

WILDLAND FIRE MANAGEMENT PLAN
HAKALAU FOREST NATIONAL WILDLIFE REFUGE
HAKALAU UNIT



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WILDLAND FIRE MANAGEMENT PLAN
HAKALAU FOREST NWR
HAKALAU UNIT

Prepared:

Andrew Kikuta
Maintenance Supervisor
Big Island National Wildlife Refuge Complex

Date

Richard Wass
Project Leader
Big Island National Wildlife Refuge Complex

Date

Andy Anderson
Regional Fire Management Officer
Pacific Region, US Fish and Wildlife Service

Date

Concurred:

Pam Ensley
Regional Fire Management Coordinator
Pacific Region, US Fish and Wildlife Service

Date

Approved:

Anne Badgley
Regional Director
Pacific Region, US Fish and Wildlife Service

Date

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EXECUTIVE SUMMARY

When approved, this document will become the Fire Management Plan for the Hakalau Unit of the Hakalau Forest National Wildlife Refuge. Major components include:

- B updated policy for fire suppression at the Hakalau Unit.
- B compliance with objectives from the 1989 Strategy Statement (CCP scheduled for completion in 2008).
- B format changes under the direction of Fire Management Handbook (Release Date 6/1/00).

This plan is written to provide guidelines for appropriate suppression activities at the Hakalau Unit. Prescribed burning will, at this time, be limited to pile burns. More extensive prescribed burning may be used in the future and would require an amendment to this plan.

INTRODUCTION

This document will establish a Fire Management Plan for the Hakalau Forest National Wildlife Refuge. This plan will meet the requirements of the National Environmental Protection Act (NEPA), the National Historic Preservation Act (NHPA) and the Endangered Species Act (ESA). A Categorical Exclusion and associated Environmental Action Statement was completed for this FMP (Appendix E). Compliance with the Endangered Species Act was made through a "no effect" determination by the project leader.

This plan is written as an operational guide for managing the Unit's wildland fire program. It defines levels of protection needed to ensure safety, protect facilities and resources, and restore and perpetuate natural processes, given current understanding of the complex relationships in natural ecosystems. It is written to comply with a service-wide requirement that refuges with burnable vegetation develop a fire management plan (620 DM 1).

This plan will cover all wildland fires. Having an approved plan will mitigate safety and operational issues and provide for effective and efficient actions. The refuge units have many resource values to be protected. Endangered species and habitat restoration are primary concerns. Suppressing wildland fires will protect the thousands of acres of outplantings to restore native ecosystems and ensure adjacent lands are not adversely affected. Prevention and suppression of fires will also protect existing native ecosystems that have not evolved with fire.

The Unit has no dedicated fire staff. Staff members are red-carded but all firefighters have other primary duties. Most have not had any fire experience. Fortunately Hawaii Volcanoes National Park (HAVO) has a full time fire staff, and is only three hours away by vehicle and thirty minutes by air. Other members of the Big Island Wildfire Coordinating Group are also available to suppress wildland fires. The Refuge has a cooperative agreement with the Hawaii County Fire Department (Appendix D).

COMPLIANCE WITH USFWS POLICY

The fragile nature of the native Hawaiian vegetation and its associated fauna were a primary consideration in the establishment of Hakalau Forest National Wildlife Refuge (NWR) in 1985. The refuge was established for the purpose of protecting and restoring endangered forest bird populations and their habitat.

Hakalau Forest NWR was established in 1985 under the authority of the Endangered Species Act to preserve and protect five species of endangered forest birds and their rain forest habitat. Although much of the Unit, previously a cattle ranch, is highly disturbed, it still contains relatively intact native forest including some of the last montane, mesic koa-`hi`a (*Acacia koa-Metrosideros polymorpha*) forests in the world. Forested portions of the Unit contain some of the highest densities of native forest birds in the State of Hawai`i (Scott *et al.* 1986) as well as 29 rare and endangered plant species (Stone *et al.* 1987).

The introduction of exotic species, logging and grazing have significantly led to the declines of indigenous populations. Grazing and the introduction of non-native flora and fauna have resulted in the decrease of the native forest to its present size and condition. Four major management strategies will be employed to protect and restore rain forest habitats at the Hakalau Unit. They include direct reforestation efforts, elimination of cattle grazing, elimination of feral pig populations, and elimination/control of alien plants including gorse, banana poka, blackberry, and kikuyu grass.

While most of the 32,733 acre (13,252 ha) Unit is closed canopy forest, over one hundred years of cattle grazing, logging and burning have converted about 5,000 acres (2,023 ha) of upper elevation forest into open woodland and pasture dominated by introduced grasses. In closed canopy sections of the Unit, disturbance from cattle (*Bos taurus*), feral pigs (*Sus scrofa*), and rats (*Rattus rattus*) have reduced populations of native understory plants and pushed some endangered plants to the brink of extinction.

No Refuge Master Plan nor Comprehensive Plan exists. A Strategy Statement was developed in 1989 that identifies the overall goal of the refuge, a set of objectives supporting the goal of the refuge and strategies addressing each objective.

The Department Manual, DM 910 (USDI 1997) states the following regarding wildland fires:

AWildfires may result in loss of life, have detrimental impacts upon natural resources, and damage to or destruction of man-made developments. However, the use of fire under carefully defined conditions is to be a valuable tool in wildland management. Therefore, all wildfires within the Department will be classified either as wildfire or as prescribed fires.

Wildfires, whether on lands administered by the Department or adjacent thereto, which threaten life, man-made structures, or are determined to be a threat to the natural resources or the facilities under the Department's jurisdiction, will be considered emergencies and their suppression given priority over normal Departmental programs.

Bureaus will give the highest priority to preventing the disaster fire - the situation in which a wildfire causes damage of such magnitude as to impact management objectives and/or socio-economic conditions of an area. However, no wildfire situation, with the possible exception of threat to human survival, requires the exposure of firefighters to life threatening situations. Within the framework of management objective and plans, overall wildfire damage will be held to the minimum possible giving full consideration to (1) an aggressive fire prevention program;

(2) the least expenditure of public funds for effective suppression; (3) the methods of suppression least damaging to resources and the environment; and (4) the integration of cooperative suppression actions by agencies of the Department among themselves or with other qualified suppression organizations.

The authority for funding (normal fire year programming) and all emergency fire accounts is found in the following authorities:

Section 102 of the General Provisions of the Department of Interior's annual Appropriations Bill provides the authority under which appropriated monies can be expended or transferred to fund expenditures arising from the emergency prevention and suppression of wildland fire.

P.L. 101-121, Department of the Interior and Related Agencies Appropriation Act of 1990, established the funding mechanism for normal year expenditures of funds for fire management purposes.

31 US Code 665(E)(1)(B) provides the authority to exceed appropriations due to wildland fire management activities involving the safety of human life and protection of property.

Authorities for procurement and administrative activities necessary to support wildland fire suppression missions are contained in the Interagency Fire Business Management Handbook.

The Protection Act of September 20, 1922 (42 Stat.857; 16 USC 594) authorizes the Secretary of 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.

The Economy Act of June 30, 1932 authorizes contracts for services with other federal agencies.

The Reciprocal Fire Protection Act of May 27, 1955 (42 USC 815a; 69Stat 66) provides authorities to enter into agreements with other Federal bureaus and agencies; with state, county, and municipal governments; and with private companies, groups, corporations, and individuals regarding fire activities. Authority for interagency agreements is found in AInteragency Agreement between the Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service of the United States Department of the Interior and the Forest Service of the United States Department of Agriculture@ (1996).

The Disaster Relief Act of May 22, 1974 (88 Stat 143; 42 USC 5121) authorizes federal agencies to assist state and local governments during emergency or major disaster by direction of the President.

The National Wildlife Refuge System Administrative Act of 1966 as amended (80 Stat927; 16 USC 1601) 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.

The Federal Fire Prevention and Control Act of October 29, 1974 (88 Stat 1535; 15 USC 2201) provides for reimbursement to state or local fire services for costs of firefighting on federal property. Wildfire Suppression Assistance Act of 1989 (Public Law 100-428, as amended by Pub L 101-11, April 7, 1989)

The Department Manual (Interior), Part 910 DM1, Wildland Fire Suppression Management (March 29, 1990) defines Department of Interior fire management policies.

FIRE MANAGEMENT OBJECTIVES

The overall objectives for fire management at Hakalau Forest NWR are to promote a program to ensure firefighter and public safety, aimed at reducing human-caused fires, and to ensure appropriate suppression response capability to meet expected wildland fire complexity. Specific fire management objectives are:

- § Promote a fire management program and control all wildland fires.
- § Protect life, property, and resources from wildland fires while considering resource values at risk. Hakalau Forest NWR was established for the purpose of protecting and restoring endangered forest bird populations and their habitat. The Unit supports a superb avifauna, rich in species and high in density. Thirty-nine bird species are found on the Unit including 14 endemic (of which eight are endangered), five indigenous and 20 aliens.
- § Use appropriate suppression tactics and strategies that minimize long-term impacts of suppression actions.
- § Utilize pile burning to safely and efficiently remove debris from resource management activities and reduce hazardous fuels.

DESCRIPTION OF UNIT

The Hakalau Unit is located about 13 miles northwest of Hilo (one hour and forty-five minutes by 4-wheel-drive vehicle) on the windward slope of Mauna Kea (Figure 1). It was established October 29, 1985 and currently consists of 32,733 acres (13,252 ha). The Hakalau Unit and the Kona Forest Unit together comprise the Hakalau Forest National Wildlife Refuge, which is the lone refuge in the Big Island National Wildlife Refuge Complex (NWRC).

The Hakalau Unit lies between the elevations of 2,500 and 6,600 ft. and contains some of the finest stands of koa and ohia forest remaining in Hawaii and the world (Figure 2). The lower slopes receive very high rainfall (approximately 300 inches per year) and are vegetated with dense forests dominated by ohia and treeferns and bisected with numerous streams and gullies. Upslope, at elevations above 4,500 ft., koa becomes codominant with ohia. The typical structure of this forest is characterized by tall koa and ohia trees forming a closed canopy. Younger ohia trees dominate the midstory and treeferns and native shrubs form the understory. Higher elevations (above about 5,600 ft.) experience less rainfall and have been subject to considerable grazing pressure for over 100 years, which has more or less eliminated the native understory. This area is a parkland habitat of open grassy areas with scattered mature koa and ohia. Intensive grazing on the uppermost portion of the Unit (above about 6,200 ft.) has eliminated even the trees, except for remnant individuals scattered through the gulches. This area is carpeted with introduced grasses, including the noxious weed gorse.

The terrain is rugged and often bisected with deep gulches which limit vehicle travel of any distance to the upslope-downslope direction rather than cross slope. There are a few "jeep trails" on the Unit but they occur mostly in the upper elevation grassland areas. Unimproved roads become impassable following heavy rains and can remain that way for several weeks.

CULTURAL RESOURCES

There are cultural/archeological sites on the Unit of varying significance. Most are rock structures vulnerable to damage by dozer activity or intense heat. Descriptions are found in Table 1. Locations of these structures are on file at the Big Island NWRC office. There are two buildings being considered for the National Historic Register. One is a cabin in the Pua Akala parcel built circa 1890, and the other is a cabin built in the Honohina parcel in the 1920's.

FISH AND WILDLIFE

The Unit supports a superb avifauna, rich in species and high in density. Thirty-nine bird species have been documented on the Unit including 14 endemic, 5 indigenous, and 20 aliens.

Substantial populations of four federally listed endangered forest birds occur on the Unit (Appendix L). They are the 'Akiapola'au (*Hemignathus monroi*), the Hawaii creeper (*Oreomystis mana*), the Hawaii Akepa (*Loxops coccineus coccineus*), and the 'Io (*Buteo solitarius*). The other four endangered birds found at Hakalau include the very rare 'O'u (*Psittirostra psittacea*) which is reported from the lower elevation 'ohi'a forests, the Nene (*Nesochen sandvicensis*) which nests in adjoining areas, and the Hawaiian Duck (*Anas wyvilliana*), and Hawaiian Coot (*Fulica americana alai*) which inhabit streams and stockponds on the Unit. The endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) is also present at Hakalau (USFWS 1991; 1992).

