

State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife
Honolulu, Hawaii 96813

Acceptance Date: June 1, 2010
180-Day Exp. Date: November 29, 2010

August 12, 2010

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

REGARDING: CONSERVATION DISTRICT USE PERMIT APPROVAL FOR THE
NORTH KONA PROTECTIVE FENCING PROJECT

APPLICANT: Hawaiian Silversword Foundation, Inc.
In cooperation with the Three Mountain Alliance (Watershed Partnership)

LANDOWNER: Kamehameha Schools

LOCATION: North Kona District, Island of Hawai'i

TMK: (3) 7-8-001:003

PARCEL AREA: 62,700

AREA OF USE: Approximately 22 miles of Fencing to protect 14,500 acres

SUBZONE: Resource

SUMMARY:

This submittal requests the Board to approve and grant a conservation district use permit (CDUP) for activities identified in the conservation district use application (CDUA) and accompanying management plan for the North Kona Protective Fencing Project (Exhibit A). This project is part of the Three Mountain Alliance watershed partnership (whose fiscal sponsor is the Hawaiian Silversword Foundation, Inc.), which was formed to provide long-term protection of the upper watershed areas of Kilauea, Hualalai, and Mauna Loa. The Three Mountain Alliance is one of eleven statewide watershed partnerships supported by the State's Watershed Partnerships Program which provides technical and financial resources for the conservation and protection of important mauka forests to ensure the state's water supply.

DESCRIPTION OF AREA / CURRENT USE:

The proposed project is located in the Lupea area on the island of Hawai'i on Subject Parcel TMK (3) 7-8-001:003. The project area borders private lands of Hokukano Ranch, Inc. (TMK (3)7-9-001:001). Hawaiian Silversword Foundation, in partnership with the Three Mountain Alliance, proposes the construction of up to 22 miles of ungulate-proof fencing, enclosing approximately 13,000 acres on the slopes of Mauna Loa in North Kona. The proposed fencing will protect a substantial portion of the second largest native mamane (*Sophora chrysophylla*) forest on the island and facilitate restoration of degraded mamane forest, habitat for the endangered palila (*Loxioides bailleui*) and for multiple endangered plant species. The construction of animal-proof fencing, followed by feral animal control, are the critical first steps to protect, and then to restore, this area. The fenced area would be suitable habitat for the reintroduction of at least seventeen rare native plant species, and upon restoration of the mamane forest, this area can become a site for the reintroduction of the palila, establishing a second, independent population from the current population.

Currently, Kamehameha Schools leases the lower portion of the TMK for cattle grazing. In addition, Kamehameha Schools has an agreement with a company offering private hunting opportunities within the project area. The current agreement notes that the license is nonexclusive and includes a reduction in the area covered by the license, to reflect the planned conservation project.

Historic Sites

The ahupua'a of Keauhou 2 encompasses roughly 113,000 acres and extends across the broad upland plateau stretching from the western summit of Mauna Loa to the summit of Hualalai. Prominent landscape features provided cultural affiliations for Native Hawaiians and served as ceremonial cores, land divisions, and resource procurement sites. An archaeological study was conducted which included review of the entire TMK (3) 7-8-001-003, as well as surrounding areas, through aerial survey methods followed by ground surveys of identified sites. During this survey, site locations were found north of the proposed project area, including a site complex known as the Waikulukulu shelter cave, consisting of a series of sinkhole formations and human modifications (fireplace, terraces); two lava dome shelters adjacent to the Judd Trail; Ahua a 'Umi Heiau and associated features; and stone walls defining paddock areas.

A number of named locations in Keauhou 2 identify cultural specific areas and impart the cultural importance of place. The following are examples of named places within Keauhou 2:

- Ho'ike Kanaka/Kahua Ho'ike Kanaka o 'Umi –Keauhou 2 ahupua'a boundary
- Wai Kulukulu (dripping water) – a water cave north of Judd trail, elevation 5480'
- Wai a Palai (water of palai) – a water hole off of 'Umi's road near Kiki'ae'ae
- Pu'u Lepo (earth mound) – another name for Kiki'ae'ae Hill
- Kiki'ae'ae/Kikiki'ae'ae (fine basket) – a boundary point for Keauhou 2 ahupua'a
- Ka 'Onohi (the eyeball) – cave
- Maka'ula'ula/Ka Maka'ula'ula (the red eye) – a boundary point - mamane trees
- 'A'ahuwela/'Ahuwela (hot clothing/garment producing heat) – a cave
- Kipuka Lupea (attractive kipuka) – kipuka and paddock
- Pu'u Lehua (lehua flower hill) – cinder cone in Ka'u volcanic series,
- Kipuka Mamani – a kipuka known for its abundance of mamane trees

The proposed fencing and conservation management poses a minimal threat to archaeological resources in the project area. The final fence alignment has been surveyed prior to construction to avoid potential adverse effects to archaeological sites and cultural resources. The fence alignment has been re-routed as necessary to protect any identified sites. Since the fencing will be aligned, where possible, adjacent to existing four-wheel drive roads, it is anticipated that construction of fencing will pose little risk to any sites unidentified during surveys.

Over the long-term, the fencing project would help preserve any unknown archaeological resources within the project area, by preventing soil disturbance and trampling of sites by hooved animals. If any sites are found during construction, appropriate mitigation and site treatments will be developed in consultation the State Historic Preservation Division and Kamehameha Schools Land Assets Division .

Contemporary Cultural Resources and Practices

The proposed action is also not expected to significantly impact Native Hawaiian traditional and cultural practices. Based on the remoteness of the project area, the limited access due to its location on private land, the conservation purpose of the fencing, and the incorporation of gates or crossovers where fencing crosses existing trails or roads, it is anticipated that fencing would have little to no impact on Native Hawaiian practices. The fencing is not designed to block access by people, but to limit animal movement.

Resources consist of diverse populations of native Hawaiian plants found within the project area. Many of these plants have cultural significance and are used traditionally. The fence will provide protection to these important cultural resources. At present, native Hawaiians may exercise their rights to visit and practice their culture in the areas as described. Access to the project site will not be altered by construction of the fence. The Three Mountain Alliance, in conjunction with Hawaii Silversword Foundation and the Kamehameha Schools plans to increase access to the area for educational and cultural purpose.

Natural Environment

The project area is characterized by several vegetation types including montane dry and mesic forests and woodlands, subalpine forests, woodlands and shrublands, and grasslands. The project area is dominated by native vegetation, although large portions of the plant communities have been highly altered by logging, cattle grazing, feral ungulates, fire, and alien plant invasion over the past 200 years. There is evidence of logging up to approximately the 6,000 foot elevation. Cattle are present in the lower portions of the project area because no fence separates this area from the lower pasture. Feral ungulates (primarily sheep) are present in large numbers throughout the entire project area. There are currently few records of wild mouflon sheep, but their populations are increasing and their range is expanding.

At least 65 native plants have been observed in the project area. These include trees such as mamane, 'ohi'a (*Metrosideros polymorpha*), koa (*Acacia koa*), and 'iliahi (sandalwood [*Santalum paniculatum var. pilgeri*]), shrubs such as 'a'ali'i (*Dodonea viscosa*) and pukiaue (*Styphelia tameiameia*), grasses such as *Carex wahuensis* and mountain pili (*Panicum tenuifolium*), and ferns such as 'oali'i (*Asplenium trichomanes var. densum*) and 'ae (*Polypodium pellucidum*). The endangered plant *Asplenium peruvianum var. insulare* occurs just inside the project area. The area also contains the largest and most intact stand of 'iliahi

(sandalwood) remaining on the island of Hawai'i. and supports the largest area of diverse native grasslands in Hawai'i. Seven species of native grass are found in sizeable quantities in several communities. Although Mauna Kea supports a larger area of mamane, the forest there lacks the species diversity found in the project area.

Native birds observed in the project area include the 'amakihi (*Hemignathus virens*), 'apapane (*Himatione sanguinea*), 'elepaio (*Chasiempis sandwichensis*), the endangered Hawai'i creeper (*Oreomystis mana*), 'i'iwi (*Vestiaria coccinea*), kolea (*Pluvialis fulva*), pueo (*Asio flammeus sandwichensis*), and the endangered 'io (Hawaiian hawk [*Buteo solitarius*]). The endangered 'ope'ape'a, or the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*), has also been observed in the project area. In addition, the project area is within the historic range of several endangered native birds, including the palila (currently restricted to Mauna Kea), the 'alala (Hawaiian crow [*Corvus hawaiiensis*])(now extinct in the wild), and the 'ua'u (Hawaiian petrel [*Pterodroma sandwichensis*]). The area also historically hosted a much larger nene (*Branta sandvicensis*) population, but only eight to ten nene still appear regularly, with others flying over on their way to Pu'u Wa'awa'a.

Four invertebrate species of concern have been observed within the project area: *Agrotis melanoneura* (moth), *Omiodes monogona* (moth), *Omiodes anastrepta* (moth), and *Plagithmysus greenwelli* (beetle). Given the relatively intact condition of the native vegetation in the project area, it is likely that additional studies would discover additional native invertebrates, both rare and common.

PROPOSED USE:

The Hawaiian Silversword Foundation, Inc., in partnership with the Three Mountain Alliance, proposes the construction of up to 22 miles of ungulate-proof fencing, enclosing approximately 13,000 acres on the slopes of Mauna Loa in North Kona. The proposed fencing will protect a substantial portion of the second largest native mamane (*Sophora chrysophylla*) forest on the island and facilitate restoration of degraded mamane forest, habitat for the endangered palila (*Loxioides bailleui*) and for multiple endangered plant species. The construction of animal-proof fencing, followed by feral animal control, are the critical first steps to protect, and then to restore, this area. The fenced area would be suitable habitat for the reintroduction of at least seventeen rare native plant species, and should restoration of the mamane forest be successful, this area could become a site for the reintroduction of the palila, establishing a second, independent population from the current population.

The project will involve the clearing of vegetation, several inches above ground level, up to a ten foot wide corridor along the length of the proposed fence alignment using hand operated tools (i.e., handsaw, pick ax, weed eater, chainsaw). A sixty- eight inch high fence will be constructed using hog wire fence mesh supported by galvanized pipes and fence posts. The outside of the fence will be skirted along the base with a hog wire apron. After construction, the project will consist of natural resource management activities such as feral animal removal, invasive weed control, fence maintenance, and monitoring to track the recovery of native plant populations.

SUMMARY OF COMMENTS:

Notice of the proposed CDUP was posted in The Environmental Notice on June 23, 2010. No

comments were received. A Finding of No Significant Impact was determined for the Final Environmental Assessment on September 23, 2007. Comments received on the Draft EA are outlined below:

Office of Hawaiian Affairs: If significant cultural deposits or human remains are encountered, work shall stop and SHPD shall be contacted.

County of Hawaii: If rare plants are encountered, they should be removed and replanted.

Tropical Reforestation and Ecosystems Education Center: Fully support.

Ka`ahahui o Ka Namelemele: Fully support.

Responses to the concerns regarding potential encounters with cultural deposits, human remains, and native plants during construction were addressed in the Final Environmental Assessment.

ANALYSIS:

Following review and acceptance for processing, the applicant was notified by letter, dated June 1, 2010 that:

1. The proposed use is an identified land use under Chapter 13-5: P-7, SANCTUARIES, requiring a board permit and submittal of a management plan; and
2. Pursuant to Section 13-5-40(a), HAR, a public hearing will not be required because the project is not in the Protective subzone.

FINAL ENVIRONMENTAL ASSESSMENT

A Finding of No Significant Impact was issued for the project and published in the OEQC Environmental Notice on September 23, 2007.

13-5-30 CRITERIA

The following discussion evaluates the merits of the proposed land use by applying the criteria established in Section 13-5-30 HAR.

- 1) *The proposed use is consistent with the purpose of the Conservation District.*

Staff is of the opinion that the proposed action will deter feral ungulates in the specific areas of the proposed fence project. The area's natural resources will be greatly preserved and potential impacts will be minimized, with mitigation measures.

- 2) *The proposed land use is consistent with the objectives of the Subzone of the land on which the use will occur.*

The objective of the Resource (R) subzone, as stated in HAR §13-5-13 is "to develop,

with proper management, areas to ensure sustained use of the natural resources of those areas.” The protection and restoration of palila habitat in a second, independent location will implement the Hawai‘i Forest Bird Recovery Plan and the State Comprehensive Wildlife Conservation Strategy.

- 3) *The proposed land use complies with the provisions and guidelines contained in Chapter 205A, HRS entitled "Coastal Zone Management", where applicable.*

The County of Hawai‘i provided a statement that the proposed project is not located in the Special Management Area (SMA).

- 4) *The proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community or region.*

Staff notes there will be positive impacts to the environment due to the proposed project. Staff is of the opinion that minor impacts have been adequately mitigated, therefore the proposed project will not have any adverse impact to existing natural resources within the surrounding area, community or region.

- 5) *The proposed land use, including buildings, structures and facilities, shall be compatible with the locality and surrounding areas, appropriate to the physical conditions and capabilities of the specific parcel or parcels.*

Staff is of the opinion the proposed fences will fit into the locality and surrounding areas, with appropriate mitigation measures and without significant or deleterious effects to the locality, surrounding area and parcels

- 6) *The existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon, whichever is applicable.*

The applicant has taken the appropriate steps to mitigate any potential impacts, and to maximize and enhance the natural beauty and open space characteristics of the subject parcel. The proposed project is intended to blend in visually with the surrounding area.

- 7) *Subdivision of land will not be utilized to increase the intensity of land uses in the Conservation District.*

The proposed project does not involve subdivision of Conservation District land.

- 8) *The proposed land use will not be materially detrimental to the public health, safety and welfare.*

The proposed action will not be materially detrimental to the public health, safety and welfare.

DISCUSSION:

The proposed use is an identified land use in the Resource subzone of the Conservation District,

according to Section 13-5-22, Hawaii Administrative Rules (HAR), P-7, SANCTUARIES, D-1, "Plant and wildlife sanctuaries, natural area reserves (see Chapter 195, Hawaii Revised Statutes (HRS), and wilderness and scenic areas, including habitat improvements under an approved Management Plan;"

Staff notes the proposed project will have a direct positive impact on the native ecosystem and watershed. The proposed project will stop feral ungulate damage, which contributes to the decline of native forest ecosystems.

Staff therefore recommends;

RECOMMENDATION:

Based on the proceeding analysis, staff recommends that the Board of Land and Natural Resources (Board) APPROVE this application to construct the proposed Norht Kona Protective Fencing Project, subject to the following terms and conditions:

- 1) The applicant shall comply with all applicable statutes, ordinances, rules, regulations, and conditions of the Federal, State and County governments;
- 2) The applicant, its successors and assigns, shall indemnify and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury or death arising out of any act or omission of the applicant, its successors, assigns, officers, employees, contractors and agents under this permit or relating to or connected with the granting of this permit;
- 3) Any work done on the land shall be initiated within one (1) year of the approval of such use (from the date of the Board's action), and unless otherwise authorized, be completed within five (5) years of the approval (from the date of the Board's action). An extension can be requested at the end of five years in the event that funding can not be acquired to complete the project within that time. The applicant shall notify the Department in writing when construction activity is initiated and when it is completed;
- 4) The applicant shall comply with all applicable Department of Health administrative rules.
- 5) In issuing this permit, the Department has relied on the information and data that the applicant has provided in connection with this permit application. If, subsequent to the issuance of this permit, such information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Department may, in addition, institute appropriate legal proceedings;
- 6) The applicant acknowledges that the approved work shall not hamper, impede or otherwise limit the exercise of traditional, customary or religious practices in the immediate area, to the extent such practices are provided for by the Constitution of the State of Hawaii, and by Hawaii statutory and case law;
- 7) Should historic remains such as artifacts, burials or concentration of charcoal be encountered during construction activities, work shall cease immediately in the vicinity of the find, and the find shall be protected from further damage. The contractor shall immediately contact

SHPD (692-8015), which will assess the significance of the find and recommend an appropriate mitigation measure, if necessary.

- 8) The applicant will coordinate with DOFAW to implement invasive species prevention protocols.
- 9) Other terms and conditions as may be prescribed by the Chairperson; and
- 10) Failure to comply with any of these conditions shall render this Conservation District Use Permit null and void.

