APPENDIX J-2

IWFMP MMR FIRE MANAGEMENT AREA

7.5. MAKUA MILITARY RESERVATION (MMR)

7.5.1. General Description.

a. Location and Size. MMR is located on the northwest side of the island, near Kaena Point. The training area extends west from the Waianae Range ridgeline to the ocean. It is approximately three miles north of Makaha, which is the nearest town. The area consists of 1696 hectares (4,190 acres) of which 69 (170 acres) are owned in fee, 1346 (3,326 acres) are ceded, one (2 acres) is Easement/License/Permit, and 316 (782 acres) are leased from the State of Hawaii. MMR is the home of the Pilila'au Range Complex, the single range facility on MMR.

b. Military Land Use. The MMR Pilila'au Range Complex is the largest training area on the Island of Oahu that will support both maneuver and live-fire training, including limited helicopter live-fire training and explosive ordnance operations. The Pilila'au Range Complex is the primary Company Combined Arms Assault Course (CCAAC) for Oahu. The range is used for combined arms live-fire exercises at the infantry company level. The impact area is used for live-fire exercises and potentially contains unexploded ordnance.

c. Training Capabilities. The Pilila'au Range Complex will support small unit training from squad/team to infantry company plus levels. All small weapon systems integral to the 25th ID(L) can be utilized in the impact area except for tracers, aerial pyrotechnics, 155mm artillery, Tube Launched Optical Weapon System (TOW), and 2.75" rockets.

d. Climate.

(1) MMR is shadowed by two mountain ranges that greatly influence its local climate. The apex at the east end of MMR ties into the Waianae Range, which is climatically downwind from the Koolau Range to the east. The Waianae Mountains peak higher than the Koolau Mountains, but the trade winds yield more precipitation to the Koolaus. The variability of the local climate influences the vegetation distribution and fire environment.

(2) The principal fire climate variables are rainfall, temperature, relative humidity, and wind speed. The following summary is distilled from a weather station located at the west end of MMR, except for the description of rainfall, which was obtained from The Atlas of Hawaii (Giambelluca and Schroeder 1998). A more complete description of the climate variability at MMR can only follow from empirical studies with more strategically placed weather stations, or high resolution weather models.

a. Rainfall. Mean annual rainfall on the island of Oahu varies from a high exceeding 6350 mm (250 in) in the Koolau Range on the eastern end, to less than 500 mm (20 in) on the leeward coast, south of Makua. The northeast trade winds are predominant over most of the islands, except where the landform provides a sheltering effect. As the moisture-laden trade winds approach Oahu from the northeast, they cross the Koolau Range almost perpendicularly, yielding precipitation as they transit the ridgeline. The Waianae Range is downwind from the Koolaus, and receives less rainfall from the trades.

b. Temperature. Average daily temperatures mostly varied between 18° C (65° F) and 27° C (80° F). They peaked between June and October, and bottomed out between December

and February. Within the course of a day, the difference between minimum and maximum temperatures varied by 8° to 12° C (15-20° F).

c. Relative Humidity. The average relative humidity data from MMR varied more from day to day than temperature did, but most values fell in a relatively narrow band between 55 and 85 percent. The middle half of the relative humidity data ranged between 63 and 71 percent. Consistent compared to continental climates, these statistics are remarkably high, considering that the MMR weather station occupies a dry site, by Hawaiian standards.

d. Wind Speed. The daily average wind speed at MMR ranged from 1 m/s (2 mph) to 9 m/s (20 mph). Examining the relative frequency of the average wind speeds, we see that most of the values are at the lower end of the range. The middle half of the data assumed values between 2.7 m/s (6 mph) and 4.4 m/s (10 mph). The modal wind speed is approximately 2.7 m/s (6 mph).