Figure 1: Hakalau Unit Vicinity Map

Figure 1. Island of Hawaii and site of Hakalau Forest National Wildlife Refuge

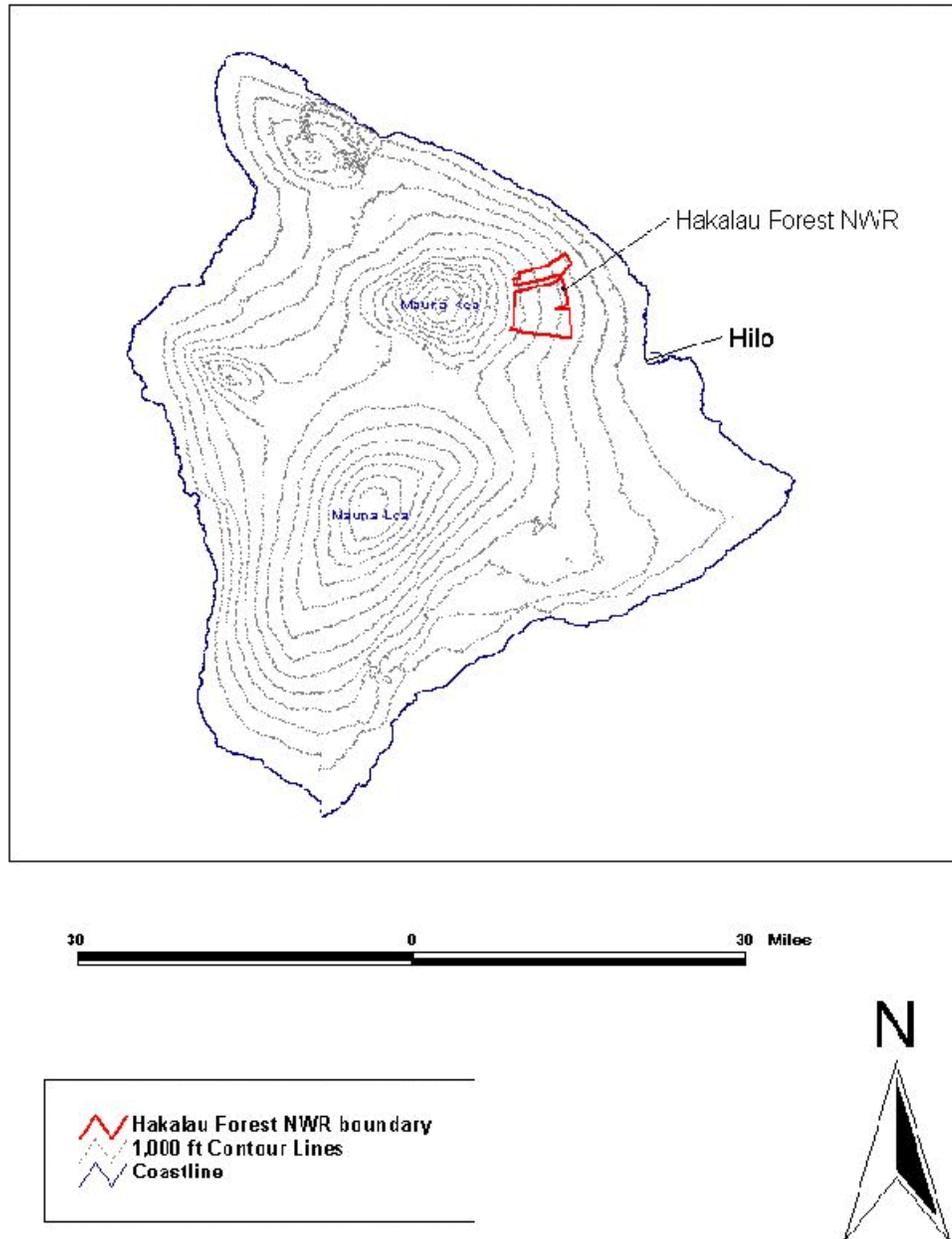


Figure 2: Hakalau Unit Map

Figure 2. Hakalau Forest National Wildlife Refuge

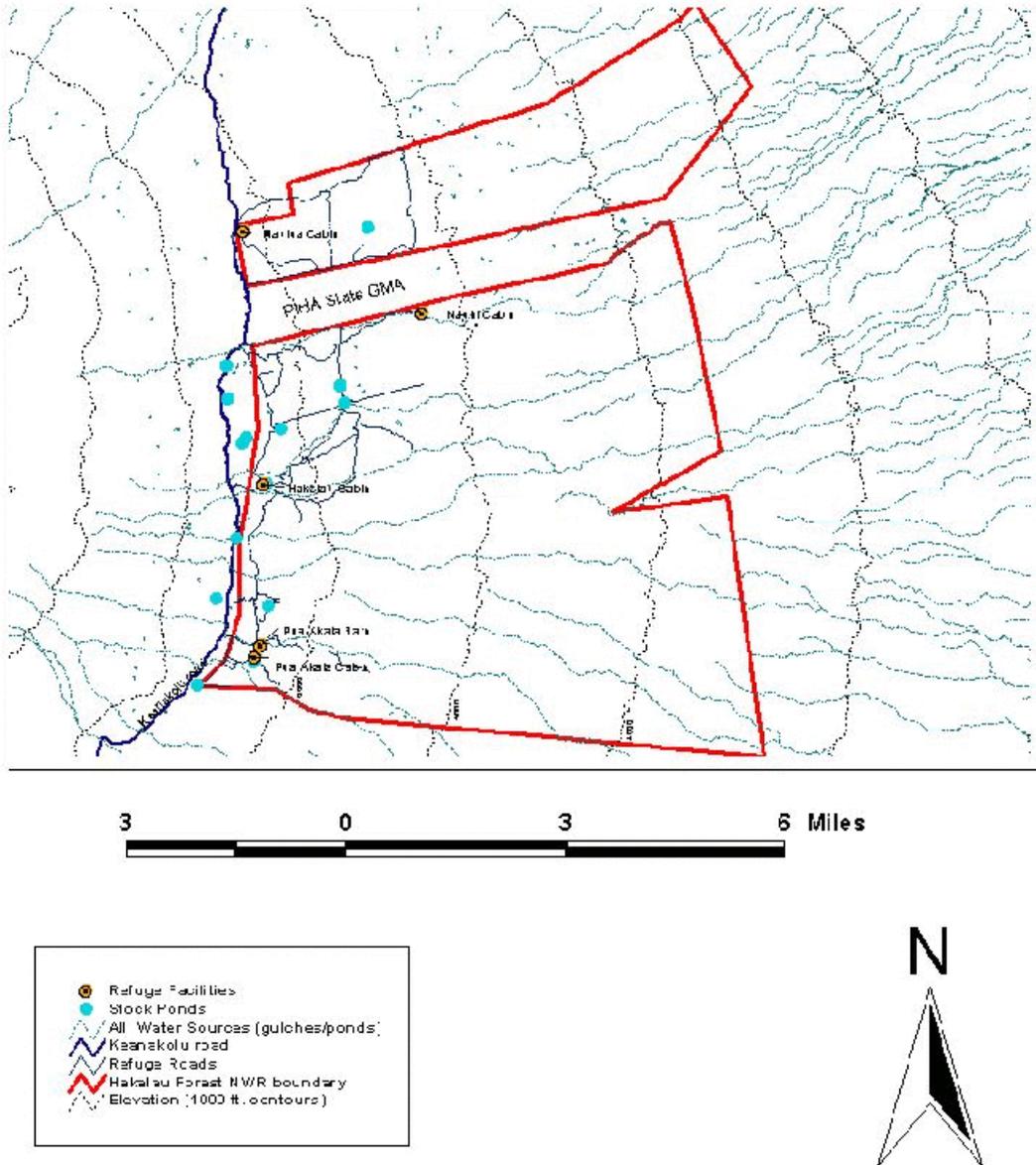


Table 1. Cultural Resources in the Hākeian Forest NWR.

Site ID	Site Type	Possible Function	Possible Date of Use/Construction	Aliquists	Location/Elevation (a)	Historical Reference	Reference
50-10-24-15071	cairn	survey boundary mark	19th century	Makakanihewa/ Hākeian Nui	same ridge as Site 18666; 5,770 ft	none	Raymond 1991
50-10-24-15072	platform	habitation	1881	Makakanihewa	in saddle; 6,300 ft	"not at present" (Covington 1881)	Raymond 1991
50-10-24-15073	enclosure	habitation	pre-1881	Makakanihewa	on nose of ridge; 6,450 ft	"old hut" (Covington 1881)	Raymond 1991
50-10-24-15074	complex of four features (cabin, enclosure, two dikiramed C-shaped)	habitation	pre-1881	Hākeian Nui	in saddle; gulch through middle of site; 6,240 ft	"Hopuval - old hut" Lamuni's Road passes through site (Covington 1881)	Raymond 1991, 1993
50-10-24-18666	pedreglyrhis (historic)	survey boundary marks	1870s?	Makakanihewa/ Hākeian Nui	same ridge as Site 15071; 6,400 ft	rock marked M Δ (RP-754) for LCA 11216; Hockley 1921)	Raymond 1993
50-10-24-21137	pedreglyrhis (historic)	survey boundary marks	1870s (CJ Lyons survey?)	Hanohihai/ Hākeian Nui	top of bluff; 6,400 ft	rock marked H H Δ (RP-754) for LCA 11216; Boundary Comm.)	present survey
50-10-24-21138	possible Lamuni's road alignment	transportation	19th century; possibly pre-contact	above Hanohihai	on rolling terrace; 6,400 ft	Boundary Commission, Covington 1881	present survey
Naahi Cahāo	historic building complex (cabins and ruins of houses)	HSPA experiment station	1924-1941	Hanohihai	on north side of Naahi gulch; 5,160 ft	Bryan 1945; anonymous 1962	present survey
Pua Ahaia Ranahi	historic building complex (ranch house, outbuildings, barn)	ranch headquarters	1884-present	Papa'hou/ Puaia'a	along branch of Puaia'a gulch; 6,300 ft	Mason 1987; R.S. Blackhear, I. Hamm interviews	John Child & Co. 1985; USFWS 1995a; present survey

Table 1: Cultural Resources at the Hakalau Unit

VEGETATION

There are five major vegetation types found on the Unit: wet Ohia, Koa-Ohia, mesic Koa-Ohia, dry Koa-Mamane, and open pasture. Vegetation variations in the Unit are patterned by elevation, temperature and rainfall, with exceptions to the zonation due to general topography, soils and the underlying substrate, microclimate, and land use practices (Figure 3).

The **Wet Ohia** zone covers essentially the entire seaward half of the Unit and is characterized by a forest dominated by ohia trees. Subcanopy trees and shrubs include kawau (*Ilex anomola*), kolea (*Myrsine lessertiana*), kopiko (*Psychotria* spp.), and olapa (*Cheirodendron trigynum*), and the ground cover is primarily ferns.

A wet **Koa-Ohia** forest extends in a narrow band from 4000' to 5000' elevation. The structure of a typical koa-ohia rainforest is characterized by tall koa and ohia trees forming a closed canopy 50-80 feet tall, ohia trees forming the mid-story, and tree ferns (*Cibotium* spp.) and native shrubs forming the understory.

A **Mesic Koa-Ohia** forest grades upland from the wet zone, rising from 4500' to 6400' elevation. The boundary between wet and dry zones roughly corresponds to the boundary between two soil types. Kolea, kawau, kopiko, and olapa are subdominant trees. The understory consists largely of shrubs such as kanawao (*Broussaisia arguta*), akala (*Rubus hawaiiensis*), ohelo (*Vaccinium calycinum*), and various ferns including hapu'u (*Cibotium* spp.).

A **Dry Koa-Mamane** zone lies at the very upper edge of the Unit, above 6000' elevation. This zone is transitional between the taller mesic stands and the lower stature mamane trees. The canopy also includes scattered naio (*Myoporum sandwicense*). The understory includes shrubs like pukiawe (*Styphelia tameiameia*) and ohelo, ferns, and native and exotic grasses.

A significant portion of the upper edge of the Unit is **Open Pasture** (Figure 4). This zone has been impacted by intensive grazing, introduced non-native weeds, and possibly forest fires. Much of the former forest has been transformed into open pasture with only remnant individuals of koa and ohia. The landscape consists largely of exotic grasses and the noxious plant gorse (*Ulex europaeus*).

A reforestation effort at the Hakalau Unit thus far spans 12 years and more than 230,000 koa trees. Koa planting is concentrated in the dry Koa-mamane and Open Pasture zones. These zones have been the most impacted by historic ranching activities that removed native vegetation and replaced it with pasture. Rare plants are planted in the Mesic Koa-Ohia zone because of their need for shade. As the koa overstory in the Open Pasture develops, these same rare plants will also be planted beneath its shade. Other native species are being cultivated in the greenhouse for yearly outplanting. Native tree species are slow growing and during sapling stages would die if caught in a fire.

Destruction of native vegetation at Hakalau has caused changes in the microclimate. Forest clearing and grazing have created extensive open pasture with increased wind speed, reduced moisture collected from fog drip, and more extreme temperature fluctuations. As a result, frost damage is one of the primary causes of planted seedling mortality at the upper elevations. Although the upper elevations of the Unit are the focus of reforestation efforts, the severity of the microclimatic influences in these areas is a major obstacle to reforestation.

PHYSICAL RESOURCES

The Unit is veined by a number of gulches and ravines. There are no perennial streams. Streams flow only after heavy rains or long duration rainy periods. Many of these gulches are feeder streams that join up at lower elevations and make it to the coast. There is great potential for fire-caused erosion to deposit silt miles away from the Unit. Former stock ponds still hold water in various locations throughout the Unit (Figure 2).

STRUCTURES AND FACILITIES.

Presently there are 44 miles of pig/cattle proof fence of which approximately 10 miles are vulnerable to fire damage. It is possible that during extreme drought conditions that all 44 miles may be affected. These fences are crucial in keeping ungulates out of the Unit.

There are several buildings on the Unit surrounded by either grass or trees. Unit staff are supported by a residence, garage, kennel, greenhouse, and storage shed. In addition, a separate structure is used to house volunteers. New crew quarters are being built to house eight employees. A separate photovoltaic/battery building is also planned. Also in the complex of buildings are a cabin built by and for USGS-Biological Resources Division, and a field station operated by the University of Hawaii School for Field Studies. A cabin built and lived in by a former lessee exists in the Maulua unit. There are two buildings being considered for the National Historic Register. One is a cabin in the Pua Akala parcel built circa 1890, and the other is a cabin built in the Honohina parcel in the 1920's. Locations of these facilities are found on Figure 2.

At the northwest corner of the Maulua tract is a 120 acre parcel owned by Nobriga Ranch. On it is located a cabin that is inhabited 80% of the time. There are also associated ranch implements and livestock.

South of the Pua Akala and Shipman parcels is Puu O'o Ranch. West of the Unit is Parker Ranch. On both of these properties, a mixture of pasture and gorse patches can be found.

Figure 3: Vegetation Zones of the Hakalau Unit

Figure 4. Hakalau Forest NWR Vegetation Communities

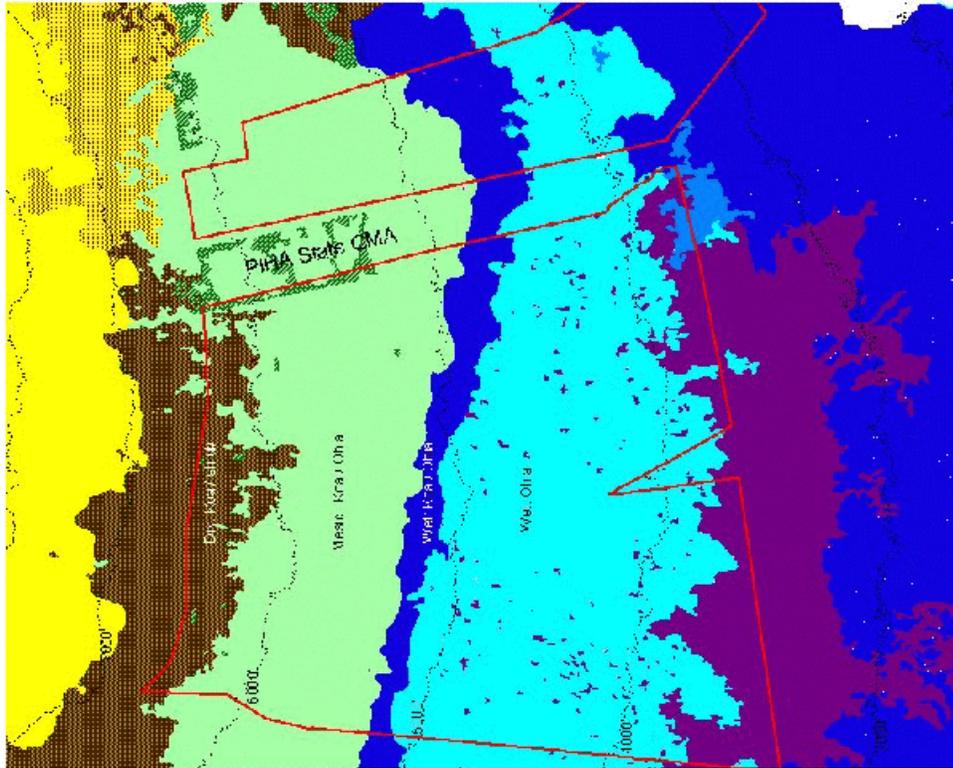
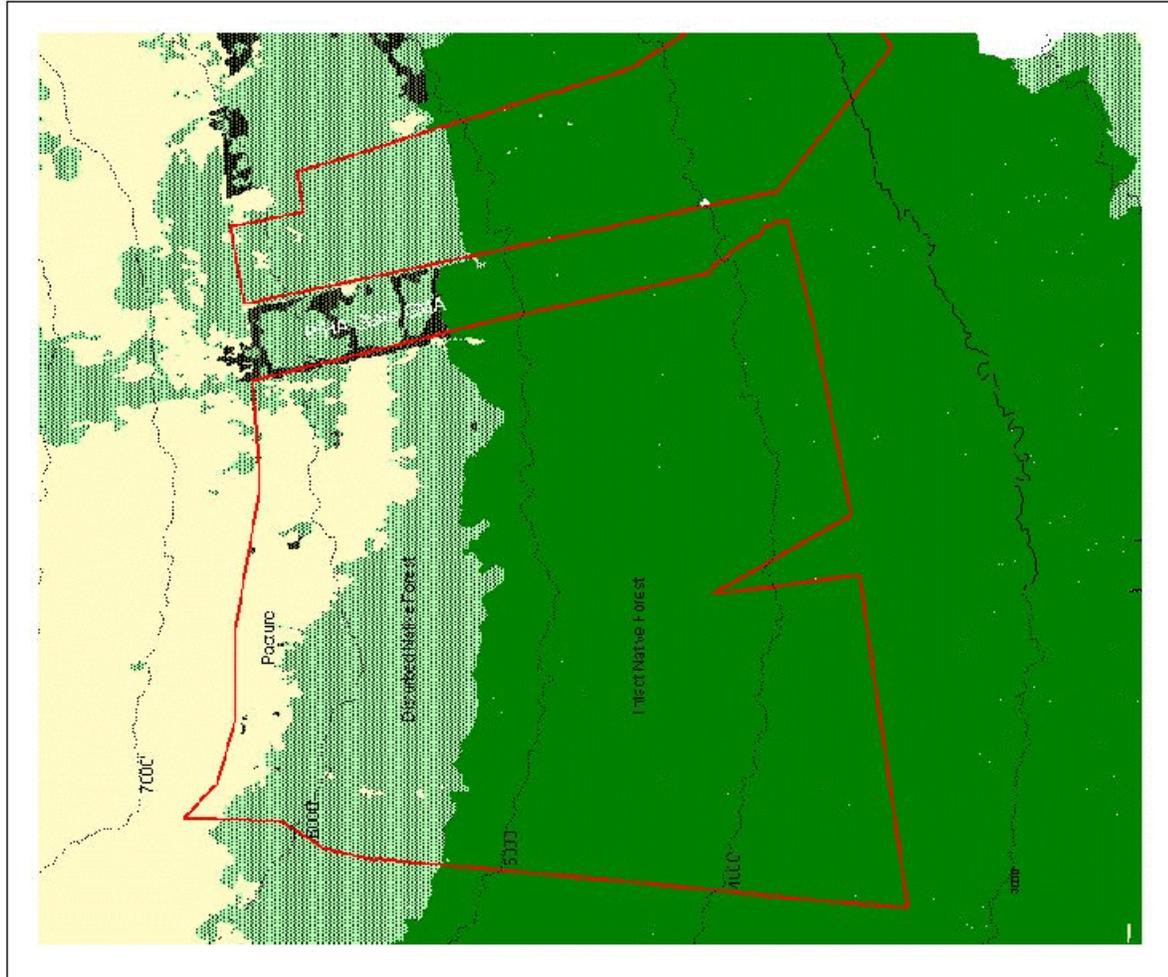


