

Ecosystem Restoration Management Plan

MIP Year 14-18, Oct. 2017 – Sept. 2022

MU: Ohikilolo (Lower Makua)

Overall MIP Management Goals:

- Form a stable, native-dominated matrix of plant communities which support stable populations of IP taxa.
- Control fire, ungulate, weed, rodent and slug threats in the next five years to support stable populations of IP taxa.

Background Information

Location: Leeward side of Northern Waianae Mountains, Southern base of Makua valley

Land Owner: U.S. Army Garrison Hawaii

Land Managers: Oahu Army Natural Resources program

Acreage: 676 acres

Elevation Range: 1200-2200 ft.

Description: Ohikilolo (Makua) MU is located in the Makua Military Reservation (MMR). The area is accessed at the mouth of the valley, or by helicopter to LZs throughout the valley. The terrain of the lower portion of the MU includes deep gulches with steep walls, and broad ridges of mixed mesic to dry forest. The upper portion, above the steep sided walls of Makua Valley, is comprised mostly of steep slope to the crest of the ridge.

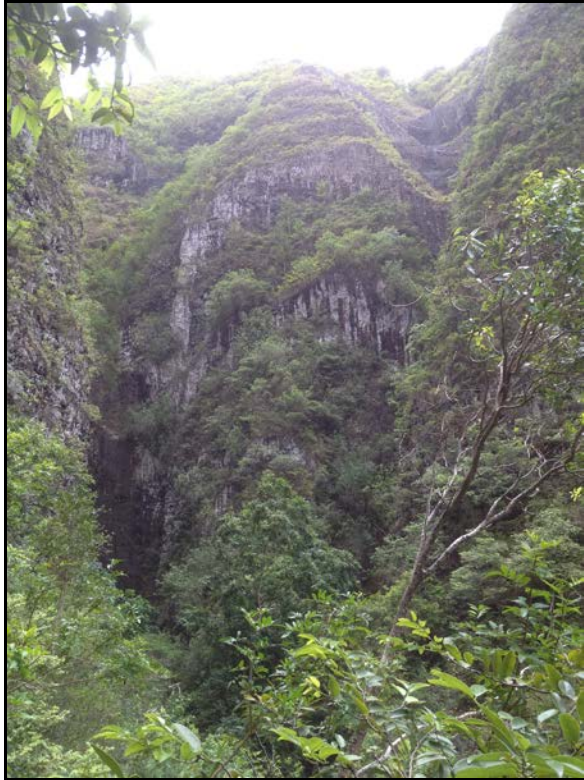
The Ohikilolo Management Unit (MU) is one of the larger MIP MUs. Management for this MU has long been divided informally among OANRP staff as the two following areas; Ohikilolo (Upper) and Lower Makua. The division is useful for management purposes because the access issues to each of the areas vary; large cliffs run approximately along the 2000 ft contour between the two. Due to unexploded ordinance (UXO) issues near the access point at the mouth of the valley the MU can only be accessed via helicopter. Lower Makua also requires contract support from UXO specialists. The two 'areas' have been treated separately in past reports because of geographic barriers; therefore, they require different management approaches. In 2012, the ecosystem restoration plan for the area discussed here was referred to as Ohikilolo (Makua)

There are many challenges to management in Makua. Access is limited, and scheduling with Range Control and UXO specialists is required, due to the large amount of UXO present in the valley. Additionally, there are ungulates in the MU, and recently there have been efforts to control animals within the MU, which include, snaring and fence construction. Currently, there are relatively few IP taxa that remain in this MU, in turn, NRS is required to accommodate actions here against actions at other MU's that contain more IP taxa.

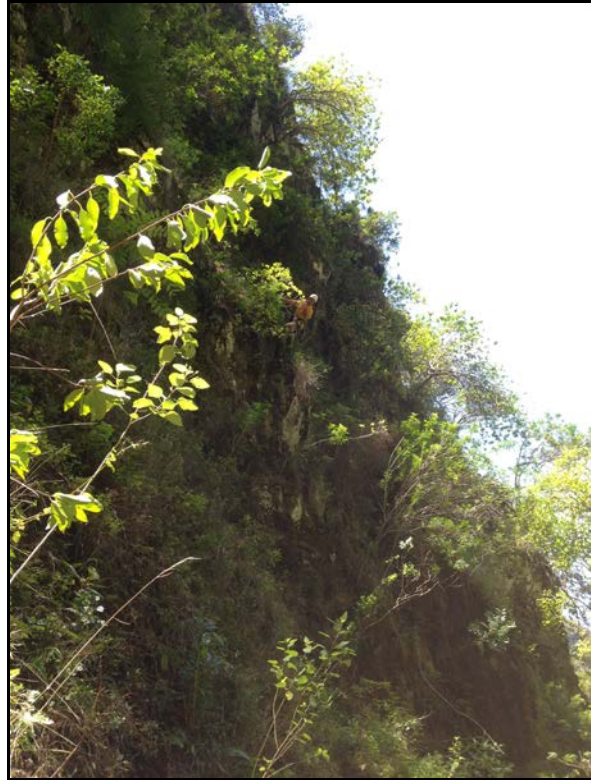
Native Vegetation Types

Wai‘anae Vegetation Types	
Dry forest	<p><u>Canopy includes: <i>Diospyros</i> sp., <i>Psydrax odoratum</i>, <i>Nestegis sandwicensis</i>, <i>Myoporum sandwicense</i>, <i>Erythrina sandwicensis</i>, <i>Reynoldsia sandwicensis</i>, <i>Rauvolfia sandwicensis</i>, <i>Santalum ellipticum</i>, and <i>Myrsine lanaiensis</i>.</u></p> <p><u>Understory includes: <i>Dodonaea viscosa</i>, <i>Sida fallax</i>, <i>Bidens</i> sp., <i>Microlepia strigosa</i></u></p>
<p>NOTE: For MU monitoring purposes vegetation type is mapped based on theoretical pre-disturbance vegetation. Alien species are not noted.</p>	

Terrain Vegetation Types at Makua



Makua valley floor looking South



Steep cliffs of Ko‘iahi gulch looking East towards cliffs above



Photo taken from the Kahanahaiki overlook looking south to Makua

MIP Rare Resources

Organism Type	IP Species	Population Reference Code	Population Unit	Management Designation	Wild/ Reintroduction
Plant	<i>Alectryon macrococcus</i> var. <i>macrococcus</i>	MMR- A,D,E, F, O-R	Makua	MFS	Wild
Plant	<i>Flueggea neowawraea</i>	MMR-C, D, E	Ohikilolo	GSC	Wild
Plant	<i>Melanthera tenuifolia</i>	MMR-C, I, J	Ohikilolo	GSC	Wild
Plant	<i>Neraudia angulata</i> var. <i>angulata</i>	MMR- A, D, E	Makua	MFS	Both
Plant	<i>Nototrichium humile</i>	MMR-D,E,H,I	Makua (S. side)	MFS	Both
Bird	<i>Chasiempis ibidis</i>	N/A		Manage	Wild

