PROPOSAL FOR THE EXTENSION OF PUU MAKAALA NATURAL AREA RESERVE

April 2010

I EXECUTIVE SUMMARY

An approximately 6,938-acre undeveloped portion of the Kulani Correctional Facility, TMK (3) 2-4-008-009, is proposed for inclusion in the State of Hawaii Natural Area Reserve System (NARS). Designation of the area as an extension of the Puu Makaala NAR would afford long-term protection to an area of outstanding habitat quality and biodiversity, and where significant conservation management has already occurred. Designation would also facilitate other conservation efforts in the region, strengthening the existing NAR and adjacent partnership lands.

II INTRODUCTION (General)

A portion of the Kulani Correctional Facility, on the windward slope of Mauna Loa, is proposed to become part of the State of Hawaii Natural Area Reserve System. This Reserve would include an area of approximately 6,938 acres in the South Hilo district of the Big Island of Hawaii.

This proposed extension of Puu Makaala NAR contains montane wet and mesic ecosystems. Landcover analyses have shown the parcel to contain large tracts of open and closed Koa/Ohia and Ohia forests, with smaller patches of Mamane/Naio forests (USDOI, 2006). These ecosystems contain 11 known endangered plant species, and Federal Critical Habitat is designated for seven plant species within the parcel. This parcel is part of a corridor of high elevation native forest that provides habitat for the endangered Hawaiian Goose, nene*, (Nesochen sandwichensis),* Hawaiian Bat, opeapea, (*Lasiurus semotus cinereus),* Hawaii creeper (*Oreomystis mana*), Hawaii akepa (*Loxops coccineus*), Akiapolaau (*Hemignathus munroi*), Hawaiian Dark Rumped Petrel (*Pterodroma phaeopygia sandwicensis),* and Band-rumped Storm Petrel (*Oceanodroma castro)* (Candidate) (OKP, 1999).

Adjacent to the southern boundary of the property is Puu Makaala Natural Area Reserve, which was designated in 1981 for its high quality montane ecosystems, high biodiversity, and geological features. The Department of Land and Natural Resources, Division of Forestry and Wildlife and the Three Mountain Alliance has partnered with the Kulani Correctional Facility to co-manage this area on a landscape scale to protect the rare species and important natural habitats that span property boundaries.

In July 2009, the Department of Public Safety announced the closing of the correctional facility and a proposal with the State Department of Defense to create a Youth Challenge Academy (YCA) in the facility, run by the Hawaii National Guard. YCA's mission is to "provide 16 to 19 year-old 'non-traditional - at risk' young men and young women, ready to move forward, with life skills, to be successful and responsible citizens within their communities, while working towards their high school diplomas," and involves a 22-week quasi-military experience (HING, 2009). This transition of management of the facility is an opportunity for careful planning and decision making for the appropriate management of this high-priority conservation area.

III BACKGROUND AND HISTORY

Past and Present Land Use

The southern section of the Kulani Correctional Facility (KCF) was established as Upper Olaa Forest Reserve in 1913, and the northern sections were proclaimed the Upper Waiakea Forest Reserve in 1923. In 1948, Executive Order (EO) 1224 withdrew 5,600 acres of the Upper Waiakea and Upper Olaa Forest Reserves to be set aside as the Kulani Prison Farm under the control and management of the then-Department of Institutions. EO 1588 set aside an additional 2300.27 acres of Upper Waiakea Forest Reserve to add to the Prison Farm in 1953. In 1981, EO 3092 withdrew 656 acres of the southernmost part of the prison set aside that surrounds Kulani cone to become part of the Puu Makaala Natural Area Reserve.

The proposed extension of Puu Makaala NAR is currently set aside to the Department of Public Safety (PSD), which operated a correctional facility in developed portions of the 7,244.27-acre KCF. The work camp began in 1946 and has grown to include a 200-bed facility. For years, approximately 900 acres of the parcel were used as pastures for cattle grazing and a piggery for job training in agricultural industries. While the former pastures are being restored after cattle removal, approximately 306 acres of semi-developed land are not included in this NAR nomination. This excluded area contains the facility, which is approximately 20 acres, and a water reservoir, cinder mining area, and a sewage facility, and the Mauna Loa Boys School.