Figure 4: Vegetation Disturbance Zones of the Hakalau Unit

Figure 5. Hakalau Forest NWR Vegetation Disturbance



WILDLAND FIRE MANAGEMENT SITUATION

HISTORIC ROLE OF FIRE

Fire appears to be a relatively infrequent, low intensity disturbance in native Hawaiian ecosystems. It was probably occasionally ignited by lava flows or lightning strikes (Mueller-Dombois and Lamoureux 1967; Mueller-Dombois 1981b; Smith and Tunison 1992). Ecologists have concluded that natural fire has not played a significant ecological or evolutionary role in most native Hawaiian ecosystems. In many cases, the introduced species in these ecosystems are better adapted to fire than native plants. At Hakalau Forest NWR, fire may have been a factor, especially at the drier upper elevations of the Hakalau Unit (J. Jacobi, pers. comm.). While some of the species in this zone are considered to be fire tolerant (*e.g.* mamane, naio, ohelo as well as some of the native bunchgrasses), none require fire in order to regenerate, and they can be killed by intense fire (Smith and Tunison 1992). Although koa are almost always killed by fire, seeds in the soil survive and are stimulated to germinate after fire (Scowcroft and Ward 1976). The tall, ungrazed, non-native grasslands that presently occur at the Unit greatly increase the risk of fire.

The Hakalau Unit lies on the wet windward side of the island, and prevailing winds are from the SSE at approximately 5 miles per hour (mph). These prevailing winds can cause clouds to collect at the higher elevations of the Unit, and it is estimated that the resulting fog drip can add as much as 35% to rainfall amounts. Mean daily humidity ranges from around 70% in the winter to about 85% in the spring and summer. Typically humidity is lowest during the mid-morning and highest during the late afternoon and early evening (USFWS 1991; 1992).

Tomonari-Tuggle cites Hall (1904) describing a fire following a drought in the Hamakua District, which is directly below the Unit. "It burned an area 15 miles long and 2 to 4 miles wide, leaving unburned only occasional patches. Trees, undergrowth, and humus were generally completely destroyed. This forest was a normal one for the islands, consisting of a fairly heavy growth of lehua and koa, with a heavy undergrowth of fern and a deep accumulation of humus. Ordinarily, this forest could not have been burned, but a severe drought prevailing for several months previously had dried it out to the point where it burned with great rapidity.

"There is distinct evidence of a severe fire upward of fifty years ago in the southern part of Hamakua. This fire burned over a tract of large, though unknown extent. It killed practically all the forest and undergrowth, and consumed the humus. Its heat must have been intense, for it baked the soil to such an extent that at the present time it shows as a brick-like layer from 2 to 6 inches thick."

The first wildland fires at the Hakalau Unit since the establishment of the Refuge occurred in 2000. It was a particularly dry year and all four incidents were human caused. Table 2 tracks the events of that year. The Unit responded to three fires that imminently threatened the Unit with fronts reaching the west boundary. Primary fuel was gorse. The Maulua fire occurred in the Unit and scorched 5 acres of mesic habitat. Primary fuel was kikuyu grass (*Pennisetum clandestinum*). Since 2000, no fires have been recorded.

Table 2: Wildland Fire History at the Hakalau Unit.

Name of Fire	Inclusive Dates	Approximate Acreage
Aahuwela	2/24/00 - 2/26/00	1400
Aahuwela II	3/16/00	3
Maulua	7/28/00 - 8/1/00	5
Piihonua	8/16/00 - 8/18/00	200

RESPONSIBILITIES

The Hakalau Unit does not have a dedicated fire management staff. Fire management responsibilities fall under the direction of the **Regional Fire Management Officer**. Locally, this is coordinated through the Refuge **Maintenance Supervisor**. The Complex Manager is responsible for planning and implementing the fire management program on the Refuge. The Regional Fire Management Officer (FMO) located in Portland, OR is responsible for fire management program oversight. The Maintenance Supervisor is assigned fire management responsibilities as a collateral duty. Pre-suppression planning and work is accomplished by Refuge staff in accordance with national and regional fire management direction under guidance from the Regional FMO. Emergency fire management actions will be handled by Refuge staff according to training and incident qualifications. The Regional FMO will be immediately notified of all emergency actions. Additional information and direction is included in the Fire Dispatch Plan (Appendix C). Primary wildland fire management responsibilities are:

Complex Manager

- § Is responsible for implementation of all fire management activities within the Big Island National Wildlife Refuge Complex and will ensure compliance with Department and Service policies.
- § Selects the appropriate management responses to wildland fire.
- § Approves any Prescribed Fire Burn Plan.

Deputy Complex Manger

- § Coordinates Complex programs to ensure personnel and equipment are made available and utilized for fire management activities including fire suppression, presuppression projects, and fire effects monitoring.
- § Ensures that the fire management program has access to Unit and Complex resources when needed.
- § Ensures that Refuge Managers and Complex staff consider the fire management program during refuge related planning and project implementation.
- § Acts as the primary Refuge Resource Management Specialist during fire management planning and operations.

Biologist

- § Coordinates through Deputy Complex Manager to provide biological input for the fire program with the Maintenance Supervisor.
- § Assists in design and implementation of fire-effects monitoring.
- § Participates, as requested, in presuppression projects, fire suppression, and rehabilitation

according to level of training.

Regional Fire Management Officer (FMO)

- \$ Responsible for all fire-related planning and implementation for the Complex.
- \$ Coordinates fire related training.
- \$ Coordinates with cooperators to ensure adequate resources are available for fire operational needs.
- \$ Is responsible for implementation of this Plan.
- \$ Submits budget requests and monitors FIREBASE funds.
- \$ Maintains records for all personnel involved in suppression and presuppression activities, detailing the individual's qualifications and certifications for such activities.
- \$ Updates all fire qualifications for entry into the Fire Management Information System.

Maintenance Supervisor

- \$ Integrates biological Unit objectives into all fire management planning and implementation.
- \$ Solicits program input from the RM, Deputy Manager and Biologist.
- \$ Supervises presuppression project planning.
- \$ Is responsible for preparation of fire reports following the suppression of wildland fires and for presuppression projects requiring such.
- \$ Prepares an annual report detailing fire occurrences and presuppression activities undertaken in each calendar year. This report will serve as a post-year's fire management activities review, as well as provide documentation for development of a comprehensive fire history record for the Complex.
- \$ Nominates personnel to receive fire-related training, as appropriate.
- \$ The Maintenance Supervisor will respond to incidents on the Unit to assist cooperators in the management of incidents on or threatening the Unit.

Incident Commander

Incident Commanders (of any level) use strategies and tactics as directed by the Refuge Manager/ Project Leader and Wildland Fire Situation Analysis (WFSA) where applicable to implement selected objectives on a particular incident. A specific Limited Delegation of Authority (Appendix H) will be provided to each Incident Commander prior to assuming responsibility for an incident. Major duties of the Incident Commander are given in NWCG Fireline Handbook, including:

- \$ Brief subordinates, direct their actions and provide work tools.
- \$ Ensure that safety standards identified in the Fire Orders, the Watch Out Situations, and agency policies are followed at all times.
- \$ Personally scout and communicate with others to be knowledgeable of fire conditions, fire weather, tactical progress, safety concerns and hazards, condition of personnel, and needs for additional resources.
- \$ Order resources to implement the management objectives for the fire.
- \$ Inform appropriate dispatch of current situation and expected needs.
- \$ Coordinate mobilization and demobilization with dispatch and the Collateral FMO.
- \$ Perform administrative duties; *i.e.*, approving work hours, completing fire reports for

command period, maintaining property accountability, providing or obtaining medical treatment, and evaluating performance of subordinates.

§ Assure aviation safety is maintained to the highest standards.

Initial attack teams

Initial attack teams will consist of experienced, fully-qualified firefighters, those on their first fire, and well-qualified leadership. Teams will be prepared and equipped with hand and power tools as needed and will be dispatched with a day's supply of food and water, so they can continue work for 24 hours without additional support.

Current suppression capability on the Unit consist of a 200 gallon slip-on unit and a D-4 dozer. The Unit maintains a ten person cache consisting of hand tools, personal protective equipment, field packs, backpack pumps, 3 chain saws, trash pump, and first aid supplies. Various other equipment, such as 4x4 vehicles and a 400 gal. portable water trailer are located at Hakalau cabin work station.

Hakalau Unit and Kona Forest Unit personnel available for fire management assignments are listed in the Annual Dispatch Plan (See Appendix C). The dispatch plan includes name, position, qualifications and experience of suppression and prescribed fire personnel.

Employees participating in any wildland fire activities on Fish and Wildlife Service or cooperators lands will meet fitness requirements established in PMS 310-1, except where Service-specific fitness requirements apply.

Exceptions to fitness requirements on initial attack activity are available from the Regional Fire Management Coordinator per guidelines in Chapter 1.5 of the Fire Management Handbook (USFWS 2000).

INTERAGENCY OPERATIONS

Cooperative agreements with various federal, state and local agencies generally provide that resources of each agency are available to assist in initial attack efforts. These agreements describe payment among cooperators, list of response areas, communications frequencies, and have been reviewed by a contract specialist and/or solicitor.

The Hakalau Unit will use the Incident Command System (ICS) as a guide for fireline organization. Qualifications for individuals is per DOI Wildland Fire Qualifications and Certification System, part of NIIMS and the National Wildland Fire Coordination Group (NWCG) Prescribed Fire Qualification Guide. Depending on fire complexity, some positions may be filled by the same person.

The **Hawaii County Fire Department** has responsibility for preventing, controlling and extinguishing fires throughout the Island. The nearest Fire Station is located in Hilo, which is almost two hours from the Unit so considerable time is required for their response. They do however have a helicopter capable of responding within minutes to assess the situation and conduct bucket work. A cooperative agreement is in place and is updated every five years (Appendix D).

The **State Division of Forestry and Wildlife** (DOFAW) has responsibility for suppressing fires that

occur on state lands that they manage. The Chief Forester has indicated a willingness to assist fire suppression efforts on the Unit as needed. State assistance is also available under the Mutual Aid Agreement between DOFAW and the Hawaii County Fire Department whereby DOFAW has agreed to assist the Fire Department with suppression and extinguishment of wildland fires occurring throughout the County.

Hawaii Volcanoes National Park (HAVO) has a full-time fire crew responsible for suppression and pre-suppression activities in the 230,000 acre park. They also assist other smaller National Park Units on the Big Island. Recent communications (Minassian 2001) indicate a willingness to respond to emergency suppression activities, and as sister DOI agency requires no Memorandum Of Agreement for them to provide resources. HAVO is located in Volcano, almost three hours away from the Unit by road. A small initial attack crew, ferried by helicopter, could be on-scene in 30 minutes.

Pohakuloa Training Area (PTA) also has a full time fire staff ready to respond to fires on the Unit. Their chief responsibility is to protect structures and endangered species habitat at the military training area. They are located at mile marker 33 on Saddle Road, one hour away from the Unit.

In 2000, all of these agencies as well as the Hawaii County Civil Defense formed the **Big Island Wildfire Coordinating Group (BIWCG)**. The purpose for this group is to coordinate the programs of the participating wildland fire agencies on the Big Island of Hawaii and provide a forum for leadership, cooperation, and the exchange of information. One of the products of this group was the creation of an MOU to acquire assistance during an emergency (Appendix F).

PROTECTION OF SENSITIVE RESOURCES

Heavy equipment use will be limited to protect rainforest habitat. Complex Manager or designee approval is required to use dozers, tractors, or other heavy equipment, except in cases where there are immediate threats to life or property.

Falling trees greater than eight feet tall should not be done to limit damage to endangered species habitat. Complex Manager or designee approval is required to fall trees over eight feet tall except in cases where trees are burning or there are immediate threats to life or property.

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" (RCRC) form (Appendix G) 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 wildland fire 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 the Hakalau Unit. 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, and documentation.

Initial attack actions would be carried out by Hawaii County Fire Department or Refuge staff. Hawaii County personnel are able to respond with slip-ons within 3 hours. Their MD500D helicopter can be on scene in 20 minutes and begin immediate bucket work. Unit engine resources can respond immediately with a qualified engine operator as allowed by Service regulations. However, this applies only to incidents on Service lands. Beyond one burn period, a qualified Engine Boss is required even during mop-up. If a qualified Engine Boss is not available, one may be requested from HAVO. HAVO personnel can respond in thirty minutes by helicopter.

The fire season for the Unit is usually tied to short term dry weather events which can happen at any time of the year. Depending on the specific weather of any particular year the seasons may be shorter or longer, may start earlier or last longer, and there is a possibility that there may be more than one season. The recent acquisition of a remote automated weather station (RAWS), combined with historic weather data will facilitate the implementation of the National Fire Danger Rating System (NFDRS). This will enable the Refuge to identify periods of high fire danger. This will also enable the Refuge to request severity funding. The recent elimination of cattle grazing on the Hakalau Unit has increased fuel loadings of non-native grass species to present a wildland fire situation that has not previously existed. It is a concern that unplanned ignitions in this current grassland situation will cause severe mortality to existing and planted native vegetation. Years of reforestation efforts could be lost from unwanted fire incidents.