MFS= Manage for Stability GSC=Genetic Storage Collection

Other Rare Taxa at Ohikilolo MU- Makua

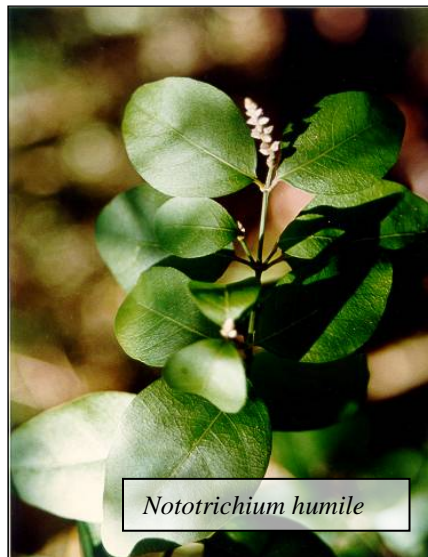
Organism Type	Species	Status
Plant	<i>Alphitonia ponderosa</i>	Species of concern
Plant	<i>Bobea sandwichensis</i>	Species of concern
Plant	<i>Bonamia menzesii</i>	Endangered
Plant	<i>Ctenitis squamigera</i>	Endangered
Plant	<i>Asplenium dielfalcatum</i>	Endangered
Plant	<i>Korthalsella degneri</i>	Endangered
Plant	<i>Lobelia niihauensis</i>	Endangered

Plant	<i>Ocrosia compta</i>	Endangered
Plant	<i>Pleomele forbesii</i>	Endangered
Plant	<i>Pteralyxia macrocarpa</i>	Endangered
Plant	<i>Sideroxylon polynesianum</i>	Endangered
Bat	<i>Lasiurus cinereus semotus</i>	Endangered

Locations of rare resources at Ohikilolo (Lower Makua)

Map removed to protect rare resources

Rare Resources at Makua



MU Threats to MIP MFS Taxa

Threat	Rare Taxa Affected	Management Strategy	Current Status, 2017
Pigs	All	Across MU	Still Present in MU. Ongoing snaring in progress. Extensive removal ongoing.
Goats	All	Across MU	No animals within fence
Weeds	All	Rare taxa sites primarily, across MU secondarily	Regular maintenance required several times per year
Black Rat	<i>Chasiempis ibidis</i> , Potential threat to <i>N. angulata</i> and <i>N. humile</i>	Across MU	There are currently no Elepio pairs in Makua therefore, no control necessary at this time.
Feral Cat	<i>Chasiempis ibidis</i>	No control	There are currently no Elepio pairs in Makua therefore, no control necessary at this time.
Mongoose	<i>Chasiempis ibidis</i>	No control	There are currently no Elepio pairs in Makua therefore, no control necessary at this time.
Slugs	Potential threat to <i>N. angulata</i> and <i>N. humile</i>	Affected rare taxa sites only	No control necessary at this time

Management History

- 1929: Army began taking parcels of land for military training.
- 1943: Military gains control of entire valley
- 1995-1997: Ground hunts were started with the use of contract hunters from the U. S. Department of Agriculture Wildlife Services while plans to install a perimeter fence to enclose MMR along the ridge crest were finalized.
- 1996-1997: The first stretch of fencing (3 km) separating MMR from the Keaau game management area was completed by the National Park Service and ~8 km of fencing was erected around the eastern perimeter of the valley.
- 1998: Large fire in Makua, live fire training is halted.
- 1999: Contract and Staff ground hunts continued from 1997-1999 to control numbers of goats. OANRP began to employ neck snares as a management tool.
- 2001: The portion of the fence from Makaleha (3 points) to the Ohikilolo camp was completed by Ranch Services separating the valley from the core populations of goats to the south and OANRP staff employed aerial shooting and “Judas goats” as management tools.
- 2001-2004: Army resumes live fire training on a limited basis.
- 2002: NRS completed a small fence around a single *F. neowawraea* at MMR-C.
- 2003: A breach in the fence allowed at least three goats to cross over from Makaha Valley into Makua Valley. These three goats were subsequently caught and no more sign was observed in the area of the breach. NRS completed a strategic fence (MMR-G) protecting *N. angulata* MMR-D, after which the *N. angulata* MMR-E reintroduction population was established to augment the existing MMR-D population.
- 2004: OANRP with help from Wildlife Services eradicated feral goats from the entire MU.

- 2005: OANRP completed two strategic fences (MMR-H) in the back of Koiahi gulch; they protect *N. angulata*.
- 2006: Four goats breached perimeter fence, all were caught.
- 2009: Last two mating pairs of elepaio observed.
- 2011: Forest tree line mapped from helicopter using GPS to establish accurate weed control boundaries.
- 2013: NRS completed strategic fence (MMR-J) creating protected habitat for outplanting *N. angulata* MMR-I outplanting.
- 2015: Access restricted due to UXO incident and closure of trail from fire break road due to UXO piled up near trail access.
- 2016: Final section of perimeter fence built on Farrington Highway; initiated snaring program within MU.

Ungulate Control

Species: *Sus scrofa* (pig) and *Capra hircus* (goat)

Threat Level: Medium for pigs; Most of the rare taxa affected by pigs are protected by smaller enclosures yet, pigs still pose a threat to broader ecosystem. Medium for goats; Goats have breached the Ohikilolo on occasion, there are numerous goats on the south facing slope of Kea'au. The last capture of goat inside the fenced area was in 2013 near "Ctinitus Ridge".

Management Objectives:

- To maintain all areas of the MU as goat-free and the fenced areas as pig-free.
- An ungulate eradication program has been initiated to remove all ungulates from the Valley. OANRP has started the program by installing snares throughout the Valley. Once RCUH completes an approved firearm use SOP OANRP can begin to use live traps and baiting stations to expand the number of tools in use.