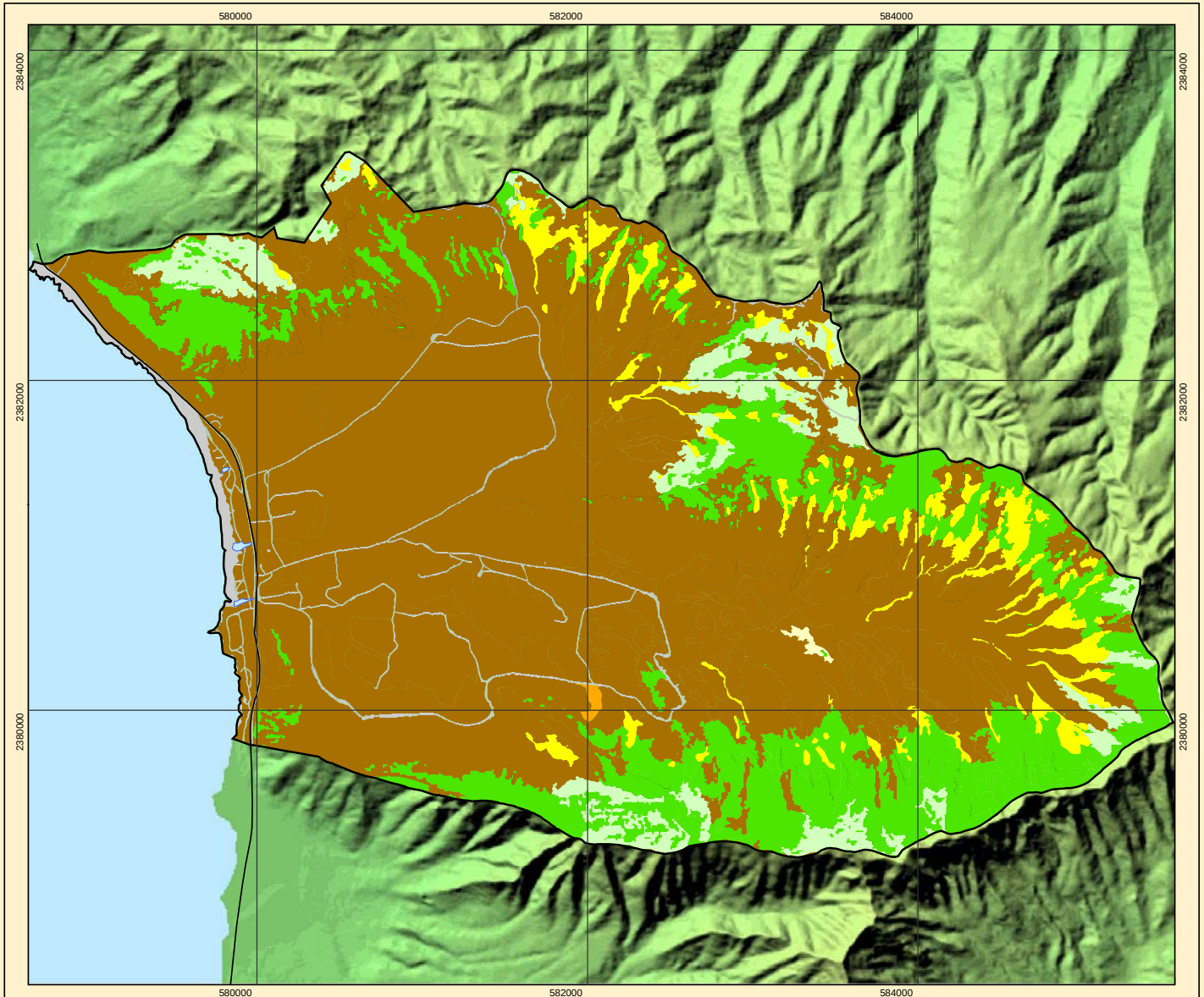
e. Topography. MMR is situated in a valley surrounded by steep slopes to the north, east, and south. The reservation extends from Farrington Highway along the coast to the Waianae Mountain Range ridgeline. It includes Kahanahaiki Valley, and the Koiahi Gulch. The reservation is about 1.5 miles wide as it is situated along the highway and approximately 2.5 miles deep at its deepest point. The valley floor varies from 8 to 162, (20 to 400 ft) in elevation. Cliffs that have heights of 850 to 1,174m (2,100 to 2,900 ft) surround the amphitheater-shaped valley.

7.5.2. Vegetation Fuels Classification.

The wildland fire fuel types found at MMR have been categorized into eight classes (Figure 9 and Table 7.5.1). These classes were derived from the National Forest Fire Laboratory (NFFL) fuel behavior models as defined by Anderson (1982). For a full description of Oahu fuel types and their derivation see Section 3.5.

Table 7.5.1
Fuel Types at MMR

Fuel Type	*Fuel Model*	*Vegetation Classifications Included (Genus only)*
Short Alien Grassland	NFFL 2	*Andropogon*
Tall Alien Grassland	Guinea Grass Custom	*Leucaena/Panicum, Melinis/Panicum, Panicum*
Eucalyptus Forest	NFFL 10	*Eucalyptus, Melaleuca*
Ironwood Forest	NFFL 9	*Casuarina*
Mixed Forest	NFFL 8	*Metrosideros/Acacia koa/Dicranopteris*
Christmas Berry Shrublands	NFFL 5	*Schinus*
Kukui Forest	Kukui Custom	*Aleurites*
Developed/Denuded	None	*Agriculture, Urban Development, Bog, Open Water, Roads*