FIRE MANAGEMENT STRATEGIES

All unplanned wildland fires will be suppressed in a prompt, safe, and cost-effective manner to produce fast, efficient action with minimum damage to resources using appropriate management strategies.

Although resource impacts of suppression alternatives must always be considered in selecting a fire management strategy, resource benefits will not be the primary consideration. Appropriate suppression action will be taken to ensure firefighter safety, public safety, and protection of the resources.

Critical protection areas such as open grasslands being reforested and Unit facilities will be protected from fire aggressively but safely. In all cases, the primary concern of fire suppression personnel shall be safety, and if needed, all individuals not involved in the suppression effort may be evacuated.

Suppression strategies should be applied so that the equipment and tools used to meet the desired objectives are those that inflict the least impacts upon the natural and cultural resources. Minimum impact suppression tactics (MIST) will be employed to protect all resources. Natural and artificial barriers will be used as much as possible for containment. When necessary, fire line construction will be conducted in such a way as to minimize long-term impacts to resources.

Heavy equipment such as crawlers, tractors, or dozers will not be used within the Unit boundaries unless their use is necessary to prevent a fire from destroying government buildings, historic resources, or planted saplings. The use of heavy equipment requires approval from the Refuge Manager or Delegate in any forested area. Falling trees greater than eight feet tall requires approval from the Project Leader or delegate.

Sites impacted by fire suppression activities or by a fire will be rehabilitated as necessary, based on an approved course of action for each incident.

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 Unit. Preparedness efforts are to be accomplished in the time frames outside the normal fire season dates.

Extended drought conditions monitored by weather readings will be used to implement a step-up plan. Burn indices will be used to warrant the level of preparedness, including shutting down the public access program. Should El Niño conditions set up, drought conditions may require severity or emergency preparedness authorization to hire additional personnel.

Hazard reduction is conducted to prevent wildland fires from spreading onto Unit structures. Grasses are periodically removed either mechanically or chemically around all structures. The grass around the main cabin is mowed regularly. Trees surrounding the Pua Akala cabin were thinned to mitigate any threats. Annual maintenance at all sites is required.

Historical weather analysis

The annual fire weather cycle is not well understood. Data has been gathered for the last 11 years from a weather station located near the Hakalau Cabin, and between 1989 and 1994 at Pau Akala (See Appendix N, Tables 7 and 8). These data are summarized in Table 3 below.

Table 3: Average Annual Rainfall (inches) by Month at Hakalau Cabin and Pau Akala.

	Hakalau Cabin	Pua Akala
Month	1990-2000	1989-1994

January	6.47	12.58
February	7.69	6.89
March	9.83	14.22
April	4.99	7.20
May	3.36	6.17
June	3.74	5.74
July	7.40	15.32
August	6.76	9.17
September	7.66	10.66
October	4.67	6.74
November	12.60	20.28
December	10.50	9.22
Total	85.67	124.19

The climate at the Hakalau Unit is characterized by moderate temperatures and wet conditions with relatively little seasonal variation. There is considerable variation however, depending upon elevation. Mean annual temperatures vary between about 65 degrees Fahrenheit (EF). at the lower elevations and 53EF at the higher elevations. Daily temperatures at the Hakalau Cabin range from highs of 50 - 75EF to lows of 30 - 50EF.

Prevailing winds are from the SSE at about 5 mph. Mean daily relative humidity (RH) ranges from around 70% in the winter to about 85% in the spring and summer. Typically, RH is lowest during the mid morning hours and highest during late afternoon and early evening. Table 4 depicts typical RH values.

Table 4: Mean Monthly Relative Humidity (RH) and Range for 1996, Hakalau Cabin

Month	Mean RH (%)	RH Range (%)
January	39.73	13.67 - 69.83
February	78.26	13.91 - 100
March	86.35	18.14 - 100

April	86.30	15.86 - 100
May	83.67	24.46 - 99.7
June	83.05	21.06 - 98.1
July	81.70	18.59 - 96.6
August	72.80	14.63 - 95.8
September	74.89	15.23 - 95.5
October	58.83	14.62 - 84.7
November	68.65	14.87 - 83.4
December	51.71	12.55 - 80.2

Rainfall shows a significant variation with elevation. Approximately 300 inches of rain falls annually at the lowermost elevations of the Unit. Rainfall decreases to about 90 inches at the upper elevations bordering Keanakolu Road. For a 25 year period between 1906 and 1931, annual rainfall at Pua Akala Ranch (elev. 6300') ranged between 38.8 and 144.4 inches with a mean of 88.2 inches. During the past eleven years at Hakalau Cabin, rainfall ranged between 42.87 and 159.56 inches with a mean of 84.27 inches.

The Pua Akala area receives about 20% more rain than Hakalau Cabin. The slightly lower elevation (about 200') and the fact that it is surrounded by forest instead of open grassland probably account for the difference.

El Niño conditions usually mean drier weather patterns. For the years 1995 through 1999 in which El Niño persisted, average rainfall was 55.57 inches, far below the historical average.

Occasionally, stochastic weather events such as drought or high winds influence growth conditions. The global weather phenomenon El Niño caused drier than normal conditions in Hawaii's weather in 1991 and 1992. Total rainfall for 1991 was only about 70% of the six-year average. This drought caused dry soil conditions which resulted in unusually high planting mortality amongst the 18,000 seedlings planted in 1992 and reduced growth rates in previous years plantings (USFWS 1991; 1992).

The air temperature above bare soil and at the level of the grass groundcover is even colder than indicated by sensors at standard height. On clear winter nights, air temperature has been observed to fall as low as 25EF for several hours (P. Scowcroft, pers. comm.). Frost and soil ice formation are common on such clear nights.

Rainfall from the past eleven years reported from a weather station at Hakalau Cabin has recorded a range of annual rainfall from 43 to 160 in, averaging 85 in. Monthly extremes for rainfall recorded since 1987 are a low of .05 in for February 1998 and a high of 40.84 in for December 1999 (Appendix N).

Fire Prevention

An active fire prevention program may be conducted in conjunction with other agencies to protect human life and property, and prevent damage to biological and cultural resources and facilities. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and

neighbor awareness of fire hazards.

The scarcity of unplanned ignitions at the Hakalau Unit is due primarily to its normally damp condition and its remote location. Few visitors from the public receive access to the Unit. Refuge staff are warned of the possibility of wildland fire from Unit activities under certain weather conditions. Arson fires of short duration have occurred along Keanakolu Road above the Unit on the west side. The road does not cross the Unit, but provides access for hunters and ranchers. These fires seem to be targeted at gorse concentrations. In 2000, there was a flurry of fire activity on or near the Unit. The Unit sustained its first wildland fire and staff responded to three other incidents (Table 2).

During periods of extreme or prolonged fire danger, emergency restrictions regarding Unit operations, or area closures may become necessary. Such restrictions, when imposed, will usually be consistent with those implemented by cooperators. The Refuge staff will recommend when such restrictions are necessary. Closures will be authorized by the Refuge manager.

Structure and Facility Protection

Structures and facilities located on the Hakalau Unit include those at the Hakalau Workstation (Hakalau Cabin; Figure 2). Structures or facilities exist in the Maulua, Lower Honohina, Shipman, and Pua Akala units. Surrounding hazardous fuels will be assessed annually. If needed, maintenance (mowing, weed eating, clearing, grubbing) will be done to mitigate the threat of fire. Fires moving in the direction of any of these structures may trigger emergency structure protection measures such as building a fire break with a dozer, or dousing flammable components with water (up to 80,000 gallons of water is available at the workstation). Other measures include using roads or other natural features for control lines or anchor points, and using burn outs to stabilize and reinforce control lines. Tactics will be determined on a case by case basis, however, under no circumstances will untrained personnel enter an engulfed building.

The University of Hawaii maintains a field station with bunks, commons area, and a lab in the Shipman Unit. It is located adjacent to Hakalau Cabin. It also maintains a field site in the same unit but approximately 2 miles away. These structures would receive the same protective considerations as Unit facilities. In all cases, the safety of personnel comes first.

There is only one private structure within 0.25 mile of the Unit boundary. This ranch house, located near the northwest corner of the Unit, is presently surrounded by heavily grazed pasture which is unlikely to carry a fire.

At the Unit compound, the lawn area around the bunkhouses is mowed monthly and provides an adequate firebreak. In periods of drought (less than 0.5" of rain in the previous 8 weeks), areas around all the structures will be mowed.

Staffing Priority Levels

This output of the National Fire Danger Rating System can assist in readiness decision making. Normally as fire danger increases, incremental preparedness actions are increased along with appropriate staffing. However, the Unit does not have full time fire staff so precautions would be in the area of preparing and positioning equipment. Otherwise, all preparedness actions outlined in section 3.1 of the Fire Management Handbook will guide the commitment of resources. The burn index (BI) is the basis to rank fire danger and reflects the difficulty in controlling a new fire start. Staffing levels 4 and 5 may require severity or emergency preparedness authorization to hire additional personnel. communication with the Regional FMO will be maintained.

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). The Hakalau Unit 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 Maintenance Supervisor in conjunction with the Regional FMO will coordinate fire training needs with those of other refuges and cooperating agencies.

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.

Firefighters will not be given assignments if knowledge and skills are not first obtained. To utilize equipment such as a Type 6 light engine, one must obtain training and experience. An exemption has been granted by the Regional Fire Management Coordinator to allow an Engine Operator to manage an engine during suppression operations on the Unit (Appendix J).

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 to complete arduous duty assignments.

Supplies and Equipment

The Hakalau Unit maintains a small fire cache at the Unit (Appendix M). Current suppression capability on the Unit consists of a 200 gallon slip-on unit and a D-4 dozer. The Unit maintains a ten person cache consisting of hand tools, personal protective equipment, field packs, back pack pumps, 3 chain saws, trash pumps, and first aid supplies. Various other equipment such as 4X4 vehicles and a 400 gallon portable trailer are located at the work station. The small staff is geared for initial attack actions based around a slip-on unit.

Additional equipment and supplies are available through cooperators and the local NPS cache. Options exist to request additional personnel and equipment through the Dispatch Plan which describes various cooperators (Appendix C). The contact list is also found in the Dispatch Plan.

DETECTION

Although 13 miles away from Hilo, the Unit is in clear view of the city. Residents have often reported wildland fires to the Hawaii County Fire Department. Flames and smoke are also visible to aircraft which pass along information to the Federal Aviation Administration (FAA).

The Fire Management Plan does not discriminate between human-caused and lightning caused fire. All

wildland fires will be suppressed. However, detection shall include an estimation of fire cause. Moreover, human-caused fires may require an investigation and report by law enforcement personnel. For serious human-caused fires, including those involving loss of life, a qualified arson investigator will be requested.

COMMUNICATIONS

The Unit maintains a VHF radio system that includes a repeater and handheld radios. All firefighters will remain in radio communication. The slip-on unit and light engine from the Kona Forest Unit also have mobile radios. The Unit does not have a dispatcher to document radio traffic. Dead spots exist throughout the Unit, requiring in most instances the use of the repeater. Crews working in the same vicinity should have no problems using the simplex channel. The Unit utilizes several different makes of radios. Communication is also facilitated by the use of cell phones which can be carried into the field. Frequencies and phone numbers are listed in the Dispatch Plan (Appendix C). Suppression efforts will be coordinated through the use of radios and cell phones.

Crews from HAVO have Unit frequencies already programmed in their radios. Responding crews from the County will be provided FWS radios when on Unit property to facilitate communication. The Refuge does not currently have permission to use County Fire Department tactical frequencies. Any additional resources requested will be provided with an appropriate number of radios. Formal agreements to share frequencies during emergency situations are being created through the Big Island Wildfire Coordinating Group (Appendix F).

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.
2. Provide for public safety.
3. Considering the current and predicted fire conditions, the Incident Commander will assess action at the beginning of each burning period.
4. The Incident Commander will assess the need for law enforcement personnel for traffic control, in
5. Document decisions and complete the fire report (DI-1202).
6. Should a wildland fire move into an extended attack a Delegation of Authority will be invoked. C

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.

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. The Hakalau Unit will be managed as one unit. Although there are four distinct vegetation communities, the overall objective is to reforest the area with native vegetation. Native Hawaiian rainforest vegetation did not evolve with fire and is adversely affected by it. Maintenance of existing rainforest or recovering degraded rainforest units does not require fire. For this reason, suppression of all unplanned ignitions with control at minimum acreage will be employed over the entire Hakalau Unit as a whole.

Endangered, Threatened, or Sensitive Species

The Hakalau Unit is managed primarily for five endangered forest bird species - Akiapolaau (*Hemignathus munroi*), Hawaii akepa (*Loxops c. coccineus*), Hawaii creeper (*Oreomystis mana*), Hawaiian hawk (*Buteo solitarius*) and O'u' (*Psittirostra psittacea*) - along with their rainforest habitat. The endangered Hawaiian Duck (*Anas wyvilliana*) occasionally occupies small stock ponds scattered throughout the abandoned pastures. Recently, several small flocks of Nene or Hawaiian goose (*Branta sandvicensis*) were re-introduced at the Unit and occupy upper elevation abandoned pastures. The endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) roosts and feeds within the forested area. All of these species are found on the Unit throughout the year. Six plants listed as endangered, *Clermontia lindseyana*, *Clermontia pyrularia*, *Cyanea shipmanii*, *Phyllostegia racemosa*, *Phyllostegia velutina* and *Cyrtandra tintinnabula*, are found in the same general area where blackberry occurs. One other listed plant, *Clermontia peleana* is found at elevations well below that of any herbicide use. A complete list of Federally threatened and endangered species can be found in Appendix L.

Fuel Types

It is difficult to classify Hawaiian vegetation into fuel models. Some such as grasses easily fit into existing models (Anderson 1982), while most others are very unique and not well understood. Fuel Models 1 through 3 (Anderson, 1982) are represented and accurately depict this fuel type in Hawaii. Fuel Model 4 best fits the gorse population on and off the Unit. This fuel type burns with extreme intensity. A 12' patch of gorse can produce flames that approach 60' in length. Under extreme conditions, the typical rainforest components would be represented by Fuel Models 10 and 11.

Fire Behavior

The lack of fire activity on the Unit makes it difficult to describe normal and extreme fire years. Fire behavior under drought conditions is expected to range from a fast running fire with 6-10 foot flame lengths in open grassland to a slow smouldering creeping fire in the intact rainforest. It will vary upon recent weather events and current conditions. Fire behavior in gorse is not well documented, but it is highly flammable with estimated 40-60 foot flame lengths.

SUPPRESSION TACTICS

Wildland fires will be suppressed in a prompt, safe, 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 fires effectively and safely. To this end, the Regional 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 Regional 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 H).

Since the objectives of fire management at the Hakalau Unit are related to protection of life and property through suppression while protecting resources, an appropriate strategy will be utilized for each incident.

Suppression Conditions

A number of actions are taken after a fire is reported including calling appropriate Refuge staff and the County Fire Department dispatch to request initial attack forces. The Regional FMO is informed and updated regularly. Additional resources will be requested from Hawaii Volcanoes National Park. However, during periods of high to extreme fire danger, they may or may not respond, especially if they

have crews fighting fires in the park or elsewhere. Any initial attack personnel not meeting NWCG standards will be relieved after qualified resources arrive on scene. The County helicopter which will be carded by Office of Aircraft Services (OAS), however, can be requested to continue aerial operations. Depending on the size of the fire, additional OAS aircraft may be ordered.

As Refuge staff gather equipment and supplies, the Incident Commander will size up the fire using personal observations as well as reports from other personnel. Additional resources are identified and ordered in accordance with the dispatch plan (Appendix C).

