to allow the existing overhead to continue action on the fire.

**GLOSSARY OF TERMS**

**Potential for blow-up conditions -** Any combination of fuels, weather, and topography excessively endangering personnel.

**Rate or endangered species -** Threat to habitat of such species or, in the case of flora, threat to the species itself.

**Smoke management -** Any situation which creates a significant public response, such as smoke in a metropolitan area or visual pollution in high-use scenic areas.

**Extended exposure to unusually hazardous line conditions -** Extended burnout or backfire situations, rock slide, cliffs, extremely steep terrain, abnormal fuel situation such as frost killed foliage, etc.

**Disputed fire management responsibility -** Any wildland fire where responsibility for management is not agreed upon due to lack of agreements or different interpretations, etc.

**Disputed fire policy -** Differing fire policies between suppression agencies when the fire involves multiple ownership is an example.

**Pre-existing controversies -** These may or may not be fire management related. Any controversy drawing public attention to an area may present unusual problems to the fire overhead and local management.

**Have overhead overextended themselves mentally or physically -** This is a critical item that requires judgment by the responsible agency. It is difficult to write guidelines for this judgment because of the wide differences between individuals. If, however, the Agency Administrator feels the existing overhead cannot continue to function efficiently and take safe and aggressive action due to mental or physical reasons, assistance is mandatory.

## FIRE COMPLEXITY ANALYSIS

| | | | **Yes/No** | |
|---|---|---|---|---|
| A. | FIRE BEHAVIOR: Observed or Predicted | | | |
| | 1. Burning Index (from on-site measurement of weather conditions). Predicted to be above the 90% level using the major fuel model in which the fire is burning. | | ___ | ___ |
| | 2. Potential exists for "blowup" conditions (fuel moisture, winds, etc.) | | ___ | ___ |
| | 3. Crowning, profuse or long-range spotting. | | ___ | ___ |
| | 4. Weather forecast indicating no significant relief or worsening conditions. | | ___ | ___ |
| | | **Total** | ___ | ___ |
| B. | RESOURCES COMMITTED | | | |
| | 1. 200 or more personnel assigned. | | ___ | ___ |
| | 2. Three or more divisions. | | ___ | ___ |
| | 3. Wide variety of special support personnel. | | ___ | ___ |
| | 4. Substantial air operation which is not properly staffed. | ___ | ___ | |
| | 5. Majority of initial attack resources committed. | | ___ | ___ |
| | | **Total** | ___ | ___ |
| C. | RESOURCES THREATENED | | | |

| | | | | |
|---|---|---|---|---|
| 1. | Urban interface. | | ___ | ___ |
| 2. | Developments and facilities. | | ___ | ___ |
| 3. | Restricted, threatened or endangered species habitat. | ___ | ___ | |
| 4. | Cultural sites. | | ___ | ___ |
| 5. | Unique natural resources, special designation zones or wilderness. | | ___ | ___ |
| 6. | Other special resources. | | ___ | ___ |
| | **Total** | | ___ | ___ |

D. SAFETY

| | | | | |
|---|---|---|---|---|
| 1. | Unusually hazardous fire line conditions. | ___ | ___ | |
| 2. | Serious accidents or facilities. | | ___ | ___ |
| 3. | Threat to safety of visitors from fire and related operations. | | ___ | ___ |
| 4. | Restricted and/or closures in effect or being considered. | | ___ | ___ |
| 5. | No night operations in place for safety reasons. | ___ | ___ | |
| | **Total** | | ___ | ___ |

E. OWNERSHIP **Yes/No**

| | | | | |
|---|---|---|---|---|
| 1. | Fire burning or threatening more than one jurisdiction. | ___ | ___ | |
| 2. | Potential for claims (damages). | | ___ | ___ |
| 3. | Conflicting management objectives. | | ___ | ___ |
| 4. | Disputes over fire management responsibility. | | ___ | ___ |
| 5. | Potential for unified command. | | ___ | ___ |
| | **Total** | | ___ | ___ |

F. EXTERNAL INFLUENCES

| | | | | |
|---|---|---|---|---|
| 1. | Controversial wildland fire management policy. | ___ | ___ | |
| 2. | Pre-existing controversies/relationships. | | ___ | ___ |
| 3. | Sensitive media relationships. | | ___ | ___ |
| 4. | Smoke management problems. | | ___ | ___ |
| 5. | Sensitive political interests. | | ___ | ___ |
| 6. | Other external influences. | | ___ | ___ |
| | **Total** | | ___ | ___ |

G. CHANGE IN STRATEGY

| | | | |
|---|---|---|---|
| 1. | Change in strategy to control from confine or contain. | ___ | ___ |
| 2. | Large amount of unburned fuel within planned perimeter. | ___ | ___ |

3. WFSA invalid or requires updating. ___ ___

**Total** ___ ___

H. EXISTING OVERHEAD

1. Worked two operational periods without achieving initial objectives. ___ ___
2. Existing management organization ineffective. ___ ___
3. IMT overextended themselves mentally and/or physically. ___ ___
4. Incident action plans, briefings, etc., missing or poorly prepared. ___ ___

**Total** ___ ___

**Signature**_____

**Date**_____ **Time**_____

**APPENDIX L: PRESCRIBED FIRE ACTIVITIES**

Month Activities

January Crew Furlough, Budget planning,

February Crew furlough, writing spring burn plans.

March Crew up and ready, Assisting Rx projects in region, Training

April Turnbull Rx, Assisting Rx in Region 1.

May Assisting Rx in R-1, Acquiring Supplies, Scheduling summer work.

June Training and Re-cert. Assisting Rx in R-1, Readiness and Proficiency.

July Assisting Rx in R-1, Project work at Refuge.

August Assisting Rx in R-1, Project work at Refuge.

September Preparing Rx projects, Project work at Refuge.

October Rx work at Refuge, Assisting Rx in R-1.

November Assisting Rx in R-1, Year end reviews, Training Nominations.

December Completing year end reports, Writing Burn plans, Budget planning.

**APPENDIX M: SAMPLE BURN PLAN**

U.S. FISH AND WILDLIFE SERVICE - REGION 1

PRESCRIBED FIRE PLAN

Turnbull National Wildlife Refuge

Burn Unit

Prepared By: Date:

Approved By:_____ Date:_____
Zone Fire Management Officer

Approved By:_____ Date:_____
Refuge Manager

The approved Prescribed Fire Plan constitutes the authority to burn. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Actions taken in compliance with the approved Prescribed Fire Plan will be fully supported.

**PRESCRIBED FIRE PLAN**

Station:

Sub Units:  Maximum Acres to be Burned:

Name of Area:  Maximum Perimeter Length:

Unit Number:

Legal Description:

Maps attached in appendix A.

## I. GENERAL DESCRIPTION OF BURN UNIT

Physical Features and Vegetative Cover Types:

Are Primary Resource Objectives of Unit adequately discussed in Fire Management Plan ?

Is the historical fire occurrence of fire of the unit adequately discussed in the Fire Management Plan?

Is the Natural role of fire adequately discussed in the Fire Management Plan?

Are the potential social/economic impacts upon visitors, users, and local communities, both on and off site, adequately identified in the Fire Management Plan?

Objectives of Fire:

Acceptable Range of Results:

## II. PRE-BURN MONITORING

Vegetation Type  Acres  %  NFFL Fuel Model

Habitat Conditions:

## III. PLANNING AND ACTIONS

Site Preparation:

Safety Considerations:

Special Safety Precautions Needing Attention:

Media Contacts:
Special Constraints and Considerations sensitive features:

Communication and Coordination on the Burn:

Interagency Coordination:

Complexity Rating:

## IV. IGNITION, BURNING AND CONTROL

| | Planned or Proposed | Actual |
|---|---|---|
| Scheduling: Approx. Date(s) | | |
| Time of Day | | |

Acceptable Prescription Range

| | Low | Desired | High | Actual |
|---|---|---|---|---|
| NFFL Fuel Model: | | | | |
| Temperature: | | | | |
| Relative Humidity: | | | | |
| Wind Direction: | | | | |
| Wind Speed (20' forecast): | | | | |
| Wind Speed (mid-flame): | | | | |

(40% of 20')
Cloud Cover (%):

Environmental Conditions: Low Desired High Actual

Soil Moisture
Fuel Moisture:(10 hr)
Litter/Duff Moisture:
Live Fuel Moisture:
Other:

Fire Behavior:
Type of Fire:
Low Desired High Actual

Rate of Spread:
Intensity:
Flame Length:
Heat/Unit Area:
Energy Release Component
Cumulative weather effects.