Makua Military Reservation
Fuels

Figure 9

Legend

Fuels

- Christmas Berry Shrublands
- Developed/Denuded
- Ironwood Forest
- Kukui Forest
- Mixed Forest
- Short Alien Grassland
- Tall Alien Grassland

- Installation Boundary
- Surface Water Body
- Roads

N

1:25,000

0 500 1,000 Meters

0 0.5 1 Mile

Data Source: Center for Environmental Management of Military Lands 2003
IKONOS 4 meter Multispectral Imagery

7.5.3. Fire History for Makua.

a. A fire history was compiled for Makua Military Reservation to the extent possible utilizing fire records provided by USARHAW Range Division and the Federal Fire Department (see also Reference 7.5.1). There were frequent gaps in important information, particularly in the acreage burned and the ignition source. Many records were destroyed following disposition of records (5 years) in accordance with Army record keeping policy.

b. Fire at MMR has been frequent in the past decade due in large part to the installation's extensive use, however, since it's closure in 1998 and subsequent limited reopening, there have been only two recorded fires, one of which was not military caused. Several fires have burned outside of the firebreak road, however, many of these started outside the firebreak, giving little indication of its effectiveness.

c. Significant points from the fire history are summarized below:

(1) The total number of fires per month illustrates that the end of the summer requires the greatest fire management vigilance, though there is also a fairly high incidence in March, April, and May.

(2) The vast majority of fires were ignited between 0900 and 1800.

(3) Median fire size is 0.1 hectares (0.25 acres), however, the average is 14.5 hectares (36 acres), indicating that there are several large fires accounting for most of the acreage burned. This is illustrated in Figure 5.

(4) The most significant cause of ignitions at MMR was tracers, which accounted for 48% of recorded fires. Tracers have been voluntarily removed from use at MMR by USARHAW, and are not currently authorized on the ranges