Full suppression actions apply to this Unit, which requires aggressive containment and control of all wildland fires. Certain guidelines have been developed to assist with this strategy to protect the Unit from unnecessary damage. Heavy equipment and falling trees is restricted due to cultural, wildlife, and safety concerns. Unless life or property is in imminent danger, consultation with the Refuge Manager or their designee prior to their use is necessary. This decision is based on the fact that the rainforest habitat is home to eight endangered birds, an endangered hoary bat, and six endangered plants and on the cultural significance found in the potential historic sites and archeological features. Issues of restrictions should be discussed with cooperators. Changes and areas of concerns should be documented.

Aircraft should avoid rainforest habitat as much as possible, especially during breeding season which runs from December through May. Flights over the forest should be 500' above ground level if not actively suppressing a fire. Chainsaws are allowed without approval to fall trees less than eight feet tall or trees that are burning. Dozers require Complex Manager or designee approval except when life and/or property are threatened. Dozers will be restricted to the open pasture habitat. Attempts should be made to stay on old dozer lines.

Wildland Fire Situation Analysis (WFSA)

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, will prepare the WFSA. A sample WFSA can be found in Appendix K. Approval of the WFSA resides with the Refuge Project Leader. 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 OAS or Forest Service approved. The Dispatch Plan (Appendix C) contains a list of current OAS vendors. Efforts are being made to certify the County of Hawaii helicopter for use by Refuge personnel. 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

There are two types of fire rehabilitation, suppression and burned area. Suppression rehabilitation restores and repairs property and resources from direct suppression activity damage, *i.e.* cut fences, dozer lines, and campsites. Burned area rehabilitation and stabilization restores resources and property damaged or otherwise impacted from a fire, *i.e.* burned waterlines, denuded hillsides, etc.

In the event of a wildland fire, rehabilitation of fire suppression damage should be accomplished immediately. An appropriate time is within 7 days after a fire is controlled unless the Regional Fire Coordinator grants an extension. Funding for suppression rehabilitation is from the specific fire cost account as established by the FMO. The Incident Commander as agreed to by the Project Leader or Refuge Manager will initiate suppression rehabilitation. Rehabilitation will be directed toward minimizing or eliminating the effects of suppression efforts and reducing the potential hazards caused by a fire. These actions may include:

- § Backfill control lines, scarify, and seed*.
- § Install water bars and construct drain dips on control lines to prevent erosion.
- § Restore natural ground contours that were altered.
- § Remove all flagging, equipment and litter.
- § Completely restore camping areas and improved helispots.
- § Revegetation to restore sensitive impacted areas due to suppression actions*.

*If revegetation or seeding is necessary, only locally procured seeds of native plant species will be used.

A written suppression rehabilitation plan may be appropriate on larger incidents. Contractors or equipment may be hired to accomplish specialized work.

If Burned Area Emergency Stabilization and Rehabilitation (BAER) is required to reduce the effects of a wildland fire, then the Refuge should request appropriate funding through the BAER fund. The Service representative at the National Interagency Fire Center administers the BAER fund. A rehabilitation and restoration survey, plan, and request must be prepared and submitted according to agency guidelines. Smaller incidents may only need simple plans prepared by Refuge staff. Larger incidents with extensive rehabilitation efforts should employ a BAER Team. A BAER Team is composed of personnel who specialize in key disciplines of resource management and are experts in BAER Plan preparation. A formal request for a BAER Team should be made in consultation with the Incident Management Team as soon as it appears damage may be significant. Instructions for BAER Team mobilization can be found in the National Wildfire Coordinating Group mobilization guide. Delays in making a request may hinder funding approval and magnify the damage. Once a BAER Team is employed, the Project Leader or a representative should provide guidance to the BAER team leader with expectations. The Project Leader, Biologist, and FMO will review all BAER Plans. The final plan will be submitted to the Region for review prior to submission to the Washington Office. Direction on BAER guidelines can be found in the Service Fire Management Handbook section 5.1.

REQUIRED REPORTING

The IC will be responsible for documenting decisions and completing the fire report (e.g., Ics-214, DI-1202). The FMO 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. All fire investigations should follow the guidelines outlined in 4.1-2 of the Fire Management Handbook (2000). A fire investigator can be ordered through HAVO.

HAZARD FUEL REDUCTION

Hazard fuel is that vegetation which presents a risk of ignition and sustaining spread of a wildland fire in relationship to a threat to some value. Hazard fuel reduction is both a fire prevention activity and a wildland fire protection measure. The objectives of this activity are:

- § Reduce the hazard risk to service structures and facilities from an approaching wildland fire.
- § Reduce the risk of fire spreading to the wildland from a fire originating in a Service owned structure or facility.
- § Provide defensible space and safety to personnel at those facilities during a wildland fire.
- § Meet federal, state and local fire hazard reduction ordinances.

Hazard Fuel Reduction Strategies

Strategies include mechanical treatment of hazard fuels and debris disposal. Mechanical treatment is accomplished by hand cutting and mowing. Structures containing flammable liquids (propane, gasoline, or oil) require vegetation be removed to bare soil at a radius of 50 feet.

Debris must be disposed of to complete hazard fuels mitigation. Debris disposal may be accomplished by scattering, chipping or pile burning. The quantity of vegetation, diameter size, crew availability, and logistical support will dictate the method used. If scattering of cut vegetation is used, an evaluation of the overall fuel loading needs to be considered so as to not add to the hazard fuel problem.

Pile Burning Guidelines

When planning to dispose of debris by pile burning, specific guidelines must be followed in order to provide for safety and reduce the escape potential. General guidelines for pile burning are the same as for prescribed burning. Service guidelines are found in the FWS Fire Management Handbook, Section 2. This section of the Hakalau Unit Fire Management Plan is for the purpose of outlining the steps to take when conducting pile burning only. No prescribed burning of standing vegetation will be conducted. References to a burn plan and burn boss are only for the purpose of pile burning.

Pile burning will be used to dispose of cut vegetation resulting from Unit activities such as annual hazard reduction around structures. Gorse piles created as a result of scraping with a dozer may be burned to remove it and destroy the seed bed. At times trees may fall which will require debris removal. The most economical and expedient method is through burning of the piled vegetation on site. Pile burning is typically rated as complexity level 3 due to the low risk of escape, limited control forces, and time of year conducted. Safety concerns are still present even at the low complexity level. Careful consideration must

be given to smoke management, escape potential and resource benefit when planning and rating a pile burn. The complexity of each pile burn will be evaluated using the NWCG Prescribed Fire Complexity Rating System Guide.

Pile Burn Plan

The Burn Boss will conduct a field reconnaissance of the proposed pile burn location with the Refuge Manager to discuss objectives, special concerns, and gather all necessary information to write the burn plan. After completing the reconnaissance, the Burn Boss will write the Pile Burn Plan.

All pile burning will have a Pile Burn Plan. The Pile 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 project area, objectives, and constraints will be clearly outlined. No piles will be ignited unless all prescriptions of the plan are met. Fires not within those parameters will be suppressed. Pile Burn Plans will follow the format found in the FWS Fire Management Handbook, Section 2.2. Pile burning is considered a complexity level 3 burn and should use the plan format contained in Appendix I. Each burn plan will be reviewed by the Complex Manager, Maintenance Supervisor, FMO, and Burn Boss. The Complex Manager has the authority to approve the burn plan.

Pile Burning Strategies and Personnel

Pile burning will only be executed by qualified personnel. Pile burning requires, at a minimum, a Type III Burn Boss. The 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 pile burn or it will not be initiated.

Weather and fuel moisture conditions must be monitored closely in the project area to determine when the prescription criteria are met or exceeded. A belt weather kit may also be utilized to augment monitoring.

The Pile Burn Plan requires the following items to be completed prior to ignition:

- \$ contingency plan
- \$ complexity analysis
- \$ review and approval signatures
- \$ go/no go checklist
- \$ weather forecast

When pertinent prescription criteria are within the acceptable range, the Burn Boss will select an ignition date based on current and predicted weather forecasts. A thorough briefing will be given by the Burn Boss on the day of the burn 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 re-checked to determine if they 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 burn pile 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 FMO 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 the burn plan. A WFSA 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 based on the contingency plan 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 if necessary. Each Pile Burn Plan will detail the contingency plan with identified resources for suppression. This plan will serve as the incident action plan during the initial attack phase of an escape.

Monitoring and Evaluation

During pile burns, monitoring can serve as a precursor to invoking suppression action by determining if the burn is in prescription, assessing its overall potential, and determining the effects of the pile burn. Pile burning does not usually require extensive monitoring. Weather, fire behavior, and smoke management are elements that require monitoring. The Burn Boss will assume responsibility for coordinating and implementing this section. Personnel may be assigned specific tasks such as weather monitoring to document these elements and keep the Burn Boss informed of conditions. Special situations or projects may dictate more extensive monitoring and evaluation.

Required Reports

All forms will be completed as outlined by the Pile Burn Plan. Accomplishments, costs, fire report (DI-1202), weather data, and first order fire effects monitoring are the responsibility of the Burn Boss. The Burn Boss may prepare a final report on the project for the Refuge Manager as requested. Information should include a narrative of the burn operation, a determination of whether objectives were met, weather and fire behavior data, number of work hours, and final cost of the burn.

AIR QUALITY / SMOKE MANAGEMENT GUIDELINES

The Hakalau Unit is in a rather remote location with the closest urban community approximately 14 miles southeast of the Unit. Approximately 10 miles in a westerly direction are several observatories. These locations may be impacted by smoke for a short period of time, but smoke is dispersed quickly through the action of the normal trade winds.

FIRE RESEARCH

Soon after the Maulua fire in 2000, plots were set up to monitor recovery. No data have been collected yet. The Unit may participate in joint research projects outside the Unit to better understand local fuels and fire effects. At the moment, all research related activities are funded through base operations.

PUBLIC SAFETY

The Hakalau Unit is dedicated to ensuring the safety of each visitor and to all residents and property adjacent to the its boundary. However, firefighter and public safety take precedence over property and resource protection during any fire management activity. For public safety, the fire scene will remain clear of unauthorized people. The responsibility for managing public safety lies with the Incident Commander.

The slip-on unit, the Type 6 light engine, and other Unit vehicles responding to a fire have first aid kits of varying size. Also available are burn kits. If medical emergencies arise, an evacuation plan will be implemented utilizing the services of the Hawaii County Fire/Rescue unit. Under most scenarios, the Fire Department will be kept apprised of all wildland fire.

PUBLIC INFORMATION AND EDUCATION

Educating the public of the importance of fire as an uncommon process in Hawaiian ecosystems is important to increasing public understanding and support for the fire management program. Although fire was occasionally started by lightning or lava (natural ignition sources), it was very uncommon and did not play an evolutionary role in the ecosystem, and sometimes was probably even detrimental. The Unit will use the most appropriate and effective means to explain the overall fire and smoke management program. The Big Island Wildfire Coordinating Group will be instrumental in educating the public of fire effects on native ecosystems as well as wildland/urban interface issues. Other agencies such as the state Division of Forestry and Wildlife are very proactive on fire prevention. 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. 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.
2. News releases will be distributed to the media as appropriate.
3. The public information outlets of neighboring and cooperating agencies and the regional office will be provided with all fire management information.
4. 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 Regional FMO and Maintenance Supervisor will retain a copy for the Unit files.

ANNUAL FIRE SUMMARY REPORT

The Maintenance Supervisor 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. The Fire Management Plan will also be updated as major policy changes and land acquisitions are made. Minor changes such as phone number corrections and personnel changes, can be made at the refuge level and attached to the plan during this yearly review process without involvement of the regional office.

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.

James P. Glynn, Deputy Complex Manager, Big Island NWRC, Hilo, HI.

John Jeffrey, Supervisory Biologist, Big Island NWRC, Hilo, HI

Donna Ball, Biologist, Big Island NWRC, Hilo, HI.

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

Jack Minassian, Fire Management Officer, Hawaii Volcanoes National Park, HI.

James Roberts, Fire Planner, Pacific Region, USFWS, Portland, OR.

Linda Watters, Assistant Refuge Supervisor, Pacific Region, USFWS, Portland, OR.

APPENDICES

APPENDIX A. REFERENCES

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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 - 3 acre or less.

Class B - more than 3 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. DISPATCH PLAN

Big Island National Wildlife Refuge Complex

HAKALAU FOREST NATIONAL WILDLIFE REFUGE

When a report of smoke or fire on the Refuge is received, get as much information from the caller or messenger as possible:

Location of smoke or fire?

Location of caller?

Name and telephone number or contact point of the caller or messenger?

Color of smoke?

Size of fire?

Type of fuel (What is burning)?

Character of the fire (Active, smoldering, etc.)?

Is anyone fighting the fire? How many personnel? Equipment?

Did they see anyone in the vicinity or vehicles leaving the area?

Is the fire site accessible by a slip-on unit?

What are the weather conditions at the fire?

1. Notify Refuge Fire Management Officer Andy Kikuta at the Refuge Office in Hilo (808-933-6915) or at the Refuge cabin (808-895-2055), or at his residence (808-959-2656 unl). **Assignments will be made at this time to notify other personnel and agencies.**
2. Notify Refuge Manager Richard Wass at the Refuge office in Hilo (808-933-6915) or at his residence (808-935-7027).
3. Notify other Refuge personnel at the Refuge Office (808-933-6915) or at their residence:

Jim Glynn, Deputy Refuge Manager 808-959-0196 unl

Jack Jeffrey, Wildlife Biologist 808-964-3535

Wayne Ortiz, Maintenance Worker Leader 808-964-5639

Steven Heusser, Maintenance Worker 808-885-8907, 808-869-2275 cellular

Mick Castillo, ES Biologist 808-938-2766
Lynne Hanzawa, Admin. Support Asst. 808-964-5821 unl

4. Notify personnel on the refuge via telephone or radio:
Cabin Phone Number: 808-895-2055
Portable radio frequency: 164.625 MHz (Channel 2 on Hakalau radios)
5. Notify personnel at the University of Hawaii Field Station, 808-987-8665.
6. The Maintenance Supervisor will notify personnel at Kona Forest NWR (808-328-7366) including the Refuge Manager (David Ledig, res 808-331-1879, cell 808-960-0312).
7. Notify the Regional FMO Andy Anderson (503) 231-6175 bus, (360)666-5031 res, (503)805-1312 cell.
8. If needed, contact Pohakuloa Training Area Fire Department (808-969-2441) for assistance. Recent communication with Zurn (September 2000) indicates a willingness to respond with a Type 6 light engine crew.
9. If needed, the Maintenance Supervisor or Refuge Manager will request assistance from Hawaii Volcanoes National Park (HAVO), Jack Minassian, FMO: 985-6042 bus, 967-8368 res, or the Hawaii County Fire Department (911). This determination will be made by the Maintenance Supervisor based on information given by the caller. The National Park is a sister DOI agency and as such will lend assistance during emergencies. Recent communication with Minassian (March 2000) confirms this willingness to respond.
10. The Maintenance Supervisor will call the Fire Department (961-8336 dispatch) to inform them of the situation and status, to determine if assistance is required.
11. If the fire is located in the upper portion of the Unit and, therefore, accessible by vehicle, the Maintenance Supervisor will dispatch qualified Refuge staff to mount an initial attack using the equipment stored in the fire cache at the Hakalau garage. Only current red-carded fire fighters may be on the fire line. Non-carded staff may be utilized in support functions. The Maintenance Supervisor, Refuge Manager, or Deputy Refuge Manager will make these determinations.
12. Initial attack operations may utilize other non-Department agencies such as the County Fire Department, State Division of Forestry and Wildlife for one burn period only.
13. If the fire is located in an inaccessible portion of the Unit, the Maintenance Supervisor will charter an OAS certified helicopter and in the company of the Refuge Manager, Deputy Refuge Manager, HAVO FMO (808-985-6042) or a representative of the County Fire Department (808-961-8336) will conduct a reconnaissance. These helicopters and pilots are also certified to conduct water bucket drops on the fire.