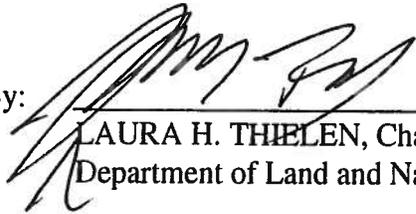
Respectfully submitted,



Paul J. Conry
Administrator

Approved for submittal:

By:



LAURA H. THIELEN, Chairperson
Department of Land and Natural Resources

EXHIBIT A- Conservation District Use Application and Management Plan

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Hawai'i Notices

SEPTEMBER 23, 2007

Waimea Water Treatment Plant Sludge Drying Beds (HRS 343 DEA)

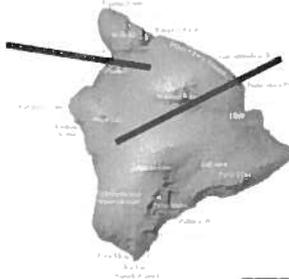
District: South Kohala
TMK: (3) 6-5-001: Parcel 003
Proposing Agency: Department of Water Supply, County of Hawai'i, 345 Kekuanaoa Street, Suite 20, Hilo, Hawai'i 96720, Contact - Keith Okamoto, (808-961-8070)

Determination Agency: Same as above.
Consultant: R.M. Towill Corporation, 420 Waiakamilo Road, Suite 411, Honolulu, Hawai'i 96817, Contact - Chester Koga, (808-842-1133)

Public Comment Deadline: October 23, 2007
Status: Draft environmental assessment (DEA) notice pending 30-day public comment. Address comments to the proposing agency with copies to the consultant and OEQC.

Permits Required: Building Permit & Grading Permit

The Hawai'i County Department of Water Supply (DWS) is proposing to construct a solar sludge drying facility to support its existing water treatment plant (WTP) in Kamuela in the South Kohala District on the Island of Hawai'i. The proposed construction will include an 84' x 110' solar dryer building, a 12' x 18' control center building, and installation of approximately 2,000 linear feet of a 6-inch diameter force main and related appurtenances. The proposed solar drying facility will be used to dewater and dry the sludge residue resulting from the water treatment process. The sludge residue is currently being discharged into an open 2.76 million gallon capacity concrete reservoir. The capacity of the reservoir to store the sludge is nearly exhausted, prompting the need for this proposed facility improvement. The purpose of this project is to address the long-term plan for sludge handling and disposal at the WTP facility. DWS proposes to commence construction in mid 2008 with construction lasting approximately 13 months. The proposed project will be funded with Hawai'i County funds at a cost between \$2.5 and \$4 million.



Consultant: NA
Status: Final environmental assessment (FEA) and Finding of No Significant Impact (FONSI).

Permits Required: CDUA

The 'Ola'a-Kilauea Partnership proposes the construction of up to 22 miles of ungulate-proof fencing, eventually enclosing approximately 13,000 acres on the slopes of Mauna Loa in North Kona on the island of Hawai'i. The proposed project is part of the ongoing conservation efforts of the 'Ola'a-Kilauea Partnership, members of which include Kamehameha Schools, the Division of Forestry and Wildlife of the Department of Land and Natural Resources, Hawai'i Volcanoes National Park, Kulani Correctional Facility (State Department of Public Safety), USGS Biological Resource Division, the US Fish and Wildlife Service, the USDA Forest Service, and The Nature Conservancy of Hawai'i. Introduced ungulates (hooved animals), including cattle, feral goats, feral sheep, mouflon sheep and feral pigs, are a significant threat to native species and to the rare natural communities found in the project area. The proposed fencing will protect a substantial portion of the second largest native mamane forest, the largest and most intact stand of 'iliihi (sandalwood), and the largest area of diverse native grasslands on the island and will facilitate restoration of habitat for the endangered palila and for multiple endangered plant species. The planned fence will be approximately seven feet tall, made of steel posts and steel wire. Barbed wire may be attached to the fencing in areas where cattle are present. Potential impacts include possible entanglement of endangered bats on barbed wire, removal of native vegetation, and the accidental introduction or spread of weeds during construction. Impact mitigation measures include limiting use of barbed wire to sections where necessary to prevent cattle intrusion, selecting final fence alignments to follow existing roadways where possible, and the incorporation of alien species prevention protocols.

Potential impacts include possible entanglement of endangered bats on barbed wire, removal of native vegetation, and the accidental introduction or spread of weeds during construction. Impact mitigation measures include limiting use of barbed wire to sections where necessary to prevent cattle intrusion, selecting final fence alignments to follow existing roadways where possible, and the incorporation of alien species prevention protocols.

North Kona Protective Fencing Project (HRS 343 FEA-FONSI)

District: North Kona
TMK: (3) 7-8-001-003
Applicant: 'Ola'a Kilauea Partnership, P.O. Box 52, Hawai'i National Park, Hawai'i 96718, Contact - Tanya Rubenstein (808-985-6197).

Approving Agency: State of Hawai'i, Department of Land and Natural Resources, Division of Forestry and Wildlife, 1151 Punchbowl Street, Room 325, Honolulu, Hawaii 996813, Contact - Christen Mitchell (808-587-0051)



APPLICANT

Legal Name: **Hawaiian Silversword Foundation, Inc. (Robert H. Robichaux, President, Board of Trustees)**

Street Address: **721 North Forgeus Avenue**

City, State and Zip+4 Code: **Tucson, AZ 85716**

Mailing Address: **PO Box 52**

City, State and Zip+4 Code: **Hawaii National Park, HI 96718**

Contact Person & Title: **Colleen Cole, Three Mountain Alliance Coordinator**

Phone No: **808-985-6197**

Fax No: **808-985-6029**

Email: **tcolleencole@gmail.com**

Interest in Property: **20 year Conservation License Agreement**

*Signature Robert H. Robichaux Date 5/24/10

*If for a Corporation, Partnership, Agency or Organization, must be signed by an authorized officer.

AGENT

N/A

PROPERTY OWNER(S) (If other than the applicant)

Legal Name: **Kamehameha Schools**

Street Address: **78-6831 Aili Drive, Suite 235**

City, State and Zip+4 Code: **Kailua-Kona, Hawaii 96740**

Mailing Address: **same**

City, State and Zip+4 Code:

Contact Person & Title: **Kamakani Dancil, Land Asset Manager**

Phone No: **808-322-5307**

Fax No: **808-322-9446**

Email: **kadancil@ksbe.edu**

Relationship to applicant: **Land Asset Manager, Kamehameha Schools (landowner representative)**

Signature K. Dancil Date 5/21/10

CONTRACTOR

N/A

Emergency Contact Information

Company/Organization Name: **Three Mountain Alliance**

Contact Person and Title: **Colleen Cole, Coordinator**

Phone No: **808-985-6197**

Fax No: **808-985-6029**

PRIOR CONSERVATION DISTRICT USE PERMITS (CDUP)

Please specify all prior CDUP received for the subject parcel.

N/A

PROPOSED USE

Total Area of Proposed Use: (indicate in acres or sq. ft):

The fenced area will be approximately 14,500 acres with approximately 3,000 acres in the Conservation District. The fence will affect a 10 foot wide corridor that is 116,160 feet long (22 miles) of which approximately 52,800 feet (10 miles) of fence line will be in the Conservation District. A total of approximately 26 acres will be affected by the proposed use of which approximately 12 acres will be in the Conservation District).

Describe the proposed use in detail. Include secondary improvements such as grading, septic tank placement, utilities, roads, driveways, fences, landscaping, etc. Illustrate general location of improvements on a TMK map; include preliminary architectural renderings with elevations and building footprints with application. Include existing (before) and proposed (after) graphics. If the parcel is or has been the subject of a violation, please include the violation number.

Hawaiian Silversword Foundation, Inc., in partnership with the Three Mountain Alliance, proposes the construction of up to 22 miles of ungulate-proof fencing, enclosing approximately 14,500 acres on the slopes of Mauna Loa in North Kona. The proposed fencing will protect a substantial portion of the second largest native mamane (*Sophora chrysophylla*) forest on the island and facilitate restoration of degraded mamane forest, habitat for the endangered palila (*Loxioides bailleui*) and for multiple endangered plant species. The construction of animal-proof fencing, followed by feral animal control, is the critical first steps to protect, and then to restore, this area. The fenced area would be suitable habitat for the reintroduction of at least seventeen rare native plant species, and should restoration of the mamane forest be successful, this area could become a site for the reintroduction of the palila, establishing a second, independent population from the current population.

This parcel has not been a subject of violation.

CONSERVATION DISTRICT REQUIREMENTS

Demonstrate that the proposed use is consistent with the following criteria. Refer to HAR, Section 13-5-30, to review criteria. Attach additional sheets if necessary.

Is the proposed land use consistent with the purpose of the Conservation District?

Yes, the proposed North Kona Fencing and Habitat Restoration project is consistent with the purpose of the Conservation District since it will conserve, protect, preserve and restore important natural resources of the state including native plants and animals.

Is the proposed use consistent with the objectives of the subzone of the land in which the use will occur?

Yes. The objective of the Resource (R) subzone, as stated in HAR §13-5-13 is "to develop, with proper management, areas to ensure sustained use of the natural resources of

those areas." Historically, palila existed over a wider range that includes the project area, but currently palila are found only on the slopes of Mauna Kea, where 95 percent of the total population is concentrated in approximately 7,400 acres. The protection and restoration of habitat in a second, independent location will implement the Hawaii Forest Bird Recovery Plan and the State Comprehensive Wildlife Conservation Strategy. The proposed project is for the implementation of conservation and restoration strategies to protect and preserve 14,500 acres.

Does the proposed land use comply with provisions and guidelines contained in Chapter 205A, Hawaii Revised Statutes (HRS), entitled "Coastal Zone Management," where applicable?

N/A

Describe how the proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community or region.

Construction of fencing would result in the disturbance of limited amounts of vegetation within a fencing corridor up to ten feet wide as a result of the clearing needed to remove potential hazards to crew and to facilitate construction. Where the fence follows existing four-wheel drive roads, very little, if any, native vegetation is anticipated to be impacted by fence construction. Due to the method of fence construction, the limited corridor to be disturbed, and the lack of streams in the project area, no significant changes in the normal runoff or percolation patterns is anticipated as a result of this project. Disturbance along the fencing corridor, as well as the transport of fence materials, equipment, and crew, could increase the potential accidental introduction or spread of non-native plants and invertebrates (including ants) to and within the project site. This will be mitigated by use of protocols to prevent introduction on materials, tools, clothing, and vehicles. Once constructed, the fence line will be periodically inspected and invasive species will be treated when found.

Limited noise and/or air pollution from helicopter sling loads and the use of small power tools will be unavoidable during fence construction. Use of this equipment is temporary and is not anticipated to significantly contribute to the overall environmental quality in the region. The proposed project has been carefully planned to protect and preserve the existing natural resources within the project area and will have no lasting effects or impacts within the surrounding area.

Describe how the proposed land use, including buildings, structures and facilities, will be compatible with the locality and surrounding areas, and to the physical conditions and capabilities of the specific parcel or parcels.

The only proposed construction is the fence, which will not negatively alter the condition of the parcel. The local area has been used for ranching for many years and there are many fences in the surrounding locale. Without fencing, sheep, cattle, and pigs would be expected to continue to damage this declining forest type and degrade rare native ecosystems. The physical component of this project, the fence, is necessary to protect this unique ecosystem from continuous degradation by feral ungulates and invasive weeds.

Describe how the existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon.

The area will remain open-space and natural beauty will be enhanced through restoration of native dry forest. The region including and surrounding the project area harbors the second largest area of mamane-containing forest on the island. These forests originally were more spatially variable and diverse in plant species and supported a unique community of animals. Only Mauna Kea supports a larger area of mamane, but the Mauna Kea mamane forest lacks the species diversity of the project area. Other mamane forest areas on the island (north and southwest Hualalai, PTA, east Kapapala-Keauhou) are much smaller and in much poorer condition than large portions of the project area and surrounding region. The diverse native grassland areas found over much of the project area are a special remnant component of the native vegetation that is particularly vulnerable to ungulate impacts. The project aims to protect and enhance these native ecosystems.

If applicable, describe how subdivision of land will not be utilized to increase the intensity of land uses in the Conservation District.

N/A

Describe how the proposed land use will not be materially detrimental to the public health, safety and welfare.

Due to the remote nature of the project, there are no anticipated effects on public health, safety or welfare. Gates will be provided at existing roadways and trails. Public health and welfare will be increased through restoration of healthy forests.

ADDITIONAL INFORMATION

Articles IX and XII of the State Constitution, other state laws, and the courts of the State require government agencies to promote and preserve cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups. The Department of Health (DOH), Chapter 343, also requires an Environmental Assessment (EA) of cultural resources in determining the significance of a proposed project.

If applicable, please provide the identity and scope of "valued cultural, historical and natural resources" in which traditional and customary native Hawaiian rights are exercised in the area.

Cultural resources will be protected from further destruction by ungulates through construction of the fence. The ahupuaa of Keauhou 2 encompasses roughly 113,000 acres and extends across the broad upland plateau stretching from the western summit of Mauna Loa to the summit of Hualalai. Prominent landscape features provided cultural affiliations for Native Hawaiians and served as ceremonial cores, as land divisions, and as resource procurement sites. At present, native Hawaiians may exercise their rights to visit and practice their culture in the areas as described.

A number of named locations in Keauhou 2 impart the cultural importance of place. The following are examples of named places within or near the project area:

- **Puu Lepo (earth mound) – another name for Kikiaeae Hill**
- **Kikiaeae/Kikikiaeae (fine basket) – a boundary point for Keauhou 2 ahupuaa, cinder cone in Kau volcanic series, elevation 5550', canoe makers from Hokukano ahupuaa lived in this area.**

- **Makaulaula/Ka Makaulaula (the red eye) – a boundary point for Keauhou 2 ahupuaa and pahoehoe kipuka; was noted for having mamane trees growing around the kipuka**
- **Aahuwela/Ahuwela (hot clothing/garment producing heat) – a cave at the corner of Kealakekua and Hokukano ahupuaa; was known to have water in it at one point, elevation 5580'**
- **Kipuka Lupea (attractive kipuka) – kipuka and paddock on old Greenwell Ranch, elevation 5600'**
- **Puu Lehua (lehua flower hill) – cinder cone in Kau volcanic series, elevation 5187'. Another name suggested is Pulehua, which means to gum the lehua flowers to catch birds. Also the site of ranch.**
- **Kipuka Mamani (obsolete spelling of mamane tree – mamane tree kipuka) – a kipuka known for its abundance of mamane trees, elevation 5600 feet.**

Identify the extent to which those resources, including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action.

Access to the project site will not be altered by construction of the fence. The Three Mountain Alliance, in conjunction with Hawaiian Silversword Foundation, Inc. and the Kamehameha Schools, plans to increase access to the area for educational and cultural purposes. In general, the proposed fencing and conservation management poses a minimal threat to archaeological resources in the project area. The final fence alignment has been surveyed (and any sites identified, recorded) prior to construction to avoid potential adverse effects to archaeological sites and cultural resources. Impacts to any identified sites will be avoided primarily through avoidance – by re-routing the fence alignment as necessary to protect the identified site. Where avoidance is not possible, appropriate mitigation and site treatments will be developed in consultation with appropriate parties, such as the State Historic Preservation Division and Kamehameha Schools Land Assets Division. Because the fencing will be aligned, where possible, adjacent to existing four-wheel drive roads, it is anticipated that construction of fencing will pose little risk to any sites unidentified during surveys. As presently designed, the fencing is not anticipated to pose long-term impacts to archaeological sites. Over the long-term, the fencing project would help preserve any unknown archaeological resources within the project area, by preventing soil disturbance and trampling of sites by hooved animals.

The proposed action is also not expected to significantly impact Native Hawaiian traditional and cultural practices. Based on the remoteness of the project area, the limited access due to its location on private land, the conservation purpose of the fencing, and the incorporation of gates or crossovers where fencing crosses existing trails or roads, it is anticipated that fencing would have little to no impact on Native Hawaiian practices. The fencing is not designed to block access to people, but to limit animal movement.