Ignition Techniques and plan:

V. SMOKE MANAGEMENT

Distance and Direction from Smoke Sensitive Area(s):

Additional Smoke Management Considerations:

Necessary Transport Wind Direction and Elevation:

Visibility Hazard(s):

Actions to Reduce Visibility Hazard(s):

Residual Smoke Problems:

VI. FUNDING AND PERSONNEL

Accounting Data:
Costs

| | Equipment & Supplies | Labor | Overtime | Staff Days | Total Cost |
|---|---|---|---|---|---|
| Administration: (planning, permits, etc.) | | | | | |
| Site Preparation: | | | | | |
| Ignition & Control: Foam,Fuel,and trucks | | | | | |
| Travel/Per Diem | | | | | |
| Monitoring/Eval. | | | | | |
| Total | | | | | |

Cost per acre for acres =

VII. BURN-DAY ACTIVITIES

Public/Media Contacts on Burn Day:

Crew & Equipment Assignments:

Burn Boss/Manager -
Ignition Specialist -
Ignition Crew -
Holding Specialist -
Holding Crew -
Aircraft Manager -
Weather Observer -
Dispatcher-
Traffic Control-

Crew Briefing Points:

Personnel Escape Plan, Buffer and Safety Zones:

Holding and Control:

Critical Control Problems:

Weather information:

Water Refill Points:

Contingency Plan for Escaped Fire:

Mop Up and Patrol:

Special Problems:

Medical Evacuation Instructions.

## VIII. CRITIQUE OF BURN

Were burn objectives within acceptable range of results? (Refer to Section I):

What would be done differently to obtain results or get better results?

Was there any deviation from plan? If so, why?

Problems and general comments:

## IX. POST-BURN MONITORING

Date:_____ Station Burn Number:_____

Length of Time after Burn:_____

Vegetative Transect:

Comments on Habitat Conditions, etc.:

Photo Documentation: Other:

FOLLOW-UP EVALUATION

Date:_____ Station Burn Number:_____

Length of Time after Burn:_____

Vegetative Transect:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Other:

Attachment 1.

**Function Command Tactical Frequency**

Operations CH1 TX 164.775, RX 166.275 CG 156.7

Divisions CH2 TX 164.775, RX 166.775

Traffic CH1 TX 164.775, RX 166.275 CG 156.7

Med-Evac CH3(SW PRIM) TX 153.890, RX 154.280 CG 114.8

IACommand CH3 A @

IA Tactical CH4(white) TX 154.010, RX 154.010

Thirteen Prescribed Fire Situations That Shout AWatch Out@.

1. You are burning with a plan that has not been approved by the appropriate line officer.

2. You are not qualified burn boss, but you have been told to go ahead and burn.

3. The objective of the burn is not clear.

4. There are areas of special concern within the burn that cannot be burned.

5. Private land or structures adjoin the burn.

6. You are uncomfortable with the prescription.

7. You have not requested a spot forecast.

8. You decide a test fire is not necessary.

9. You decide all your people are old hands and no briefing in necessary.

10. Escape probability is small so you don=t bother with the escape planning.

11. You, or the firing boss, are beginning to lose control of your torch operators.

12. Mop-up and patrol instructions are not specific or understood by the mop-up forces.

13. You haven=t lost one in a long

**GO-NO-GO CHECKLIST**.

Turnbull NWR, Cheney, WA. Revised 7/14/2000.

YES NO__Do you have an ***APPROVED*** prescribed fire plan?

YES NO__Are ***ALL*** the fire prescription Elements met?

YES NO__Are ***ALL*** the smoke management specifications met?

YES NO__Are ***ALL*** Permits and clearances obtained?

YES NO__Has a ***SPOT*** Weather forecast been obtained and is it favorable?

YES NO__Are ***ALL*** required personnel in the plan on the site?

YES NO__Has the contingency planning process adequately considered fuels adjacent to and within a reasonable proximity to the burn area?

YES NO__Have ***ALL*** personnel been briefed on the project objectives and their assignment?

YES NO__Have ***ALL*** personnel been briefed on safety hazards, escape routes, and Safety Zones?

YES NO__Have ***ALL*** the required notifications been made as specified in the plan?

YES NO__Are the on site holding forces adequate for containment under the expected conditions?

YES NO__In your opinion, can the prescribed fire meet the planned objectives, and be carried out according to the approved plan?

I certify that I have reviewed the burn objectives and have reviewed and in agreement that the prescribed fire complexity analysis is correct, and that all of the above questions were answered “YES”.

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PRESCRIBED FIRE BURN BOSS DATE

**APPENDIX N: FIRE EFFECTS**

A. Ponderosa Pine Forest

The effects of fire on ponderosa pine, both prescribed and wildland fire, have immediate effects in terms of injury and mortality, as well as indirect effects in altering the environmental conditions within the stand.

Direct effects can be observed in terms of scorching and charring of the tree bole, limbs and needles. Fire can often cause "cat facing" or depressions at the base of the tree where fire has burned into the interior tissue of the tree. These depressions can often claim more than 60 percent of the base of the tree and the tree will survive. Charring of external bark on ponderosa pine while not aesthetically pleasing, is often of no consequence in the long term health of the tree. Ponderosa pine have thick external bark layers up to 1.5 inches thick which protect the internal cambium from injury. In areas where natural fires occur, the canopy of the ponderosa pine are up the tree bole 50-70 feet. This is caused by previous fires which "prune" off the lower branches. The tree becomes more efficient from a photosynthetic standpoint, since most of the tree canopy is high above the forest collecting sunlight, with most of the older, lower branches being removed. The tree is also more resistant to canopy scorch injury with the branches higher on the tree bole. Research has demonstrated that ponderosa pine can sustain up to 90 percent crown scorch and survive (Harrington, 1981). Experience with prescribed fire in ponderosa pine stands at Turnbull NWR show that this level of crown scorch is survivable, but the tree often dies in following years due to pine beetle attack (*Dendroctonus ponderosae*), injury to surface root systems or some combination of factors.

Mortality resulting from fire, whether related directly to the fire, or subsequent mortality factors such as insects or disease does not always seem directly related to the intensity of fire or the level of crown scorch or bole char. Monitoring of post-fire mortality in prescribed fire at Turnbull NWR has demonstrated that groups of trees of the same age class, height and diameter, growing in the same immediate area (within feet of each other), being subjected to the same level of fire intensity, exhibit differential resistance to mortality or subsequent secondary effects. This suggests some level of genetic variation in terms of adaptability to fire, insects and disease. Post-settlement second growth ponderosa pine forests of the interior west have grown to maturity without the influence of frequent natural fires or insect attacks as genetic selection factors. All of the trees that regenerated following the removal of the old growth were able to survive due to fire suppression activities. In the past, the frequent natural fires would allow only the most fire adapted trees to reach maturity, and being fire adapted would make them resistant to the injuries that predisposed trees to insect attack. Without the influence of fire in thinning stands of ponderosa pine and selecting the most fire adapted trees, present conditions of stands that are overstocked with 500-1000 trees per acre have been attained throughout the current range of the species. Many of these trees are in very poor condition resulting from competition for light, moisture and soil nutrients. Herbaceous growth is very low within the stands due to the lack of light penetrating to the forest floor and with habitat conditions that are of limited value to wildlife. Fuel loading is extreme in many cases and ladders fuels within these stands create conditions for extreme crown fires. These types of stands have been described by researchers as being predisposed to major insect infestations. Stand conditions include single species, even aged stands, 50-100 years in age, with the majority of trees in the 8-12 inch diameter class, and basal area within the stand exceeding 150 square feet/acre (Smartwell and Stevens, 1975).