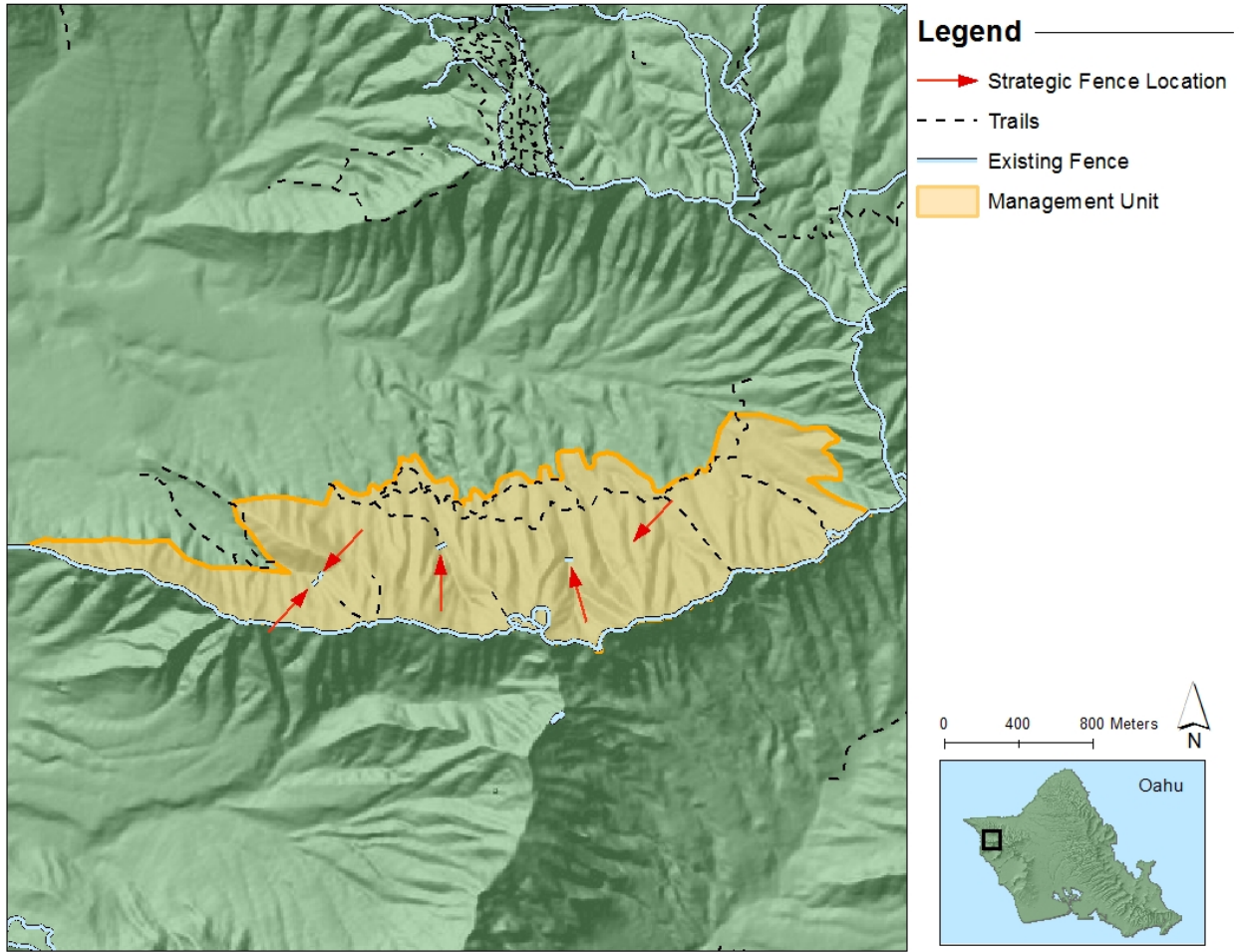
Strategy and Control Methods:

- Maintain MU as goat free, and continue snaring efforts if detection of goats is found.
- Conduct fence checks when access is granted.
- Note any pig sign while conducting day to day actions within fences.
- If any pig activity is detected, work with Ungulate Management/Elepaio Stabilization Coordinator to implement snaring.

Discussion: There are five small fences in this portion of the MU. Given the small sizes of the fence, it is especially important that ungulates do not enter and become trapped in the fence as extensive damage can quickly occur. Checks (including maintenance) on fence integrity will be conducted, as well as, monitoring for ungulate sign during the course of other field activities. The major threats to the fence include falling rocks from steep areas above the units, streams carrying rocks down gulches into the fence, fallen trees, and pigs uprooting areas beneath the fence line. Fences are also checked after extreme weather events.

A pig eradication program has been initiated utilizing neck snares across MU and the greater valley of Makua. Snares are strategically placed near strategic fences, wallows, and water sources. Poachers still hunt the valley illegally and vandalism had been documented in which snares are repeatedly tampered with.

Ungulate Management



Weed Control

Weed Control actions are divided into 4 subcategories:

- 1) Vegetation Monitoring
- 2) Surveys
- 3) Incipient Taxa Control (Incipient Control Area - ICAs)
- 4) Ecosystem Management Weed Control (Weed Control Areas - WCAs)

These designations facilitate different aspects of MIP/OIP requirements.

Vegetation Monitoring

MU Vegetation Monitoring

As previously discussed, this large MU has been divided into different regions to facilitate management. Vegetation cover across the Ohikilolo (Upper) section was monitored in 2010 and again on 2016. The steep cliffs dividing Ohikilolo (Upper) from Ohikilolo (Makua) cannot be monitored for vegetation cover at the current time. Remote monitoring technologies are being considered and if a feasible methodology becomes available, vegetation cover monitoring may take place in this cliff community. Installing gigapan stations at the Makua lookout at Kahanahaiki will be explored to guide *T. ciliata*, *G. robusta*, and other low numbered weed taxa to guide management. This document focuses on the lowest elevation section of the MU, Ohikilolo (Makua). As defined by the MIP, the major vegetation cover goals are as follows:

Primary Management Objective:

- Assess if the percent cover for both the alien understory and canopy is 50% or less across the entire management unit (Oahu Implementation Team *et al.* 2008). If alien species cover is not below the 50% goal, use repeated MU monitoring to determine whether or not the value of alien species is decreasing significantly toward that goal.

Secondary Management Objective:

- Assess if the percent cover for both the native understory and canopy is 50% or more across the entire management unit (Makua Implementation Team *et al.* 2003). If native species cover is not above the 50% threshold, use repeated MU monitoring to determine whether or not the value of native species is increasing significantly toward that goal.

Sampling Objective:

- Be 95% confident of detecting a 10% change in both non-native and native understory vegetation in the understory and canopy.
- The acceptable level of making a Type 1 error (detecting a change that did not occur) is 10% and a Type 11 error (not detecting a change that did occur) is 20%.
- Minimum detected change between two samples being compared is 10% over the sampling period.

Given the low number of MIP taxa (5) located in the Makua portion of the MU, OANRP has decided that investigating the primary and secondary management objectives at this time is not the highest priority for monitoring staff. Also, since Makua is entirely in an UXO area and entry requires an UXO escort, ground-based monitoring would be very expensive.

Surveys

Potential Vectors: Army Training, OANRP staff, pigs, poachers, wind.

Management Objective:

- Prevent the establishment of any new invasive alien plant or animal species through regular surveys along, landing zones, camp sites, fencelines, trails, and other high traffic areas (as applicable).

Strategy and Control Methods:

- Survey LZs and Campsites used in the course of field work, not to exceed once per quarter.
- Note unusual, significant, or incipient alien taxa during the course of regular field work, particularly *Cenchrus setaceus*
- Map and complete Target Species form to document sighting.

Management Responses:

- Any significant alien taxa found will be researched and evaluated for distribution and life history. If found to pose a major threat, control will begin and will be tracked via Incipient Control Areas (ICAs)

Surveys are designed to be the first line of defense in locating and identifying potential new weed species. Landing zones, fencelines, and other highly trafficked areas are inventoried regularly; (Army roads are covered by the Lower Ohikilolo ERMUP) LZs are surveyed annually and transects are surveyed at least annually, while all other sites are surveyed quarterly or as they are used. At Makua, only landing zones and transects are currently surveyed regularly.