OAS Carded helicopters (as of October 2001):

Volcano Helicopters	(808)967-7578 bus	David Okita
	(808)935-4588 hangar	

(808)925-3333 pager
 (808)959-2674 res (unl)

Safari Aviation	(808)246-0670	Paul Darryl Daniel Malavenda Joseph Rice
Blue Hawaiian Helicopters	(808)871-6971	Jeffrey Anderson Ralph Dwyer Michael Montgomery
Tropical Helicopters	(808)325-5943	Calvin Dorn
Windward Aviation, Maui	(808)877-3368 bus (808)572-3639 res	Don Shearer Richard Baldwin Steven Madewell Torbjorn Corell
Cherry Helicopters, Inc.	(808)293-2570	Joseph Allen Gregory Mattson
Pacific Helicopter Tours	(808)871-9771	Uli Bergmann Howard Esterbrook Gary Freeman
Inter-Island Helicopters, Kauai	(808)335-5009 bus	Ken D'Attilio Edward Wagner Perry Kriniti

13. Current suppression capability on the Unit consists of a 200 gallon slip-on unit and a D-4 dozer. The Refuge maintains a ten person cache in the garage consisting of hand tools, personal protective equipment, field packs, fedcos, chain saws, trash pumps, hoses, Class A foam, and first aid supplies. Various other equipment, such as 4x4 vehicles, 1000 gallon folding tank and a 400 gallon portable water trailer are located at the Hakalau Cabin work station. The Kona Forest Unit resources include a 300 gallon Type 6 light engine that can respond in 4 hours.

14. Portable cellular phones may be used on the fire to coordinate with other agencies.
 Cell phone #1 (808) 938-6404
 Cell phone #2 (808) 895-3226

Fire Management Team

Name	Position	Qualifications	Experience	Red Card	Date of Last Pack Test
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Hakalau Forest NWR:

Dick Wass	Refuge Manager	S130,190,390	Rx	Yes	9/6/00
Jim Glynn	Deputy Refuge Manager	S110,130,190,390, Fire Ecology, I220	Rx, Wildfire	No(Field)	9/6/00
Jack Jeffrey	Biologist	S130,190	Rx	Yes	9/6/00
Donna Ball	Biologist	S130,190	Rx	No	
Baron Horiuchi	Horticulturist	S130,190		No	
Andy Kikuta	Maintenance Supervisor	S130,190,390,211, S212,336,PFPI, RxB3	Rx, Wildfire	Yes	9/6/00
Wayne Ortiz	Maintenance Worker(Leader)	S130,131,190	Rx, Wildfire	Yes	9/6/00
Steven Heusser	Maintenance Worker	S130,190	Wildfire	Yes	9/6/00
Mick Castillo	ES Biologist	S130,190		Yes	2/10/01

Kona Forest NWR:

David Ledig	Refuge Manager	S130, 190,110	Rx, Wildfire	Yes	9/6/00
Jeff Burgett	Biologist	S130,190		Yes	2/24/00
John Klavitter	Biologist	S130,190		Yes	9/6/00

15. Other personnel to be involved if necessary:

Jerry Leinecke, Field Supervisor, Hawaii/Pacific Islands
 NWR Complex Office: (808) 541-1201 Residence: (808) 395-6227
 Jon Giffin, State Division of Forestry & Wildlife: (808) 974-4221

Roger Erb, FWS, Chief of Fire Management, National Interagency Fire Center (NIFC), 3833 Vista Ave.

Logistics Support, NIFC, Boise: (208) 389-2400

Interagency Coordination Center, South Zone, Riverside, CA: (714) 276-6721

Alfred Nobriga, Alfred Nobriga Ranch: (808) 885-6342 (Waimea), (808) 327-8502 (Maulua) or
 (808) 937-3371 (mobile cellular), (808) 934-8075 (Hilo), (808) 964-3077 wait for dial tone then
 02121 (Ranch house)

Robbie Hind, Manager, Parker Ranch: (808) 885-7311

Paul Ducasse, Chief Ranger, Hawaii Volcanoes National Park: (808) 985-6003

Tim Tunison, Chief Resources Management, Hawaii Volcanoes National Park: (808) 985-6085
 Fire Cache, Hawaii Volcanoes National Park: (808) 985-6044

Jim DuPont, Hawaii Island Manager, State Division of Hawaiian Homelands: (808) 885-7091

Donna Stovall, Refuge Manager, Oahu Refuges: (808) 637-6330, (808) 625-8685 res.

George Fisher, Dozer Operator, Oahu Refuges: (808) 637-6330, (808) 637-6422 res.

Ken Zurn, Fire Chief, Pohakuloa Training Area: (808) 969-2441, (808) 961-9190 res.

Warren Hahlbeck, Fire Fighter, Pohakuloa Training Area: (808) 969-2441

Kaumana Fire Station, Capt. George Van Gieson: (808) 961-8675, (808) 968-6638 (res)

Pam Ensley, Regional Fire Management Coordinator: (503) 231-6175 (bus), (360) 835-7004 (res), (503) 781-7978 (cell)

Roddy Baumann, Regional Prescribed Fire Specialist: (503) 231-2075 (bus), (360) 573-9444(res), (503) 784-8348(cell)

APPENDIX D: FIRE AGREEMENTS

COOPERATIVE AGREEMENT

Between the

HAKALAU FOREST NATIONAL WILDLIFE REFUGE

US FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR

and the

HAWAII COUNTY FIRE DEPARTMENT

THIS COOPERATIVE AGREEMENT is made and entered into between the U.S. Fish and Wildlife Service, an executive agency of the United States Department of the Interior, hereinafter referred to as the "Service" and the Hawaii County Fire Department hereinafter referred to as the "Cooperator", pursuant to 31 USC 6305, Using Cooperative Agreements.

The Fish and Wildlife Service enters this Cooperative Agreement in accordance with the Fire Protection Act of September 20, 1922 pursuant to 42 Stat. 857 and 16 USC 594 and in accordance with the Reciprocal Fire Protection Act of May 27, 1955 pursuant to 69 Stat. 66, 67 and 42 USC 1856, 1856a, and b. The Cooperator enters this Agreement pursuant to the authority provided by the regulations governing the Hawaii County Fire Department.

PURPOSE AND OBJECTIVES

The Cooperative Agreement is made for the purpose and objective of providing funds for supporting firefighting services provided by the Hawaii County Fire Department on lands within the boundaries of Hakalau Forest National Wildlife Refuge and to provide a public benefit through U.S. Fish and Wildlife Service support and assistance.

RECITALS

WHEREAS, the U.S. Fish and Wildlife Service is an agency of the Federal Government primarily responsible for the welfare and protection of lands and wildlife within the boundaries of the Hakalau Forest National Wildlife Refuge and:

WHEREAS, it is the desire of the Service to provide maximum protection to the Refuge, its lands, wildlife, personnel and facilities from fire and:

WHEREAS, it is the desire of the Cooperator to provide protection for its lands, citizens and buildings within Hawaii County from fire and:

WHEREAS, the objective, as stated in 6 RM 7.3 of the "Refuge Manual" on fire management is "...to protect and enhance habitat for fish and wildlife production and diversity and to protect and enhance natural ecosystems on these (refuge) lands."

DEFINITIONS

1. Refuge Lands: Lands administered and/or protected by the Hakalau Forest National Wildlife Refuge/U.S. Fish and Wildlife Service; these lands constitute the Refuge's jurisdictional area.
2. Fire District: Lands protected by the Hawaii County Fire Department; these lands constitute the Cooperator's jurisdictional area.
3. Wildland Fire: An unplanned ignition that requires suppression action.
4. Boundary Fire: A fire burning astride a boundary between lands protected by two or more agencies or, due to conditions on the ground in the fire area, believed to be burning astride a boundary.
5. Protecting Agency: The party with responsibility for suppression of wildland fires within their jurisdictional area.
6. Supporting Agency: The party without responsibility for suppression of wildland fires on a particular property that is furnishing support and assistance to the protecting agency.

AGREEMENT

IT IS HEREBY AGREED as follows:

I. COOPERATIVE PROJECT

The cooperative project to be accomplished under this Agreement is the suppression of wildland fires on Service lands, *i.e.* Hakalau Forest National Wildlife Refuge.

II. TERM OF AGREEMENT

This Agreement shall become effective upon being executed by both parties and shall continue in effect until September 30, 1997. It shall be considered as automatically extended for one (1) year each October 1 thereafter, until September 30, 2002. Rates will be negotiated and signed by amendment 60 days prior to fiscal year end for the following fiscal year.

III. TRANSFER OF FUNDS

Payments will be made by Treasury check upon receipt of the products described in Attachment A, and a

properly executed invoice based on actual expenses for fire suppression, control and mop-up. Submittal of the work products and billings should be made to the following address:

U.S. Fish and Wildlife Service
Hakalau Forest National Wildlife Refuge
32 Kinoole Street Suite 101
Hilo, HI 96720

IV. MUTUAL COOPERATION

Each party agrees to cooperate with the other to accomplish the purpose and objectives of the Cooperative Agreement, and in fulfilling its obligations as herein provided.

V. SPECIFIC OBLIGATION OF THE PARTIES

A. Service's Obligation

The Service shall furnish the Cooperator with the following assistance to accomplish the cooperative project:

1. Provide available staff and equipment to suppress fires on Service lands at the request of the Cooperator Fire Chief or his designee.
2. Delegate command authority to the Cooperator Fire Chief or his designee during wildfire suppression activities by the Cooperator on Service lands.
3. Provide advice to the Cooperator Fire Chief relative to best access routes to the fire, location of roads and natural features that might serve as fire breaks, location of water sources on or near the Refuge, fuel types on the Refuge, areas with particular resource value and deserving of special protection, etc.
1. Reimburse the Cooperator and assist State agencies for firefighting services at the rates set forth in Attachment A.

B. Cooperator's Obligation

The Cooperator shall furnish the following to accomplish the cooperative project:

1. Respond immediately upon notification by any individual or agency of a wildland fire on Service lands.
2. Provide, as available, the manpower, equipment and expertise for suppression of wildland fires on Service lands under the direction of the Cooperator Fire Chief and in cooperation with the Refuge Manager.
3. Request suppression assistance from state and federal agencies for large fires on Service lands if the Cooperator is unable to provide sufficient manpower and equipment to extinguish the fire.

1. At the first indication of a wildland fire (or other emergency) on Service lands, provide immediate notification to the Refuge Manager at the telephone number listed below.

VI. PROJECT OFFICERS

The Service's Project Officer shall be:

Richard C. Wass, Refuge Manager
Hakalau Forest National Wildlife Refuge
32 Kinoole Street Suite 101
Hilo, HI 96720
Telephone: 933-6915 (office) 935-7027 (home)

The Cooperator's Project Officer shall be:

Lloyd Narimatsu, Battalion Chief
Hawaii County Fire Department
466 Kinoole Street
Hilo, HI 96720
Telephone: 961-8373

VII. SPECIAL TERMS AND CONDITIONS

1. This agreement shall not affect the rights of any party to recover suppression costs and/or damages sustained as a result of the negligent or willful act of any person causing a fire.
2. No party shall be liable to any other for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement, except as provided herein.
3. The parties may work jointly on fire trespass investigations and fire law enforcement. Reports thereof may be prepared independently and separately.
4. Copies of fire reports shall be mutually provided to the other agency(ies) involved in the fire suppression as soon as possible following the fire action.
5. The Service will reimburse the Cooperator for actual suppression costs, at the rates specified per Attachment A.

VIII. TERMINATION

This Agreement may be terminated by either party giving the other at least 30 days written notice in advance. Termination shall not relieve either party of obligations left outstanding under the terms of this agreement.

IX. GENERAL PROVISIONS

Office of Management and Budget (OMB) Circulars applicable to State, Local and Tribal Governments, A-102 (Admin), A-87 (Costs) and A-128 (Audits) are hereby incorporated by reference. Copies are

available upon request.

X. AMENDMENTS

Amendments to the Agreement may be proposed by either party and shall become effective upon being reduced to a written instrument executed by both parties.

IN WITNESS WHEREOF, each party hereto has caused this Cooperative Agreement to be executed by an authorized official on the day and year set forth opposite their signature.

U.S. FISH AND WILDLIFE SERVICE

By: _____ Date: _____
Contracting Officer
U.S. Fish and Wildlife Service
Eastside Federal Complex
911 NE 11th Avenue
Portland, Oregon 97232-4181

By: _____ Date: _____
Assistant Regional Director-Refuges
U.S. Fish and Wildlife Service
Eastside Federal Complex
911 NE 11th Avenue
Portland, Oregon 97232-4181

COOPERATOR

By: _____ Date: _____
Mayor, County of Hawaii
25 Aupuni St.
Hilo, Hawaii

Recommend Approval:

Chief, Hawaii County Fire Department

Date: _____

Approved as to Form and Legality:

Deputy Corporation Counsel

Date: _____

SCHEDULE OF SUPPRESSION REIMBURSEMENT

The U.S. Fish and Wildlife Service will reimburse the Hawaii County Fire Department for services as listed below paid in half hour increments calculated from the time the suppression unit leaves the Station until it arrives back at the Station.

A fire suppression unit is any truck with water carrying and pumping capability which is attended by a crew of at least two operators/firefighters.

- A. False alarms and fires suppressed prior to arrival: \$90.00 per unit per hour.
- A. Actual suppression activities: \$150.00 per unit per hour.
- A. Mop-up, overhaul, fire watch and other specifically authorized post suppression activities: \$120.00 per unit per hour.
- A. Helicopter support to include reconnaissance, staff transport, and bucket drops: \$650/hr.

APPENDIX E: ENVIRONMENTAL ACTION STATEMENT

**Department of the Interior
U.S. Fish and Wildlife Service**

ENVIRONMENTAL ACTION STATEMENT

CATEGORICAL EXCLUSION FOR THE WILDLAND FIRE MANAGEMENT PLAN for HAKALAU FOREST NATIONAL WILDLIFE REFUGE of the BIG ISLAND NATIONAL WILDLIFE REFUGE COMPLEX

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and have determined that the following proposed action is categorically excluded from NEPA documentation requirements (e.g., preparation of an EA or EIS) consistent with guidance provided in 516 DM 2, Appendix 1 and 516 DM 6, Appendix 1.4.

Proposed Action

The proposed action is to implement the Wildland Fire Management Plan for Hakalau Forest NWR of the Big Island National Wildlife Refuge Complex. Hakalau Forest Unit was established for the purpose of protecting and restoring endangered forest bird populations and their habitat. Reforestation and elimination of exotic plants such as gorse and blackberry, and feral ungulates are among the management goals of the Refuge that relate to fire management. The basic fire management strategy for the Refuge is to suppress wildland fires since they are not believed to have played a significant ecological or evolutionary role in most native Hawaiian ecosystems and have negative impacts on the native biological communities.