The conditions previously described approximate the current stand structure of ponderosa pine forests within Turnbull NWR. As indicated, the majority of the standing basal area of ponderosa pine forest on the refuge is within the 6-20 inch diameter class with much of the total tree count in the seedling sapling stage. Pine forests within the refuge would obviously benefit from thinning, either through prescribed fire or commercial timber stand improvement. Benefits would be realized in the prevention of large crown fires and reduction of the potential for pine beetle infestations.

Pine that survive in an environment of frequent fire realize the benefits of reduced competition. In the refuge environment of shallow soils and low levels of precipitation, pine regeneration that survive a fire increase growth rates in relation to the greater levels of solar insolation, increased soil moisture and nutrients available. Fire is a critical component of the nutrient cycle in the ponderosa pine forests. Fire plays an important role in soil surface seedbed preparation for regeneration of seedling ponderosa pine. Refuge soils are relatively young "entisols" having evolved only since the last glacial flood period in which much of the existing topsoil was removed. These shallow soils have very thin organic layers, which are the reservoirs of nutrients essential to tree growth. In dry environments, decomposition of organic matter by soil fungi and bacteria takes place very slowly. Fire performs an essential role in nutrient cycling in all dry vegetation community environments whether it be interior ponderosa pine

forest, prairie grasslands or sagebrush/chaparral environments.

**B. Deciduous Woodland and Shrub Communities**

Aspen and shrub habitat types comprise only a small portion of the habitat types at Turnbull NWR (approximately 60 acres), but they are among the most important for a wide variety of wildlife.
Aspen and shrub communities grow primarily on the perimeters of seasonal wetlands and in riparian areas. Shrubs and trees occurring in association with aspen, include black cottonwood, red-osier dogwood, water birch, willow, black hawthorne and chokecherry. Many of these deciduous trees and shrubs have similar ecological requirements, life history and habitat values, but aspen is more abundant and is important habitat for wildlife species at Turnbull NWR.

Aspen communities are very dynamic and generally occur in a variety of successional stages throughout their range, depending on location and local environmental factors (fire, flooding, grazing). Aspen occurs in a variety of associations with grasses, forbs, shrubs and other trees in varying combinations of species and structure. Aspen bark, leaves, buds, catkins and suckers provide important and nutritious food sources for deer, elk, small mammals and birds. Aspen and shrub stands provide important nesting, feeding and cover for a variety of birds (DeByle 1985). Aspen communities have the highest bird species diversity of any habitat type within Turnbull NWR as studies have indicated. (M. Rule, pers. communication).

Aspen grows rapidly, primarily from root suckers (ramets), but these clones are relatively short lived, ranging from 40 to 80 years in age, before disease, insects or fire kill the tree, resetting stand succession (Perala and Carpenter 1985). Root suckering is the primary means of aspen reproduction in western North America, since conditions of moisture, temperature and soil status required for seed germination and seedling survival are rarely present (Covington *et al.* 1983).

Aspen is distributed as both seral and climax communities within Turnbull NWR. Seral aspen communities grow on the perimeters of seasonal wetlands interspersed with an overstory of ponderosa pine. Many of these aspen stands are dying out due to competition with the invading ponderosa pine. Aspen within these mixed stands are in poor condition due to the fact that aspen is a shade-intolerant species. Reproduction from root suckers is very low within these sites. Climax aspen communities exist in a few locations where soil moisture is too high for pine encroachment, but dry enough for aspen to survive.

Studies of prescribed fire effects in aspen communities demonstrate high degrees of variability depending on the flammability of the stands. Because of the wide range of successional stages and understory shrub/forb/grass components fire effects vary widely. Aspen being thin barked is easily killed by fire, with temperatures as low as 147 degrees being sufficient to damage cambium, buds and leaves. However, mortality is also closely related to fire intensity, duration and flame length. Injury and mortality to aspen, as with other species of trees, shrubs and grasses is reported to be minimized when burned during periods of dormancy (Rouse 1986).

Aspen responds to fire with vigorous resprouting from root suckers when above ground stems are killed, even with high intensity burns. Aspen is a prolific colonizer and can become the dominant species on sites where it formerly comprised only a minor portion of the preburn species composition (Brinkman and Roe 1975). Dark post-burn soil surfaces which heat up more rapidly than unburned areas are believed to promote rapid early season suckering and competitive advantage for aspen.

Studies indicate moderate to high intensity fires promote the most abundant and vigorous resprouting, with 20,000 to 35,000 stems per hectare (Bartos and Mueggler 1981, Brown and DeByle 1989). Sucker response from low intensity fire was found to be poor due to competition from mature trees. With higher mortality levels in mature trees apical dominance is reduced and sucker stimulating cytokinins are concentrated in the root systems (Schier 1981).

Many aspen communities at Turnbull NWR are indicating signs of decadence, disease and lack diversity in terms of age class structure. Some aspen communities growing on the perimeters of seasonal and semi-permanent wetlands have been crowded by pine to the point that the only remaining aspen are growing in the center of the formerly wet

basin, where sunlight can still reach
down through the dense canopy of pine. The skeletons of the former aspen stand ring the edge of the wetland, or have fallen over into the basin. The condition of these aspen stands coincides with an alarming loss of water levels in wetlands at Turnbull NWR, even though annual precipitation inputs have remained relatively constant. As ponderosa pine around wetland perimeters grow larger and denser, aspen communities become less evident and water levels in seasonal/semi-permanent wetland basins continue to drop, with coincident invasion of reed canary grass into areas that were formerly wet for longer periods each year, choking out other native semi-aquatic flora. Increases in water yield by removing the influence of pine invasion into aspen stands with prescribed fire is well documented in fire effects literature (Jaynes 1978 and Gifford *et al.* 1983,1984).

Most wetlands at Turnbull NWR are dependent upon soil infiltration, and surface runoff from small local watersheds for primary hydrologic inputs. Without aggressive prescribed fire programs, the potential for ponderosa pine to impact refuge wetlands will continue. Wildlife and unique semi-aquatic flora that depend upon the presence and normal functioning of these wetlands will be impacted. If one were to turn back the clock of forest succession, it is evident that the current status of ponderosa pine invasion in aspen habitat adjacent to wetland basins began with the advent of fire suppression policies and exclusion of fire from the forest ecosystems of Turnbull NWR. Extensive use of fire is indicated in order to restore aspen communities and enhance forest wetland habitats.

**C. Wetlands**

Wetlands, also known as marshes, swamps and bogs are transitional habitats between open water and dry land. Because of the wide variety of physical conditions found between dry land and open water, a great diversity of habitat conditions exist which support a wide variety of plants and animals in great numbers.

Wetlands at Turnbull NWR range from large open marshes with significant areas that maintain permanent water, to seasonal meadows and forest swales which are only inundated for a short period of time in the early spring from snowpack runoff, yet are critical to the life cycle of many plants and animals. Some wetlands retain characteristics of all the various wetland types and associated plant species, represented by transitional gradients of various wetland/vegetation types in response to annual cycles of inundation and seasonal drying. Important emergent wetland vegetation species include cattail (*Typha latifolia*), bulrush (*Scirpus microcarpus*), rushes (*Juncus* sp.) and sedges (*Carex* sp.). Sub-merged aquatic macrophytes also provide important food for waterfowl and the invertebrate species that some species of waterfowl utilize. These species include the pondweeds (*Potamogeton sp.*), bladderworts (*Utricularia sp.*) and milfoils (*Myriophyllum sp.*).

Wetlands are the most productive and important of all wildlife habitats. Wetlands perform functions important to the health and well being of humans as well, including water purification, groundwater recharge, flood water retention and sediment entrapment. They also provide tremendous aesthetic and educational opportunities for all of us.