Incipient Taxa Control

All weed control geared towards eradication of a particular invasive weed is tracked via Incipient Control Areas, or ICAs. Each ICA is species-specific and geographically defined. One infestation may be divided into several ICAs or one ICA, depending on infestation size, topographical features, and land ownership. Some ICA species are incipient island-wide, and are a priority for ICA management whenever found. Others are locally incipient to the MU, but widespread elsewhere. In either case, the goal is eradication of the ICA. The goals, strategies, and techniques used vary between ICAs, depending on terrain, surrounding vegetation, target taxon, size of infestation, and a variety of other factors.

Management Objectives:

- Eradicate ICAs through regular and thorough monitoring and treatment. In the absence of any information about seed bank longevity for a particular species, eradication is defined as 10 years of consistent monitoring with no target plants found.
- Study seed bank longevity of ICA taxa, and revise eradication standards per taxon.
- Evaluate any invasive plant species newly discovered in MU, and determine whether ICA-level control is warranted. Factors to consider include distribution, invasiveness, location, infestation size, availability of control methods, resources, and funding.

Strategy and Control Methods:

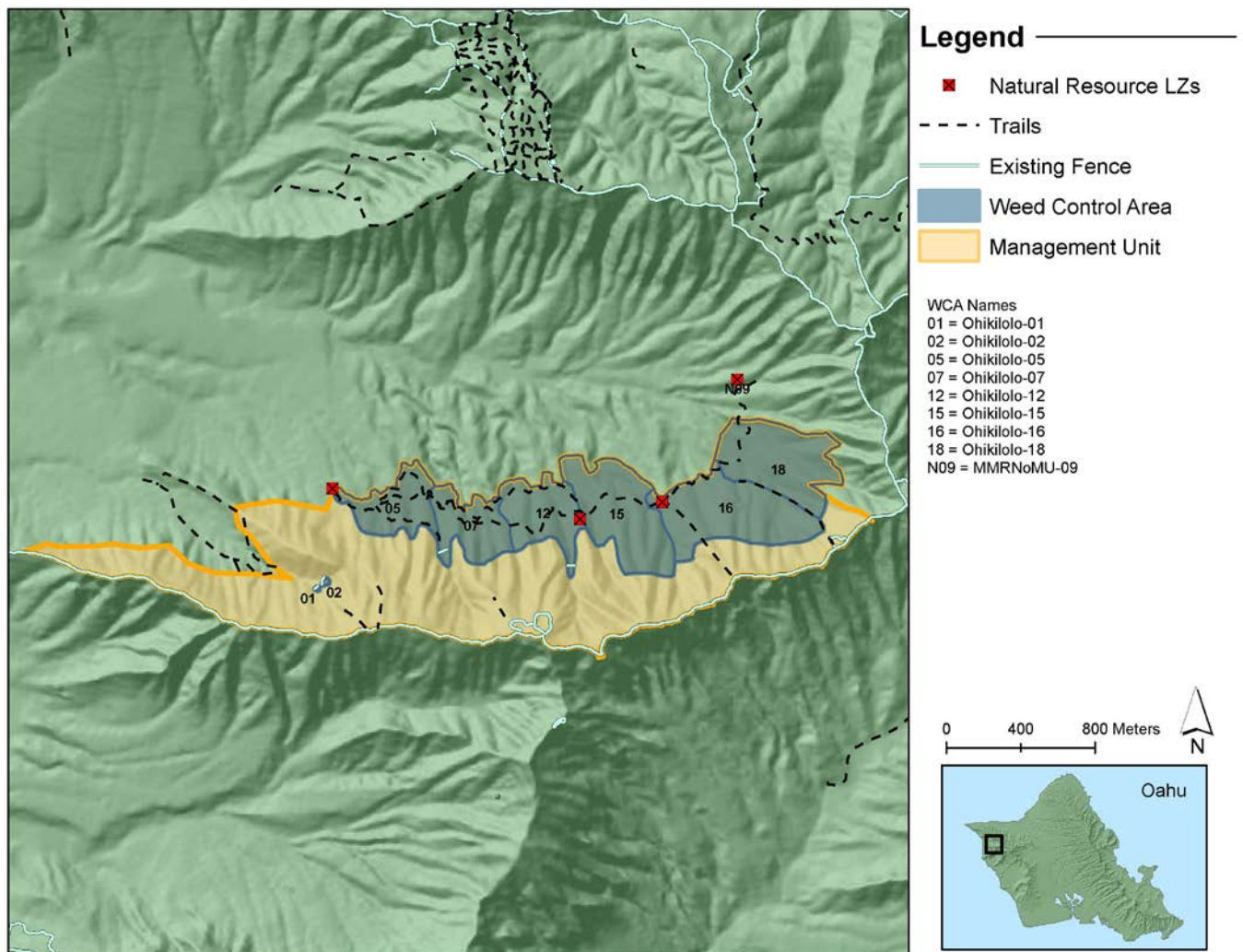
- Species and ICAs are listed in the table below. History and strategy is discussed for each species.
- Monitor the progress of management efforts, and adjust visitation rates to allow staff to treat plants before they mature. Remember that one never finds 100% of all plants present.

- Use aggressive control techniques where possible. These include power spraying, applying pre-emergent herbicides, clearcutting, aerial spraying, and frequent visits.

There is only one incipient species identified by OANRP in the MU, but due access challenges the ICA is not visited frequently. OANRP will continue to monitor and conduct incipient control when appropriate.

Taxon	ICA Code	Control Discussion
<i>Sideroxylon persimile</i>	MMR-Sidper-01	<i>S. persimile</i> is found in abundance just to the south of the Makua MU in lower stretches of Makaha valley. The ICA is located at Makua Well site, at bottom of NerAng gulch. One immature tree found in 2013. Tree was cut down at that time, but staff did not have herbicide. NRS have not been back to monitor due to Range entry restrictions around UXO stockpile.

Weed Control Areas



Ecosystem Management Weed Control

All weed control geared towards general habitat improvement is tracked in geographic units called Weed Control areas, or WCAs. The goals, strategies, and techniques used vary between WCAs, depending on terrain, quality of native habitat, and presence or absence of rare taxa.

MIP Goals:

- Within 2m of rare taxa: 0% alien vegetation cover except where alien removal causes harm.
- Within 50m of rare taxa: 25% or less alien vegetation cover
- Throughout the remainder of the MU: 50% or less alien vegetation cover

Management Objectives:

- In lieu of any vegetation monitoring, goal is to focus efforts within 50m of rare taxa and through forest patches, and in these areas work towards reducing alien cover to 50% or below.
- No monitoring is in place for any of the MIP goals for this portion of the MU. Instead, gigapan photo points will be installed to detect novel alien canopy weeds, which will be a priority for control.
- If monitoring for any MIP goal is installed, and if results suggest goals are not being met, staff will increase/expand weeding efforts.