Reference 7.5.1
MMR Fire History

Figure 1
Number of Fires per Year
at MMR 1987 - 2002

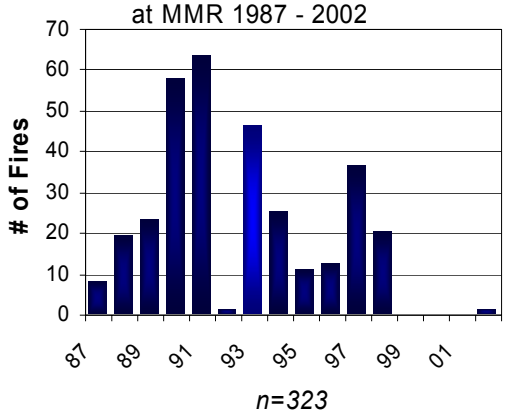


Figure 2
Number of Fires per Month
at MMR 1970-1998

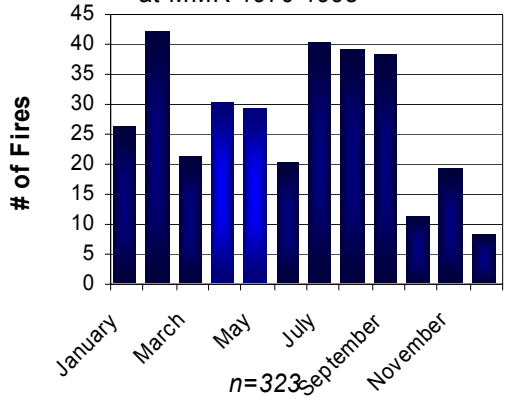


Figure 3
Number of Fires at MMR
by Time of Ignition 1970-1998

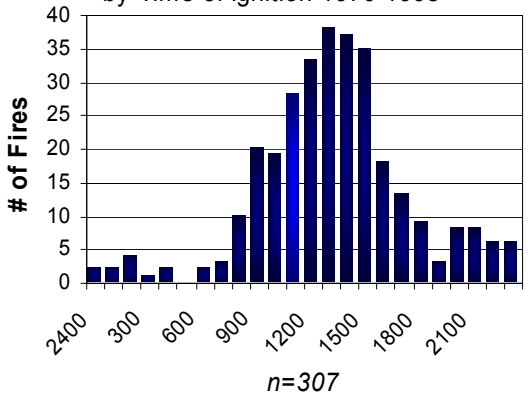


Figure 4
Number of Fires by Acreage Class
at MMR 1970-1998

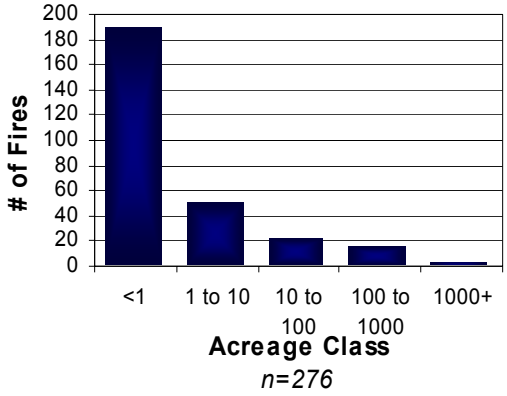


Figure 5
Percent of Total Area Burned 1970-1998 by Fire Size Class at MMR

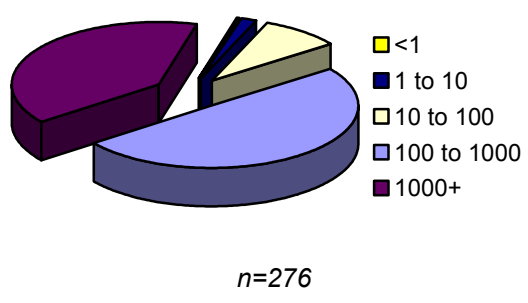
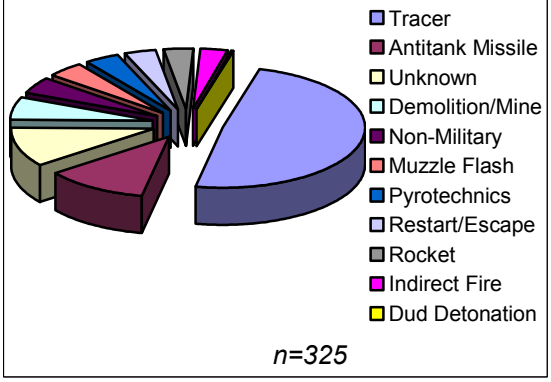


Figure 6
Fire Ignition Sources as a Percent of All Fires From 1970-1998



7.5.4. Resource Protection

a. Biological Sensitive Areas (BSA). BSAs are delineated at MMR to assist in setting resource management priorities. BSAs depict areas with rare and/or endangered species. Training limitations are imposed on BSA-1 and BSA-2 areas, or those with the highest native natural resource value. (See Figure MMR-2)

(1) Portions of MMR have been designated BSA-1 and 2 areas. The BSA-1 and BSA-2 areas in MMR are located as follows:

a. BSA-1: an extensive area along the entire eastern half of the MMR boundary extending into the interior of the reservation;

b. BSA-1: a small area along the southern boundary beginning about one kilometer east of the coastline; and

c. BSA-2: a small area along the southern boundary beginning at Farrington Highway and extending east.

(2). Other sensitive natural areas at MMR include archaeological management areas, places where significant archaeological sites and/or structures (cultural resources) are known and require resource protection, and SEAs, areas designated for resource protection. SEAs combine protection of both natural and cultural resources (i.e., they contain BSA-1, BSA-2 and archaeological management areas).

(3) Nine native natural communities have been identified, two of which are considered rare. These BSAs are defined as habitat that contains or has the potential to contain a high density of federally listed threatened and/or endangered species.

b. Protected Species.

(1) The USFWS has identified numerous threatened and endangered species that are known to inhabit the area in around MMR. Table 7.5.3 lists these species and their status. Another native bird that has been identified at MMR, the Oahu Elepaio (*Chasiempis sandwichensis* ibidis), is proposed for endangered status.

(2) The existence of species of Hawaiian or Oahu Tree Snails (genus *Achatinella*) which were listed as endangered under the Federal Endangered Species Act of 1973 is of particular interest at MMR. Species of the *Achatinella* snail may be found above 900-foot elevations in the Waianae Range. The snails have been greatly reduced in number due to their extreme localization (often one species to a single tree), a low reproductive rate, virtually no defense mechanisms, and a general dependency on relatively intact native forest conditions. As a result, an assessment has been conducted of the distribution and abundance of snails of this genus within the boundaries of MMR (a live-fire and maneuver training area) to measure the environmental impacts on military training activities.

(3) Areas within MMR have been identified as *Achatinella* habitat, which has influenced the training activities that can be conducted. Studies have concluded that the greatest threat to the Oahu tree snail is the risk of fire and explosive impacts (Christensen and Hadfield, 1984). This resulted in limits being set for the explosive impact area to exclude known inhabited areas as well to provide buffer zones. Recommendations of the study have been implemented.

c. Cultural Resources.