Wetlands are very dynamic ecosystems in that they are always changing with water levels, seasons and time. Sediments from erosion in uplands continually fill in wetland basins making them more shallow until vegetation encroaches areas of open water, growing thicker and decomposing each year, trapping more sediment until the wetland becomes a meadow and eventually a forest.

If this process continued unchecked through time it would seem logical that we would have few if any wetlands remaining, but natural systems are always in a process of continual change. Many natural science researchers have noted that there are two features common to all natural communities. First, all natural communities are dynamic systems. Species diversity, population numbers and age structure all change with time. Secondly, natural communities are all different as we move from one location to another. Diversity and change are the common language of all natural things. Disturbance from natural forces such as volcanoes, floods and fire are the primary mechanisms by which natural communities change and remain different from one another, hence the tremendous variety we see in the natural world around us.

Within natural communities of the inland northwest as well as throughout North America, fire is the most recurrent and important factor of change, renewal and rebirth. Ecosystems of Turnbull NWR, including wetlands, were historically maintained and renewed by the force of fire caused by late summer lightning strikes in upland Ponderosa Pine forest. These fires continued to burn unchecked by modern fire suppression forces and techniques, eventually

burning into seasonally dry wetlands removing the accumulation of vegetation and organic matter. Estimates of historic fire occurrence obtained from fire scar analysis on tree rings from similar Ponderosa Pine habitats has shown fire return intervals of approximately 15 to 20 years. Indeed, after looking at fire scars on some of the remaining old trees at Turnbull, we confirmed fires did historically burn the area at 10 to 20 year intervals. These pre-historic fires were primarily low intensity ground fires, since their frequency of occurrence did not allow large accumulations of dead fuels, which create large intense forest fires. However, they were of sufficient magnitude to burn into thick mats of emergent vegetation (cattail and bulrush) which covered unburned wetlands bringing about recurring revitalization of habitat conditions. Fire in wetlands would reset the successional cycle bringing back into balance the amount of open water and emergent vegetation areas providing the diversified conditions needed for adult foraging and nesting in addition to the rearing of young broods. Research has indicated that optimal conditions for waterfowl nesting and brood habitat maintain mosaic conditions in a 50:50 ratio between open water and areas of emergent vegetation (Murkin et. al, 1982). Habitat management strategies providing optimal wetland habitat conditions for nesting waterfowl at Turnbull NWR call for maintaining a balance of 50% open water / 50% emergent nesting cover (interspersion ratio). Experience in prescribed fires conducted in emergent vegetation communities over the past several years at Turnbull NWR indicate that the burns are effective in reducing dead biomass, but reduction in total cover lasts less than one year if water management capability is not available to keep resprouting vegetation from emerging, since cattail is capable of withstanding extended periods of inundation. In order to achieve effective reduction of emergent vegetation with prescribed fire, the burn must be accompanied by flooding a wetland for a period of time to a depth exceeding 18 inches over emergent vegetation to prevent resprouting of the emergent vegetation (Nelson, N., Dietz, R., 1966).

Fire in wetlands and surrounding upland can also affect water chemistry. Infusion of pyrolytic organic nutrients such as nitrogen, phosphorus and potassium can affect water pH, and create flushes of accelerated growth in plant biomass and reciprocal increases in aquatic invertebrate populations. This flush of nutrients can be beneficial in small amounts for wildlife species, which utilize the wetlands, or detrimental in large amounts by creating large algae mats, causing subsequent anaerobic conditions in the wetlands which accelerates eutrophication processes.

**D. Grasslands and Shrub Steppe**

Approximately 6,500 acres of refuge vegetation is classified as grassland or shrub-steppe. Grassland associations range from upland areas dominated by bunchgrasses such as Idaho fescue and Bluebunch wheatgrass interspersed with mature ponderosa pine, pure stands of grasses, and grass species intermingled with sage, buckwheat and other forbs.

As with other vegetation communities on Turnbull NWR, fire exclusion has altered the natural succession and composition of grassland communities. Many grassland communities are being invaded by ponderosa pine that would have been eliminated as seedlings by frequent lightning caused fires (Moir 1966). As pine canopies close in over grassland areas the composition of the understory begins to change from bunchgrasses and herbaceous species to more shade tolerant species such as snowberry or are covered in thick mats of needles and dead branches. Many upland grassland habitats are rapidly changing from open areas with scattered pine, to thick stands of pine regeneration. Conversion of grasslands to forested stands of pine creates more dangerous fire suppression problems with grass fuels intermixed with doghair thickets of pine. Fire in grassland fuels, while generally fast moving are less intense than forest fires and easier to control with suppression forces. Grassland areas are also important hunting and foraging areas for wildlife on the refuge. Management strategies for this vegetation community must consider the removal of encroaching forest and the continuing maintenance of these areas with frequent prescribed fire treatment.

Most western grassland communities evolved in fire environments with frequent natural fire events ranging from every 3-5 years to longer intervals of up to 70 years (Weaver 1951, Vogl 1965). Short interval fire frequencies (5-20) years is most often reported for grassland habitats. Most gramanid species are well adapted to fire either through structural, physiological or reproductive strategies. Perennial bunchgrasses indigenous to Turnbull NWR such as Idaho fescue, bluebunch wheatgrass, needlegrasses, and sandberg bluegrass grow from central root mounds called tufts, or tussocks. These bunchgrasses are capable of vegetative reproduction from these tufts and will present new flower/seed stalks each spring. At the time of the year that natural fire occurred, growth, flowering and seeding of the plant is complete and the plant is in a physiological state of dormancy. As fire passes through a stand of

bunchgrass, the dead upper portions of the plant are burned off leaving the tuft intact to produce new growth the following year or to reproduce from unburned vegetative structures. Seasonality of fire is critical for bunchgrasses. As with other types of vegetation early season burning creates high mortality rates as the high moisture content of the plant causes exceptional heat transfer to internal tissue. Studies have indicated high mortality levels to Idaho fescue from spring and summer burns with virtually no mortality in the fall when the plants were dormant, although the fire reduced basal area of the tufts. Junegrass (*Koelaria cristata)* was found to be one of the most fire resistant of the perennial bunchgrasses (Britton and Sneva 1977). Other research indicates higher post-fire density (Dix 1960) and increased junegrass yields compared to unburned controls (Blaisdell 1953). Needlegrasses (*Stipa* sp.), as with other perennial bunchgrasses, can be damaged by fire if burned while plant tissues are still active. Wright and Klemmendson 1965, found that season of burn, not burning intensity, was the critical factor in mortality of needle-and-thread (*Stipa comata)*. Similar results were reported by the same researchers for Sandberg bluegrass (*Pos sandbergii*). Britton and Sneva 1977, observed 50% mortality of bluebunch wheatgrass from spring burns with 78% reduction in basal area. Fall burns showed only 47% reduction in basal area with no mortality. Evidence indicates that exotic annual grasses such as cheatgrass can be significantly reduced by intense fire which destroy annual seed crops (Robocket *et al.* 1965).Young (1976), conducted his research in eastern Washington, found that germinable cheatgrass seed sources were reduced by 80 to 99% in intense fires.

Shrub steppe communities on the refuge, while limited in extent are important habitat components from the standpoint of diversity and the limited amounts of this habitat which exist due to conversion to agricultural land. Shrub Steppe species such as Black sage (*Atemesia tripartita)* and buckwheat (*Eriogonum* sp.) do not resprout readily after fire and primarily reproduce from seed sources. Rabbitbush (*Chrysothamnus* sp.) readily resprouts following fire and reports indicate that the species is benefited by fire (Cottam and Stewart, 1940). Shrub steppe communities generally occupy very dry sites with shallow soils. Grass development in these areas is sparse, making fire spread difficult. However, it should be noted that due to the dry environment in which it is found, fire still plays an important ecological role in community dynamics, nutrient cycling, reproduction and succession for component species. While fire may not be as critical in shrub-steppe habitats as it is to pine/bunchgrass associations, prescribed fire should still be used periodically to restore natural processes.