The Lower Makua dry forest is unique, with impressively tall native canopy and numerous *Ochrosia compta*. There are large groves of native-dominated dry forest, and qualitative observations of weeded areas suggest that these areas are recovering well. However, there is continued pressure at the forest edge from encroaching alien grasses.

WCAs are divided by a series of ridges and gulches and need to be GPSed to aid weed data tracking. The WCA numbers are not sequential as Ohikilolo (Makua) and Ohikilolo (Upper) together make up the Ohikilolo MU. WCAs are prioritized based upon rare resources and the status of each WCA based upon staff observations. WCAs closer to the campsite will be a higher priority for conducting large scale canopy sweeps. During the next five years NRS will be rotating between Ohikilolo-12, Ohikilolo-15, and Ohikilolo-16, focusing on one WCA per year. Large scale weed sweeps often include the use of chainsaws to girdle large trees before applying herbicide. Incision Point Application (IPA) will be used to on bigger trees during target canopy sweeps.

UXO is a major safety concern. If an area is deemed unacceptably dangerous, NRS will not conduct weed management in it. This is particularly true for specific types of UXO that can be obscured by dense grass, and areas where dense grass obscures the ground.

Summary of Target Taxa

Taxa	Distribution	Notes
<i>Araucaria columnaris</i>	Restricted	No <i>A. columnaris</i> is known from the Makua portion of the MU, but it is known from Ohikilolo (Upper). It has wind-dispersed seed, and immature trees have been found more than 300m from the now-dead source tree. If found in Makua, it should be controlled. No herbicide is required for control of immature; they can be pulled or simply cut down. Bigger trees can be controlled utilizing IPA methods.
<i>Blechnum appendiculatum</i>	Widespread	This invasive fern should be target in areas directly around rare taxa. It forms thick mats that may inhibit successful establishment of seedlings

<i>Caesalpinia decapetala</i>	Restricted	This thorny vine, once established, is horrendous to walk through and control. Any locations found should be GPSed, controlled, and possibly designated as ICAs.
<i>Cenchrus setaceus</i>	Restricted	Highly invasive, there is an infestation of this grass to the south on Ohikilolo ridge. This is a high priority for control everywhere on the Waianae coast. No plants are currently known from this MU, but staff will be vigilant in looking for new incursions of this taxon.
<i>Coffea arabica</i>	Widespread	While common in Koiahi gulch, <i>C. arabica</i> is not known from areas east of Koiahi ridge. It should be a priority for early detection and rapid control. Can be controlled utilizing IPA methods.
<i>Fraxinus uhdei</i>	Restricted	One large mature tree was known from Ohikilolo (Upper), but none are currently known from Makua. If found, this is a high priority for control.
<i>Grevillea robusta</i>	Widespread	<i>G. robusta</i> has wind dispersed seeds, colonizes cliffs, and is allelopathic. It should be controlled during WCA sweeps. Can be controlled utilizing IPA methods.
<i>Heliocarpus popayensis</i>	Restricted	Uncommon in the MU, <i>H. popayensis</i> was seen and controlled once in the past 10 years. Trees are large, soft-wooded, with wind-dispersed seed. It can form large stands. This is a high priority target. Can be controlled utilizing IPA methods.
<i>Leucaena leucocephala</i>	Widespread	Common in the MU, this is a target whenever seen near native forest patches. It is best controlled with Garlon 4 in a 40% mix or with IPA Milestone.
<i>Melia azedarach</i>	Widespread	This tree is widespread, but not very common. It is a target in WCAs.
<i>Melinis minutiflora</i>	Widespread	Grasses are a high priority target for control in WCAs, particularly (but not only) around native forest.
<i>Montanoa hibiscifolia</i>	Scattered	This shrubby tree grows quickly, thrives in dry, steep habitats, and produces wind-dispersed seed. It should be controlled wherever seen.
<i>Morella faya</i>	Restricted	One <i>M. faya</i> was controlled in Ohikilolo (Upper) years ago. If any plants are found, they should be controlled immediately and monitored as an ICA. Can be controlled utilizing IPA methods.
<i>Psidium cattleianum</i>	Widespread	By far the most common canopy weed, <i>P. cattleianum</i> is the primary target of WCA control. Trees in and near native forest patches are highest priority. Care should be taken not to open large stands of <i>P. cattleianum</i> , creating light gaps optimal for grasses. Can be controlled utilizing IPA methods.
<i>Schinus terebinthifolius</i>	Widespread	Widespread across the MU, <i>S. terebinthifolius</i> becomes the dominant vegetation as the ridges climb in elevation. Not a priority in the upper regions but will be controlled on target sweeps in lower elevations; not a priority. Can be controlled utilizing IPA methods.
<i>Spathodea campanulata</i>	Scattered	While this tree has a wide distribution, it is not common in the MU. It should be treated wherever seen. Can be controlled utilizing IPA methods.
<i>Sphaeropteris cooperi</i>	Restricted	Found only a few in nearby gulches. Zero tolerance for this species. Control shall be recorded in WCAs.
<i>Syzygium cumini</i>	Widespread	With its thick bark, <i>S. cumini</i> is difficult to control. Chainsaw girdling and Garlon application are most effective. IPA is not effective on this species. Need more trials to determine what herbicide works. This tree should be targeted around native forest patches.
<i>Toona ciliata</i>	Scattered	No large monoculture stands of <i>T. ciliata</i> are currently known from Makua. If left unchecked, this tree would likely behave as it has in Makaha and Kaluaa. It is a priority target and should be controlled whenever seen. IPA with Milestone and Polaris is effective.
<i>Triumfetta semitrilobata</i>	Widespread	This shrub should be controlled around rare taxa and along trails.
<i>Urochloa maxima</i>	Scattered	Formerly <i>Panicum maximum</i> . This grass has a very high burn index. Any patches in/near native forest patches are a high priority for control.

WCA: Ohikilolo-01 (Koiahi, South Nerang)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *S. campanulata*, *T. ciliata*, *Ageratina adenophora*, *Buddleia asiatica*, *Melinis minutiflora*

Notes: This area is degraded with few native species remaining, and work is focused tightly around plants/base of cliff in hopes of fostering recruitment. *N. angulata* are present at the back of the gulch on cliffs. There are a few *N. humile* at the foot of the cliffs. Fence repairs are periodically needed due to large boulders washing down the gulch and cliffs above. Weeding should be prioritized around *Microlepis strigosa* as it fills in after weed removal and provides a dense understory. Invasive grasses and ferns can be controlled around native plants.

WCA: Ohikilolo-02 (Koiahi, North Nerang)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *M. minutifolia*, *Blechnum appendiculatum*, *A. adenophora*, *Psidium cattleianum*

Notes: This area is degraded with few native species remaining, and work is focused tightly around *N. angulata* plants at the base of the cliff they occur to encourage favorable habitat for recruitment. There are a few *N. angulata* at the foot of the cliffs but the majority of the plants are located on the inaccessible cliffs. Fence repairs are periodically needed due to large boulders falling from cliffs above. Weeding should be prioritized around *Microlepis strigosa* as it fills in after weed removal and provides a dense understory. Invasive grasses can be hand pulled around native plants, but eliminating large patches of grass is difficult because water has to be hiked in for herbicide.