(1) There are 51 known archaeological sites located at MMR. Archaeological inventory surveys of previously unsurveyed areas are conducted on a project-by-project basis. There are numerous archaeological sites located within the firebreak roads, which is where all training takes place. About 27 percent of MMR has been sampled by archaeological surveys and other sites may be present. Cultural resource management surveys conducted at MMR have identified prehistoric and historic sites, and areas that are likely to contain more sites have been identified.

(2) A map analysis indicates possible conflicts within the firebreak road where most training is conducted. Cultural resources outside the firebreak are much less likely to be adversely impacted by training. (See Figure MMR-2, Appendix 1, MMR SOP).

(3) Explosive detonation is the most common identified threat to cultural resources at MMR. The use of explosive ordnance has the potential to damage archeological sites. Climbing and walking on archaeological features can be very destructive and can result in the tumbling of stones and the alteration of the integrity of the feature.

d. Wildfire Prevention Analysis (Figure 10).

(1) The wildfire prevention analysis shows most of the area outside of the fuelbreak roads to be the highest priority for pre-suppression funding and implementation.

Unit A - Southern Firebreak
- Ignition - High — Significant military activity, no tracers
- Hazard - Moderate — Composed largely of *Panicum maximum*, but areas of heavy training use are mowed
- Value - Low — No federally listed species

Unit B - Southern MMR
- Ignition - Moderate — No military training, but in close proximity to heavy use areas
- Hazard - High — Fuels are mostly composed of *Panicum maximum*, steep slopes
- Value - Moderate — Several federally listed species

Unit C - Eastern and Northern MMR
- Ignition - Moderate — No military training, but slight chance of overshot munitions
- Hazard - High — Much of the area is dominated by highly flammable species
- Value - High — Many federally listed species

Unit D - Northern Firebreak
- Ignition - Moderate — No military training, but in close proximity to heavy use areas
- Hazard - High — Fuels are mostly composed of *Panicum maximum*
- Value - Low — No federally listed species

(2) By assigning values of 0, 1, and 2 to the low, moderate, and high designations respectively, and adding the values for ignition potential, hazard, and value, a priority level for each area has been determined:

Table 7.5.2
MMR Pre-Suppression Priority

Map Label	*Training Areas Included**	*Pre-Suppression Priority*
Unit C	Eastern & Northern MMR	5
Unit B	Southern MMR	4
Unit A	Southern Firebreak	3
Unit D	Northern Firebreak	3

7.5.5. Fire Protection

a. Firebreak System.

(1) MMR has an existing firebreak system that is designed to serve as control lines for fire containment and allow safe vehicle access for fire fighting personnel and equipment. (See Figure 11).

a. North Firebreak. The north firebreak is a roadway that completely circles the north training and impact area. Minimum training or live-fire takes place here. However, because of rough terrain, prescribed burning is usually the only fuel modification conducted in this area. Fuel loading within the north firebreak can be high depending on the last wildfire/prescribed burn.

b. South Firebreak. The south firebreak is a roadway that completely circles the south training and impact area. This is the critical firebreak since this is the area in which most of the training exercises takes place and where most of the fires start or escape. However, most of the fuel modifications are done here to prevent ignitions and fire escape.

c. Interior fire access roads within the south firebreak roads act as additional control lines during fire suppression. They serve to also assist with fuel modifications.

(2) Both firebreaks need to be maintained throughout the year to be effective. The MMR Range Operations Supervisor and the Wildland Fire Program Manager will coordinate with the Range Facility Maintenance Manager and Range Planner to develop an annual work plan that includes but is not limited to:

a. Capital improvements for new construction, maintenance and rehabilitation of existing fire/fuelbreaks.

b. Fuel modifications by mowing vegetation inside the firebreak road, providing terrain allows for the ability to reduce fuel loading (See Fuels Reduction below).

c. Chemical herbicide or growth retardant and prescribed burning techniques should be utilized whenever possible (See Fuels Reduction below).

d. Schedule of when firebreaks will be maintained throughout the year and by priority.