What feasible action, if any, could be taken by the Board of Land and Natural Resources in regards to your application to reasonably protect native Hawaiian rights?

The project is located within a remote area, the protective fence will have access gates, and the private landowner retains control of access to the parcels as it has historically,

prior to this application. The project will not change or require any additional actions or measures to protect native Hawaiian rights.

Does the proposed land use have an effect (positive/negative) on public access to and along the shoreline or along any public trail?

The project will not have any effect on public access. Due to the remote nature of the project area there has been little access in the past.

Does the proposed use have an effect (positive/negative) on beach processes?

N/A - The project is not located near the beach.

Will the proposed use cause increased runoff or sedimentation?

The project will not cause increased runoff or sedimentation. Once fencing is completed and feral ungulates are removed, the project is anticipated to reduce runoff and sedimentation.

For soils in the project areas, runoff is medium and the erosion hazard is slight. The project area is predominantly pahoehoe lava flows with a relatively smooth, ropy surface. In some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. Soils in the project area are primarily characterized as rLW (lava flows, pahoehoe) and rKHD (Kekake extremely rocky muck, 6 to 20 percent slopes). Pahoehoe lava has little soil covering and is typically bare of soil and/or vegetation except for mosses and lichens with scattered trees and shrubs in cracks and crevices. Kekake series soils consist of well-drained, thin organic soils over pahoehoe lava bedrock. Small portions of the project area contain soils characterized as HDD (Hanipoe silt loam, 12 to 20 percent slopes), rMWD (Mawae extremely stony muck, 6 to 20 percent slopes), rLV (lava flows, aa), and rRO (rock land).

Will the proposed use cause any visual impact on any individual or community?

No, the project is located in a remote area of North Kona, far from public view. Restoration of the forest will improve the visual aesthetics of the site.

Are there existing structures on the parcel? Yes No
If yes, please describe below and include/illustrate on a map entitled *existing structures*.

There are five existing water tanks located within the project area (see attached map entitled "Existing Structures", page 13).

Will any existing structures be demolished or removed? Yes No
If yes, describe how below. Please indicate/illustrate demolished structure on a map entitled structures to be demolished/removed.

Has the parcel been graded or landscaped? Yes No
If yes, describe below. Please describe cubic yards affected and/or area of landscaping on a map entitled areas previously graded or landscaped.

Describe existing utilities. Include electricity, water, telephone, drainage, and sewerage. Please illustrate on a map entitled existing utilities.

There are no existing utilities within the project area.

Describe existing access. Illustrate and include roadways and public trails on a map entitled *existing access*. Give major street names if available.

A number of four-wheel drive roads of varying quality currently exist in the TMK and provide access to and within the project area. A map is attached to the Environmental Assessment.

Describe Flora and Fauna. Illustrate general location and types of flora and fauna on a map entitled *resources*. Indicate if rare or endangered native plants and/or animals are present.

Appendix A (p. 36) in the North Kona Protective Fencing Project Environmental Assessment shows vegetation zones in and surrounding the project area. Influenced by the geologic characteristics, the project area contains broad, well-developed vegetation zones. Looking south from the plateau, the mamane belt abruptly narrows in width as the slopes of the west flank become steeper, and the mamane forest nearly disappears altogether soon after entering South Kona district. Similarly, zones of koa and other forest types are also narrower to the south.

The project area is characterized by several vegetation types including montane dry and mesic forests and woodlands, subalpine forests, woodlands and shrublands, and grasslands. Major plant communities found within the project area include:

- Ohia dominated forest or woodland on aa lava or at upper elevations
- Mixed koa forest with native shrubs, sedges, and/or grasses
- Pukiawe-aalii shrubland
- Grassland communities with very few trees.

At least 65 native plants have been observed in the project area. These include trees such as mamane, ohia (*Metrosideros polymorpha*), koa (*Acacia koa*), and iliahi (sandalwood [*Santalum paniculatum var. pilgeri*]), shrubs such as aalii (*Dodonea viscosa*) and pukiawe (*Styphella tameiameiae*), grasses such as *Carex wahuensis* and mountain pili (*Panicum tenuifolium*), and ferns such as oalii (*Asplenium trichomanes var. densum*) and ae (*Polypodium pellucidum*). Appendix B (p. 38) in the Environmental Assessment contains a list of native plants observed in the project area. The endangered fern *Asplenium peruvianum var. insulare* occurs just inside the project area.

The project area also supports several unique plant communities, including the largest and most intact stand of iliahi (sandalwood) remaining on the Island of Hawaii. In addition, the project area supports the largest area of diverse native grasslands in Hawaii. Seven species of native grass are found in sizeable quantities in several communities, including under mamane forest and in native shrublands. Finally, the region including and surrounding the project area also harbors the second largest area of mamane forest on the island. Although Mauna Kea supports a larger area of mamane, the forest there lacks the species diversity found in the project area.

The project area is dominated by native vegetation, although large portions of the plant communities have been highly altered by logging, cattle grazing, feral ungulates, fire,

and alien plant invasion over the past 200 years. There is evidence of logging up to approximately the 6,000 foot elevation. Feral ungulates (primarily sheep) are present in large numbers throughout the entire project area. There are currently few records of wild mouflon sheep, but their populations are increasing and their range is expanding.

As a result, currently, the most intact plant communities are the subalpine forest/shrub/grassland units above the 6,000 foot elevation. These include mixed tree communities and associated shrub and grassland habitats, as well as the subalpine ohia forest on both aa and pahoehoe lava. These areas are above the current and probably historic distribution of cattle. At lower elevations, particularly in areas previously used for grazing, non-native pasture grasses constitute part of the plant community, either as understory in closed/open koa-mamane-llahi-aalii forest or as part of pasture grasslands dominated by alien species. Highly invasive fountain grass (*Pennisetum setaceum*) is found in portions of the project area and has the potential, if not addressed, to aggressively spread widely.

The proposed fencing will also provide protection or allow for restoration of the following threatened (t) or endangered (e) species historically known from the area: *Asplenium peruvianum* var. *insulare* (e), *Cyperus fauriei* (e), *Delissea undulata* ssp. *undulata* (e), *Neraudia ovata* (e), *Portulaca sclerocarpa* (e), *Silene hawaiiensis* (t), *Solanum incompletum* (e), and *Stenogyne angustifolia* (e). Appendix C (p. 40) in the Environmental Assessment contains a list of rare plant species, including these species as well as other rare plants that could benefit from the proposed action.

Native birds observed in the project area include the amakihi (*Hemignathus virens*), apapane (*Himatione sanguinea*), elepaio (*Chasiempis sandwichensis*), the endangered Hawaii creeper (*Oreomystis mana*), iiwi (*Vestiaria coccinea*), kolea (*Pluvialis fulva*), pueo (*Asio flammeus sandwichensis*), and the endangered io (Hawaiian hawk [*Buteo solitarius*]). The endangered opeapea, or the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*), has also been observed in the project area. A species list of native fauna thought to be located in the project area is included in the Environmental Assessment, Appendix D.

In addition, the project area is within the historic range of several endangered native birds, including the palila (currently restricted to Mauna Kea), the alala (Hawaiian crow [*Corvus hawaiiensis*])(now extinct in the wild), and the uau (Hawaiian petrel [*Pterodroma sandwichensis*]). Historically, the project area supported a unique community of native birds, including four finch-billed honeycreepers, of which only the palila has survived (but no longer in the project area). The area also historically hosted a much larger nene (*Branta sandvicensis*) population, but only eight to ten nene still appear occasionally, with others flying over on their way to Puu Waawaa.

Preliminary invertebrate studies with a focus on moths have recently been done in the project area by USGS-BRD. These surveys identified 70 species and morphospecies from 13 families of moths, of which 46 are endemic to the Hawaiian Islands. Of the endemic species collected, two *Argotis* (*Noctuidae*) species and one *Scotorythra* (*Geometridae*) species appear to be new to science, and three species were previously considered to be extinct. Also of note was the collection of only one morphospecies of the seven species of *Cydia* potentially found feeding on mamane seeds. *Cydia* moths were fairly common but their caterpillars, which are important foods of palila, were rarely found inside mamane pods.

As noted earlier, the project area supports the largest and most intact stand of sandalwood or iliahi remaining on the island of Hawaii. Several rare insects are known from this forest type. Some are obligate specialists on sandalwood trees and may face extinction due to the loss of their host plants.

Four invertebrate species of concern have been observed within the project area: *Agrotis melanoneura* (moth), *Omiodes monogona* (moth), *Omiodes anastrepta* (moth), and *Plagithmysus greenwelli* (beetle). Given the relatively intact condition of the native vegetation in the project area, it is likely that additional studies would discover additional native invertebrates, both rare and common. Two species of non-native ants were collected in the lower portion of the survey area, including the big-headed ant (*Pheidole megacephala*) (*Fabricius*), a worrisome pest due to its large population size and its aggressive tendencies to attack arthropod and vertebrate species (the other ant species found is *Cardiocondyla venestula*).

Many species of introduced game birds and alien songbirds are found in the project area, including the red-billed leiothrix (*Leiothrix lutea*), Northern cardinal (*Cardinalis cardinalis*), Japanese White-eye (*Zosterops japonica*), mynah (*Acridotheres tristis*), spotted dove (*Streptopelia chinensis*), house finch (*Carpodacus mexicanus*), Northern mockingbird (*Mimus polyglottos*), California quail (*Callipepla californica*), Erckel's francolin (*Francolinus ercelli*), and turkey (*Meleagris gallopavo*).

Non-native animals observed or thought to occur in the project area include mouflon sheep (*Ovis musimon*), feral sheep (*Ovis aries*), cattle (*Bos taurus*), and feral pigs (*Sus scrofa*). Small-animal predators include rats (*Rattus spp.*), mice (*Mus musculus*), feral cats (*Felis silvestris*), feral dogs (*Canis familiaris*), and mongoose (*Herpestes auropunctatus*).

Describe topography and submit a map entitled topography. If ocean area, give depths. Submit detailed contour maps for ocean area and areas where slopes are 20% or more. Contour maps will also be required for uses involving tall structures, gravity flow and other special cases.

The North Kona Protective Fencing Project area is on land owned by Kamehameha Schools near Puu Lohua in the ahupuaa of Keauhou 2 in the North Kona District (TMK (3)-7-8-001-003). The TMK covers approximately 62,700 acres, while the project area is composed of approximately 14,500 acres. The elevation ranges from approximately 5,000-7,000 feet. A map illustrating the location of the project area is included in the Environmental Assessment as Appendix A (p. 36).

If shoreline area, describe shoreline and surrounding area. Indicate and illustrate if shoreline is sandy, muddy, rocky, cliffs, reefs, or other features (such as access to shoreline) on a map entitled *coastal resources*. A current shoreline certification is required for uses that may affect shoreline resources.

N/A - The project is not located near the shoreline.

If shoreline area, describe and illustrate any coastal hazards such as erosion, flooding, tsunami, etc. Attach any relevant maps delineating the hazard zone (FEMA, FIRM maps).

N/A - The project is not located near the shoreline.

Describe existing covenants, easements, and restrictions. If State owned land, indicate present encumbrances.

The project area is located on land owned by Kamehameha Schools. The Hawaiian Silversword Foundation has negotiated a 20-year license agreement (expires December 1, 2029) with Kamehameha Schools to implement and maintain the proposed conservation project.

Identify any historic, archeological or cultural sites within or near the parcel. Please submit or include any current management plan. If applicable, indicate location(s) on a map entitled *historical, archaeological, and cultural resources* and describe below.

Archival information indicates that the forested uplands of Keauhou 2 were likely most commonly used by Native Hawaiians for specialized resource procurement activities, such as bird catching/collecting and plant/hardwood harvesting. Many of the sites associated with these activities, such as shelters, were likely temporary in nature and reabsorbed into the landscape. An exception is excavated pits, which appear well preserved in the archaeological record. Excavated pit site areas have been well documented, and appear to be predominantly located on Mauna Loa flow types classified as k2 in an elevation range between 6,000 and 8,000 feet. As these same conditions are present within the upper eastern portion of the project area, it is possible that similar sites may be discovered during surveys of the final fence alignment.

A few trail routes are found within the saddle region of Mauna Loa and Hualalai, however, several sources from the time period post-contact (e.g., William Ellis) indicate the absence of trails across the plateau between Hualalai, Mauna Loa, and Mauna Kea. The extensive history of ranching in the uplands of Mauna Loa and Hualalai is evident on the landscape, including walls, roads and trails, paddocks, pastures, water tanks, and irrigation systems. Most of these features have not been formally recorded. From the archival information and these surveys, a list of archaeological sites potentially located in the project area was generated, including temporary habitation sites, caves, ponds/water holds, ahu, trails, excavated pits, shrines/heiau, ranch structures, walls, paddocks, enclosures, temporary camps, water tanks, irrigation systems, logging/milling stations, and roads/trails.

Surveys of the general project area began in March 2006, and surveys of the final fence alignment have now been completed. The proposed fencing and conservation management pose a minimal threat to archaeological resources in the project area. The minor ground disturbances that results from fence construction include clearing the corridor of vegetation and embedding metal T-stakes at intervals, activities that have relatively low potential for ground disturbance. Impacts to any identified sites have been avoided primarily through avoidance – by re-routing the fence alignment as necessary to protect the identified site. Because the fencing will be aligned, where possible, adjacent to existing four-wheel drive roads, it is anticipated that construction of fencing will pose little risk to any sites unidentified during surveys. The results of the archeological survey have been sent to the State Historic Preservation Division (SHPD). Any conditions on the project suggested by SHPD will be incorporated into the conditions of the Conservation District Use Permit.

Adjacent Property Owners

Please list all adjacent property owners. If no address is available indicate north, south, east and west or mauka, makai or other common county directionals.

TMK: 3-7-9-001

Legal Name: Hokukano Ranch Inc

Street Address: 81-6580 Mamalahoa Hwy

City, State and Zip code: Kealahou, HI 96750

Mailing Address: PO Box 2240

City, State and Zip: Kealahou, HI 96750 Phone No.: (808) 323-2299

Location to TMK: Southwest of parcel where proposed fence construction will occur

CERTIFICATION

I HEREBY CERTIFY THAT I HAVE READ THIS COMPLETED APPLICATION AND THAT, TO THE BEST OF MY KNOWLEDGE, THE INFORMATION IN THIS APPLICATION AND ALL ATTACHMENTS AND EXHIBITS IS COMPLETE AND CORRECT. I UNDERSTAND THAT THE FAILURE TO PROVIDE ANY REQUESTED INFORMATION OR MISSTATEMENTS SUBMITTED IN SUPPORT OF THE APPLICATION SHALL BE GROUNDS FOR EITHER REFUSING TO ACCEPT THIS APPLICATION, FOR DENYING THE PERMIT, FOR SUSPENDING OR REVOKING A PERMIT ISSUED ON THE BASIS OF SUCH MISREPRESENTATIONS, OR FOR SEEKING OF SUCH FURTHER RELIEF AS MAY SEEM PROPER TO THE LAND BOARD.