The Department of Public Safety and the DLNR – Division of Forestry and Wildlife joined the Olaa-Kilauea Partnership in 1994 by signing a Memorandum of Understanding. In 2007, that partnership expanded to become the Three Mountain Alliance (TMA). TMA works through partnering to expand watershed protection and management to over one million acres across the volcanoes of Mauna Loa, Kilauea and Hualalai, thus making it the largest cooperative land management effort in the state of Hawaii. Three Mountain Alliance and the Department of Public Safety have implemented conservation projects to successfully protect Kulani from ungulates and have worked to control invasive plant species. This includes fencing the entire Kulani parcel combined with units in the Puu Makaala NAR and vicinity.

Since 1994, Kulani has provided important in-kind support for TMA projects by providing staff and inmate assistance with critical conservation activities. TMA work at Kulani includes fence maintenance, pig control, weed control, native habitat restoration, and providing work training to Kulani inmates.

Partnership activities at Kulani are guided by:

- TMA Memorandum of Understanding (MOU) signed by the Department of Public Safety (DPS) in 2007. This MOU replaced the Olaa Kilauea Partnership MOU which was signed by the Department of Public Safety (DPS) in 1994 and 2001.
- TMA Management Plan (2008) (www.hawp.org), and Final Environmental Assessment and Management Plan for the Olaa - Kilauea Partnership (1999).

- Wetland Restoration Project (within and around Mauna Loa Boy's School) approved for implementation by the DPS (June 2000).
- Kulani is within the State Conservation District which regulates land use for the purpose of conserving, protecting, and preserving the important natural resources of the State. Environmental compliance is required for projects occurring in the Conservation District.

Accomplishments:

- Since 1995, the TMA has provided a Conservation Workline supervisor. Kulani inmates and staff have provided a large cost savings to the TMA by assisting with fence construction, bulldozing fence corridors and other conservation projects, and inmates have received vocational training.
- The Partnership purchased fence materials and provided environmental compliance for Kulani boundary fencing to reduce trespass into the facility and benefit the environment.
- The Partnership removed feral pigs from Kulani and released pigs in a public hunting area to benefit hunters. Pig control has important conservation benefits and has also reduced hunter trespass into Kulani.
- Partnership staff provided inmates with an Environmental Studies Program during 2000 and 2001. Classes covered environmental topics, Hawaiian cultural practices, and job tips.
- The Partnership assisted with paving a portion of Stainback Highway.
- The TMA established a Kulani native plant horticulture program to provide inmate education and to propagate native plants for restoration and landscaping. The TMA provided funding for greenhouse construction, partial support for a horticultural instructor, and supplies. In 2008, inmates propagated over 2,700 native plants for TMA reforestation projects. They also assisted with forest restoration by planting over 1,000 native plants in Hawaii Volcanoes National Park, landscaped the Kulani visitor center, and provided over 500 plants for the Volcano Art Center Forest Fair.
- The TMA has assisted Kulani with biological surveys required for environmental compliance including development of the sewage treatment facility.
- The TMA was nationally recognized in May 2009 with the Partners in Conservation Award by the Department of the Interior. The award is one of the highest established to recognize conservation achievements. It enables the Secretary to acknowledge in one award the contributions of both Interior and non-Interior personnel, recognizing outstanding conservation results produced primarily because of the engagement of many partners, specifically highlighting the partnership with the correctional facility.
- Annual forest bird surveys have been conducted since 1977 by Kamehameha Schools, DOFAW, the National Park Service, the USGS, and the USFWS in Kulani-Keauhou and other nearby areas.
- The Hawaii Silversword Foundation (HSF) has outplanted 3,093 silversword (*Argyroxiphium kauense*) seedlings in the Boys School Unit at Kulani

> Correctional Facility. HSF has also outplanted 1,743 *Clermontia peleana* seedlings and *Cyanea shipmanii*, *C. stictophylla*, *Phyllostegia racemosa*, and *Vicia menziesii* in and immediately adjacent to Kulani in the Puu Kipu Unit. These species are all endangered.