WCA: Ohikilolo-05 (Firebreak Road to Banana Gulch)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *S. campanulata*, *Montanoa hibiscifolia*, *Melia azedarach*, *Syzygium cumini*, *P. cattleianum*

Notes: Currently this WCA is difficult to access due to the UXO stock pile near trailhead. Therefore, actions are not scheduled until issues are resolved. Two populations of *Bohea sandwichensis* are present in this gulch. Continued non-native canopy removal may help with the re-establishment of native seedlings. Grass control is needed on the western end of the WCA to minimize ingress into the native forest. *M. strigosa* was noted filling in the gaps after weed control. Spraying grass below *Dodonaea viscosa* at the top of ridges will perhaps aid native recruitment. Some gulches are fairly native-dominated in the understory and canopy, with *Diospyros sandwicensis* being the most common species. Large overstory of invasive trees like *Aleurites moluccana* and *Syzygium cumini* are encroaching into gulch areas and towards the base of cliffs. The ridges are largely unforested at the north end of the WCA, where the grass encroaches to the forest edge. At the edge of the grassy ridges there is a border of *P. cattleianum* that prevents grass from moving upslope of the gulch. Most weeding efforts are concentrated on the eastern part of the WCA, close to the border of WCA 7, due to the presence of native-dominated forest nearby.

WCA: Ohikilolo-07 (Nerang to Well Ridge)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *B. appendiculatum*, *M. hibiscifolia*, *T. ciliata*, *S. terebinthifolius*, *A. adenophora*

Notes: The majority of weeding efforts in this WCA occur in an area known as “Banana gulch”, where populations of *Melanthera tenuifolia*, *Nototrichium humile*, and *Neraudia angulata* are located. They are protected by a small strategic fence in the back of a slot gulch on the west end of the WCA. *N. angulata* was reintroduced but there was a low survival rate, therefore there are no scheduled actions to weed within this area for the next five years. Target sweeps will be focused in Ohikilolo-12 and Ohikilolo-15 due to their close proximity to camp. In the past, weeding efforts have been focused along the trails within this WCA. Continued non-native canopy removal may help native seedlings establish. Large overstory invasive trees like *Aleurites moluccana* and *Syzygium cumini* are encroaching on gulches and farther back into slot gulches towards the base of cliffs. The ridges are largely unforested at the north end of the WCA where the grass encroaches to the forest edge.

WCA: Ohikilolo-12 (Ron’s Rock to Dividing Ridge)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *P. cattleianum*, *G. robusta*, *S. campanulata*, *T. ciliata*, *S. cumini*, *S. terebinthifolius*

Notes: A small fence was built in the back of the main gulch of this WCA and *N. angulata* was reintroduced. Priority is to maintain the weeds around the *N. angulata* and clear the fence. Continued non-native canopy removal may help native seedlings re-establish in the gulches. Large overstory of invasive trees like *Aleurites moluccana* and *Syzygium cumini* are encroaching into gulches and farther back into slot gulches towards the base of cliffs. The ridges are largely unforested at the north end of the WCA where the short grasses encroach to the forest edge. At the edge of the grassy ridges, there is a border of *P. cattleianum* to slow its progress further into the slopes of the gulch. This WCA is somewhat unique, in that there are archeological sites as well as *Sideroxylon polynesianum*, a rare tree/shrub found in dry forest areas.

WCA: Ohikilolo-15 (Dividing Ridge to Campsite)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *P. cattleianum*, *G. robusta*, *S. campanulata*, *T. ciliata*, *S. cumini*, *S. terebinthifolius*

Notes: This is one of the largest WCAs in Makua. Due its location, just a few ridges over and west of the Lower Makua Campsite DZ, accessibility allows for more frequent plant monitoring and weeding. This large area is home to several managed taxa including *F. neowawraea* (fenced), *A. macrococcus*, and *B. sandwicensis*. Additional native plants present in this area include *D. sandwichensis*, *P. odoratum*, *Sapindus oahuensis*, *Nestegis sandwicensis*, and the rare *Alphitonia ponderosa*; it is a high priority for WCA canopy sweeps. Continued non-native canopy removal may help native and endangered seedlings re-establish. Luckily there is not much grass under the very tall native and non-native canopy. Preventing grass on the ridge from entering the gulches is a priority, so leaving monotypic stands of *P. cattleianum* is necessary to form a barrier to grass ingress. There is an increasing population of *Toona ciliata* in the western most gulch and scattered throughout the WCA. Sweeps targeting *T. ciliata* will be conducted in order to prevent this species from establishing in gulches.

WCA: Ohikilolo-16 (Campsite to Arch site)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *P. cattleianum*, *G. robusta*, *S. campanulata*, *T. ciliata*, *S. cumini*, *S. terebinthifolius*

Notes: Commonly referred to by staff as “The Nicest Patch Ever,” this WCA contains an abundance of common and rare natives, as well as endangered taxa including, Elepaio. Care must be taken to not impact trees that Elepaio nests and fledglings are found. Future efforts will focus on sweeps up towards steep cliffs, due to the close proximity of Campsites/LZs to weeding areas. Large, monotypic stands of *P. cattleianum* will be avoided, and weeding will focus on chainsaw girdling and herbicide application to *P. cattleianum* that is intermixed with natives. Although the highest concentrations of *Alectryon macrococcus* var. *macrococcus* reside here, there has been a steady decrease possibly due to rat predation, disease, and black twig borer (*Xylosandrus compactus*) damage. In the past, extensive weed control focused on this intact native forest due to the presence of native tree canopy. The WCA is responding well to weeding efforts, with increasing amounts of native understory plants. Continued follow-up weeding will prevent alien overstory species from establishing.

WCA: Ohikilolo-18 (CteSqu to FluNeo)

Veg Type: Dry forest

MIP Goal: Less than 25% non-native cover

Targets: *G. robusta*, *S. campanulata*, *T. ciliata*, *P. cattleianum*, *S. cumini*, *M. hibiscifolia*

Notes: This WCA contains Elepaio, as well as rare and endangered taxa such as, *A. macrococcus* var. *macrococcus*, *Pteralyxia macrocarpa*, *A. ponderosa*, and *Ctenitis squamigera*, but weed control here is a low priority. Continued non-native canopy removal may help native seedlings re-establish. There are several native patches within this area that are threatened by dense stands of *P. cattleianum*. One the most effective weed control efforts to combat this weed involves chainsaw girdling. Trials are still in place to test the efficacy of IPA methods on *P. cattleianum*. In doing so, it is important to prevent large light gaps that could allow invasive weeds to establish in the understory. The priority for this WCA is to concentrate weeding efforts in the flat area below *A. ponderosa*.