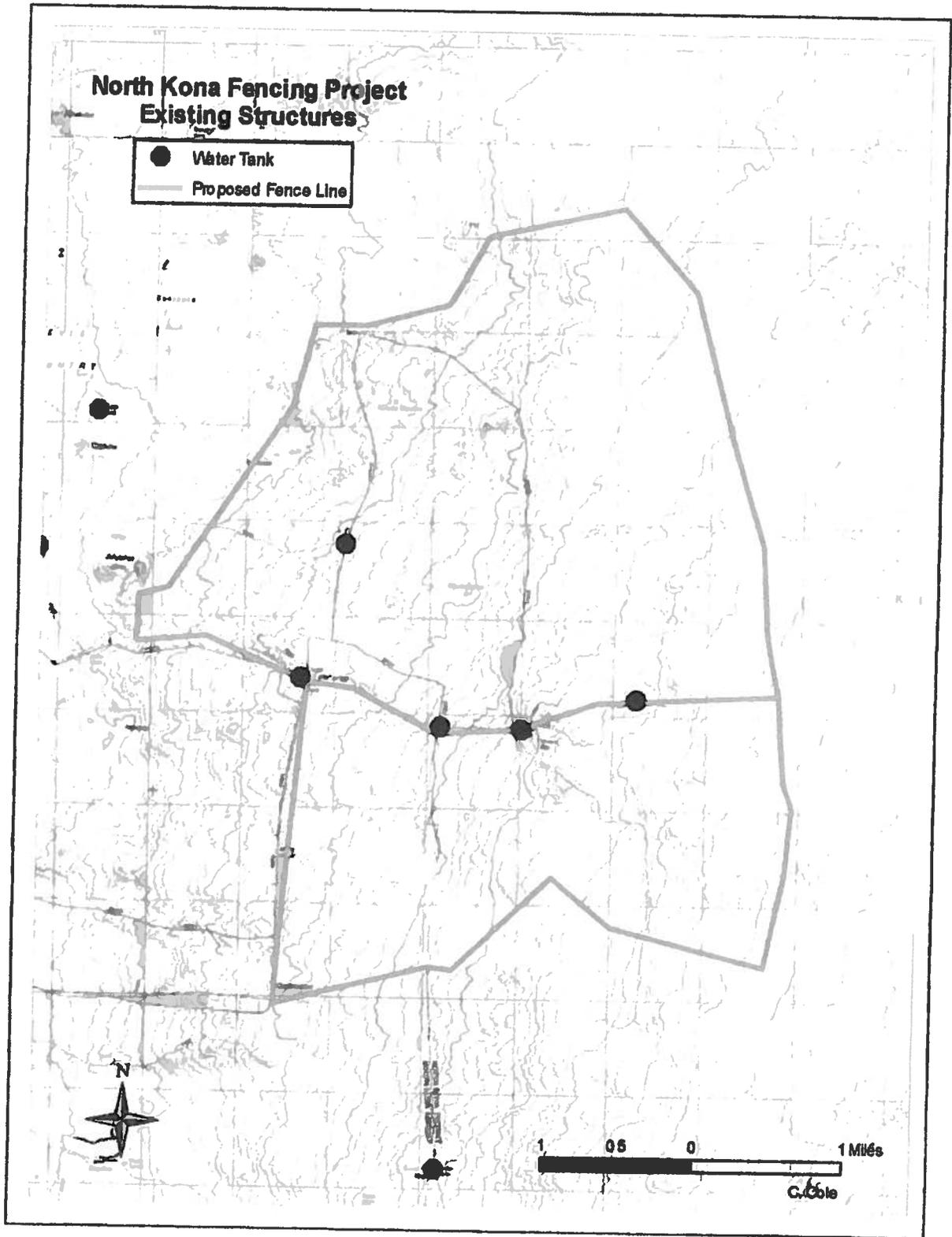
I HEREBY AUTHORIZE REPRESENTATIVES OF THE DEPARTMENT OF LAND AND NATURAL RESOURCES TO CONDUCT SITE INSPECTIONS ON MY OR MY CLIENT'S PROPERTY. UNLESS ARRANGED OTHERWISE, THESE SITE INSPECTIONS SHALL TAKE PLACE BETWEEN THE HOURS OF 8:00 A.M. AND 4:30 P.M.

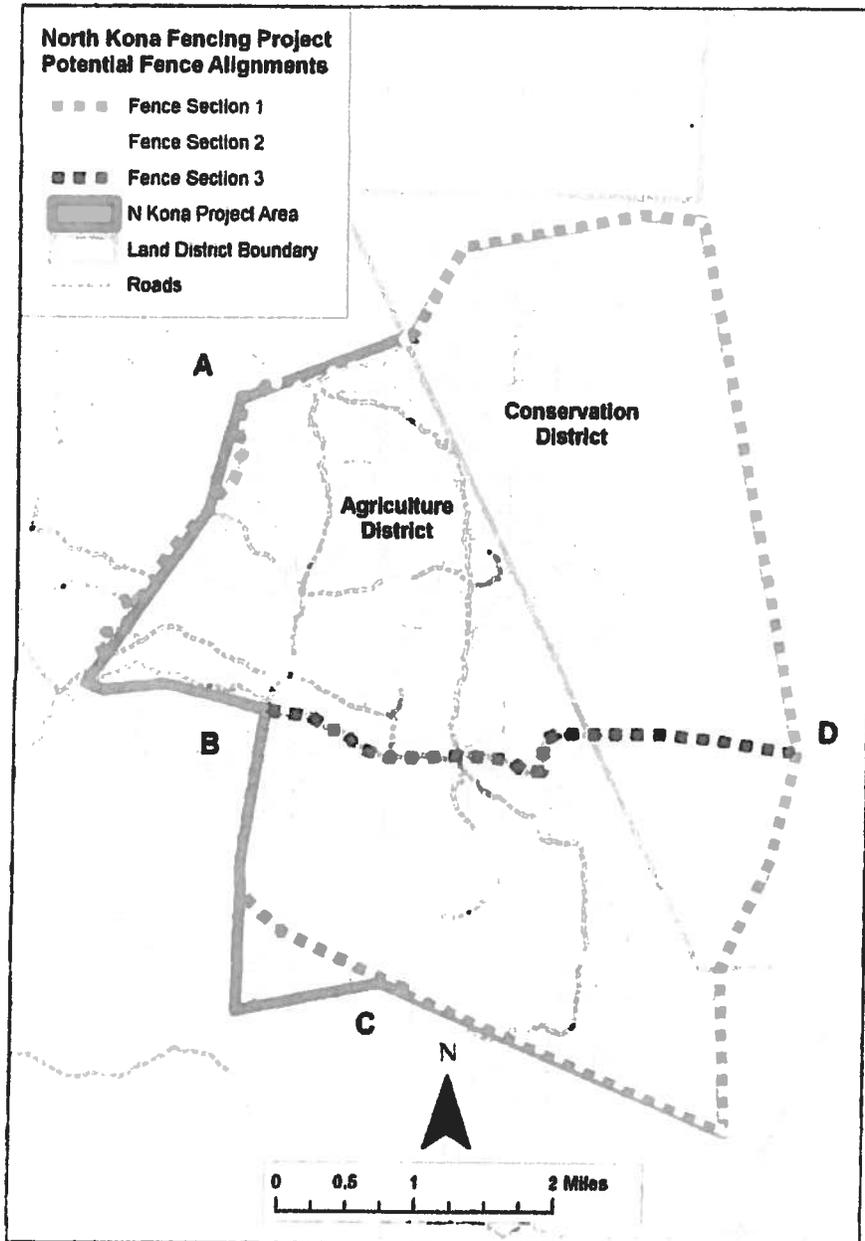
Robert H. Reicheaux
Signature of Authorized Agent(s) or if no agent, signature of Applicant

AUTHORIZATION OF AGENT

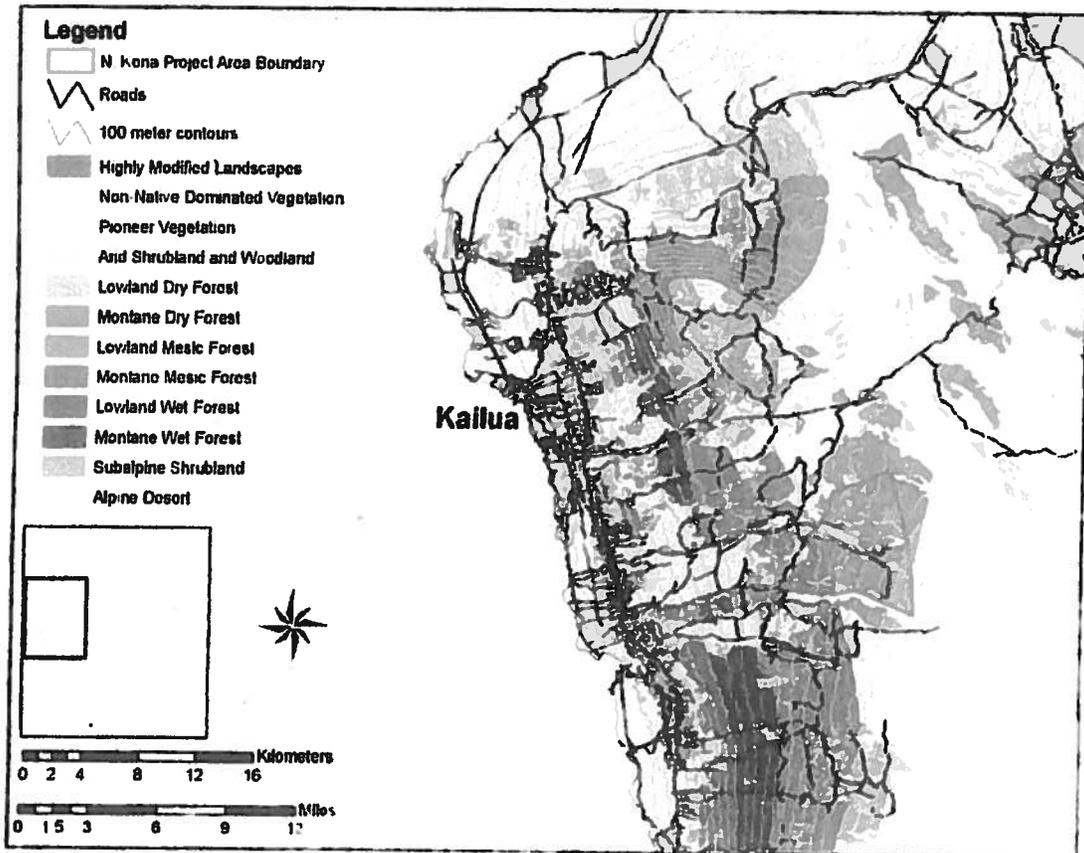
I HEREBY AUTHORIZE _____ TO ACT AS MY REPRESENTATIVE AND TO BIND ME IN ALL MATTERS CONCERNING THIS APPLICATION.

Signature of Applicant(s)





Map B. Potential fencing alignments



Map A. North Kona Fencing and Habitat Restoration Project Area.

North Kona (Lupea) Management Plan

(2009 – 2029)

Hawaiian Silversword Foundation and Three Mountain Alliance

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MANAGEMENT OBJECTIVES

The project objective is to protect and restore approximately 13,200 (5,340 ha) of native forest on Kamehameha Schools (KS) lands in the vicinity of Kīpukalupea the District of North Kona on the Island of Hawai'i. These lands are of high conservation value and have the potential to support endangered bird species such as the palila (*Loxioides bailleui*) as well as fourteen rare and/or endangered plant species. Management actions needed to protect and restore this native forest include fence construction, alien animal control, invasive alien plant control, fire control, and reforestation.

PROJECT AREA BACKGROUND INFORMATION

Project Property Description

Property location – The property is located on KS lands in the North Kona District. The project area elevation ranges from approximately 5,000-6,500 ft (1,500 m to 2,000 m).

Property or management area size – 13, 200 acres (5,340 ha).

Property tax map key number - TMK 3-78-001-003 (a portion of this TMK).

Property Zoning – The area is zoned both Agricultural and Conservation district (Resource subzone). The Conservation district boundary bisects the project area. An Environmental Assessment for the project was completed in 2006. A Conservation District Use Permit application will be submitted for the portion of the project proposed for Conservation District lands.

Location and Topographic Map – See Figure 1.

Project Implementation

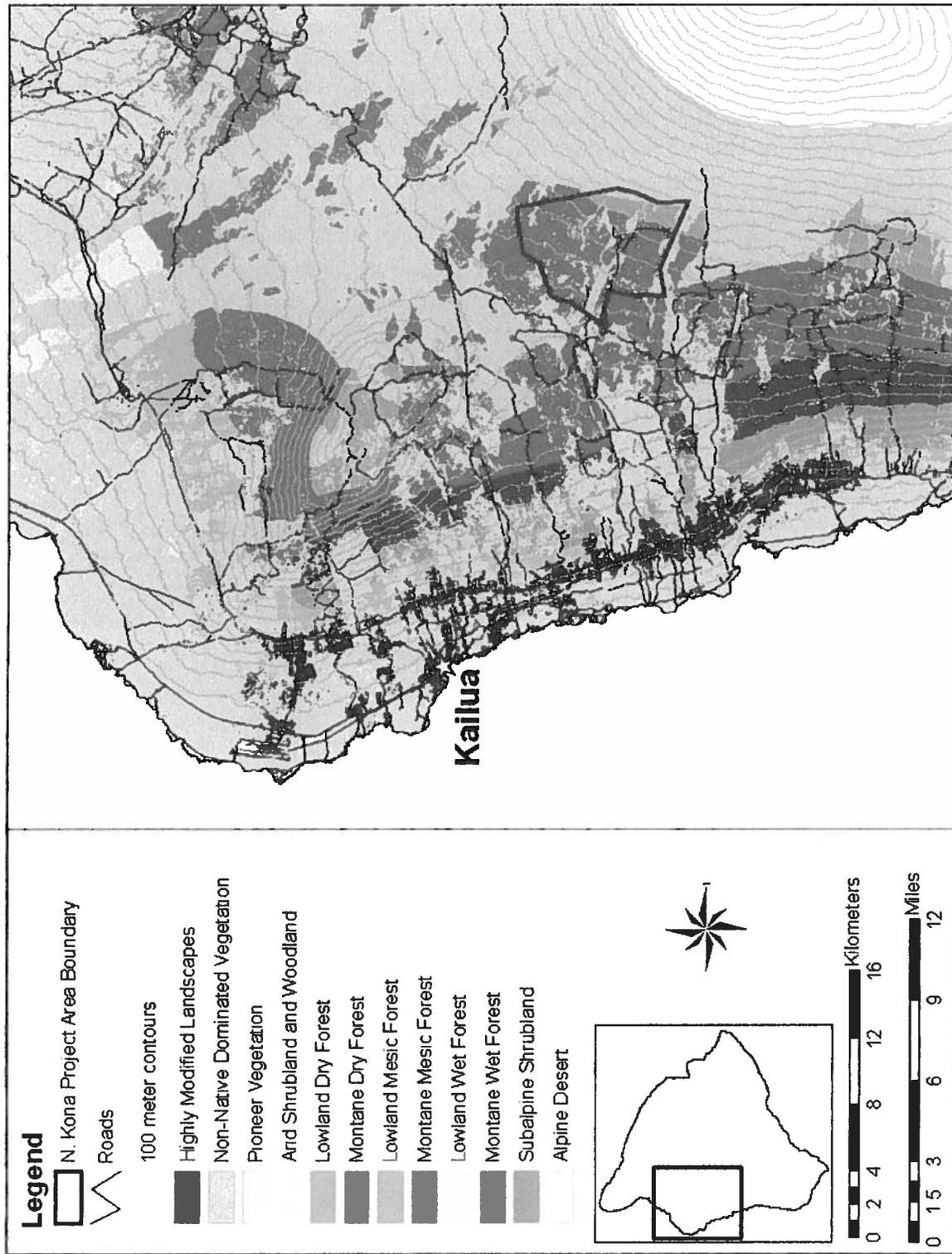
The Three Mountain Alliance (TMA) and the Hawaiian Silversword Foundation (HSF), a 501(c) (3) non-profit organization, will implement this project in cooperation with KS. HSF will have a long-term conservation license from KS (landowner) to do the management actions outlined in this management plan. KS is a TMA member and will be actively participating in the project.

The TMA will provide overall project guidance, and TMA staff will organize and assist with implementing the proposed management actions. Additional staff for management actions will be contracted and/or hired. The TMA, established in 1994 (as the Olaa Kilauea Partnership), is a cooperative land management effort for over one million acres of federal, state, and private lands on the Island of Hawaii. Members include five federal agencies, two state agencies, and two private non-profit organizations. The TMA has successfully implemented numerous joint resource management and research projects including fencing of large areas, feral animal control, alien plant control, and endangered plant reintroduction.

The HSF is dedicated to conserving and restoring the native plants and ecosystems of Hawaii through research, management, and education, with a focus on endangered-plant reintroduction and ecosystem restoration.

Various entities have supporting the project by providing funding for fencing including the U.S. Fish and Wildlife Service (Landowner Incentive Program and Private Stewardship Program) and the Hawaii Division of Forestry and Wildlife (Watershed Partnership Program Grant). Kamehameha Schools is providing support for management projects (fencing, feral animal control, weed control and fire planning).