Natural Area Reserve System (NARS) staff are already highly involved in implementing these conservation projects, as well as planning for future protection of this area. While much of the costly management activities, such as fence construction and ungulate removal, have already been completed, maintenance of infrastructure is needed in the future. This area is appropriate for extensive restoration of endangered plants since it is one of only a few such areas protected from pigs and cattle. Control of new or incipient weed invasions is needed to prevent degradation of the area. Management success has already been demonstrated with koa and ohia forest restoration occurring in areas relieved from feral ungulate pressure and the removal of domestic cattle from former pastures in 2005. The TMA management plan highly prioritizes the continued need for management of this area.

Cultural/Recreational Uses

The State Historical Preservation Division noted in 1998 that there were no known records of archeological surveys in this area, and predicted that few sites would be found in the forested area which is well inland of the zone of pre-contact Hawaiian permanent settlement (OKP, 1998).

In 2004, a cultural study of the Puu Makaala Natural Area Reserve was conducted for the NARS. This study included cultural information on uses, beliefs, etc that also could apply to Kulani, such as:

> Kū-ka-ʻōhiʻa-Laka, is a defied guardian of the ʻōhiʻa growth of ʻŌlaʻa; Ua-kuahine, is the body form of a goddess of the rains in ʻŌlaʻa; and Kū-lili-ka-ua is the god of the thick mists that envelop the forests of the upper Puna.
>
> (Kumu Pono Associates, 2004)

This cultural study also documents traditional accounts, bird catching practices, visitor descriptions from the historical period, land tenure documents, surveys and government communications about this area and may be found at: http://hawaii.gov/dlnr/dofaw/nars/reserves/big-island/puumakaala

The Puu Oo trail also crosses a part of the northern area of the proposed Reserve, which was a historic cattle crossing route.

Previous Studies

This area has been surveyed for biological resources including vegetation and endangered plant species, forest bird populations, avian diseases, yellowjacket wasps, and alien plant and ungulate levels. The following text in this section summarizes a 2003 informational document by the Olaa-Kilauea Partnership on studies done in Kulani:

USGS-BRD researchers have conducted annual surveys of endangered, native, and alien bird species at Kulani since 1992 to assess bird distribution and status (OKP, 2003). This data also provides valuable baseline information to evaluate the long term trends of native species to management actions (e.g. feral ungulate removal, predator removal, and alien plant removal). USGSBRD Researchers mist-netted birds and sampled blood and collected mosquitoes in the Mauna Loa Boys School exclosure from 1992-1994 (Gorresen *et al,* 2005). They have also sampled mosquitoes inside and outside fenced, pig free exclosures at Hawaii Volcanoes National Park.

Recent research has focused on determining the distribution and disease vector potential of mosquitoes, the prevalence of pox and malaria in native and introduced birds at different elevations, and the effect of reducing feral pig numbers on mosquito populations. The conclusions of the research are as follows (Atkinson *et al.* 1995; LaPointe 1996):

- Distribution of pox and malaria is dependent on elevation and mosquito abundance, and higher prevalence occurs at lower elevations with higher mosquito populations. At higher elevations, cool temperatures limit number of mosquitoes and inhibit development of malarial parasites in the vector. Transmission of both diseases is seasonal, with peaks during warmer months of the year when numbers of mosquitoes are highest.
- Primary reservoir hosts are native species, particularly apapane. Iiwi have low prevalence of infection because of their high susceptibility to malaria (most die before they can be captured).
- Outbreaks are epizootic in nature, involving large numbers of susceptible birds. Researcher documented outbreaks in 1992 and 1994. Factors controlling these outbreaks are complex, involving rainfall, temperature and abundance of uninfected, susceptible hosts.