Regeneration of perennial grasses in units that were burned with fall burning conditions at Turnbull NWR in 1990 and 1992 have shown excellent results in terms of low mortality rates and increased growth. In many cases the bunchgrasses are visibly more apparent due to the removal of dead biomass (logs, branches, needles), reduction of competing shrub layers (particularly snowberry) and infusion of nitrogen to the soil. Proposed prescribed fire strategies will enhance the abundance and distribution of native bunchgrasses.

## E. Fire Effects: Wildlife

### 1. Direct and Habitat Fire Effects

The effects of fire on wildlife inhabiting the channeled scabland ecosystem can be considered "direct," which are injury and mortality resulting from exposure to the fire or "indirect" effects caused by the alteration or destruction of habitats utilized by wildlife within the perimeter of the fire (Walter, 1977).

Direct mortality resulting from fire is low or insignificant in relation to total wildlife populations. Most species of wildlife can escape the lethal effects of a fire by selecting an insulated micro-environment (burrows, dens, wetlands), or by rapidly emigrating from the path of the fire by running or flying away (Lillywhite, 1982).

Cooper (1961), and Lawrence (1966) found that most small mammals with burrowing habits can survive the direct effects of wildland fire by waiting for the fire to pass over in the insulated protection of their burrows. Their survivability is due to the great decrease in temperature in the ground only a few centimeters below the surface, while most of the heat produced by the fire is convected upward.

Some species of wildlife are actually attracted by fire. Birds of prey have been observed hunting within burned areas while active combustion is still occurring, seeking out small mammals fleeing into open areas. Red-tailed hawks have been observed hunting within prescribed fire units on the refuge during mop-up operations for small mammals and snakes exposed within the burned area. Elk and Deer have been observed moving through burned areas only days after a prescribed fire, licking ash from consumed vegetation, presumably obtaining salts and minerals in their

diets that is not attainable otherwise.

Invertebrate populations have shown much more susceptibility to the direct effects of fire, particularly those, which inhabit soil organic and duff layers. Fellin and Kennedy (1972) demonstrated forest floor invertebrate population levels are a function of the time since the last fire. In some cases, fire can help to reduce population levels of insects that infest and kill mature ponderosa pine forests.

The major effect of fire on wildlife populations occurs indirectly through alteration of habitat. Changes that occur in wildlife habitat following a fire are primarily due to modification of the structure and composition of the vegetation communities within the burned area. Structural changes in vegetation communities following fire are dependent upon the intensity of the fire and the pre-fire structural composition.
Current habitat structure within the refuge is primarily a result of decades of vigorous fire exclusion policies. Much of the ponderosa pine habitat type is represented by overstocked forest stands with closed canopies and dense "doghair" thickets of sapling and pole size trees ranging up to 1,000 trees/acre. Current forest conditions have a high degree of structural diversity including large amounts of dead woody material (hazard fuel), extensive amounts of brushy undergrowth and pine regeneration that create ladder fuels which allow fire to burn into the overstory crowns of mature trees. Natural stands of ponderosa pine (prior to the advent of fire suppression and intense grazing) were described as being "open and park-like" with groups of trees (15-25/acre) consisting of various age classes, dominated by large trees greater than 15 inches in diameter (Covington and Moore 1993). The understory of pre-settlement ponderosa pine forests were dominated by grasses and forbs as a result of frequent low intensity fires which maintained the open canopy structure of the forest and did little damage to mature trees. The structural diversity of pre-settlement ponderosa pine forests consisted of an overstory of mature pine and an understory dominated by bunchgrasses forbs, and low growing shrubs. The frequency of natural fire gave deciduous trees (aspen, willow, cottonwood)competitive advantage on the moist soils of wetlands and riparian zones due to their ability to resprout following fire, and "pioneer" re-establishment of the deciduous forest on the site, eventually shading out seedling pine. Present conditions of extreme fuel loadings, overstocked regeneration and large amounts ladder fuels can cause large intense "stand-replacement" wildland fires, which totally destroy the existing forest canopy. This results in radical alteration of the forest habitat structure from a closed canopy forest to a site being totally open, occupied by grasses, forbs and seedling regeneration.

Perhaps the most profound influence of fire exclusion on wildlife habitat within the refuge has been the reduction in the abundance and distribution of aspen and shrub communities. Aspen has been noted as being the most important tree species to a broad range of wildlife, from birds to mammals, in north America. Shields (1981), found that of 737 vertebrate species present in the intermountain west, 140 utilized aspen for feeding, nesting or cover. Many species utilize aspen year round, but the nutritional qualities of the species are especially important during the fall and winter when the protein levels of other important forage is low (Tew 1970). Elk utilize aspen year round, but it is most important during severe winters with heavy snowfall when grass becomes unavailable (Barmore 1967). Aspen leaves are a preferred browse of whitetail deer. Studies have indicated that aspen comprises up to 27% of whitetail diets in locations where aspen is abundant (Muegler 1985b). Small rodents such as pocket gophers, mice and voles feed on aspen bark and cambial tissue below the snowpack during winter months (Debyle 1985a, Sheppard 1986). Aspen stands provide important feeding and nesting sites for a diverse array of bird species. Many birds utilize aspen stands of a particular seral stage, which emphasizes of managing aspen to develop stands of varying age classes. The soft wood of aspen provide excellent nest sites for cavity nesting birds such as chickadees, nuthatches, sapsuckers, woodducks, buffleheads, woodpeckers and owls (Debyle 1985).

The moist soil conditions present in deciduous wood/shrublands adjacent to wetlands and streams contributed to high levels of biomass accumulation. When infrequent drought conditions occurred, natural fires would burn through these areas more readily and with higher intensity. This fire regime prevented the encroachment of closed canopy pine forests in these areas and allowed shade intolerant species such as aspen, willow, cottonwood and various shrubs to continue their dominance of the site with vigorous root sprouting. Currently, many of these deciduous tree and shrub sites on the refuge are in poor condition as a result of fire exclusion allowing ponderosa pine to persist and dominate by eventually shading out the deciduous species. As a result the distribution and extent of deciduous tree and shrub species has decreased on the refuge progressively over the past several decades. Fire exclusion has ultimately created more structural diversity within refuge forest and grassland habitats in the vertical dimension by allowing the development of sub-canopies of shrubs in open forest stands, overstory development of

mature pine within stands of deciduous trees/shrubs and encroachment of pine into grasslands. While vertical habitat structure has increased, the horizontal structural diversity that was created and maintained by frequent natural fires is decreasing. Fire exclusion has brought about conditions of very homogenous age class structure within forest habitat, decreased the vigor and abundance of deciduous tree and shrub habitats as well as the extent of grassland habitat types.

Grasslands and meadow habitats within the refuge are also tending towards conditions of increased habitat structure complexity as a result of fire exclusion. Many grasslands and meadows on the refuge are being invaded by ponderosa pine regeneration which will eventually decrease the amount of available open grassland and meadow habitat type. The frequent low intensity natural fires of pre-settlement periods would ensure that pine seedlings were killed by the fires that burned through the thick foliage of the grasslands and meadows, maintaining the open habitat structure.

Fire in wetlands can have a variety of effects including the reduction of dead biomass in stands of emergent vegetation, decreasing the ratio of emergent vegetation to open water areas and alters the horizontal structural arrangement wetland vegetation. During periods of drought fire can be deep into wetland basins removing accumulated organic matter which deepens the basin, maintaining the dynamic successional status of this important habitat type. Nutrients released from the combustion of dead biomass in wetlands can increase the productivity of submerged aquatic vegetation and aquatic invertebrates, which are important food sources for a variety of waterfowl.

**2. SPECIFIC FIRE EFFECTS**
**a. Large Mammals**

**ELK (*Cervis elanphus*)** Turnbull NWR supports a population of approximately 80-100 elk based upon estimates from a 1993 aerial survey of the refuge. This population is a recent arrival on the refuge, migrating into the refuge from the north Idaho area over the past decade.