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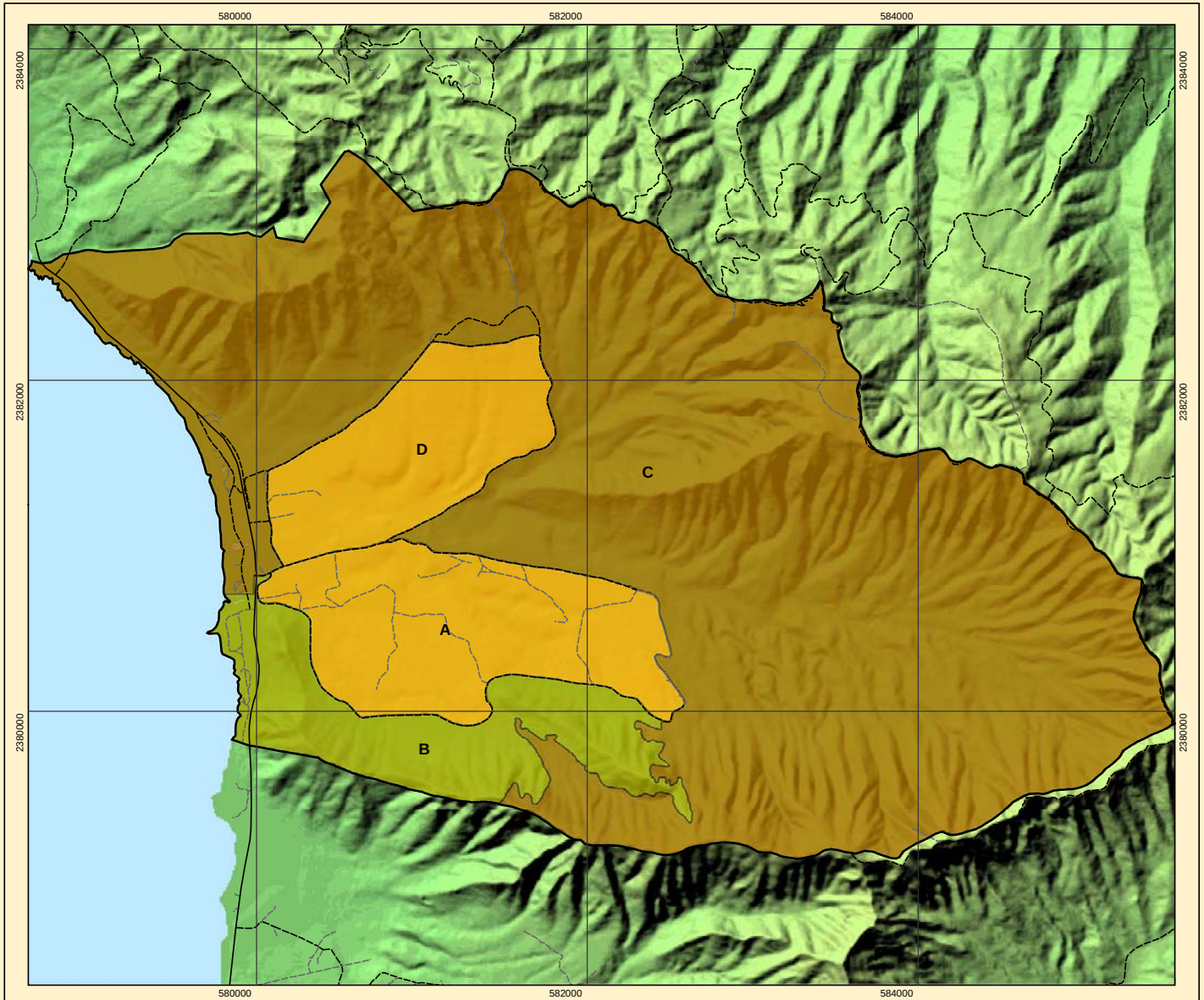


Makua Military Reservation
Pre-Suppression Priority

Figure 10

Legend

Pre-Suppression Priority

- None
- Low
- Moderate
- High
- Very High

- Installation Boundary
- Surface Water Body

Roads

- Primary
- Tertiary
- Unimproved

N

1:25,000

0 500 1,000 Meters

0 0.5 1 Mile

Data Source: Center for Environmental Management of Military Lands 2003

b. Fuels Reduction.

(1) Burning, mowing, chemical herbicides and grazing will all be considered as potential fuels management alternatives (see Figure 11).

(2) Fuels at MMR have been managed for a number of years using mowing and herbicide application.

a. Many of the frequently used sites within the south lobe of the firebreak are mowed to stubble height regularly. This will be continued.

b. Herbicide is applied on both sides of a majority of the length of the firebreak roads. It is applied by boom sprayer to the greatest distance this method will allow. This will be continued.