Preferred breeding sites for mosquitoes are associated with fallen tree ferns that have been hollowed by pigs. Starch in the core of trees ferns is a major food source for pigs. The presence of mosquito breeding sites decreases in pig-free fenced units (Lease *et al.* 1996).

USGS-BRD is testing alien wasp control methods and studying the non-target impacts of wasp control on picture wing *Drosophila* flies. Personnel have performed surveys in Kulani and the National Park to monitor wasps and native invertebrates, and to evaluate the effectiveness of poison baiting, and nest removal. Poison baiting has been shown to be effective, and comparison of Kulani with similar upper elevation portions of the National Park indicates that the general absence of wasp nests at Kulani is better for native birds and insects. USGS-BRD personnel have also assisted Kulani with the removal of yellowjacket wasp (*Vespula pensylvanica*) nests which are hazardous to staff and inmates.

Biologists have collected data along transects at Kulani on the absence/presence of all alien plant species. NPS staff have done extensive monitoring in the Partnership area to show the recovery of native forests following pig removal.

IV JUSTIFICATION (Specifics)

Scientific Value

This area is of high scientific value and has been used as a research site for many studies. Kulani provides a study site to test the effectiveness of management activities such as outplanting, invasive weed control and predator control in areas protected from ungulates.

Representativeness

This area would help complete the NAR System by including representative samples of montane mesic and wet ecosystems on the windward slope of Mauna Loa. The montane mesic ecosystem in this ecoregion is not represented in any other NAR, and contains many endangered species that are not found in the other NARS that contain this ecosystem.

While Puu Makaala NAR is adjacent and contains similar wet ohia/hapuu forest, the proposed Kulani parcel contains larger tracts of wet koa/ohia forest, which are generally found on older substrates (OKP, 1999). As Kulani is more mauka (upland) of Puu Makaala NAR, there are many other natural communities not found in the NAR. The western section contains tall stature koa/ohia – dominated forest with other native trees, shrubs, hapuu ferns, and ground fern understory (OKP, 1999). Young-intermediate aged lava flows of Kulani contain a mesic ohia forest and an understory of native trees, shrubs, ferns and grasses without the prominent hapuu component (OKP, 1999). Dry native shrub with scattered ohia and dry ohia forest with mixed native trees and native shrub understory natural communities cover mauka areas (OKP, 1999).

Smaller unique natural communities in Kulani include low stature ohia with native trees, shrubs, and the native grass *Deschampsia nubigena* (OKP, 1999). In wetter areas, there are small pocket bogs created by depressions in the lava flow surface, and small wetlands composed primarily of the sedge *Carex alligata* (OKP, 1999).

Endangered plants of KCF not currently known in the Puu Makaala NAR include the *Argyroxiphum kauense, Asplenium fragile* var. *insulare,* and the *Plantago hawaiensis.*

Additionally, the ecosystems of Kulani are important for the representation of forest bird habitat, especially as climate change is forecasted to increase disease vector ranges. Kulani has some of the highest densities of native forest birds areas on the island and is very important as most of the area is above 5,000 feet, where climate restricts mosquitoes and development of malarial parasites (US DOI, 2006). This area has been designated an "Important Bird Area" by the Audubon society, as one of the most important remaining concentrations of endemic Hawaiian birds, including populations of four species that are endemic to Hawaii Island and are listed under the U.S. Endangered Species Act (National Audubon Society, 2009). This area is also immediately adjacent to a potential Alala release site.

Researchers have documented various soil microarthropods, damselflies (*Megalagrion*), picture wing (*Drosophila*) flies, and common *Succenia* tree snails. Lava tubes may harbor additional undocumented invertebrates (OKP, 1999).

Natural Communities and their Status

Kulani contains dry, high-elevation communities in various ages of lava substrate, in

addition to the wetter forests and wetlands also found in Puu Makaala NAR. Landcover analyses and many years of field work have shown the parcel to contain large tracts of intact open and closed Koa/Ohia and Mamane/Naio forests (US DOI, 2006). While these tracts are of very high quality and intactness, approximately 900 acres of this area in two locations were converted to pasture and other prison-related activities. However, large areas of native trees remain in these degraded areas, and with cattle removal in 2005, regeneration of native forest is already occurring. This is an ongoing restoration site as the areas are surrounded by high-quality native forest.