Figure 1. Project Area Location and Plant Communities (Price et al 2007).



Climate/Geology/Soils

The site ranges in elevation from 1,500 m to 2,000 m (4,920 ft to 6,560 ft), and receives approximately 600 mm (24 in) of rainfall per year (Giambelluca et al. 1986). This area falls within the moderately dry moisture zone as mapped by Price et al. (2007).

Most of the area is covered by either 'a'ā or pāhoehoe lava flows erupted from Mauna Loa volcano between 200 and 3,000 years ago (Wolfe and Morris 1996, Sherrod et al. 2007). However, a few small sites within the project area have substrates between 5,000 and 11,000 years old. The area is predominantly pāhoehoe lava flows with a relatively smooth, ropy surface. In some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. Pāhoehoe lava has little soil covering and is typically bare of vegetation except for mosses and lichens with scattered trees and shrubs in cracks and crevices. There are also smaller areas with 'a'ā lava flows.

The project area is located on the plateau formed by the gradual burying of the Hualālai southeast rift zone by the northwest slope of Mauna Loa, the more active of the two volcanoes. Located on the portion of Mauna Loa that is away from the rapidly covered regions of the two rift zones, the project area is composed of older summit overflows that are interspersed with more recently erupted flows from "radial vents" such as "Honey Bee." Ash ejected from some of these scattered vents has contributed to soil development.

Natural Resources Conservation Service soil maps classify the soils in this area as lava flows, Kekake extremely rocky muck 6-20% slope, Mawae extremely stony muck 6-20% slopes, and Hanipoe silt loam 12-20% slope. Soil maps show Kekake soils as the most common soil type. These well-drained, shallow soils form in organic matter over pāhoehoe lava. The area also contains smaller regions with Mawae series soils. These soils consist of well-drained, thin organic soils formed over fragmental 'a'ā lava. There are a small section of Hanipoe soils in the Puu Lehua area. This series consists of well-drained silt loams that formed in volcanic ash.

Vegetation and Land Cover

James D. Jacobi (2009) completed vegetation surveys (Figure 2) in the project area in 2003-2004 and complete results are summarized in the report "Baseline Survey for Rare Plant Species and Native Plant Communities within the Kamehameha Schools' Lupea Safe Harbor Planning Project Area." The following section on vegetation and land cover is excerpted from this report. Appendix 1 contains a complete plant species list resulting from these surveys.

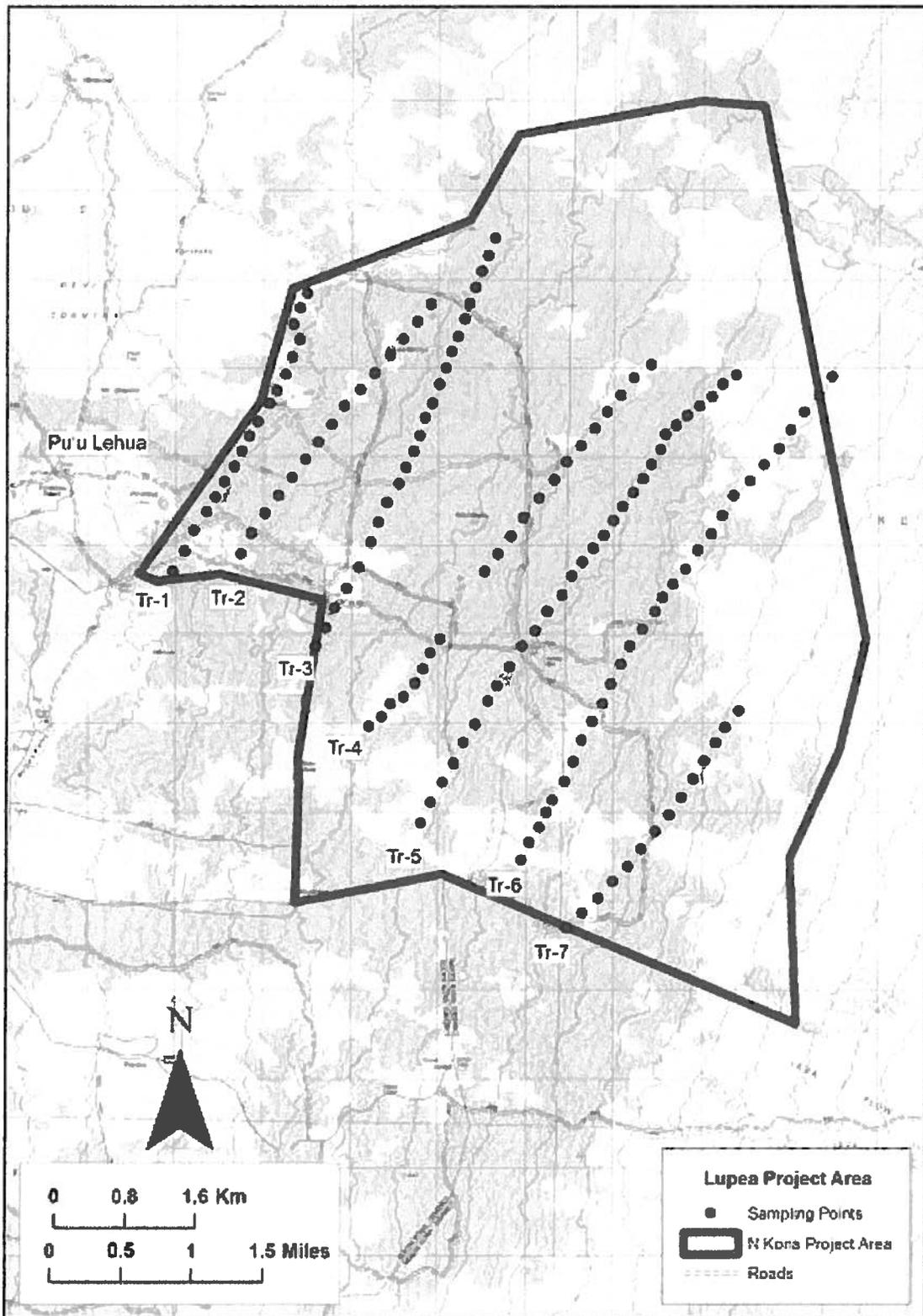


Figure 2. Transects and sampling points established within the Lupea Project area (Jacobi 2009).

Plant Communities

At a general scale, the plant communities within the project area fall under the montane dry vegetation zone, as mapped by Price and Jacobi (U.S Geological Survey, unpublished data) (Figure 1). However, most of the plant communities found in large portions of the project area have been highly altered by logging, cattle grazing, feral ungulates, fire, and alien plant invasion over the past 200 years. Evidence for logging is evident throughout the area up to approximately 1,830 m (6,000 ft) elevation.

The dominant native plant species within the Lupea Project area include the trees: koa (*Acacia koa*), māmane (*Sophora chrysophylla*), naio (*Myoporum sandwicense*), and 'iliahi (*Santalum paniculatum*); and shrubs: pūkiawe (*Leptocophylla tameiameia*) and 'a'ali'i (*Dodonaea viscosa*). 'Ōhi'a (*Metrosideros polymorpha*) is the dominant tree on the few 'a'ā lava flows that run through the area, as well as at upper elevations in the subalpine woodland.

The major plant communities within the North Kona (Lupea) Project area include:

- Mixed māmane-naio-koa-'a'ali'i-'iliahi woodland with native shrubs and/or grasses
 - Closed/open māmane-naio-koa-'a'ali'i-'iliahi forest with native shrub and grass understory (generally at upper elevations of the survey area)
 - Closed/open māmane-naio-koa-'a'ali'i-'iliahi forest with alien grass understory (generally at the lower elevation portion of the survey area)
- 'Ōhi'a dominated forest or woodland on 'a'ā lava or at upper elevations (also includes scattered individuals of other tree species: koa, māmane, naio, 'iliahi, and 'akoko)
 - Open/closed tall 'ōhi'a with native shrubs (on 'a'ā lava flows)
 - Scattered tall 'ōhi'a with native shrubs (on 'a'ā lava flows)
 - Open/scattered low-stature 'ōhi'a above 1,830 m (6000 ft) elevation on both 'a'ā and pāhoehoe lava flows
- Pūkiawe-'a'ali'i shrubland
 - Native shrubland dominated by pūkiawe and 'a'ali'i
 - Native shrubland dominated by pūkiawe and 'a'ali'i but with scattered koa, 'iliahi, māmane, and other tree species
- Grassland communities with very few trees (may include koa, māmane, naio, 'iliahi, 'a'ali'i) (not directly sampled).
 - Native grassland patches above 1,830 m (6000 ft) elevation
 - Pasture grassland dominated by alien species

The most intact plant communities are the native subalpine forest/shrub/grassland units above approximately 1,830 m (6,000 ft) elevation. These include the mixed tree communities and associated native shrub and grassland habitats, as well as the subalpine 'ōhi'a forest on both 'a'ā and pāhoehoe lava. This site is one of the most diverse areas for native grass species on the island of Hawai'i. These grasses are probably more abundant and diverse here than anywhere else in the Hawaiian Islands and the prominence of them in the understory and open

shrubland areas is unique. These upper sections of the project area are above the current and probably historic distribution of cattle. Additionally, the feral sheep and goat populations do not currently appear to be very large at these upper elevations.

Jacobi (2009) found a total of 109 plant species (44 endemic species, 21 indigenous species, 43 introduced species, and 1 believed to be a Polynesian introduction).

Native Plants

In addition to the common trees and shrubs in the native plant communities described above, surveys found a total of 13 fern species and seven grass species.

One listed Endangered plant, *Asplenium peruvianum* var. *insulare*, was found within the survey area (Figure 3). This fern is generally found in the entrances to lava tubes or other similarly shaded and protected areas. However, the single documented plant was found growing on rotting logs and soil on the surface of the lava. Additionally, Jacobi (2009) found one immature plant that may be *Sicyos macrophyllus*, a candidate species for listing as well as four plant species within the survey area that are considered to be rare and recognized as “species of concern” (SOC) since they appear to be declining in distribution and abundance statewide (Figure 3). These included *Chamaesyce olowaluana*, *Eragrostis deflexa*, *Sisyrinchium acre*, and *Tetramolopium consanguineum* (Figures 4 and 5).

Jacobi (2009) also found several other notable native species including the fern *Polystichum hillebrandii* at a few sites, as well as very robust populations of ‘iliahi (*Santalum paniculatum*; sandalwood) throughout the survey area. Hawaiian sandalwood trees were extensively logged during the 1800s and the Lupea population of *Santalum paniculatum* appears to be one of the largest and best preserved, mixed size-class stands of this species in the entire state.

The large area within and adjacent to the project area has enough successional maturity and age heterogeneity to have harbored even more native species than were recorded during surveys. Originally, the area’s climate was mesic to dry, and these zones on nearby similarly old substrates supported a rich collection of plant communities. There, species such as *Melicope volcanica*, *Melicope hawaiiensis*, *Exocarpos gaudichaudii*, *Haplostachys haplostachya*, *Delissea undulata*, *Zanthoxylum hawaiiense*, *Neraudia ovata*, *Festuca hawaiiensis*, *Solanum incompletum*, *Nothocestrum breviflorum*, *Stenogyne angustifolia*, *Dubautia linearis*, *Eragrostis atropioides*, *Eragrostis grandis*, *Sicyos macrophyllus*, *Kadua coriacea*, and more are likely to have occurred. Similarly, the uplands may have harbored *Exocarpos menziesii*, *Portulaca sclerocarpa*, *Silene hawaiiensis*, *Argyroxiphium kauense*, and others.

Analysis of a database which models the potential (similar to historical) range of all native Hawaiian plant species (Price 2004, Price et al. 2007) produced a list of 105 vascular plant species (ferns, monocots, and dicots) that could be expected to be found within the project area based on historical information and locations of these species in similar habitats on the island of Hawai‘i. Thirty-nine of the native species predicted by Price were found during the survey. Price’s potential species list also includes 45 taxa that were not found during surveys. Some of these species are extremely rare or, in some cases have been locally extirpated. However, most

of these plants that were predicted but not found would be expected to be located with additional searching, or may potentially recolonize the area following the elimination of ungulates and other restoration efforts. When restoration of the vegetation occurs after ungulate elimination from this area, it may be appropriate to consider reintroducing some of these species into the remaining areas of native vegetation.

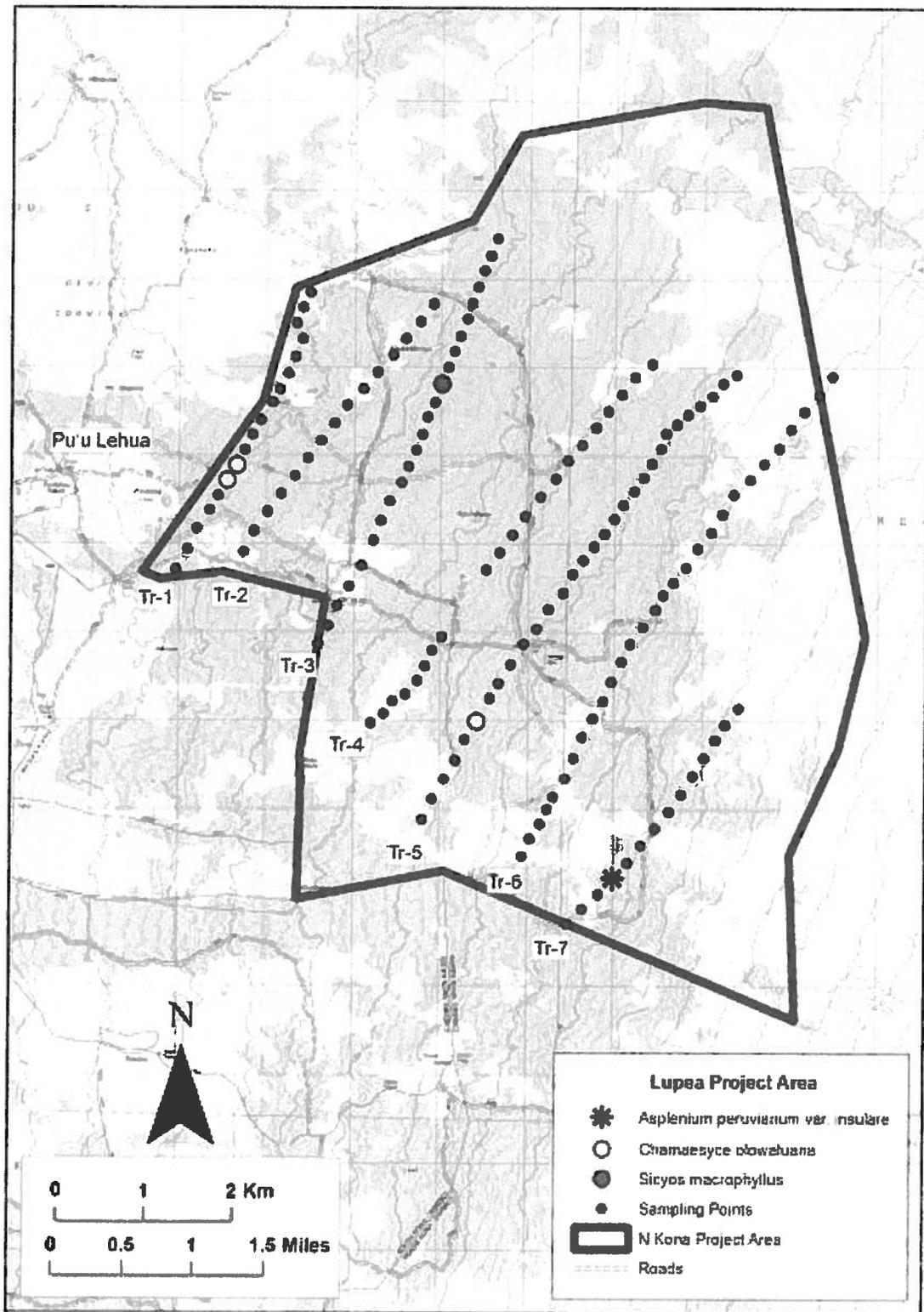


Figure 3. Location of *Asplenium peruvianum* var. *insulare*, *Chamaesyce olowaluana*, and *Sicyos macrophyllus* plants found during the 2003 - 2004 survey of the Lupea Project area (Jacobi 2009).