Direct mortality to elk resulting from fire have been shown to be minimal due to the ability of elk to emigrate from areas involved in wildland fire (Kramp 1985). Fire effects on elk are primarily due to changes in habitat structure, increases in biomass and vegetation species diversity which occur as a result of fire. 82% of elk observations in 1991 occurred with the perimeter of the 500 acre McDowell prescribed burn conducted on Turnbull NWR in 1990. Foraging within the burn perimeter by the refuge elk herd was still significant during 1993. Monitoring of vegetation transects within the MacDowell burn showed large increases in herbaceous species diversity one year after the burn. Numerous site preference studies indicate that elk prefer to browse on burned as opposed to unburned sites ( Martinka 1974, Davis 1977, Canon 1985). Elk are ruminant herbivores, utilizing a wide variety of vegetation depending on the season. Grasses and forbs are preferred browse during spring and early summer, while woody browse is preferred in winter. Elk will browse conifers in areas where snow covers other forage (Nelson 1982).

Fire can adversely affect elk habitat by decreasing the amount of dense thickets of ponderosa pine regeneration which elk require for protection against heat and extreme cold. Thickets are also used as calving areas and security cover (Skovlin 1982). Optimal elk habitat includes recently burned areas with high biomass production adjacent to areas of dense cover. Prescribed fire is routinely used to create or enhance elk habitat by most wildlife management agencies. Research indicates that burning for elk habitat should occur with short rotations over large areas or in dispersed mosaic patterns to reduce over-utilization of the burned area by elk (Brown 1985).

**White-tailed Deer (*Odocoileus viginianus*)**
White-tailed deer, like elk, are recent arrivals to the refuge environment. Changes in forest habitat structure brought about by fire suppression, which created dense thickets of reproduction, created habitat suitable to the white-tailed deer (Severson 1983). Whitetails prefer dense forest cover near wetlands and riparian areas. These dense cover areas, preferably of coniferous trees, which provide better protection in winter, are used by groups of whitetails which "yard" or concentrate during the cold winter season (Matfield 1984). Studies have shown that whitetails are very adaptable to habitat disturbances, such as agriculture and forestry practices and prefer these areas if adequate cover is nearby. Current habitat conditions at Turnbull NWR, dense thickets of pine reproduction (resulting from timber harvest without subsequent thinning) adjacent to wetlands and riparian areas are ideal for whitetails. The

refuge is also surrounded by agricultural land to the south and west.

Whitetails are browsers and utilize a wide variety of vegetation in their diets. Forage consumed includes leaves, woody twigs and stems of brush and deciduous trees, as well as seeds and fruits, and to a lesser extent grasses and forbs (Hesselton 1982). Many studies have been conducted on the effects of fire on whitetail habitat and indicate that whitetails will preferably utilize burned areas over adjacent unburned habitat (Orme 1976, Keay 1980, Freedman 1983). It has also been demonstrated that fire increases the nutritional quality of browse utilized by deer. This effect is most pronounced during the winter when more green grass and herbs are available on burned sites due to less dead biomass present within the burned area (Hobbs and Spowart, 1984). Monitoring of prescribed fires conducted on the refuge in 1990 and 1992 have shown significant increases in the species diversity following application of fire. Since deer are browsers, depending on a wider variety of plants in their diets, prescribed fire should improve the quality of deer habitat and food availability.

**Coyote (*Canis latrans)***
The coyote is omnivorous, feeding both on prey animals and plant fruits, seeds, shoots and roots. Since the coyote is a highly mobile and adaptable animal, direct mortality or injury from fire is rarely a factor. Primary fire effects on coyotes occur in the alteration of the habitat that it exploits for food. Fire may expose den sites hidden in dense shrub or forest areas, in which event a new site would be selected. Significant increases in small mammal populations, which are important food sources for coyotes, have been documented in post-fire habitats (Ahlgren 1966)**.** Herbaceous plants and shrubs proliferate in post-fire environments providing beneficial food sources for coyotes. Snowberry, a prolific resprouter following fire, produces abundant amounts of fruit**, which** has been observed with great frequency in coyote scat during the fall season at Turnbull NWR. Coyotes also exploit waterfowl nests for eggs and young during the spring season. Fire management practices, which improve coyote habitat and food sources, and reduce dense cover for upland nesting waterfowl species, may be detrimental to refuge waterfowl management goals**.**

**Badger *(Taxidea taxus)***
Badgers occur in significant densities throughout the open pine grasslands of Turnbull NWR. Badgers are excellent excavators, spending much of their time underground in dens or burrowing to dig out prey species such as ground squirrels or marmots. This burrowing habit makes badgers relatively immune to direct mortality resulting from wildland fire. It is possible that a badger could be trapped above ground by a fast moving fire, or suffocated in a burrow located in an area of extremely heavy forest fuels where combustion removes available oxygen. Like the coyote, badgers benefit from fire effects on habitat components, which promote increases in small mammal populations, which are their primary food source.

**Porcupine (*Erethizon dorsatum)***
Porcupine are relatively abundant on the refuge. Their slow moving mode of travel and propensity to escape danger by climbing trees makes them potential candidates for direct injury and mortality in fire situations. Porcupine prefer to eat the cambium of young ponderosa pine trees. Fire management practices, which promote regeneration of pine and maintain uneven age class structure in forest communities will benefit porcupine.

**b. Small Mammals**

Direct fire effects on small mammals is dependent on the primary habitat of the species. Burrowing mammals such a mice, moles and ground squirrels can escape harm from a fire by remaining within a burrow where temperatures are cooler due to the upward convection of radiant heat. Tree dwelling mammals such as squirrels and chipmunks have a tendency to escape from harm in the canopies of trees where radiant heat is concentrated causing significant mortality (to the benefit of raptors and coyotes). Numerous studies have indicated positive benefits resulting from fire which generally increase the abundance of small mammal populations (Bock and Bock 1985). The increase in abundance is attributed to increased food supplies, particularly in relation to seed production and availability. Algren (1967) found that deer mice *(Peromyscus* sp.) were benefited by the large amounts of pine seed available after fire which were exposed in soil layers after the herbaceous vegetation cover was removed by fire. These studies indicated that most of the population increase occurred the first year following the fire and declined in subsequent

years.
Species of mammals that feed on insects and other invertebrates (worms, grubs, snails etc.) in/on surface habitats may be affected in immediate post fire environments due to the loss of food sources that are consumed in the organic layers of the soil surface. Shrews and moles may be temporarily affected by fires occurring within their habitats.

**c. Waterfowl**

Fire effects on waterfowl primarily involve habitat alteration. Direct mortality is negligible as fire in wetlands occur during the summer and late fall after nesting season and first year birds are able to fly. Prescribed burns can be conducted to avoid critical nest/brood periods.

Fire in wetlands can remove accumulations of emergent vegetation biomass creating more open water areas for successful waterfowl brooding. Nutrient input following fire in and around wetlands can increase the productivity of submerged aquatic vegetation and algae. The increased productivity of the wetland not only provides food from the aquatic vegetation but also invertebrate populations, which are important food sources for many species of waterfowl. On the negative side, fire can destroy important nesting cover for waterfowl in emergent vegetation communities. Fortunately, this effect is countered by the rapid regrowth of emergent vegetation, which can resprout from root-system tubers.

Removal of thick stands of brush can be detrimental to species of birds that utilize these habitats for nesting and escape cover from predators. Some species of ducks, such as mallards, American wigeon and green-winged teal, utilize dense brush as nesting cover in upland pine forests near wetlands. These species would be negatively impacted by the removal of this brush cover by fire. Recovery of brush species such as snowberry (*Symphocarpus alba*) can take several years to attain density and height sufficient to provide good nesting cover.