Rarity

See Appendices for lists of rare species known from this area. Federal Critical Habitat is designated for seven species of plants in Kulani. This area is also within the current ranges and Recovery Area for the Hawaii Creeper, Akiapolaau, and the Hawaii Akepa (USFWS, 2006).

The protection of this area from ungulates and the horticulture program at Kulani Correctional Facility facilitates reforestation. A large outplanting program has increased species populations, such as for the Mauna Loa silversword, *Argyroxiphium kauense*, which is only known from three sites in the wild (OKP, 2003).

Biological/Ecological Design

The boundaries of this proposed NAR are meant to extend the current Puu Makaala NAR into more mauka (high elevation) forests that support high densities of forest birds, and unique endangered plant species. By encompassing a larger area over more diverse types of habitat, the extended Puu Makaala NAR will be a more complete representation of the natural communities of that area. The NAR will also be more defensible as a larger contiguous area is designated and managed for long-term ecosystem preservation.

The proposed boundaries also follow where fenced, pig-free areas currently exist. Other resources include a greenhouse and active management programs such as the outplanting done by the Hawaii Silversword Foundation, the Three Mountain Alliance, and the collaboration with the NARS staff.

Location and Size

The proposed extension of Puu Makaala NAR is located on the windward slope of Mauna Loa on the Big Island of Hawaii, South Hilo District, and includes approximately 6,938 acres (out of 7244.27) of land set aside to the Department of Public Safety. The area is identified by TMK (3) 2-4-008-009, and is approximately 6 miles long and 3 miles wide at its widest point. The elevational gradient is from approximately 4600ft elevation to 6229ft.

The portions of the KCF (approximately 308 acres) excluded from this proposal are mostly developed or surrounding lawns.

Neighboring the proposed reserve to the north and east is the Upper Waiakea Forest Reserve and Hawaii Volcanoes National Park. To the west are lands owned by Kamehameha Schools. To the south is Puu Makaala NAR.

Threats (Human/Biological)

While the area is fenced and pig free, mouflon sheep and goats may be a threat as their numbers increase in the state lands to the north (OKP, 2003). Pigs are still a threat to the area if fences are not regularly maintained as high populations of pigs occur in Forest Reserve lands to the east.

The TMA has identified the following high priority weeds for the entire partnership area: miconia (*Miconia calvescens*), firetree (*Morella faya*), banana poka (*Passiflora tarminiana*), yellow Himalayan raspberry (*Rubus ellipticus*), and strawberry guava (*Psidium cattleianum*). The 1989 Management Plan for the Puu Makaala NAR also included Palm grass (*Setaria palmaefolia*), blackberry (*Rubus argutus*), Kahili ginger (*Hecychium gardnerianum*) and clidemia (*Clidemia hirta*), and Firetree (*Myrica Faya*) as priority weed threats. Ohia dieback is not a threat, but gaps provide openings for subsequent weed invasions (DOFAW, 1989).

Invertebrates are threatened by the yellowjacket wasp and extermination of plant species that are specifically needed to complete their life cycle (OKP, 2003).

Studies of bird populations since 1977 have shown that at least five native birds (Akiapolaau, Creeper, Elepaio, Omao and Iiwi) in this area may be declining in occurrence and/or density (Gorresen *et al,* 2005). Akepa trends were variable, which may leave a downward trend undetected (Gorresen *at al,* 2005). Amakihi and Apapane were the only birds that showed increasing or stable trends in this area (Gorreson, *et al,* 2005). Native forest birds are threatened by mosquitoes (*Culex quinquefasciatus*) which transmit avian malaria and pox, and increases in the density and impacts of predator populations, particularly rats (*Rattus rattus, R. exulans*) (OKP, 2003). Small mammal predators also are threats to native plants, as they devour seeds and seedlings. Habitat degradation as well as the loss of genetic diversity also cause the decline of these birds. Observed birds such as the Japanese White-eye (*Zosterops japonicus*) and redbilled Leiothrix (*Leiothrix lutea*) may also compete, spread invasive species, and act as disease reservoirs. The Japanese bush warbler (*Cettia diphone*) is present nearby in Waiakea but has not been recorded in Kulani (Gorreson *et al,* 2005). Non-native forest birds exhibited declines in occurrence/ and or density in Kulani since 1977 (Gorreson *et al,* 2005).