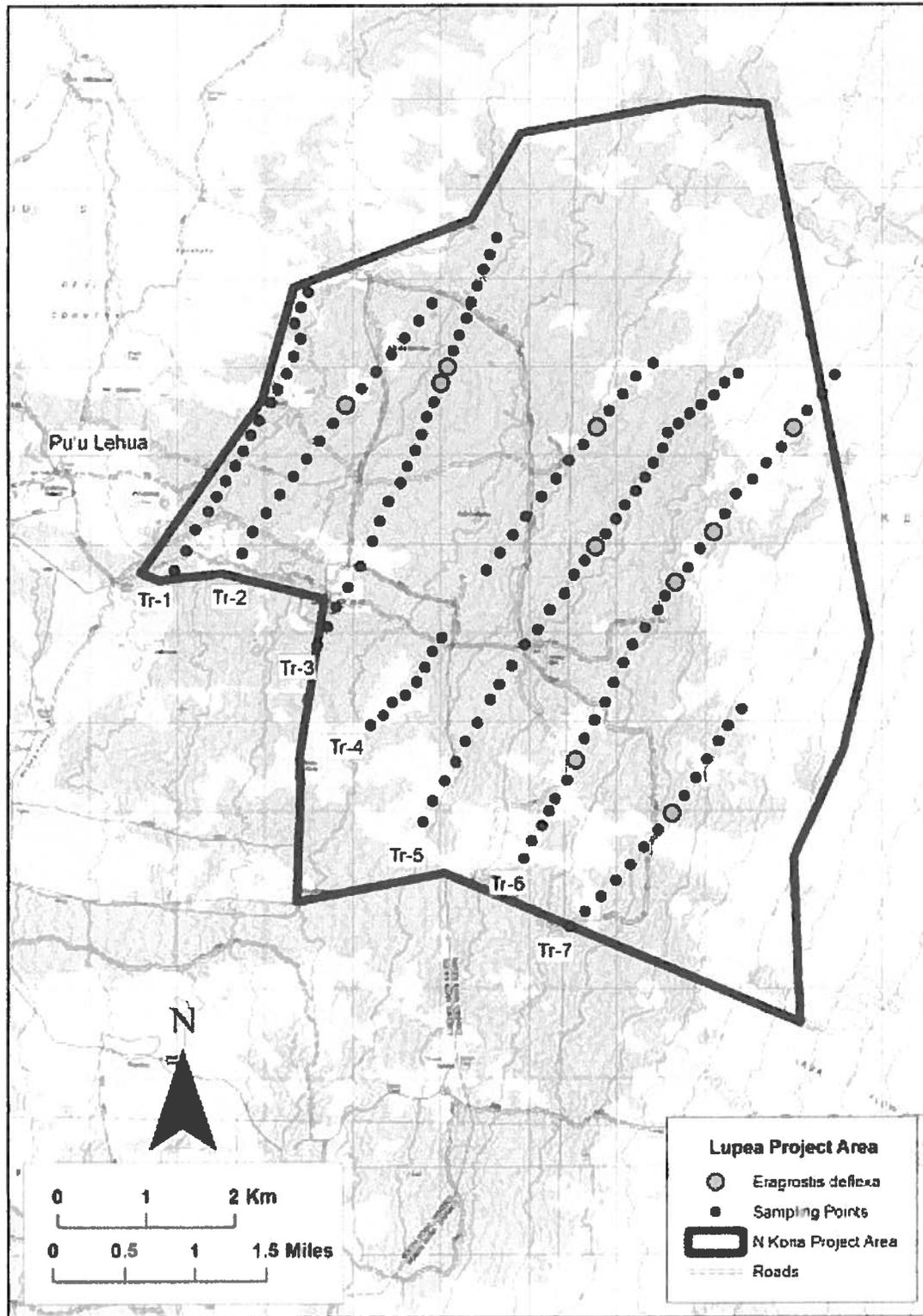


Figure 4. Location of *Eragrostis deflexa* plants found during the 2003 - 2004 survey of the Lupea Project area (Jacobi 2009).

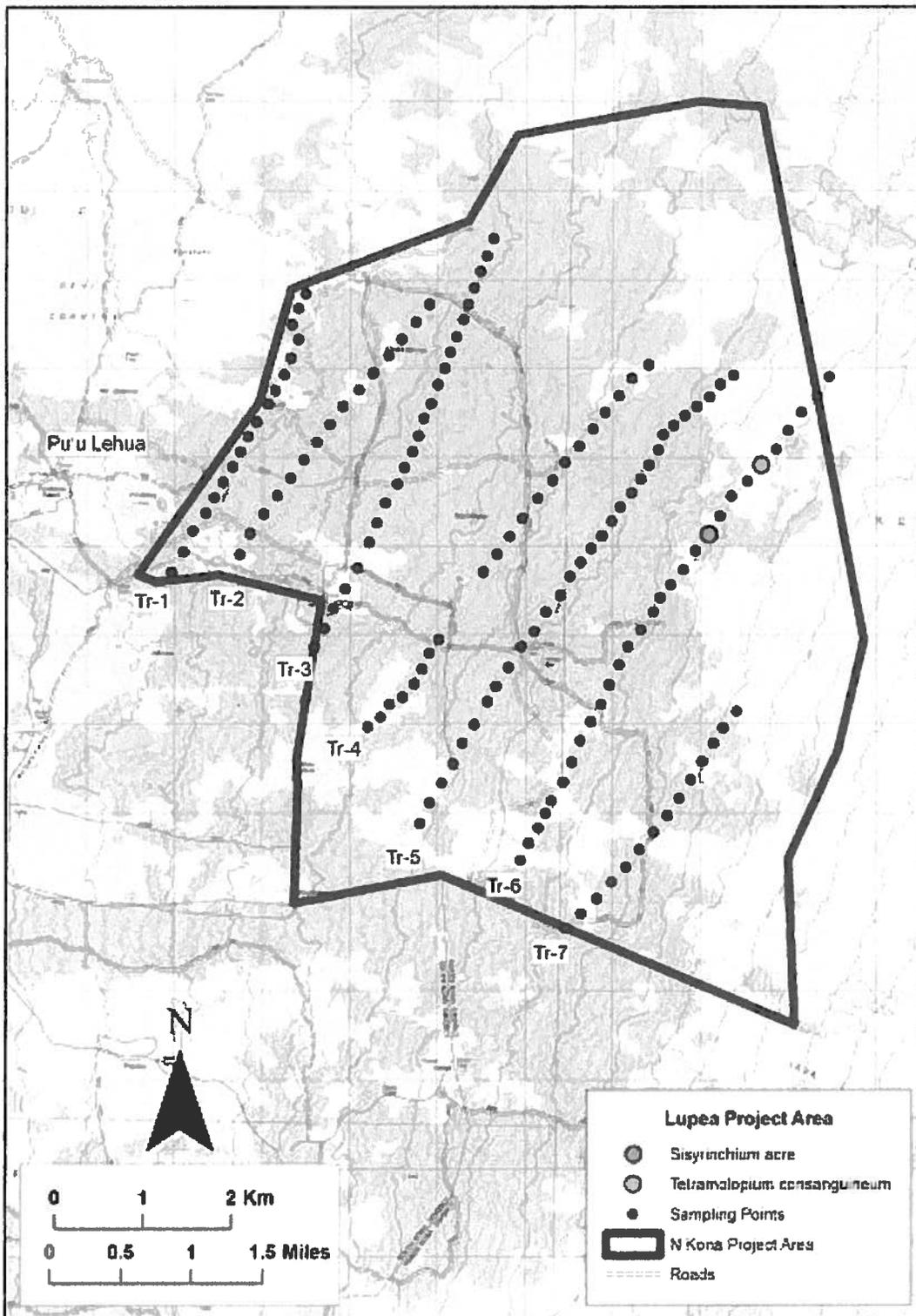


Figure 5. Location of *Sisyrrinchium acre* and *Tetramolopium consanguineum* plants found during the 2003 - 2004 survey of the Lupea Project area

Introduced Plants

Jacobi (2009) found 43 introduced plant species within the survey area. Highly invasive species include the grasses *Pennisetum clandestinum* and *Pennisetum setaceum*; vines *Delairea odorata* and *Passiflora tarminiana* (formerly called *Passiflora mollissima*); herbs *Senecio madagascariensis* and *Verbascum thapsus*; and the shrub *Rubus niveus*.

Verbascum thapsus was the most widespread of the invasive weeds (Figure 10). *Pennisetum clandestinum* is an upland pasture grass and was found distributed primarily in the lower and middle sections of the site, except on recent 'a'ā lava flows (Figure 7). *Pennisetum setaceum* is a major concern and has been expanding its distribution into upper elevation dry habitats on the island of Hawai'i (Figure 8). This invasive species is of particular concern as it enhances the spread and intensity of fire in areas that it becomes abundant. *Delairea odorata* was the other species found widespread across the area, mostly in the lower and mid-elevation areas (Figure 6).

The other three invasive plants (*Rubus niveus*, *Senecio madagascariensis*, and *Passiflora tarminiana*) were extremely rare within the survey area, but do pose a threat to management of the native plant communities if they increase in distribution and abundance. *Rubus niveus* was found in the lower, southern portion of the area. This species was probably introduced as an ornamental and is generally scattered across the mesic habitats immediately below the survey area. It has the potential to form dense bramble patches in the lower, moister sections of the Lupea Project area. Only two *Senecio madagascariensis* plants were found during this survey. Over the past decade, *Senecio madagascariensis* has been increasing in both distribution and abundance in open dry and mesic habitats on the islands of Hawai'i and Maui. Besides its potential competitive impacts with native understory vegetation, *Senecio madagascariensis* is toxic to cattle and poses a serious threat to cattle ranching. *Passiflora tarminiana* was also recorded on very few stations (Figure 6). This species is a serious pest in native montane wet and mesic forests, but appears to be less of a problem in montane dry habitats like the Lupea Project area. It is not clear if its limited distribution there is a result of habitat features or if browsing by cattle, sheep, and goats has controlled it. This is definitely a species to watch and possibly actively control following removal of the ungulates.

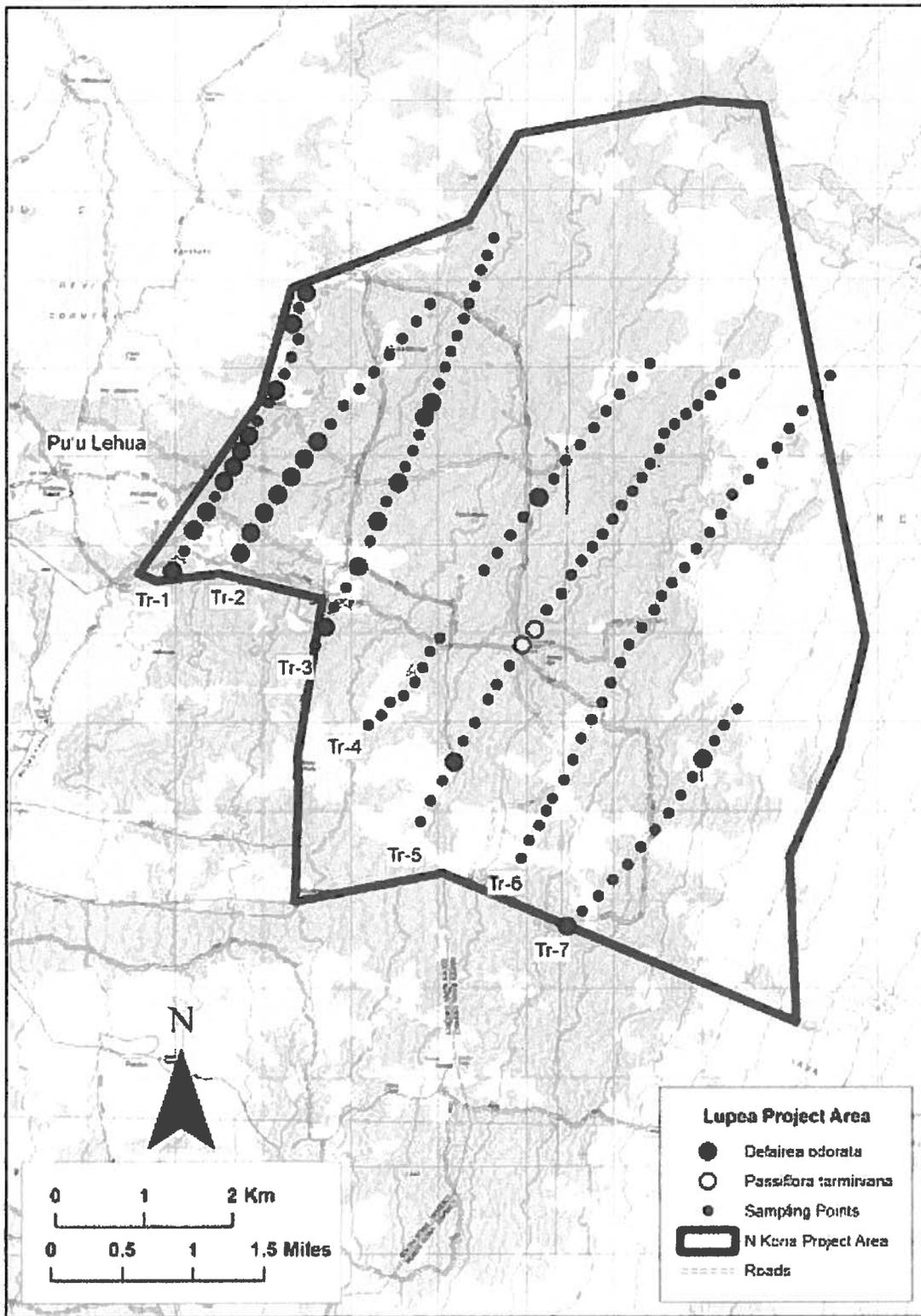


Figure 6. Location of *Delairea odorata* and *Passiflora tarminiana* plants found during the 2003 - 2004 survey of the Lupea Project area (Jacobi 2009).