Refuge Manager

Date

APPENDIX F: BIG ISLAND WILDFIRE COORDINATING GROUP

Big Island Wildfire Coordinating Group Charter

I. MISSION STATEMENT:

The Big Island Wildfire Coordinating Group (BIWCG) was established to coordinate the programs of the participating wildland fire agencies on the Big Island of Hawai'i, to provide a forum for leadership, cooperation and the exchange of information, to further interagency cooperation, communications and coordination, and to implement directions and standards for incident management activities. By pooling the resources of the various agencies, the combined strength and efforts would afford the people of the Big Island more extensive and effective protection of lives, property, natural and cultural resources.

II. OBJECTIVES:

- A Provide leadership and a coordinated direction to wildland fire management programs on the island of Hawai'i;
- A Provide a forum for the exchange of ideas and the development of consistent policies;
- A Foster cooperation, avoid wasteful duplication, and facilitate maximum efficiency in wildland fire management programs through coordinated planning and the utilization of shared resources;
- A Establish and maintain an interagency approach to wildland fire management programs through the development and nurturing of interagency bonding and facilitation of a high degree of professionalism, trust, and mutual assistance among wildland fire management agencies;
- A Identify issues, establish priorities, develop alternatives, and recommend a unified course of action to respective agency administrators.

III. MEMBERSHIP:

The BIWCG membership will be composed of the lead fire manager or his/her designee from each of the following agencies located on the Big Island:

Hawaii County Fire Department
Hawaii County Civil Defense Agency
Dept. of Land & Natural Resources -Division of Forestry and Wildfire
National Park Service
U.S. Fish & Wildlife Service
U.S. Army
Dept. of Transportation -Airports Div., Hawaii District.

The BIWCG is composed of the designated Member Representatives of the signatories to this Charter. Each agency will have one vote. They serve until replaced by their member organization. Individual Member Representatives are their organization's authoritative source of information and operational commitment to this Charter's purpose and objectives. They are responsible to ensure that respective organization policy and procedures are maintained and administrators are informed. Members communicate agency policies to the BICWG to facilitate development of consistent and similar policies of the group. They coordinate BIWCG recommendations for their organization's acceptance and implementation. Member Representatives or an 'Acting' participate in meetings and work efforts of the BIWCG and serve as its officers where appropriate.

Associate Members: It is recognized that there are various groups, organizations and individuals that share the goals of BIWCG. Interested parties shall apply for Associate Membership and will be voted upon, requiring 2/3 approval of the voting membership. Associate Members do not have voting privileges.

IV. MEETINGS:

The BIWCG will meet quarterly. The committee members may deem more frequent meetings necessary. The Chairperson with consensus of the group will establish meeting dates and times. Issues that require a vote will be decided upon by a 2/3 majority.

V. OFFICERS:

The BIWCG will establish officers to facilitate the accomplishment of its work. The positions to be filled are 1) Chair, 2) Vice-Chair, and 3) Secretary.

The Chair, Vice-Chair, and Secretary will serve for 1-year terms on a rotational basis. The Vice-Chair shall advance to the office of the Chair and the Secretary shall advance to the office of the Vice-Chair. The group shall then vote upon the position of the Secretary. The cycle shall be so that all members have the opportunity to fill the officer positions.

VI. DUTIES & RESPONSIBILITIES OF THE OFFICERS:

Chair: The Chair is responsible for calling the meeting, setting the agenda, and running the meeting. The term of office is One year or upon permanent vacancy of the Chair.

Vice-Chair: The Vice-Chair will assume the duties of the Chair during any absence of the Chair and will be the next Chair. The term of office is one year.

Secretary: The Secretary shall ensure that the minutes of the meetings are recorded, edited, filed, and distributed to the members and their respective agencies.

The Secretary and Chair will determine the extent of support at each meeting (i.e. note-taking, recorder, portable computer, facilitator, audio-visual equipment, guest speaker, etc.)

Working Committees: The BIWCG will identify issues and concerns of mutual interest and task out assignments to specific working committees. The BIWCG will provide direction, oversight, and coordinating group minutes to the working committees.

Specific working committees may be formed to deal with such areas as training, logistics coordination, incident management team selection and management, and equipment standardization. Other working committees will be formed as needed.

Working committees may define Task Groups, which may have one or more responsibilities. The group, upon completion of the task, shall dissolve unless additional tasks, i.e. project implementation/monitoring, are assigned.

Working committee members will elect a Chair. Minutes of the meeting will be taken and distributed. Committee Chair or their representatives are encouraged to attend the BIWCG meetings.

VII. FINANCIAL:

Participation in activities sanctioned or sponsored by the BIWCG is at individual member organization

expense. When funding of BIWCG sponsored projects are needed from more than one of its members, those organizations should share the costs as appropriate. Cost sharing is encouraged subject to individual member funding availability and to internal legal requirements and fiscal controls.

VIII. GENERAL PROVISIONS:

- 1) The parties hereto, in writing, may terminate the instrument in whole, or in part, at any time before the date of expiration. Any party may withdraw from the Group by giving 30 days written notice.
- 2) This instrument in no way restricts the Cooperators from participating in similar activities with other public or private agencies, organizations, and individuals.
- 3) Pursuant to Section 22, Title 41, United States Code, no member of, or Delegate to, Congress shall be admitted to any share or part of this instrument, or any benefits that may arise therefrom.
- 4) This instrument is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between the parties to this instrument will be handled in accordance with applicable laws, regulations, and procedures including those for Government procurement and printing. Such endeavors will be outlined in separate agreements that shall be made in writing by representatives of the parties and shall be independently authorized by appropriate statutory authority. This instrument does not provide such authority. Specifically, this instrument does not establish authority for noncompetitive award to the cooperator of any contract or other agreement. Any contract or agreement for training or other services must fully comply with all applicable requirements for competition.
- 5) Modifications within the scope of this instrument shall be made by the issuance of a mutually executed modification prior to any changes being implemented.

IX. PRINCIPAL CONTACTS:

Mr. Bruce Butts, HI County Civil Defense Agency
920 Ululani St.
Hilo, HI 96720
Tel: (808) 935-0031

Mr. Jack Minassian, National Park Service
Hawaii Volcanoes National Park
PO Box 52
Hawaii National Park, HI 96718
Tel: (808) 985-6042

Mr. Andy Kikuta, U.S. Fish and Wildlife Service
32 Kinoole St.
Hilo, HI 96720
Tel: (808) 933-6915

Mr. Gayland Enriques
Attn: APVG-GTG. Stop 215
Bldg. 1150

Schofield Barracks, HI 96857-5000
Tel: (808) 655-2284

Mr. Steve Bergfeld, Division of Forestry & Wildlife
19 E. Kawili St.
Hilo, HI 96720
Tel: (808) 974-4227

Mr. Wayne Ching, Division of Forestry & Wildlife
1151 Punchbowl St., Rm.325
Honolulu, HI 96813
Tel: (808) 587-4173

Mr. Steve Iwamoto, Hawaii County Fire Dept.
777 Kilauea Ave. Rm. 6
Hilo, HI 96720
Tel: (808) 961-8348

Chief Kenneth Zurn, Pohakuloa Fire Dept.
Bldg. T-390, PO Box 4607
Hilo, HI 96720
Tel: (808) 969-2441

X. ADOPTION OF POLICY:

It is important that the BIWCG's recommendations receive formal agency review, acceptance, and distribution for implementation. Operational changes, which do not include policy changes or costs, may be implemented directly through their appropriate channels. The respective agency administrator will approve items, which require policy changes, modifications, or costs.

Between the
HAWAII COUNTY FIRE DEPARTMENT
HAWAII COUNTY CIVIL DEFENSE AGENCY
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
NATIONAL PARK SERVICE
U.S. FISH AND WILDLIFE SERVICE
U.S.ARMY
AND
DEPARTMENT OF TRANSPORTATION
AIRPORTS DIVISION, HAWAII DISTRICT

I. Introduction

Fire management in Hawaii continues to be a matter of concern to the public and to the Hawaii County Fire Dept., Hawaii County Civil Defense Agency, Department of Land and Natural Resources-Division of Forestry and Wildlife, National Park Service, U.S. Fish and Wildlife Service, U.S. Army, and Department of Transportation- Airports Division, Hawaii District, hereafter called the "agencies". Considerable progress has been made in fire suppression and fire use by all the agencies. Cooperation in all aspects of fire suppression has benefited all agencies. Because fire recognizes no boundaries, programs must lead to more productive cooperation and efficient operations between these agencies.

II. Authority

There are numerous Federal, State and County laws that allow each agency head to enter into Memorandum of Understanding with other agencies.

III. Objective

- A. To provide a basis for cooperation between the agencies on all aspects of fire suppression and as authorized in non-fire emergencies.
- B. To facilitate the exchange of personnel, equipment, supplies, and services between the agencies.

IV. Program Coverage

The agencies agree to cooperate in the full spectrum of fire suppression activities and as authorized in non-fire emergencies to achieve agency goals. Cooperative efforts shall be provided for to facilitate

efficient use of personnel, supplies, equipment, aviation services and other resources. Activities may include, but are not limited to:

- A. Prevention of human-caused fires;
- B. Training of personnel to common standards;
- C. Pre-suppression activities;
- D. Suppression of fires;
- E. Rehabilitation of areas burned by wildfire;
- F. Exchange of technology and database;
- G. Fire research.

V. Statement of Work

- A. Agency representatives shall coordinate information on available personnel, equipment, and supplies as necessary.
- A. That any agency may, when it deems it necessary, request assistance of the other agency: and upon receipt of such request, or upon its own initiative, the other agency shall assist the requesting agency with whatever personnel and equipment it may have available at the time; however, in no instance shall the responding agency be under a duty to assist the requesting agency when the personnel and equipment available to it are, or would thereby be, rendered insufficient to meet the actual or realistically potential needs of the community or area served by the agency.
- A. An agency is expected to take prompt initial action, with or without request, unless otherwise provided for, on fires within zones of mutual interest. Where one agency takes initial action in the protective unit of the other, the initial attack agency shall continue to fight the fire until relieved by an officer of the other agency.
- B. When fires burn or threaten lands of more than one agency, officials to suppress the fire will conduct joint planning.
- C. Agencies permit the use of its respective radio communication frequencies to all signatory agencies of this MOU.
- D. Agencies shall not bill for services rendered by the signatory agencies of this MOU.
- E. That each agency shall be separately liable to all third parties who may have a legal or equitable claim against the agency arising out of its tortuous misconduct while engaged in the performance of its duties.
- F. Each agency shall make direct settlement from its own funds for all liabilities it incurs under this MOU.

VI. General Provisions

This MOU will take effect on the date of the last signature. The MOU shall remain in effect for a period of 5 years, and may be extended and amended by mutual MOU at any time. Any signatory agency may terminate their participation in this MOU by written notice to all other signatories. The remaining signatories may continue the provisions of this MOU.

VII. Required Clauses

During the performance of this MOU, the participants agree to abide by the terms of Executive Order

11246 on non-discrimination and will not discriminate against any person because of race, color, religion, sex, or national origin.

No member or delegate to Congress, or resident Commissioner shall be admitted to any share or part of this MOU, or to any benefit that may arise therefrom, but this provision shall not be construed to this MOU if made with a corporation for its general benefit.

VIII. Waiver

Each party to this MOU does hereby expressly waive all claims against the other party for compensation for any loss, damage, personal injury or death occurring in consequence of the performance of this MOU.

IX. Approval

IN WITNESS WHEREOF, the parties hereto have executed this MOU:

Edward Bumatay
Fire Chief
Hawaii County Fire Dept.

Date: _____

William G. Davis
Administrator
Hawaii County Civil Defense

Date: _____

John J. Reynolds
Pacific West Regional Director
National Park Service

Date: _____

Anne Badgley
Region 1 Regional Director
U.S. Fish and Wildlife Service

Date: _____

Gilbert Coloma-Agaran
Chairman
Dept. of Land and Natural Resources

Date: _____

Sammy C. Houseberg
Director, Installation Fire and Safety Office
U.S. Army, Hawaii

Date: _____

Kazu Hayashida
Director of Transportation, Hawaii

Date: _____

APPENDIX G: 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 H: DELEGATION OF AUTHORITY

DELEGATION OF AUTHORITY

Region 1, U.S. Fish and Wildlife Service

Hakalau Forest National Wildlife Refuge

_____, you are assigned as Incident Commander of the _____ Incident, on the Hakalau Forest National Wildlife Refuge. You have full authority and responsibility for managing the fire suppression operation on this incident within the framework of legal statute, current policy, broad direction, and the Wildland Fire Situation Analysis (WFSA). Your primary responsibility is to achieve complete control of the fire by organizing and directing the fire suppression organization in an effective, efficient, and economical manner.

You should be guided in your duties by the fire job descriptions relating to Incident Commander, as found in the Fireline Handbook. Strongly consider long-term ecosystem health, and the effects of suppression actions in the development of appropriate suppression responses. These issues are to be addressed and documented in the WFSA.

You are accountable to the Complex Manager _____ of the Hakalau Forest National Wildlife Refuge, who is the Line Officer. _____ may serve as the Line Officer Designee for this incident.

You will immediately notify me in person in the event of:

- (1) a serious injury or fatality,
- (2) threat to private property,
- (3) if the incident exceeds the limits of the selected alternative of the WFSA.

Much of the Hakalau Forest National Wildlife Refuge is home to endangered species. Your job as Incident Commander is critical, as you must minimize damage to the habitats, as well as provide for fire fighter safety. Minimum environmental suppression tactics shall be used, commensurate with forecasted and threatened resource values. Unless there are immediate threats to life and/or property, you must receive approval from the Complex Manager or Designee to use heavy equipment (dozers, tractors, etc.) or fall any unburned trees greater than eight feet tall.

You are to be guided by the Wildland Fire Situation Analysis, approved by _____, Project Leader.

The Resource Advisor assigned to your incident will be _____.

, Complex Manager

Date: _____

APPENDIX I: SAMPLE PILE BURN PLAN

Debris Pile Burn Plan

Refuge:_____

Project Name:_____

Location:_____ Township____ Range__ Section_____

Lat_____ Long_____

Checklist:

1. EA optional.
2. Resource objectives.
3. Less than 1 ton per pile, completely dried.
4. Minimum resources (equipment & personnel) required are present.
5. Weather parameters established.
6. Low potential for escape. Good clearance.
7. No fire behavior prediction required.
8. Can be written to be valid up to 3 years per site, with annual review.
9. Burn day required.
10. Less than (<) one acre in size.
11. Complexity level should rate as level 3.
12. Intended for administrative sites, campgrounds, occupancy trespass, etc.

Debris & Pile Burn Plan
(continued)

Note: This plan is intended for burning debris and piles (activity fuels) from Refuge operations such as fuel break construction and hazard reduction. This plan format should only be used outside of declared fire season for the area considered. THIS PLAN IS FOR COMPLEXITY LEVEL 3 PILE BURNING.

Refuge: _____

Project Name: _____

Prepared By: _____ Date Prepared: _____

Reviewed By: _____ Date Reviewed: _____

Refuge Manager Approval: _____ Date: _____

Environmental Assessment Met (where documented): _____

Estimated Cost: \$ _____ 1202: _____ Funding Code: _____

Project Area Description (Attach Map of Burn Area)

General Location: _____

Legal Description: T. _____ R. _____ S. _____

Burn Objectives: _____

Number, Species, and Size of Piles: _____

Adjacent Fuel Description: _____

Debris & Pile Burn Plan

(continued)

Weather Forecasts: The Pile Burn Boss is responsible for weather being taken every hour while burning to ensure prescription compliance. Contact the Emergency Communications Center (ECC) for weather forecasts and burn day designation. Contact ECC by radio when ignition is starting, giving legal description of area burning; and when burning is over, giving number of acres or piles burned.