Present Level of Protection

Development is regulated by the rules of the State Conservation District as well as State and Federal Endangered Species rules.

According to Hawaii Revised Statutes, Title 13, Chapter 5, which regulates the Conservation District, the objective of the Resource Sub-zone is to "…develop, with proper management, areas to sustain use of the natural resources." Approximately 1,162 acres of the entire parcel is in the "General" Sub-zone of the Conservation District. The objective of this Sub-zone is to "designate open space where specific conservation uses may not be defined, but where urban use would be premature."

Additionally, the presence of endangered species and critical habitat are additional regulatory layers. Designation of critical habitat requires Federal agencies to consult with the Fish and Wildlife Service on actions the Federal agency carries out,

funds, or authorizes, to ensure that their actions will not destroy or adversely modify critical habitat. Activities that modify or degrade the habitat for these species could constitute an incidental take of species which would require a license and/or a Habitat Conservation Plan.

In Kulani, conservation management activities have been ongoing since 1992, and it currently has one of the highest levels of management protection in Hawaii. The inclusion of this area in the Olaa Kilauea Watershed Partnership, which later became the Three Mountain Alliance resulted in a major increase in conservation activities in this area, as Kulani is in the core of the partnership. More details on management is found in the "Background and History" section of this nomination. However, TMA members are bound by a Memorandum of Understanding that is voluntary and can be terminated at any time.

In July 2009, the Department of Public Safety announced the closure of the Kulani Correctional Facility, and mentioned negotiations with the State Department of Defense to develop a Youth Challenge Academy in the facility. During this time of transition with the property, the future designation, access arrangements, and management capabilities are uncertain. NAR designation would best allow partners to follow through on their current path to protect probably the finest and highest quality forest on the island of Hawaii.

Long-term Ecological Viability

Field observations and landcover mapping have shown the high quality of the forest outside of the former pasturelands. DOFAW Management Guidelines has mapped areas immediately adjacent to the proposed Reserve as "Highest Quality Native" which are described as having minimal disturbance, with low levels (less than 10%) of non-native plants in any vegetative layer (DOFAW, 2009). The Nature Conservancy's ecoregional plan, which measured the condition of ecosystems, as well as their size and context to determine their future viability, rated the montane wet forests of that region as good (TNC, 2006). Despite the "good" condition of the montane mesic forests, the plan rated the montane mesic forests as having a "fair" viability due to its fair context and size (TNC, 2006). The complete fencing and ongoing management of the area also greatly increases the long-term viability of this forest. Additionally, the presence of the Three Mountain Alliance and the management efforts on adjacent lands will also benefit Kulani. There are additional landscape-scale fences in the vicinity of Kulani, primarily in Puu Makaala NAR, Kilauea Forest, Keauhou, and Hawaii Volcanoes National Park. Additional fencing is proposed for Puu Makaala NAR immediately adjacent to Kulani.

However, without binding commitments for continued access and management capabilities, the future of this area is uncertain.

Environmental Consequences of No Action

The environmental consequences of no action would be to lose an opportunity to designate an area that is high quality and appropriate as a NAR on all measures, during a key time of transition. Environmental consequences of no action would mean less long-term management protection and future hurdles to implement proactive conservation

projects such as active efforts for increase existing populations of endangered species. If access and management agreements did not favor conservation projects in the future for this area, management of Puu Makaala NAR as well as neighboring Kamehameha Schools land (Kilauea and Keauhou) would also be affected because the fence units cross land ownership boundaries.