WCA: MMRNoMU-09 (Elepaio 15 LZ)

Veg Type: Dry forest

MIP Goal: None

Targets: *G. robusta*, *S. campanulata*, *T. ciliata*

Notes: This LZ was created to assist the monitoring of Elepaio in the gulches upslope. This small area is rarely used. It was cleared of weeds and overhanging vegetation in 2016 to ensure a safe and appropriate LZ and has been maintained as needed. If access to this part of the valley is needed in future, additional maintenance be performed.

Small Vertebrate Control

Species: *Rattus rattus*, *Mus musculus*

Threat level: Low

Seasonality/Relevant Species Biology: Year round.

Management Objectives:

- Monitor rare taxa populations of *N. angulata* for rat damage; promptly initiate control if damage is noted.

Strategy and Control Methods:

- Monitor *N. angulata* populations, as well as other native species to determine impacts by rodents.

Discussion: Currently no rodent control is conducted by OANRP at Lower Makua since rodents are not deemed a threat at this time. If rare plants are determined to be impacted adversely by rodents, OANRP will evaluate the use of localized rodent control for the protection of these species. Given the small size and dry habitat, a grid of A-24 traps might effectively reduce rat numbers to allow for even greater regeneration of fruiting canopy species like *Diospyros spp.* which already recruits more readily than other native canopy species.

Slug Control

Species: *Deroceras laeve*, *Limax maximus*

Threat level: Low

Seasonality/Relevant Species Biology: Tend to be more active in the wet season

Management Objectives:

- Note any feeding damage to *Neraudia angulata* and *Nototrichium humile* suspected to be caused by slugs.
- If damage is observed, determine slug abundance in the area and potentially initiate molluscicide application.

Slugs have not, to date, been observed feeding on *Neraudia angulata* and *Nototrichium humile*. Both taxa occur in habitat frequented by slugs making contact possible. Additionally, slugs are not abundant in dry forest. They are not a high threat to any rare taxa in this area.

Ant Control

Species: *Plagiolepis alludi*, *Anoplolepis gracilipes*

Seasonality/Relevant Species Biology: Varies by species, but nest expansion observed in late summer, early fall

Management Objectives:

- Eradicate incipient ant invasions and control established populations when densities are high enough to threaten rare resources.
- Sample ants at human entry points a minimum of once a year. Use samples to track changes in existing ant densities and to alert NRS to any new introductions.

Strategy and Control Methods:

- If incipient species are found and deemed to be a high threat and/or easily eradicated locally (<0.5 acre infestation) begin control.
- Determine extent of *A. gracilipes* infestation, if small, eradicate locally using Safari 20 SG
- Ant populations will be kept to a determined acceptable level across the MU to maintain ecosystem health.

Ants have been documented to pose threats to a variety of resources, including native arthropods, plants (via farming of Hemipterian pests), and birds. The distribution and diversity of ant species across the lower Makua MU has not yet been sampled.

Black Twig Borer Control

Species: *Xylosandrus compactus*

Threat level: High

Seasonality/Relevant Species Biology: Peaks have been observed from October to January on Oahu

Management Objectives

- Reduce BTB populations to a level optimal for *Flueggea neowawraea* survival.
- Annual or every other year census monitoring of *Flueggea neowawraea* populations to determine BTB damage.

Strategy and Control Methods:

- During the last survey efforts there were no report of any live *Alectryon macrococcus* var. *micrococcus*. There are no effective control methods available. Heavy watering and fertilization of targeted plants has been successful at reducing BTB damage in agricultural settings, but is not practical here on the wild plants, and there are currently no reintroductions planned. NRS maintain contact with BTB research community and will investigate any new techniques that appear to be applicable to forestry settings.

Fire Control

Threat Level: High

Seasonality/Potential Ignition Sources: Fire may occur whenever vegetation is dry. Generally this happens in summer, but may occur at other times of the year, depending on variations in weather pattern. Invasive grass has a high fire index, and surrounds the MU. There have been numerous fires in Makua valley, both from fires set by the military and by arsonists along Farrington Hwy.

Management Objective:

- To prevent fire from burning any portion of the MU at any time.

Strategy and Control Methods:

- If a fire occurs, conduct a post-fire survey, including mapping the perimeter of the fire and document damage via photos. If possible, rehabilitate burned areas with native species.

Discussion: The Makua portion of the Ohikilolo MU is at high risk from fire. The Army has instituted several control measures to reduce the likelihood of fires starting in the valley during training exercises. These include regular maintenance of the firebreak road, limitation of training to within the firebreak road, and the establishment of a weather-based index to guide training activities. The index evaluates rainfall, temperature and wind conditions to produce a color-coded fire condition rating. Live fire-training may occur during 'green' conditions, but not during 'amber' or 'red' conditions. In addition, the Army maintains an Army Wildland Fire crew who are trained in fighting wildfires, and has two dip ponds on site. The Army has a grass cutting contract to maintain low fuels around select areas within the firebreak road, and has also conducted controlled burns to reduce fuel loads.

In 2010-2011, OANRP participated in fuels management work conducted by CALIBRE. This project, funded through the Garrison, looked at novel herbicide combinations, aerial spraying, and remote fuel breaks. Through this project, some remote fuel breaks were sprayed outside of the firebreak road, adjacent to several different MUs in MMR, including Ohikilolo (Makua). If CALIBRE obtains further funding, OANRP will continue to collaborate with them.

No live-fire training has occurred in the past ten years, but arson fires and out-of-prescription burns have threatened portions of the MU. Live-fire training appears unlikely to resume in the next five years.

OANRP will continue to focus on maintaining good communication with the interagency Wildland Fire Working Group to facilitate positive on-the-ground fire response throughout the Waianae range. OANRP will support fire fighting with helicopters and staff. In WCAs, grass patches no canopy weeding will be done on the edge of the grass/forest line to suppress grass incursion into forested areas.

In the future, staff will continue to consider whether any of the following fuel suppression options are feasible, productive, and cost-effective for the grassy slopes between the forest line and the firebreak road: aerial spraying of grass, fuel suppression via planting of trees that produce heavy shade (such as mango), and fuel suppression via planting of common natives (such as *Dodonea viscosa* or *Osteomeles anthyllidifolia*).

Action Table

The table below is a comprehensive list of threat control actions planned for the MU for the next five years. Actions are grouped by type; for example, Ungulate Control or Ant Control. Weed control actions are grouped into the following categories: General Survey, ICA code, or WCA code. Cells filled with hatch marks denote the quarters in which an action is scheduled. IP years run from October of one year through September of the next. Therefore, Quarter 4 (October-December) is listed first for each report year, followed by Quarter 1 (January-March), Quarter 2 (April-June), and Q3 (July-September). Species names are written as six-digit abbreviations, such as ‘CenSet’ instead of *Cenchrus setaceus*, for brevity.