Prescription:

Season of Burn (Fall, Spring, Summer, Winter): _____

	<u>Acceptable Range</u>	<u>Desired</u>	
Air Temperature			_____
Relative Humidity(%)			_____
Wind Speed			_____
Fuel Moisture			
		1 Hour T.L.	_____
		10 Hour T.L.	_____
100 Hour T.L.	_____		
Adjacent Live Fuel Moisture Low/High			
Wind Direction Preferred:	_____		
Acceptable:_____ Unacceptable:			

Debris & Pile Burn Plan
(continued)

Smoke Management

Permitting Agency: _____

Total Tons Per Acre Emissions: _____

Distance and Direction from Smoke Sensitive Area(s): _____

Necessary Transport Wind Direction(s): _____

Visibility Hazard(s) (i.e., roads, airports, etc.): _____

Actions to Reduce Visibility Hazard(s): _____

Can Residual Smoke Be a Problem? _____

Other Considerations: _____

Special Constraint(s)/Consideration(s): _____

Firing Technique: _____

Holding Force Instructions: _____

Mop Up Instructions _____

Debris & Pile Burn Plan
(continued)

Contact Plan (Who will notify the following and when): _____

Key People: _____

Local Landowners: _____

Private Land Within Proposed Burn (Identify on Map): _____

Fire Protection Agencies: _____

Dispatcher: _____

Public Affairs Officer: _____

News Releases to Local Papers and News Media: _____

Debris & Pile Burn Plan
(continued)

Safety Plan

All line employees involved in the actual burning of standing and/or piled fuels will have on their person and use as necessary the following protective clothing:

1. Hard hat
2. Goggles
3. Gloves
4. Fire resistant pants
5. Fire resistant shirt
6. Fire shelter
7. Laced boots as used in fire suppression

Employees involved in a project with an assignment not related to actual burning should have with them all of the above safety equipment and be so equipped if their unplanned duties expose them to line work and/or the actual burning.

Each burning plan will designate fire safety responsibility. This designation should include the following considerations:

1. Escape routes
2. Safety areas
3. Closest recognized burn treatment facility and specific methods of travel to burn center or hospital

Hospitals

<u>Center Name</u>	<u>Address</u>	<u>Travel Time</u> <u>Air/Ground</u>	<u>Phone</u>	<u>Helipad</u> <u>Yes/No</u>	<u>Burn Center</u> <u>Yes/No</u>
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Debris & Pile Burn Plan
(continued)

Medical Emergency Procedures

1. Give First Aid at scene.
2. Contact Hawaii County Fire Department
3. Make transportation arrangements.

Comments: _____

Debris & Pile Burning Checklist

(A “NO” response to any item means STOP!)

1. Are all fire prescriptions met?
2. Has dispatch been notified?
3. Is it a permissive burn day?
4. Is fire weather forecast favorable?
5. Are all personnel required in the burn plan on site?
6. Have all personnel been briefed on the burn plan requirements?
7. Have all personnel been briefed on safety hazards, escape routes and safety orders?
8. Is all the required equipment in place and in working order?
9. Are all personnel aware of mop up requirements before abandonment?
10. Are all answers to all the above questions “Yes”?

If all ten questions have been answered “Yes”, you may proceed with lighting.

APPENDIX J: EXEMPTION REQUEST

BIG ISLAND NATIONAL WILDLIFE REFUGE COMPLEX
32 KINOOLE STREET, SUITE 101
HILO, HI 96720
Telephone (808)933-6915 Fax (808)933-6917

Memorandum

October 18, 2001

To: Pam Ensley, Regional Fire Management Coordinator

From: Richard C. Wass, Complex Manager

Subject: Engine Operator Exemption

As per the Fire Management Handbook Section 1.5 (6/8/01), I am requesting that, within the Big Island National Wildlife Refuge Complex, an Engine Operator be permitted to run an engine in the absence of a qualified Engine Boss. I understand that this is Service policy only, applies only to fires located on Refuge lands, and that a qualified Engine Boss must be present for any assists to our interagency cooperators.

Upon detection of any wildland fire on Refuge lands, assistance will be requested from interagency cooperators. This assistance, however, often does not arrive on scene for 3 hours or more. These requirements outlined in the Fire Management Handbook provide us with the appropriate flexibility to manage wildland fires on Refuge lands until assistance does arrive.

I would appreciate your concurrence with this issue, so that we may continue to operate our engines safely, effectively, and in full compliance of Service standards.

If you have any questions, please feel free to contact Andy Kikuta or me at 808-933-6915.

/s/

Richard C. Wass

Concurred By:

Pam Ensley
Regional Fire Management Coordinator

Date

APPENDIX K: SAMPLE WFSA

13. Jurisdiction: US Fish and Wildlife Service	14. Geographic Area:
15. Unit: Hakalau Forest National Wildlife Refuge	16. WFSA Number of .
17. Fire Name:	18. Incident Number:
19. Accounting Code:	
20. Date/Time prepared / / @ : .	
21. Attachments	
<ul style="list-style-type: none"> -Complexity Analysis X -Risk Assessment/Analysis X Probability of success Consequences of Failure -Maps -Decision Tree -Fire Behavior Projections X -Calculations of Resource Requirements -Other 	

OBJECTIVES AND CONSTRAINTS

<p>1.Objectives (Must be specific and measurable) These objectives must be considered in the development of alternatives in III, below. Suppression objectives must relate to the Unit resource management objectives.</p> <p>a. Safety (These must receive the highest priority)</p> <ul style="list-style-type: none"> -Public -Firefighter <p>b. Economic (May include closure, which could impact the public through transportation, communication and resource values)</p> <p>c. Environmental (e.g. management objectives for wildlife habitat, water quality, etc.)</p> <p>d. Social (May include local attitudes towards fire that might affect decisions on the fire)</p> <p>e. Other (e.g. legal or administrative constraints needing consideration such as fire encroaching onto other jurisdictions)</p> <p>2.Constraints (e.g. environmentally and culturally sensitive areas, irreparable damage to resources, and economic constraint)</p>
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ALTERNATIVES

	A.	B.	C.
Wildland Fire Strategy	e.g. Allow fire to play a natural role	e.g. Aggressive attack	
Narrative			
Resources Needed			
Hand Crews			
Engines			
Dozers			
Air Tankers			
Helicopters			
Final Size			
Est. Contain/ Control Date			
Costs			
Risk Assessment			
-Probability of success			
-Consequence of failure			
Complexity			
Attach maps for each alternative			

EVALUATION OF ALTERNATIVES

	A.	B.	C.
Evaluation Process			
Safety			
Firefighter			
Aviation			
Public			
Sum of safety values			
Economic			
Forage			
Improvements			
Recreation			
Water			
Wildlife			
Other			
Sum of economic values			
Environmental			
Air			
Visual			
Fuels			
T&E Species			
Other			
Sum of environmental values			
Social			

Employment			
Public Concern			
Cultural			
Other			
Sum of social values			
Other			
Sum of other values			
TOTAL			

ANALYSIS SUMMARY

	A.	B.	C.
Compliance with Objectives			
Safety			
Economic			
Environmental			
Social			
Other			
Pertinent Data			
Final fire size			
Complexity			
Suppression cost			
Resource values			

Probability of success			
External/Internal Influences			

VI. DECISION

The Selected Alternative is:	
Rationale:	
Agency Administrator's Signature	Date/Time

VII. DAILY REVIEW

			P R E P A R E D N E S S L E V E L	I N C I D E N T P R I O R I T Y	R E S O U R C E A V A I L A B I L I T Y	W E A T H E R F O R E C A S T	F I R E H A Z A R D I C T I O N S	W F S A V A L I D
Date	Time	By						

VIII. FINAL REVIEW

The elements of the selective alternative were met on:

Date

Time:

By:

Agency Administrator

APPENDIX L: THREATENED AND ENDANGERED SPECIES

Table 5. Threatened and Endangered species on the Hakalau Unit of Hakalau Forest NWR.

Species	Common Name	Status
<i>Hemignathus munroi</i>	akiapolaau	Endangered, forest bird
<i>Loxops c. coccineus</i>	Hawaii akepa	Endangered, forest bird
<i>Oreomystis mana</i>	Hawaii creeper	Endangered, forest bird
<i>Psittirostra psittacea</i>	ou	Endangered, forest bird
<i>Buteo solitarius</i>	Hawaiian hawk, io	Endangered, forest bird
<i>Anas wyvilliana</i>	Hawaiian duck, koloa	Endangered, duck
<i>Branta sandvichensis</i>	Hawaiian goose, nene	Endangered, goose
<i>Fulica alai</i>	Hawaiian coot, alae keokeo	Endangered, coot
<i>Lasiurus cinereus semotus</i>	Hawaiian hoary bat, apeapea	Endangered, bat
<i>Asplenium schizophyllum</i>	ncn	Species of concern, Plant
<i>Clermontia lindseyana</i>	oha wai	Endangered, Plant
<i>Clermontia peleana</i>	ncn	Endangered, Plant
<i>Clermontia pyrularia</i>	oha wai	Endangered, Plant
<i>Cyanea shipmanii</i>	haha	Endangered, Plant
<i>Cyrtandra tintinabula</i>	haiwale	Endangered, Plant
<i>Eurya sandwichensis</i>	anini	Species of Concern, Plant
<i>Phyllostegia floribunda</i>	ncn	Candidate 1 Species, Plant
<i>Phyllostegia brevidens</i>	ncn	Species of Concern, Plant
<i>Phyllostegia racemosa</i>	kiponapona	Endangered, Plant
<i>Phyllostegia velutina</i>	ncn	Endangered, Plant

<i>Phyllostegia vestita</i>	ncn	Species of Concern, Plant
<i>Phytolacca sandwichensis</i>	ncn	Species of Concern, Plant
<i>Platydesma remyi</i>	pilo kea	Candidate1 Species, Plant
<i>Ranunculus hawaiiensis</i>	makou	Species of Concern, Plant

APPENDIX M: EQUIPMENT INVENTORY

Table 6. Equipment inventory for the Hakalau Unit of Hakalau National Wildlife Refuge.

Location	Item	Quantity	Source
Pua Akala Barn	Frog Pond, 1000 gal	1	Fire
Pua Akala Barn	2" pump	1	DRMO
Pua Akala Barn	2" suction hoses	2	Fire
Pua Akala Barn	2" hose, poly	100'	Fire
Hakalau shed	2" pump	1	DRMO
Hakalau shed	3" pump	1	DRMO
Hakalau shed	2" suction hose, 8'	6	Fire
Hakalau shed	3" suction hose, 8'	8	Fire
Fire Cache	pants, 34x34	2	Fire
Fire Cache	pants 32x30	2	Fire
Fire Cache	pants, 30x30	2	Fire
Fire Cache	pants, 8x32	2	Fire
Fire Cache	pants, 38x34	1	Fire
Fire Cache	shirt, small	2	San Luis
Fire Cache	shirt, medium	3	San Luis
Fire Cache	shirt, large	3	Fire
Fire Cache	shirt, x-large	1	Fire
Fire Cache	glove, small	7	Fire
Fire Cache	glove, medium	7	Fire
Fire Cache	glove, large	6	Fire
Fire Cache	face/neck shroud	3	Fire
Fire Cache	helmet	6	Fire
Fire Cache	goggle	3	Fire
Fire Cache	head lamp	8	Fire
Fire Cache	fire shelter	8	Fire
Fire Cache	fire shelter, practice	2	Fire
Fire Cache	first aid kit	3	Fire

Fire Cache	field pack	2	Fire
Fire Cache	water bottle	3	Fire
Fire Cache	wind meter	3	Fire
Fire Cache	fedco	6	Fire
Fire Cache	pulaski	7	Fire
Fire Cache	shovel	5	1261
Fire Cache	flapper	6	Fire
Fire Cache	mcleod	2	Fire
Fire Cache	drip torch	1	Fire
Fire Cache	propane torch	2	Fire
Fire Cache	propane tank, 1 gal.	3	Fire
Fire Cache	1.5" hose, cotton	6	DRMO
Fire Cache	1" hose, poly	4	Fire
Fire Cache	Silvex, 5 gal	5	Fire
Fire Cache	fittings/nozzles	many	Fire
Garage	chainsaw, 025	1	1261
Garage	chainsaw,026	2	1261
Garage	chainsaw, 044	1	1261
Office	tent, 1 man	2	Fire
Office	sleeping bag	2	Fire
Office	sleeping pad	2	Fire
Office	duffle bag	2	Fire
Office	radio chest harness	10	Fire

APPENDIX N: RAINFALL DATA FOR 1990-2001 AT HAKALAU CABIN AND 1989-1996 AT PAU AKALA.

Table 7. Rainfall Data (inches) for Years 1990 to 2001 at Hakalau Cabin.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
January	27.42	0.85	0.91	1.70	5.80	8.12	4.49	1.65	0.74	10.4	9.11	0.84
February	18.85	5.24	1.07	0.67	7.45	0.62	20.76	5.25	0.05	24.54	0.08	16.02
March	7.96	36.89	0.95	3.39	13.70	0.94	10.21	13.67	1.64	15.77	3.02	2.68
April	1.56	4.95	0.56	3.73	6.34	6.85	3.84	3.04	13.30	7.45	3.32	10.10
May	4.33	5.94	1.60	4.44	2.87	3.11	1.30	4.35	7.57	0.56	0.88	3.69
June	3.95	3.32	2.69	1.95	3.83	0.98	4.48	14.41	2.76	0.19	2.53	1.93
July	5.42	2.88	8.85	18.33	9.44	6.99	6.45	14.60	1.90	0.53	5.96	2.25
August	4.69	8.95	9.28	4.03	12.68	6.39	1.54	13.11	3.20	1.69	8.75	3.97
September	17.44	4.01	12.64	3.09	15.68	3.59	3.36	4.10	7.20	5.07	8.04	2.71
October	10.98	1.78	3.22	4.81	2.68	2.22	2.40	5.37	7.20	3.04	7.62	
November	39.09	3.37	12.72	5.17	35.23	2.51	6.10	5.99	7.90	2.85	17.66	
December	17.87	7.46	10.37	9.66	6.49	0.55	3.35	6.56	11.42	40.84	0.95	
Total	159.56	85.64	64.86	46.47	122.19	42.87	68.28	92.10	64.88	112.93	67.92	

Table 8. Rainfall Data (inches) for Years 1989 to 1994 at Pua Akala, Hakalau Unit.

	1989	1990	1991	1992	1993	1994
January	30.75	26.81	2.39	0.65	0.57	14.32
February	5.06	21.64	3.91	0.38	1.17	9.17
March	3.10	12.77	48.42	1.42	3.25	16.37
April	15.83	2.48	9.54	2.26	6.40	6.66
May	14.28	6.03	4.24	1.99	5.33	5.13
June	7.53	6.57	4.93	4.14	3.42	7.86
July	30.51	6.97	3.50	12.96	24.44	13.51
August	4.54	6.50	13.54	8.48	5.57	16.38
September	6.48	16.78	2.29	16.48	4.25	17.65
October	10.13	13.06	1.79	4.69	5.81	4.96
November	0.72	43.37	5.56	13.95	7.00	51.1

December	1.22	20.97	4.80	15.21	7.60	5.54
Total	130.15	183.95	104.91	82.61	74.81	168.65