Urgency

Recommending NAR designation is urgent. If the NARS Commission does not act at this time, a window of opportunity to facilitate access and conservation management agreements and designation may be lost.

V. MANAGEMENT NEEDS

Threats Requiring Management

Management needs include:
- Fence and infrastructure maintenance.
- Maintenance of ungulate-free management units.
- Weed control.
- Predator (e.g. small mammals and predatory non-native invertebrates) control.
- Native habitat restoration, natural and managed (including monitoring of rare species).
- Continue vocational training: Horticulture program/greenhouse, native restoration.

Administrative (size, boundaries, access: roads & trails, maps more specific than in introduction, TMKs)

The portion of TMK (3) 2-4-008-009 that is the KCF is 7244.27 acres; this nomination proposes that approximately 6,938 acres surrounding the developed portion of the prison and facilities become a NAR. Two areas are proposed to be excluded from the NAR – Section 1 is the main facility (approximately 300 acres) and Section 2 contains the Mauna Loa Boy's School (approx 5.7 acres). Stainback Highway accesses the parcel, and terminates in the prison facility. A network of roads and fencelines intersect the property, and follow most of the parcel's boundaries. Five fence units divide the property: the Boys school unit in the north, the north and south boundary units, and the Puu Kipu unit. A small portion of the south boundary unit also encloses the Puu Makaala NAR. A large part of the Puu Kipu unit is on Kamehameha Schools land to the west.

VI. PUBLIC SUPPORT

Agencies, Organizations, and Individuals Contacted

Three Mountain Alliance
DLNR, Division of Forestry and Wildlife, Natural Area Reserves System
Department of Public Safety

VII. BIBLIOGRAPHY/REFERENCES

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Appendices

1. Endangered Plants Found in Proposed Extension of Puu Makaala NAR

Scientific Name	Common Name	Critical Habitat
Argyroxiphum kauense	Ahinahina, Kau silversword	Y
Asplenium fragile var.*insulare*		
Clermontia lindseyana	Oha	Y
Clermontia peleana		
Cyanea shipmanii	Haha	Y
Cyanea stictophylla		Y
Cyrtandra giffardii		
Phyllostegia racemosa	Kiponapona	Y

Phyllostegia velutina		Y
Plantago hawaiensis	Laukahi	
Vicia menziesii	Hawaiian vetch	

Critical Habitat for *Phyllostegia hawaiensis* is also designated in this area.

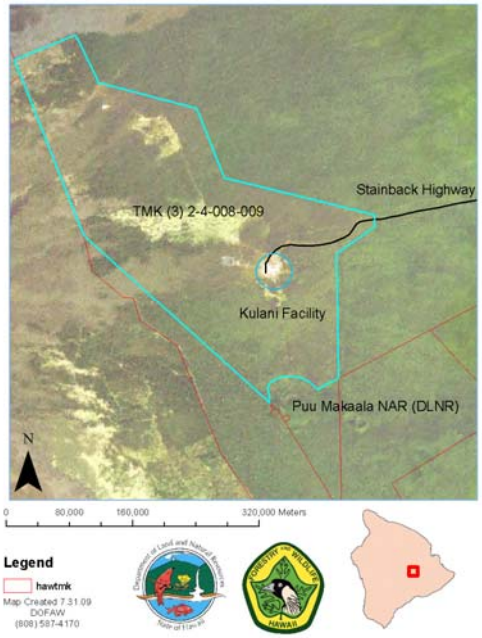
2. Native Vertebrates Found in Proposed NAR

Endangered
Hawaiian goose, nene,
(Nesochen sandwichensis)
Hawaiian bat, opeapea,
(*Lasiurus semotus cinereus)*
Hawaii creeper (*Oreomystis mana*)
Hawaii akepa (*Loxops coccineus*)
Akiapolaau (*Hemignathus munroi*)
Hawaiian hawk or Io (*Buteo solitarius*)
Hawaiian Dark Rumped Petrel
(*Pterodroma phaeopygia sandwicensis)*
Band-rumped Storm Petrel (Candidate)
(*Oceanodroma castro)*