Fire can also create snags that are important to cavity nesting birds such a owls, bluebirds, wood ducks, mergansers, buffleheads and woodpeckers. Trees weakened or killed by a fire also provide excellent feeding areas for insect eating birds, which feed on the larva of beetles, which lay their eggs in the inner bark.

**d. Neotropical Migratory Birds**

Neotropical migratory songbirds have shown dramatic population declines in the breeding bird surveys conducted over the past 26 years (Robbins et. al 1991). Declines in species, which inhabit forest and grassland habitats, have shown the most significant decreases. Neotropical migrants are species, which utilize northern hemisphere habitats for breeding purposes and winter in equatorial and southern hemishpere habitats. Agricultural practices, forestry and urbanization have dramatically impacted forest and grassland habitats in both hemispheres as the demands of a growing human population increase. Due to the declining populations of these songbirds, the fact that they are "Federal Trust" species and that management practices which target these species often benefit a wide range of other species, they have been given special emphasis in habitat management planning at Turnbull NWR.

At Turnbull NWR, the majority of neotropical migrants are found within aspen/shrub habitat types. The structural diversity, lush foliage and ground cover of these habitats provide excellent foraging areas for these songbirds which depend on insects as primary food sources (M. Rule, personal communication). Examples of neotropical migrants which have been identified as "key" species (species which management efforts will target, but benefit other species which utilize the same habitat) include the willow flycatcher (*Empidonax traillii*), various wood warblers (*Dendroica* sp.), vireos (*Vireo* sp.) and other songbirds.

Fire effects on neotropical migrants occur primarily through the alteration of the structural composition of aspen and other shrub habitats. Fire management objectives for aspen and shrub habitats will consider maintaining these communities in various stages of successional status. Young recently burned aspen and shrub communities have vigorous stands of re-sprouting trees and shrubs, which will provide excellent forage opportunities for the insects that various species depend upon in the herbaceous understory and short canopy. The dense vegetation will also provide protection from predators and numerous nesting sites. Older stands will provide nesting sites within cavities created in the larger trees and forage opportunities for insects which specialize in exploiting old, less vigorous stands

of aspen and other deciduous trees.

Fire exclusion in aspen and shrub communities, like grasslands, has promoted significant encroachment of ponderosa pine into stands that were previously dominated by the deciduous trees and shrubs. Many aspen and shrub communities have evolved in areas where natural fire plays and important role in ecosystem processes. Aspen and shrub communities found at Turnbull NWR require frequent disturbance to initiate resprouting and maintain stand vigor. Fire also helps prevent the encroachment of pine into these stands by maintaining open canopy conditions for the shade intolerant deciduous aspen, willow, dogwood and hawthorne stands.

Fire management practices, which restore the role of fire into the critical aspen and shrub communities, will benefit neotropical migrant species on the refuge. Restoration of fire into these habitats will foster vigorous healthy stands, with variation in age class structure, increase the distribution and density of the stands while providing excellent cover, forage and nesting opportunities for a wide range of wildlife species.

**e. Upland Game Birds and Raptors**

As with other types of wildlife, fire effects on birds and their associated habitats can be both beneficial and detrimental. Many studies have reported dramatic increases in seed eating birds utilizing burned areas, which have vigorous regrowth of vegetation (Vogl 1967, Lawrence 1966). Forest canopies are opened up by fire allowing more sunlight to penetrate to the surface. The increased sunlight produces post-fire reproduction of plant species which lay dormant as seed in the soil. Increased levels of soil nutrients also contribute to the extensive post-fire production of herbaceous biomass.

Ruffed Grouse (*Bonasa umbellus*) and Mountain Quail (*Oreortyx pictus)* benefit from fire in aspen and shrub communities with the vigorous post-fire resprouting which produces extensive amounts of buds and catkins which are a preferred forage (Udvardy 1977). Removal of brush can negatively affect these species through loss of the dense cover they depend upon for nesting and escape from predators.

Removal of vegetation and thick stands of brush and pine reproduction create excellent hunting areas for owls and other raptors by making it easier to find the abundant small mammals that are present in recently burned areas. Red tailed hawks have been observed successfully hunting within prescribed burns only hours after the fire has been completed. Fire can also create nest sites in large ponderosa pine which are utilized by cavity nesting owls such as the pygmy owl (*Glaucidium gnoma)* the northern saw-whet owl (*Aegolius acadicus).*

**f. Reptiles and Amphibians**

Fire can cause direct mortality to reptiles and amphibians while at the same time altering habitats that they utilize. Species such as the western painted turtle (*Chrysemys picta)* and the long-toed salamander (*Ambystoma macrodactylum*) which utilize upland areas for part of the year are directly affected by fires occurring in their habitats. The painted turtle lays eggs in shallow "scrapes" exposing the eggs to fire induced mortality. The long-toed salamander, which inhabits the underside of decaying logs, is also directly affected by intense fires, which consume all surface organic material. Snakes such as the western garter snake (*Thamnophis elegans),* rubber boa (*Charina bottae)* generally escape direct fire effects by crawling under rocks or seek refuge in mammal burrows. Removal of cover by fire exposes snakes to easy predation by raptors as observed on the Palmer Meadow prescribed burn (10/93), when a red tailed hawk captured and consumed a large rubber boa.

Fire in dry wetlands may cause significant mortality to reptiles and amphibians that burrow into the muddy organic layer to survive the dry season if the fire is intense enough to burn deep into organic layers. Observation of wetland burns conducted in 1990 and 1992 indicate that consumption of wetland bottoms is minimal.

Infusion of organic nutrients from fire in wetlands and surrounding upland areas can increase the availability of aquatic insects and invertebrates that frogs (*Rana* sp.), turtles and salamanders feed upon.

Fire can also play a role in increasing wetland habitat availability through the removal of large pine trees, which have encroached the periphery of small forested seasonal wetland areas due to fire exclusion. Removal of these trees reduces the amount of water transpired by the trees making more available for wetland inhabitants over a longer period of time each season. Jaynes (1978) and Gifford (1983,1984) demonstrated that in the absence of fire to reset succession in aspen communities, pine eventually dominates the site, significantly reducing water yields in the Colorado River Basin.

**g. Invertebrates**

Fire can affect invertebrate populations in forest, grassland and wetland habitats through direct mortality or through alteration of the habitat that they utilize. Fire studies have indicated marked declines in insect populations in immediate post-fire environments both in the soil and on the surface (Metz and Dindal 1980). Other soil dwelling invertebrates are similarly affected. Changes in invetebrate populations in the post-fire environment are related to changes in post-fire vegetation composition.

Many forest insect pests such as ticks, spend portions of their life cycle in or on the forest floor in litter or decaying material. Fire can be used to beneficially reduce populations of these insects. Many insects such as pine beetles (*Dendroctonus* sp.) and wood boring beetles (*Genus* sp.) are attracted to areas burned by fire by chemical or infra-red detection capabilities. These insects attack trees scorched and stressed by fire and lay eggs in cambial tissue. Larvae then kill the tree by destroying the cambial tissue. This process has been observed following prescribed fire on Turnbull NWR with significant numbers of trees killed by beetles after surviving the fire. The process is selective and seems to be related to fire injury and some level of genetic resistance, since not all tree injured are attacked and some with no apparent fire related stress are killed by beetles. The relationship between beetles, pine and fire is one that developed long before fire exclusion became federal land management policy and has a role in the natural nutrient cycling process of forest ecosystems.

**E. Fire Effects: Water Quality and Hydrology**

The primary influence of fire on hydrologic regimes and water quality involve increases in water yield, sedimentation, organic nutrient levels and water temperature. The effects of fire on water quality and hydrology vary in relationship to the length of time since the fire occurred.

The removal of forest cover resulting from a wildland fire will increase annual water yields. Water yields gradually decrease as the forest regrows utilizing more soil moisture in evapotranspiration (Helvy 1980). The most dramatic effects on hydrology and water quality occur after severe burns that remove overstory forest vegetation. Low intensity burns that only remove understory vegetation do not alter hydrologic output or water quality. Fires effects on water quantity and quality are also dependent on the size of the burn, the general slope of the watershed and the types of soils present within the burned area. In severe fires, destruction of organic material in the soil reduce the interception of precipitation at the surface and increase infiltration and direct runoff into stream channels or wetlands, increasing sediment deposition and inflow of organic ions from burned material.