(3) Prescribed burning will be considered as an alternative within the installation.

a. Most prescribed burning will occur within the firebreaks to keep fuel loads under control, thereby preventing a major fire.

b. Occasionally, it may be necessary to burn areas outside of the firebreak roads. This will be carried out under the supervision of a Type 1 qualified Incident Commander and only when deemed absolutely necessary. The utmost care will be taken to ensure that no escaped fires are allowed, extra resources are on site, and that containment lines are sufficient. No prescribed burns will be allowed outside of the flat valley bottoms.

c. Special considerations are necessary for any prescribed burn at Makua Military Reservation. Because Makua is highly sensitive culturally and environmentally, damage to resources from prescribed fires is not acceptable. Though there is always a risk of escape, it must be minimized to a greater degree at Makua by establishing a greater margin of error during the planning phase of the burn. This may mean that certain management objectives will have to be achieved using other means. The following restrictions will apply to all prescribed fires within MMR without exception:

i. The determination of whether to burn on a given day will not be influenced by cost or the demands of any agency or entity. The decision to burn will be decided entirely by the conditions of the fuels, current and predicted weather, the quality and quantity of resources on site, and the best judgment of the Burn Boss.

ii. No prescribed burn will be ignited or allowed to continue during the Red fire danger rating category.

iii. All considerations for any prescribed fire will assume worst case fuel conditions (i.e. fully mature guinea and molasses grass), regardless of the conditions in the intended burn area.

iv. The prescription window will be written such that the hottest conditions will produce flame lengths of no more than 4.45m (11 ft). This determination will be made using the Custom Guinea Grass fuel model within the BEHAVE fire prediction program. Estimates of live fuel moisture will be made using the rough guidelines established by the NWCG on page B-29 of the Fireline Handbook.

v. Regardless of the other conditions in the prescription window, the relative humidity will not be less than 55%. Fire behavior at Rh's less than this value are often extreme.

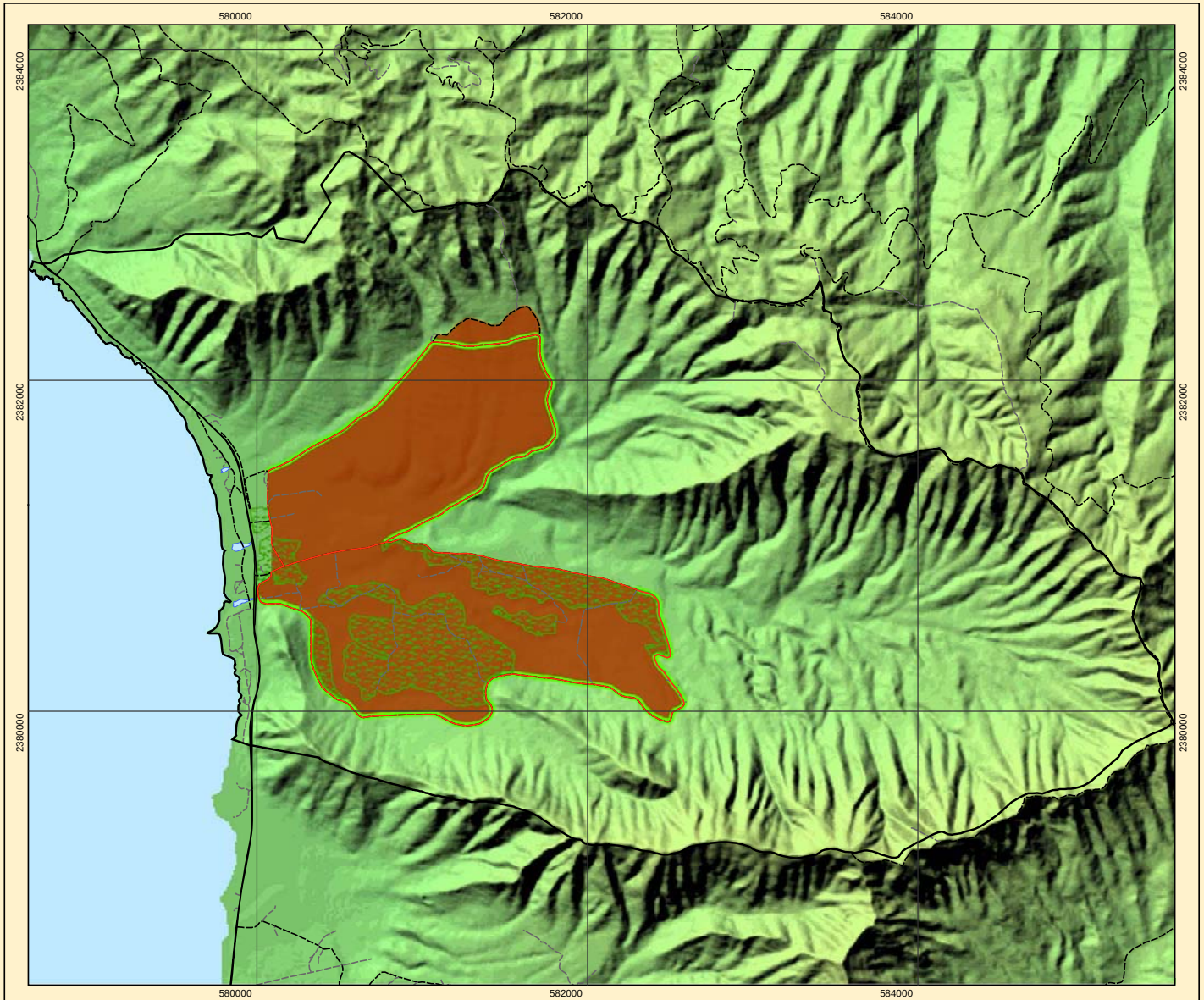
vi. Regardless of the other conditions in the prescription window, the maximum 20 foot windspeed will not be greater than 15 mph.