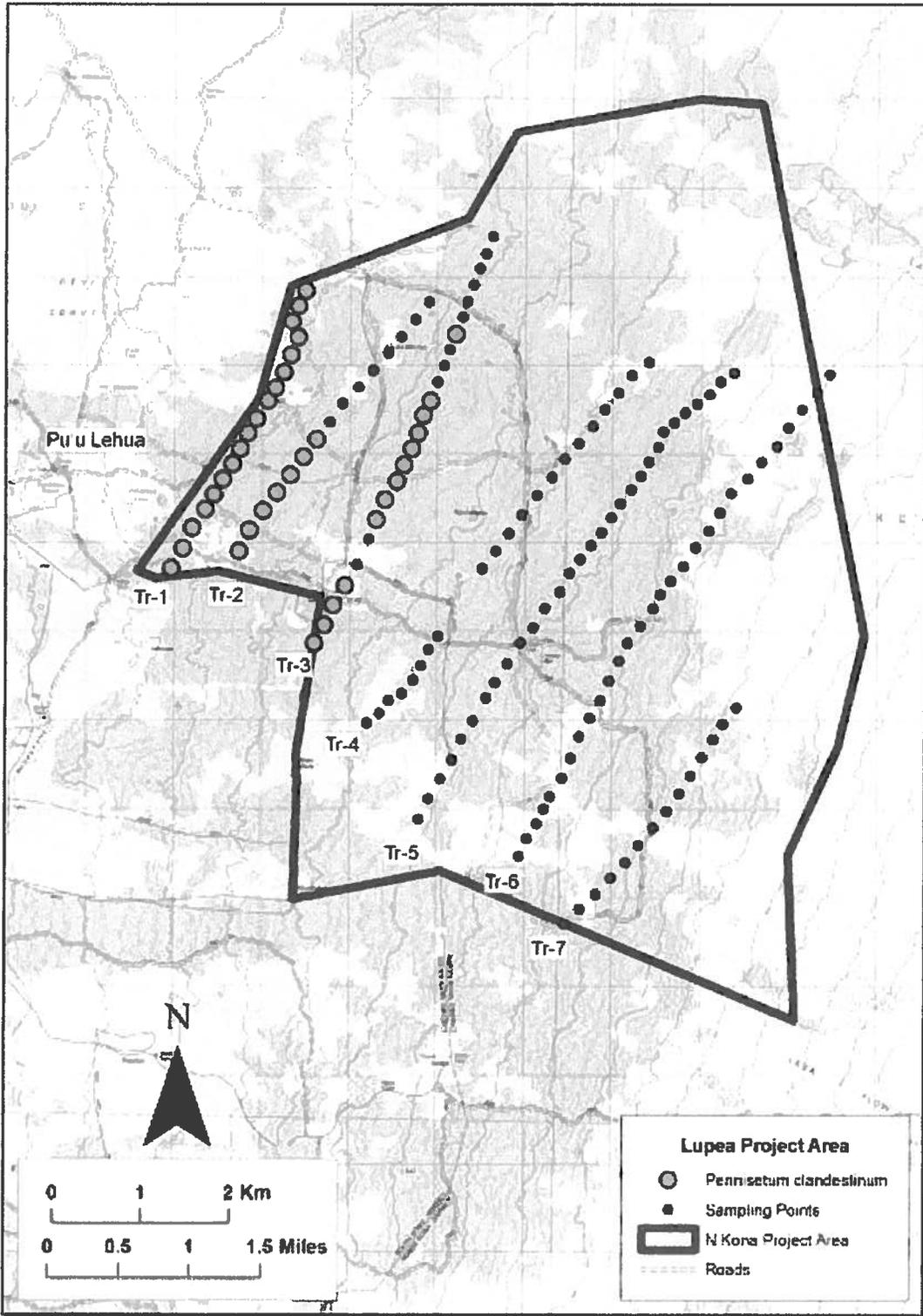


Figure 7. Location of *Pennisetum clandestinum* plants found during the 2003 - 2004 survey of the Lupea Project area (Jacobi 2009).

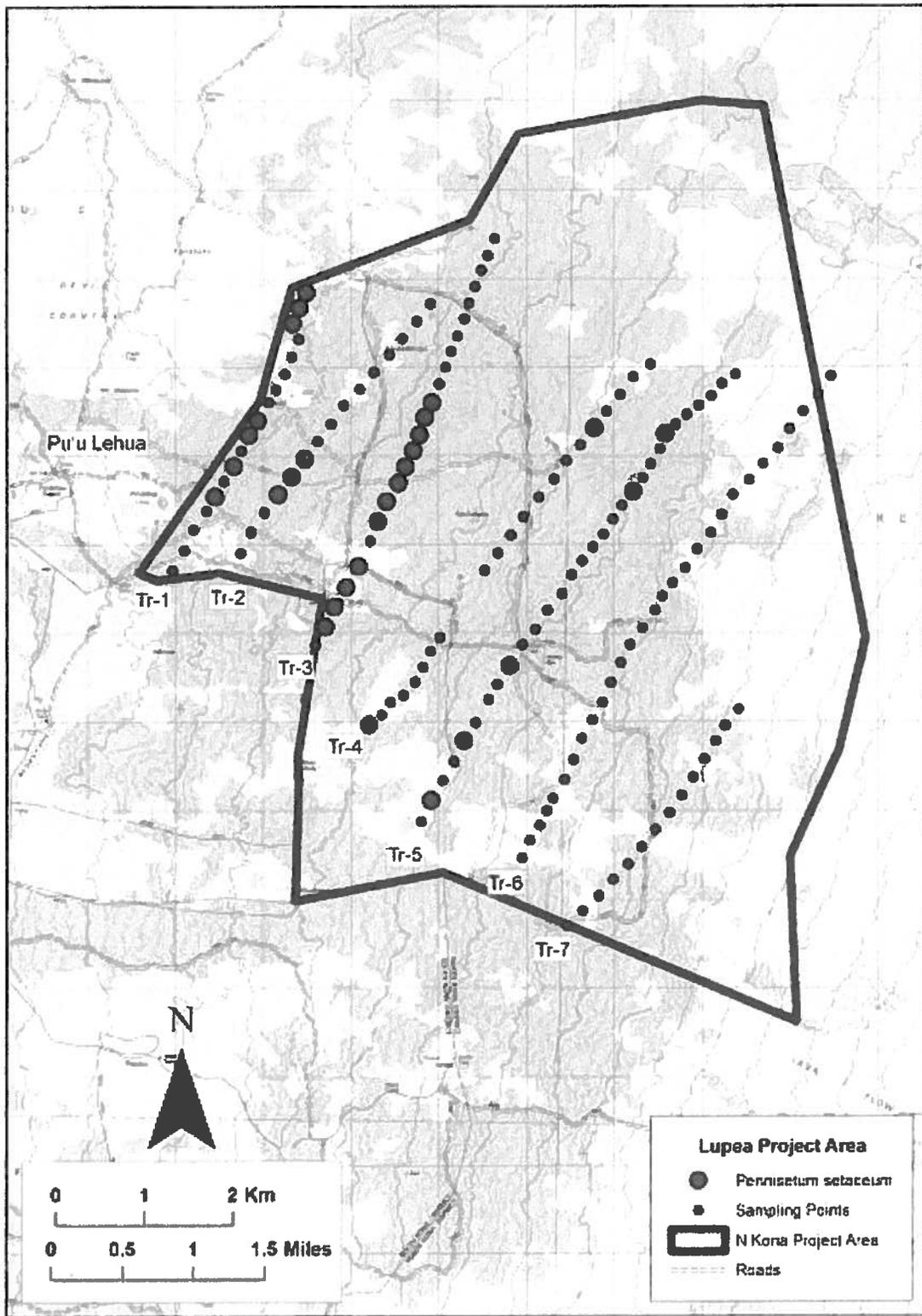


Figure 8. Location of *Pennisetum setaceum* plants found during the 2003 - 2004 survey of the Lupea Project area (Jacobi 2009).

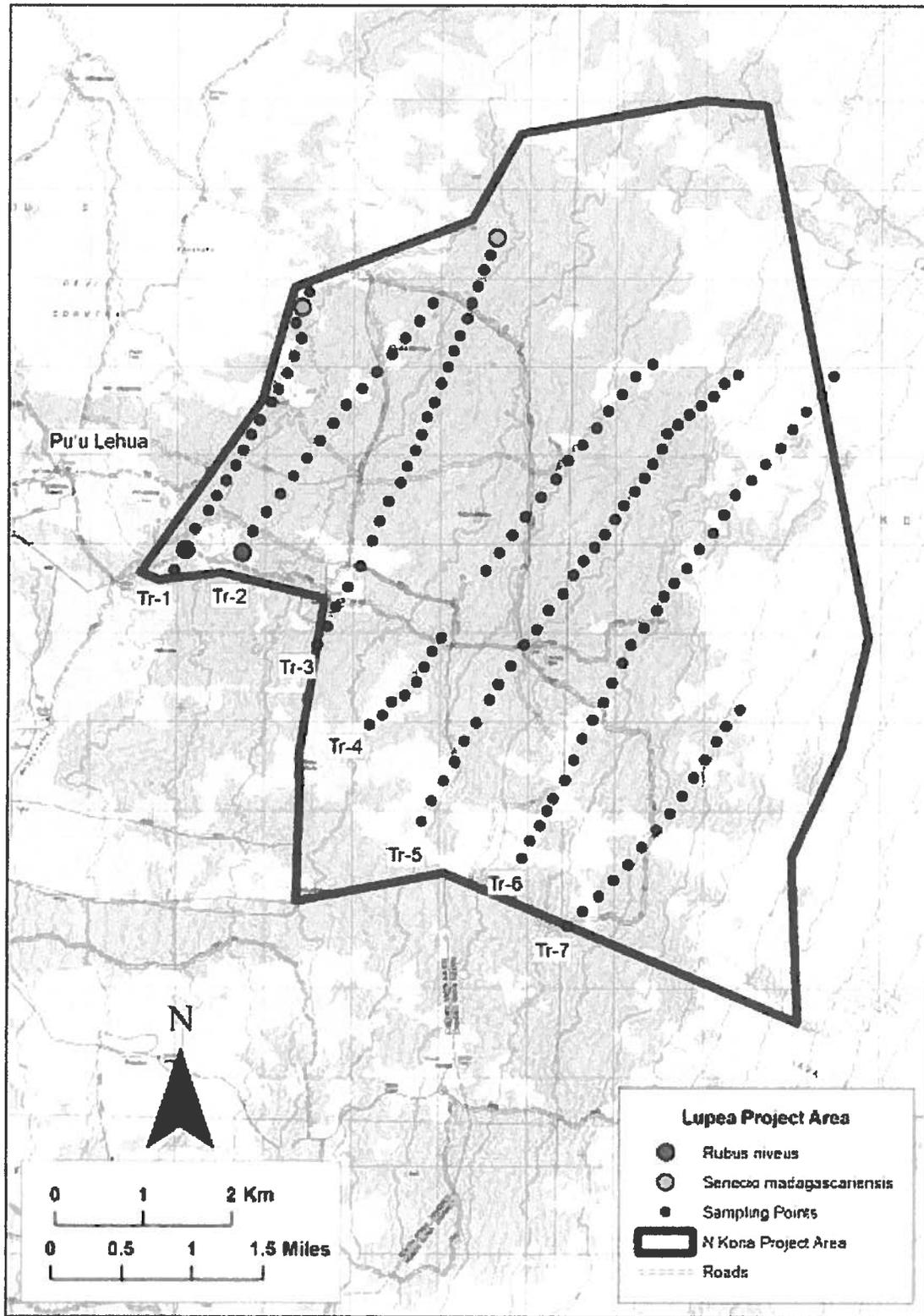


Figure 9. Location of *Rubus niveus* and *Senecio madagascariensis* plants found during the 2003 - 2004 survey of the Lupea Project area (Jacobi 2009).

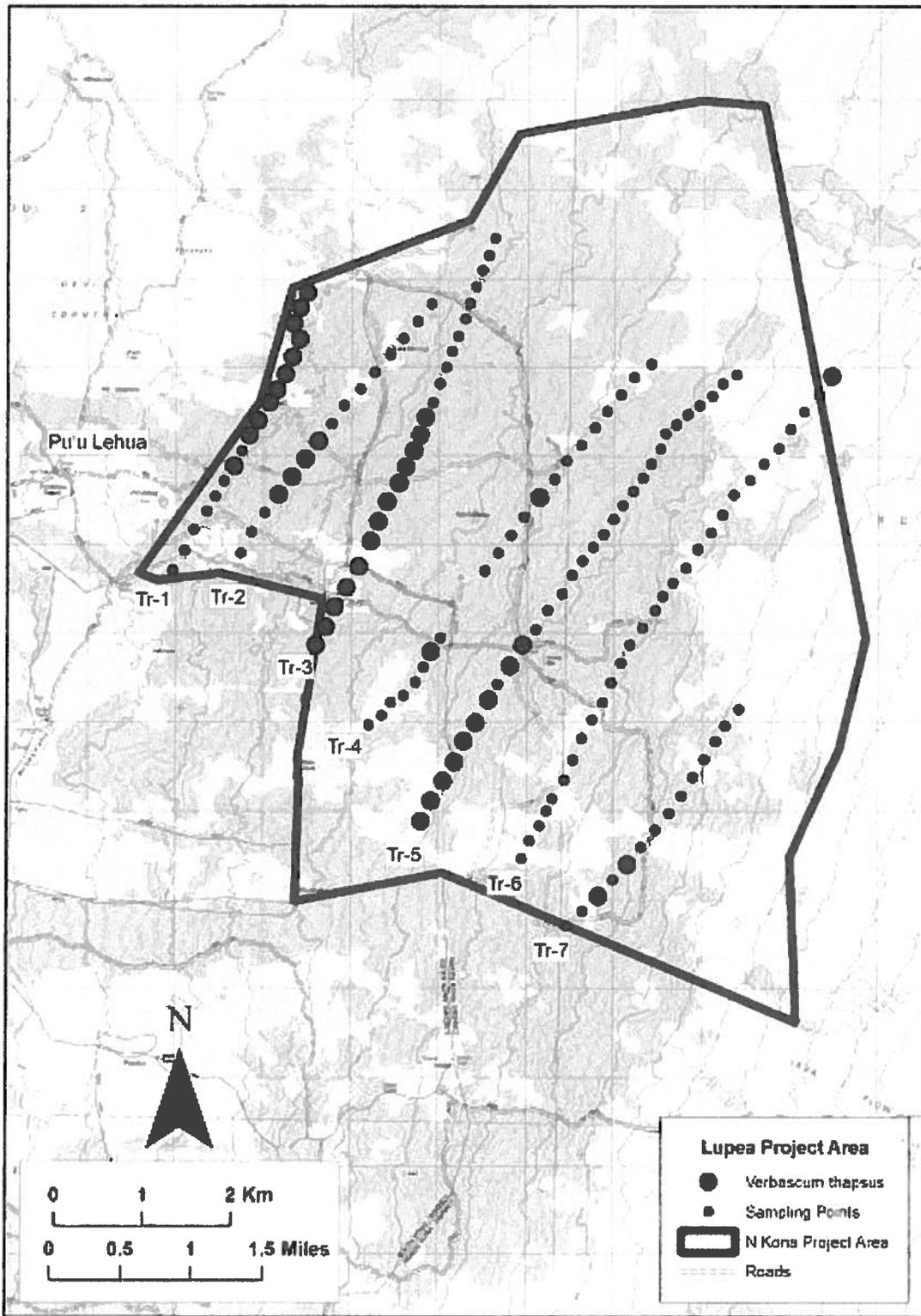


Figure 10. Location of *Verbascum thapsus* plants found during the 2003 - 2004 survey of the Lupea Project area. (Jacobi 2009)

Wildlife

Native Wildlife

This region once supported a unique community of native birds, including four finch-billed honeycreepers, of which only the palila is still extant (but no longer in the project area). This area has been proposed as a release site for captive-reared palila. There was also once a much larger nene population, but only 8-10 nēne still appear regularly with others flying over the area on the way to Pu'u Wa'awa'a. Native birds and mammals still present are listed below.

Table 1. Summary of Native Birds and Native Mammals found in Project Area

<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>	<u>STATUS*</u>
'amakihi	<i>Hemignathus virens</i>	Common
'apapane	<i>Himatione sanguinea</i>	Common
'elepaio	<i>Chasiempis sandwichensis</i>	Common
Hawai'i Creeper	<i>Oreomystis mana</i>	Endangered
i'iwi	<i>Vestiaria coccinea</i>	Uncommon
Hawaiian Hawk ('Io)	<i>Buteo solitarius</i>	Endangered
Pacific golden-plover or kolea	<i>Pluvialis fulva</i>	Common
Nēnē	<i>Nesochen sandvicensis</i>	Endangered
Hawaiian Owl (Pueo)	<i>Asio flammeus sandwichensis</i>	Common
Hawaiian Hoary Bat ('Ōpe'ape'a)	<i>Lasiurus cinereus semotus</i>	Endangered

* Endangered means the species is officially listed as endangered by both the Federal and State governments.

This area is a potential reintroduction site for the palila, and endangered forest bird that was once known from the area. Palila are the last remaining seed-eating Hawaiian honeycreeper in the main Hawaiian Islands. Currently, palila are found only on the slopes of Mauna Kea, on the Island of Hawai'i. About 95% of the total population is concentrated in about 30 km² of habitat on the western slope, and populations elsewhere are scattered and possibly declining. The palila range is vastly diminished and vulnerable to a variety of alien threats and stochastic events. Historically, this species existed over a much greater range, including portions of the North Kona District. This effort will restore habitat in order to establish a second, independent population of birds to guard against catastrophic events, as called for in the latest revision of the U.S. Fish and Wildlife Service Hawaii Forest Bird Recovery Plan. Also, this area provides upper elevation forested habitat above areas containing mosquitoes (mosquitoes carry diseases such as avian pox and malaria).