Besides increasing water yield, the removal of overstory forest vegetation adjacent to streams or wetlands can increase water temperature. The removal of the vegetation increases the amount of direct solar insolation to the water body resulting in increased water temperature (Levno and Rothacher 1969). Increased stream temperatures can influence aquatic flora and fauna. Increased water temperatures in small seasonal forested wetlands could benefit migrating waterfowl and early season nesters with additional early season food sources.

Studies have indicated increased levels of nitrate-nitrogen and phosphorus in post-fire water quality analysis (Tidemann 1978). These increases have been found to produce concurrent increases in stream flora and fauna. Inorganic and organic chemical increases have been found at levels that generally do not exceed water quality standards. These increases are temporary and generally do not exceed one hydrologic cycle following the application of fire.

**F. Fire Effects: Soils**

Fire effects on soils can be both detrimental and beneficial depending on the fire intensity and duration in relation to

the management objectives for a particular area or habitat type. Fire can affect the chemical and physical properties of soil. Chemical properties of soils are altered during the process of pyrolysis, the degree depending once again on the intensity of the fire. Many important soil nutrients can be increased through the decomposition of dead organic matter on the soil surface during a fire. Low intensity fires facilitates the cycling of important organic nutrients such as nitrogen, phosphorus, potassium, calcium and magnesium. Infusion of these nutrients in the post-fire environment benefits plant communities with vigorous regrowth of herbaceous species, shrubs and trees. Removal of dead organic surface litter can expose soil surfaces which helps to promote natural seed regeneration of the site from sources stored in the soil or imported to the site by wind dispersal or by wildlife. Intense wildland fires can volatilize organic nutrients causing net loss from a site of important nutrients. Nitrogen, one of the most important soil nutrients is easily volatilized by fire. Studies have indicated losses of 10 to 20% of nitrogen from ponderosa pine forests soils following fire (White *et al.* 1973, Welch and Klemmendson 1975). Research conducted on prescribed fire in ponderosa pine forests in Arizona indicated significantly higher levels of nitrogen in the first year following fire in stands where large amounts of dead fuels are present (Ryan and Covington 1986). However, most studies which track long term nitrogen loss from prescribed burns conducted a 4-5 year intervals indicated that no decrease in soil nitrogen levels, with actual increases in the upper soil horizons, even though nitrogen is volatilized. (Alban 1977, Burns 1952, Metz *et al.*, 1971). This may in large part be due to the ability of many post-fire pioneer species to fixate or remove nitrogen from the atmosphere through a symbiotic relationship with root bacterial microorganisms (*Nitrosomas & Nitrobacter)*. Species such as lupine (*lupinus* sp.), alder (*Alnus* sp.) and many other grass, forb and shrub species have the ability to fix atmospheric nitrogen to replace losses to fire. In any case, fire is critical in dry pine forests for nutrient cycling, which in the absence of enough moisture to support decomposition of organic matter with soil fungi and bacteria, rely upon fire to liberate stored nutrients.

Fire can alter the physical properties of soils through the removal of organic components, which bind soil particles. Loss of organic matter can increase the erodability of soils, particularly in areas with steep slopes. Where organic soil layers are consumed by fire, soil water storage capacity and infiltration rates are reduced (Campbell *et al.* 1977). As soil aggregates held together by organic matter are destroyed by fire, smaller particles fill soil pores between larger particles reducing water infiltration, increasing runoff and subsequently increase erosion (Vogl and Ryder, 1969). Fire can also create water repellant layers in soils resulting from the distillation and subsequent hardening of organic matter and sinks into the soil creating impermeable subsurface layers which increase the potential for sheet erosion (Debano, L. 1974).

Another important aspect of fire effects on soils involves soil microorganisms. These microorganisms consist of fungi and bacteria which live within soil organic layers and interact with the roots systems of trees, shrubs and other plants in positive, often symbiotic relationships, or negative parasitic relationships. Studies have shown that fire can reduce the incidence of some forest tree root pathogens such as fomes root rot (*Fomes annosus*) (Froelich, R. 1979). In other cases, beneficial soil fungi called mychorrhizae, which grow as fine hairs on small roots, and help trees take up additional nutrients and moisture from the soil, are adversely affected by intense fires (Tarrant 1956).

Observations of soil conditions resulting from prescribed fire conducted since 1990 at Turnbull show the results of the varying intensity with which fires burn over the landscape. While most areas are subjected to light intensity fires, certain areas with deep accumulations of surface fuels show signs of sterilization where no vegetation is observed revegetating the site for several years following the application of fire. These areas are generally small (less than 10 $m^2$) and primarily occur around the base of large trees where pine needles have accumulated several feet deep after years of fire exclusion. The extreme soil heating, which occurs around these trees, can kill the root system of the tree or interrupt mychorrhizal associations critical to the health of the tree.

**G. Fire Effects: Air Quality**

Fire effects on air quality fall into three classifications, visibility, particulates and pollutants. All three classes can affect human health and safety. Both wildland fire and prescribed fire can cause impairment of air quality in the above mentioned categories, but prescribed fire can mitigate those impacts through regulations, timing and techniques of application.

Wildland fires, as demonstrated during the historic fires of 1994 in the northwest, have the capability to affect air quality not only in the vicinity of the fire, but hundreds of miles downwind. Air quality deterioration during large

wildland fires can last for weeks or months. These events affect visibility on roads and airports, often requiring closures. The particulates and pollutants have been demonstrated to be hazards to human health, with over 130 known carcinogenic substances found in forest fire smoke, including formaldehyde, methane, carbon monoxide, benzene, to name a few. an These particulates and pollutants are particular hazards to local residents, individuals with existing breathing problems and to firefighters, who must endure extreme exposure for weeks at a time. These air pollution problems are exacerbated by the extreme levels of fuel loading that have accumulated in forests of the northwest with 60 years of fire exclusion policies. Many forests, such as those at Turnbull have changed from light grass fuel understories which burn clean (rapid oxidation, low levels of particulates) to heavier forest fuels under closed canopies which, with higher moisture levels retained in the woody fuels burn slower and liberate more particulates and other pollutants.

Fire suppression policies at Turnbull NWR must be sensitive to potential impacts from wildland fires occurring on the refuge to air quality in Spokane. Spokane County is designated as a "Non-attainment area" for particulate matter under the provisions of the 1993 Federal Clean Air Act. Since most wildland fires on the refuge occur with prevailing westerly winds, smoke will carry directly into downtown Spokane. Refuge wildland fire suppression, fire prevention and prescribed programs and policies must recognize the potential for all aspects of the fire management program to impact the ability of Spokane County to meet the mandates of the Clean Air Act. Fire effects on air quality resulting from prescribed fire can be mitigated by utilizing weather, fuel moisture conditions and burning techniques, which promote rapid combustion of fuels and dispersal of smoke. Low humidities and fuel moisture promote rapid and complete combustion of fuels. More complete combustion prevents lower levels of particulates and toxic gas combustion byproducts from being emitted into the atmosphere. Burning with proper windspeeds both at the surface level and aloft promotes dispersal and mixing of smoke particulates and gases throughout the air column to reduce effects downwind and on-site. Utilization of proper wind direction can minimize smoke effects on populated areas and in areas where visibility/air quality is a concern from a safety/public health standpoint such as roads, highways, airports schools and hospitals.

Forest fire smoke can have beneficial effects for the forest due to the demonstrated toxic effects of smoke on various forest diseases including root rots and blister rusts. Studies by Parmenter and Uhrenholdt (1976) demonstrated wood smoke having a deliterious effect on spore germination and mycelial growth for several common forest pathogens.

## APPENDIX O: COMPLIANCE DOCUMENTATION