(4) Grazing will be considered as an option to control fuels, particularly within the northern half of the valley where there is very little training.

7.5.6 Project Budget FY 03 to 05*

PROJ/FEWR NO.	PROJECT TITLE	EST COST (x $1000)	FUNDED BY	FY
MMR 03-01/2	Prescribed Burn Plan 2- Settlement Agreement	**155**	IFSO	O3
TA100073J	Vegetation Control MMR	**330**	DPW ENV	O3
TA100083J	Upgrade MMR Water Distribution System	**90**	DPW	O4
TA100093J	Replace Dip Pond Liners at MMR	**60**	DPW TCCC	O4
EPR	Makua Implementation Plan (Wildfire Management)		DPW ENV	O4
	Total	**635**		

*See Annex I for the sustainment budget



Makua Military Reservation
Firebreaks and Fuels Management

Figure 11

Legend

- Firebreak
- Potential Prescribed Burning
- Herbicides
- Mowed Areas
- Installation Boundary
- Surface Water Body

Roads

- Primary
- Tertiary
- Unimproved

N

1:25,000

0 500 1,000 Meters

0 0.5 1 Mile

Data Source: Center for Environmental Management of Military Lands 2003
USARHAW IFSO

Table 7.5.3
Federally Listed Species
Makua Military Reservation and Neighboring Lands*

Federal Status	Hawaiian / Common Name	Scientific Name
PLANTS:		
Endangered	Mahoe	*Alectyron macrococcus* var *macrococcus*
Endangered	None	*Alsinidendron obovatum*
Endangered	None	*Bonamia menziesii*
Endangered	Kamanomano	*Cenchrus agrimonioides* var. *agrimonioides*
Endangered	Akoko	*Chamaesyce herbstii*
Endangered	Pauoa	*Ctenitis squamigera*
Endangered	Haha	*Cyanea grimesiana ssp. grimesiana*
Endangered	Haha	*Cyanea longiflora*
Endangered	Haha	*Cyanea superba ssp. superba*
Endangered	Haha	*Cyrtandra dentata*
Endangered	Haha	*Delissea subcordata*
Endangered	Fern, no common name	*Diellia falcata*
Endangered	Na'ena'e	*Dubautia herbstobatae*
Endangered	Spurge	*Euphorbia haeleeleana*
Endangered	Mahamehame	*Flueggea neowawraea*
Endangered	None	*Hedyotis degeneri* var. *degeneri*
Endangered	None	*Hedyotis parvula*
Endangered	None	*Hesperomannia arbuscula*
Endangered	Pepperwort	*Lepidium arbuscula*
Endangered	Nehe	*Lipochaeta tenuifolia*
Endangered	None	*Lobelia niihauensis*
Endangered	None	*Lobelia oahuensis*
Endangered	None	*Neraudia angulata* var *angulata*
Endangered	None	*Neraudia angulata* var *dentata*
Endangered	Kului	*Notorichium humile*
Threatened	Makou	*Peucedanum sandwicense*
Endangered	None	*Phyllostegia kaalensis*
Endangered	Laukahi kuahiwi	*Plantago princeps* var *princeps*
Endangered	Loulu	*Pritchardia kaalae*
Endangered	Snakeroot	*Sanicula mariversa*
Endangered	None	*Schiedea hookeri*
Endangered	None	*Schiedea kaalae*
Endangered	None	*Schiedea nutallii* var. *nutalii*
Endangered	None	*Silene lanceolata*
Endangered	None	*Spermolepis hawaiiensis*
Endangered	None	*Tetrmalopium filiforme* (both varieties)
Endangered	Opuhe	*Viola Chamissoniana ssp. Chamissoniana*
Animals:		
Endangered	Oahu tree snail	*Achatinella mustelina*
Endangered	Oahu elepaio bird	*Chasiempis sandwichensis gayi*
Endangered	Oahu creeper bird	*Paroreomyza maculata*
Endangered	Hawaiian hoary bat	*Lasiurus cinereus semotus*

*According to Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at Makua Military Reservation. November 2, 1998.