Action Type	Actions	MIP Year 14 Oct 2017- Sept2018				MIP Year 15 Oct 2018- Sept2019				MIP Year 16 Oct 2019- Sept2020				MIP Year 17 Oct 2020- Sept2021				MIP Year 18 Oct 2021- Sept2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
General Survey	LZ-MMR-08: Survey Lower Makua campsite (08) LZ whenever used, not to exceed once per quarter. If not used, do not need to survey.																				
	LZ-MMR-69: Survey Upper Lower Makua LZ (69) whenever used, not to exceed once per quarter. If not used, do not need to survey.																				
	LZ-MMR-75: Survey Lower Makua trailhead LZ whenever used, not to exceed once per quarter. If not used, do not need to survey.																				
	LZ-MMR-146: Survey Arch Camp LZ (#146) whenever used, not to exceed once per quarter. If not used, do not need to survey.																				
	LZ-MMR-147: Elepaio 15 LZ (#147) whenever used, not to exceed once per quarter. If not used, do not need to survey.																				
	LZ-MMR-188 Survey Luna Skeet LZ (#188) whenever used, not to exceed once per quarter. If not used, do not need to survey.																				
	WT-Ohikilolo-01: Install weed transect along Koiahi access trail. GPS trail and mark route in field to ensure same trail can be walked in future years.																				
	WT-Ohikilolo-01: Survey Koiahi transect annually; transect begins at trailhead and ends at Neraudia fences.																				

Action Type	Actions	MIP Year 14 Oct 2017- Sept2018				MIP Year 15 Oct 2018- Sept2019				MIP Year 16 Oct 2019- Sept2020				MIP Year 17 Oct 2020- Sept2021				MIP Year 18 Oct 2021- Sept2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
ICA	Monitor/control SidPer at Makua Well every 6 months/yearly. Survey entire ICA. Pick and remove from field any potentially mature fruit. On first visit, survey surrounding area widely to locate any additional plants.																				
Ohikilolo-01 (South Nerang)	Conduct understory and canopy weed control across WCA annually. Focus around Nerang and native species patches. Target understory weeds, Spacam, gradual control of canopy weeds.																				
	Control alien grasses across WCA, annually, or as needed.																				
Ohikilolo-02 (North Nerang)	Conduct understory and canopy weed control across WCA annually. Focus around Nerang and native species patches. Target understory weeds, Spacam, gradual control of canopy weeds.																				
	Control alien grasses across WCA, annually, or as needed.																				
*Ohikilolo-05 (Firebreak Road to Nerang Gulch)	Control canopy weeds and selected understory weeds across WCA. Focus on native forest patches as first priority. Target TooCil, MonHib, Grerob, SzyCum, PsiCat, etc. Avoid creating large light gaps. Avoid killing thick Psicat/weed stands on edge of grass, as don't want to open more areas to grass. Sweep entire WCA once every 3-5 years. Always GPS weeding areas.																				

Action Type	Actions	MIP Year 14 Oct 2017- Sept2018				MIP Year 15 Oct 2018- Sept2019				MIP Year 16 Oct 2019- Sept2020				MIP Year 17 Oct 2020- Sept2021				MIP Year 18 Oct 2021- Sept2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
*Ohikilolo-07 (Nerang to Well Ridge)	Control canopy weeds and selected understory weeds across WCA. Focus on native forest patches as first priority. Target TooCil, MonHib, Grerob, SzyCum, PsiCat, etc. Avoid creating large light gaps. Avoid killing thick Psicat/weed stands on edge of grass, as don't want to open more areas to grass. Sweep entire WCA once every 3-5 years. Always GPS weeding areas.																				
	Control all weeds within fenced Nerang zone every 6 months. Focus around Nerang/Nothum plants and potential reintro spots. Target Bleapp, Agerip, Chrsp, Monhib, Helpop, understory weeds. Remove canopy weeds gradually.																				
	Control weedy grasses within Nerang enclosure every 6 months, as needed. Exercise care when working around rare taxa.																				
Ohikilolo-12 (Ron's Rock to Dividing Ridge)	Control canopy weeds and selected understory weeds across WCA. Focus on native forest patches as first priority. Target TooCil, MonHib, Grerob, SzyCum, PsiCat, etc. Avoid creating large light gaps. Avoid killing thick Psicat/weed stands on edge of grass, as don't want to open more areas to grass. Sweep entire WCA once every 3-5 years. Always GPS weeding areas.																				
	Control weedy grasses within Nerang reintro/exclosure every 6 months, as needed. Exercise care when working around rare taxa.																				
	Prep reintro zone. Control all weeds within fenced Nerang reintro zone every 6 months. Focus around potential reintro spots. Target																				

Action Type	Actions	MIP Year 14 Oct 2017- Sept2018				MIP Year 15 Oct 2018- Sept2019				MIP Year 16 Oct 2019- Sept2020				MIP Year 17 Oct 2020- Sept2021				MIP Year 18 Oct 2021- Sept2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	Bleapp, Agespp., Chrsp, Monhib, Helpop, understory weeds. Remove canopy weeds gradually.																				
Ohikilolo-15 (Dividing Ridge to Campsite)	Control canopy weeds and selected understory weeds across WCA. Focus on native forest patches as first priority. Target TooCil, MonHib, Grerob, SzyCum, PsiCat, etc. Avoid creating large light gaps. Avoid killing thick Psicat/weed stands on edge of grass, as don't want to open more areas to grass. Sweep entire WCA once every 3-5 years. Always GPS weeding areas.																				
Ohikilolo-16 (Campsite to Arch site)	Control canopy weeds and selected understory weeds across WCA. Focus on native forest patches as first priority. Target TooCil, MonHib, Grerob, SzyCum, PsiCat, etc. Avoid creating large light gaps. Avoid killing thick Psicat/weed stands on edge of grass, as don't want to open more areas to grass. Sweep entire WCA once every 3-5 years. Always GPS weeding areas.																				
*Ohikilolo-18 (Ctesqu to Fluneo)	Control canopy weeds and selected understory weeds across WCA. Focus on native forest patches as first priority. Target TooCil, MonHib, Grerob, SzyCum, PsiCat, etc. Avoid creating large light gaps. Avoid killing thick Psicat/weed stands on edge of grass, as don't want to open more areas to grass. Sweep entire WCA once every 3-5 years. Always GPS weeding areas.																				
MMRNoMU-09 (Elepaio 15 LZ)	Clear and maintain LZ as needed.																				
Ungulate Control	Conduct post-storm fence monitoring trips.																				
	Monitor Lower MakuaPU fences MMR-H and																				

Action Type	Actions	MIP Year 14 Oct 2017- Sept2018				MIP Year 15 Oct 2018- Sept2019				MIP Year 16 Oct 2019- Sept2020				MIP Year 17 Oct 2020- Sept2021				MIP Year 18 Oct 2021- Sept2022			
		4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
	G. Other small fences in PU are low priority.																				
Ant Control	Conduct survey for ants at lower Makua Landing Zone																				
	If any high risk species are present begin control																				
Slug Control	Monitor rare plants for signs of slug damage																				
	If slugs found to exceed acceptable levels during monitoring, maintain slug bait at sensitive plant population(s)																				
Fire Control	Maintain LZs																				

*Low priority, few rare taxa in area or partially closed by range control.