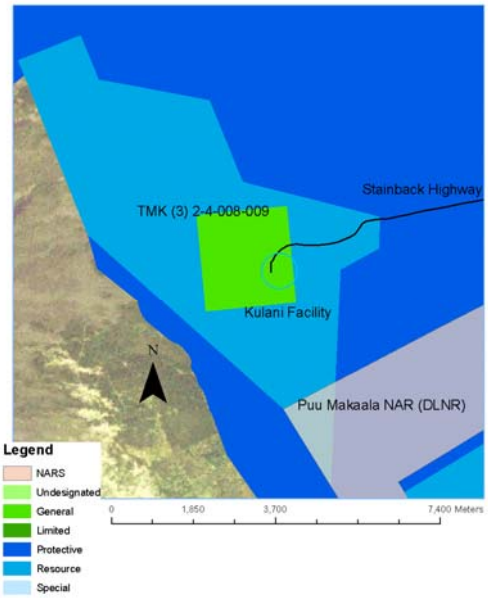
Non-Endangered
Apapane (*Himatione sanguinea*)
Amakihi (*Hemignathus virens*)
Iiwi (*Vestiaria coccinea)*
Elepaio (*Chasiempis sandwichensis*)
Omao or Hawaiian thrush
(*Phaeornis obscurus*)
Hawaiian owl or pueo
(*Asio flammeus sandwichensis*)
Pacific golden-plover or kolea
(*Pluvialis fulva*)

3. Maps

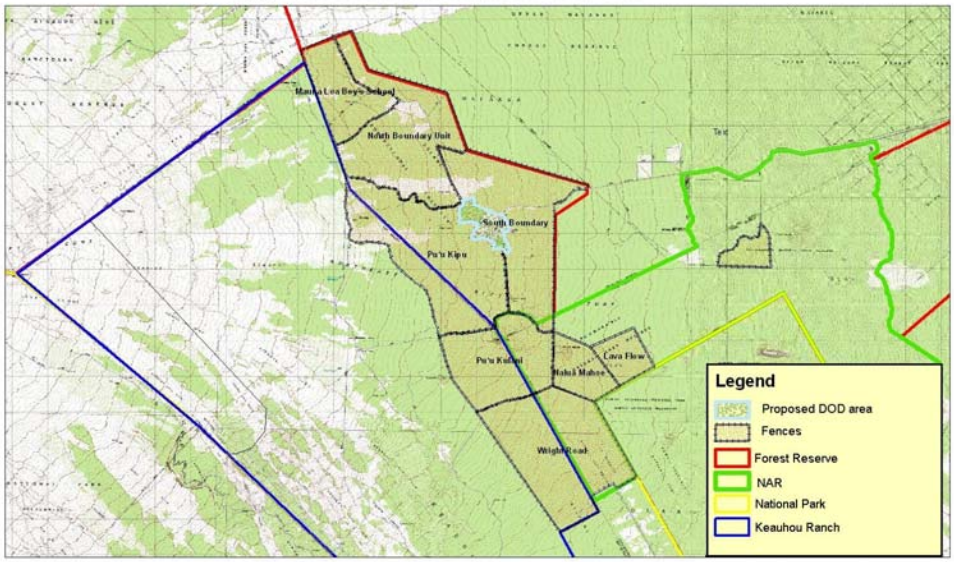
Kulani Correctional Facility TMK (3) 2-4-008-009



KCF Conservation District Subzones



Suggested DOD Area In Kulani Fenced Units



0 1,950 3,900 7,800 11,700 15,600
Meters

Below: Aerial view of Section 1 of proposed area excluded from the proposed NAR (approx 300 acres) containing main facilities; remaining undeveloped area to be designated a Natural Area Reserve.
Left: Aerial view of Section 2 of proposed area (approx 5.7 acres, 500' x 500' sq) excluded from NAR proposal of Mauna Loa Boys School.