Preliminary invertebrate surveys with a focus on moths were have done by the U.S. Geological Survey Biological Resources Division (USGS) in 2003. Surveys identified 70 species and morphospecies from 13 families of moths, of which 46 species are endemic to the Hawaiian islands. Of the endemic species collected, two *Agrotis* (Noctuidae) species and one

Scotorythra (Geometridae) species appear to be new to science, and three species were previously considered to be extinct. Also of note was the collection of only one morphospecies of the seven species of *Cydia* potentially found feeding on mamane seeds. *Cydia* moths were fairly common, but their caterpillars, which are important foods of palila, were rarely found inside mamane pods. Two species of non-native ants were collected in the lower portion of the survey area. Of these, the big-headed ant *Pheidole megacephala* (Fabricius) is the most worrisome ant species because of its large population size and its aggressive tendencies to attack arthropod and vertebrate species.

USGS sampled the project area for Hawaiian hoary bat vocalizations in 2008. Habitats sampled include forest edge and scattered trees with grassland from 1,600 – 1,800 meters elevation. Sampling results showed bat activity at moderate to high levels and indicate that the Lupea project area may be particularly important as a winter foraging area for Hawaiian hoary bats (Bonocorso 2009).

Non-Native Wildlife

Many species of introduced game birds and songbirds inhabit the area including red billed leothrix (*Leiothrix lutea*), northern cardinal (*Cardinalis cardinalis*), Japanese white eye (*Zosterops japonicus*), mynah (*Acridotheres tristis*), spotted dove (*Streptopelia chinensis*), house finch (*Carpodacus mexicanus*), Northern mockingbird (*Mimus polyglottos*), California quail (*Callipepla californica*), Erckel's Francolin (*Francolinus ercelli*) and Turkey (*Meleagris gallopavo*).

Non-native mammals found in the area include mouflon sheep (*Ovis musimon*), feral sheep (*O. aries*), cattle (*Bos taurus*), pigs (*Sus scrofa*), and goats (*Capris hircus*). Rodents include rats (*Rattus rattus*), mice (*Mus musculus*), mongoose (*Herpestes auropunctatus*) and cats (*Felis catus*).

Feral ungulates (primarily sheep) are present in large numbers throughout the entire area. There are currently few records of mouflon sheep, but their populations are increasing and range is expanding into the area.

Cultural History and Human Use

An overview report on the cultural resources of the area was prepared as part of the environmental compliance for project area fencing (Dougherty and Moniz-Nakumura 2006). The cultural resources of the area can be categorized into three general categories: traditional native Hawaiian or early post contact period remains primarily associated with specialized resource procurement activities; named natural features with associated cultural affiliations; and historic period modifications reflecting the transition to upland ranching including historic buildings and features.

Boundary Commission testimonies reveal an intimate knowledge of the region, place names, and their association with oral histories and traditional cultural practices. Testimonies include reports of trail usage and historic road development, ritual and ceremonial sites, resource

collection that includes koa, māmane and ‘iliahi harvesting, collecting and hunting of both nēnē and u‘au (dark-rumped petrel), and knowledge of shelter caves and waterholes and known residences in the general area. Ahua a Umi heiau is located in the region. This significant site is associated with one of the greatest “kings” or moi of Hawaii Island, Umi.

Historic-era changes in the islands included economic transitions that reduced the overall value of traditional forested resources, and wild cattle hunting was replaced by ranching that became well established in the upland forested zones. The general area was used for ranching (sheep, goats and cattle) from the mid-1800’s to the present. Charles Wall established a sheep station at Kanahaha and in 1875 sold his interest to Dr. Georges Phillippe Trousseau. Trousseau continued to make improvements at the station and increased his livestock numbers. He sold all the animals plus the numerous buildings and crops to Henry N. Greenwell in 1879. The Greenwell family continued to actively ranch in the area for the next century.

Archeological remains within the project area may be limited to surface sites and buried cultural deposits. Traditional native Hawaiian practices in the upland regions were limited to specialized resource collection activities; the temporary shelters used during these activities are most likely camouflaged by time and the elements. Place names of the forest were recorded during Boundary Commission testimony and attest to a connectedness to the land. Historical resources of ranch activities predominate, with numerous ranch walls and paddocks across portions of the project area.

SUMMARY OF MANAGEMENT ACTIVITIES

The objective of this project is the protection and restoration of approximately 13,200 acres (5,340 ha) of diverse native forest. The management activities required to achieve this objective include fencing to protect existing forests from ungulates, ungulate control, invasive plant control, fire protection and reforestation.

Additional management may be needed once the major threats (ungulates, weeds and fire) are under management (rare species management including non-native mammalian predator control, rare plant reintroduction).

The proposed project is the first large-scale effort to protect and restore māmane naio ecosystems on the Kona side of Hawai‘i Island, and thus provides a unique opportunity to protect this rare type of habitat.

Fencing

We are planning to construct approximately 18 – 25 miles of fencing to enclose the best remaining native forest in the project area. There will be two major phases of fence construction to complete two enclosed management units of 6,000 – 8,000 acre size. Fencing may need to be done in smaller strategic increments due to funding limitations. We are planning to use fence specifications needed to deter mouflon sheep and other ungulates; however, we will also be exploring the feasibility of less expensive alternatives to mouflon fencing such as electric fencing. The fence line will be surveyed to avoid potential adverse

effects to archeological and cultural sites and listed species. Fencing will provide long-term benefits by allowing for effective control of feral ungulates. Fencing will result in the protection of diverse native forest, and recovery of rare and endangered species. Fencing will also enable restoration of the area. The area needs to be protected from ungulates before large-scale active restoration efforts can begin (e.g. reforestation, outplanting of rare and endangered plants). The completed fence will require regular inspections and maintenance (quarterly).

Management Needs

- Year 1 -3 Complete phase 1 (Lupea Unit) fence construction. Our goal is to completely enclose the unit by the end of year 3, but fencing may need to be done in strategic phases due to funding limitations.
- Years 3 – 20 Inspect and maintain fenced Lupea Unit on a quarterly basis.
- Year 10 - 12 Complete Phase 2 fence construction
- Years 12 – 20 Inspect and maintain phase 2 fenced unit on a quarterly basis.

Introduced Ungulate Control

Ungulate control (primarily feral sheep, mouflon sheep and pigs) will be initiated when fencing construction starts and will continue until all ungulates have been removed from the completed, fenced unit. Ungulates are the most critical threat to this parcel. They consume and trample native plants, create conditions for non-native plant infestation and establishment, prevent the establishment of native plants, serve as vectors for the dispersal of non-native plants, and disrupt soil nutrient cycling. The spread of most other non-native species is enhanced by the disturbance of soil, surface litter, and vegetation cover. The cumulative effect of ungulates is the decline of intact native ecosystems, including the decline of suitable habitat for threatened and endangered forest birds, plants, and invertebrates.

Māmane is a preferred food of ungulates in Hawaii, and ungulates profoundly impact survival of seedlings and trees. When populations of ungulates are reduced in māmane forests, as has occurred recently on Mauna Kea, lower branches of trees quickly recover. Additionally, māmane seedling recruitment dramatically increases where seed banks have not been depleted.

Animal control measures will consist of driving animals out of fenced units, aerial and ground-based shooting, trapping, and/or snaring. Initial ungulate reduction will begin once the first phase of fencing is completed, even if the unit is not yet fully enclosed. Strategic fencing will greatly reduce animal movements and limit ingress into the area. Once fencing begins, control of ungulates will be ongoing with annual reductions in population within the strategic fencing. Large reductions in ungulate populations will be achieved once control is initiated. Once the fenced units are completely fenced and enclosed we will be able to achieve complete removal of ungulates within approximately 3-years. The ungulate-free units will need to be monitored annually for ungulate ingress.

- Years 1-2 Monitor ungulate numbers to determine population estimates for project area. Monitoring will help determine ungulate management (i.e. how many sheep will need to be removed during every year of control effort to reduce the population).

- Year 2 Initiate ungulate control in the project area once initial strategic fencing is completed. Radio collaring approximately six sheep to track movements and assist with control. Sheep and mouflon control will include driving animals out of unit, aerially assisted ground hunting and staff hunting. Pig control will include trapping, staff hunting and snaring.
- Years 3-5 Complete ungulate control in the Lupea Unit by removing all ungulates once fenced management unit is completed.
- Years 5 -10 Monitor ungulate-free units for ungulate ingress.
- Years 11-13 Initiate ungulate control in phase 2 fenced unit.
- Years 13-14 Complete ungulate control in phase 2 fenced unit.

Invasive Weed Control

The management goal for the weed control program is to protect the most intact native areas from disruptive plant species, and begin control efforts while populations are still localized. While the upper elevations of the project area have relatively low levels of disruptive invasive plants, the lower elevations have some severe infestations that should be controlled as soon as possible to prevent and/or slow their spread. The problem of non-native, invasive plants in native habitats is a well-recognized management problem in Hawaii's natural areas. Certain weeds displace native plants and are capable of converting native ecosystems to alien dominated vegetation, altering soil moisture, nutrient and fire regimes, and reducing habitat for native species. Weed species with small, localized populations should be controlled to preclude costly control programs in the future.

The invasive weed control program will occur concurrently with fencing and animal control in both fenced and unfenced areas. Effective weed management needs to be closely integrated with other management activities such as fencing, feral ungulate control, reforestation and fire management. Halting the spread of fountain grass into new areas to reduce fuel build up will also be a general focus of TMA weed efforts. In the long-term, forest recovery will result in reduced abundance of many weed species.

The greatest current threats to the project area, and the initial focus of mapping and control efforts, will be fountain grass (*Pennisetum setaceum*), Cape ivy (*Delairea mikanioides*), Mysore raspberry (*Rubus niveus*), and banana poka (*Passiflora mollissima*). Non-native pasture grasses such as kikuyu grass (*Pennisetum clandestinum*) will need to be targeted for control in certain areas to enhance natural regeneration of native trees and shrubs. Additional species may also be controlled if they become a problem.

The weed control program will include:

1) Distribution mapping of priority weeds and development of a control strategy. Weed mapping is essential to developing a comprehensive control strategy. Distribution mapping includes compiling transect monitoring data, incidental observations and reconnaissance surveys to map the distribution and abundance of weeds. Information from the surveys (Jacobi 2009) needs to be updated and transects re-established and re-surveyed. Results from these surveys can then be used to better delineate the weed populations core extent and outlying individuals, and facilitate the development of control strategies.

2) Control using herbicide or manual methods. There are new weed control technologies (e.g. aerial herbicide application) that may be more cost effective for remote, isolated populations of priority weeds such as fountain grass.

Initial control work will focus on containing and eventually suppressing fountain grass and cape ivy to limit their spread in areas where they are just starting to become established. This containment approach is used with large weed populations and/or in areas that can not yet be managed as Special Ecological Areas (SEAs) due to limited resources. This approach is used to prevent the expansion of weeds from core infestations into new areas. Core populations can be reduced through suppression (reduction of the core population).

The Special Ecological Area (SEA) approach will eventually be used to control high priority weed species within fenced management units once ungulates are removed. Field crews perform systematic ground and/or aerial sweeps to remove all target weed species detected in the area. The initial knockdown of weeds is followed by subsequent revisits at 1-4 year intervals to keep infestations at low or manageable levels (maintenance phase). Populations of weeds can be reduced and maintained at very low levels after several cycles of control work. In SEA's, while the goal is to eliminate all the weeds each visit, there will always be new establishment of weeds that will need to be controlled in subsequent control visits. As weed densities decrease, workloads decrease and the time between control intervals can be increased.

3) Weed monitoring to determine the effectiveness of control effort. Staff will re-establish transects established by Jacobi (2009) to implement systematic weed inventories in high priority weed control areas. Roads will be regularly checked for new species, and vehicles should be inspected on a regular basis for weed seeds and other pests. Certain weeds may increase in the short-term, as a result of animal control. It will be critical to reduce and/or eliminate satellite populations of these weeds to allow for natural forest recovery. New mapping technologies using high-resolution aerial imagery and remote sensing offer great potential for large-scale, cost effective mapping of certain priority weeds.

- Weed Sanitation Protocol
- Re-establish transects to monitor weed distribution and abundance

Forest Improvement and Reforestation

Once key threats are reduced through fencing, ungulate and weed control, management efforts can focus on forest improvement and reforestation to enhance biodiversity. We anticipate that most of the area will not require active forest improvement and reforestation, aside from removing the alien ungulates. Some portions of the area already have relatively intact forest canopy and will not require intensive reforestation efforts. We will focus on restoration of rare and endangered species in these more intact forest areas. Other areas more heavily impacted by ungulates will require reforestation of the common, native tree and shrub species.

The initial stages of forest improvement will be to determine the site's potential for natural regeneration, and determine what limiting factors may exist to limit regeneration. For example, rats are known to eat the seeds of several plant species, and 'iliahi seeds are highly susceptible to

rat predation. Rat control may be an important management tool to increase iliahi populations in the project area. Pasture grasses, especially dense, mat-forming species such as kikuyu are likely to limit the germination and development of some species. Control of non-native grass in certain areas will enhance natural regeneration. Other techniques, such as seed scatter, will also be used to augment natural recruitment.

Some portions of the area (approximately 500 acres) will require a more active reforestation. We have not yet determined the specific sites requiring reforestation but these sites will primarily be in the Mizota's kipuka portion of the project area. These areas have been more heavily impacted by past grazing activities and currently have more invasive grass cover and fewer existing trees. Planting of seedlings may be needed where seed sources are lacking, desired species are slow to respond, and time is critical in key areas. Planting will also allow for engaging the public, creating demonstration areas, and developing vegetative fire breaks. Planting will be done in strategic locations to promote forest regeneration. Monitoring of natural regeneration plots will help determine which species need the most active intervention.

We will use propagation materials from local sources to ensure we will be growing locally adapted genotypes. Volcano Rare Plant Facility will propagate listed endangered plant species for outplanting. Various groups such as students and volunteers, will be involved in seed collection, site planning, site preparation, planting and follow-up care. Follow-up care to outplanted plants may include watering, fertilizing, controlling invasive weeds, and monitoring survival and growth.

We will place special emphasis on the recovery of māmane because the endangered palila depends heavily on the seedpods of this tree for foraging. Management activities will benefit the palila by improving habitat and providing a potential reintroduction site. Palila eat māmane seeds and flowers year-round and caterpillars found on māmane are an important source of protein, especially for nestlings.

Iliahi Restoration Techniques

- Years 1 – 5 Develop a forest restoration strategy for the Lupea Unit. Establish experimental plots to develop restoration techniques for target species (e.g. māmane and 'iliahi).
- Years 5 – 10 Initiate forest restoration strategy in the Lupea Unit once all ungulates have been removed from the fenced unit.
- Years 11 - 20

Rare Plant Restoration

There are not currently any endangered plants known from the project area, although *Asplenium peruvianum* var. *insulare* occurs just outside the project area. Other species are historically known from the area or are found nearby and could be reintroduced to the area once fencing and feral ungulate control is completed. KS is currently working on developing a Safe Harbor Agreement to allow for the reintroduction of plants to the area.

Proposed baseline levels for observed and predicted rare plant species in the Lupea Project Area (Jacobi 2009).

Taxon	Status	Baseline	
		Observed	Frequency
<u>Observed during surveys</u>			
<i>Asplenium peruvianum</i> Desv.	E	Y	<1%
<i>Chamaesyce olowaluana</i> (Sherff) Croizat & O.Deg.	SOC	Y	2%
<i>Eragrostis deflexa</i> Hitchc.	SOC	Y	7%
<i>Sicyos macrophyllus</i> A.Gray	C	Y?	<1%
<i>Sisyrinchium acre</i> Mann	SOC	Y	<1%
<i>Tetramolopium consanguineum</i> (A.Gray) Hillebr.	SOC	Y	<1%
<u>Predicted for project area but not observed</u>			
<i>Bidens campylotheca</i> Sch.Bip.	SOC	N	0.0%
<i>Cyperus fauriei</i> Kük.	E	N	0.0%
<i>Cystopteris douglasii</i> Hook.	SOC	N	0.0%
<i>Delissea undulata</i> Gaudich.	E	N	0.0%
<i>Dubautia arborea</i> (A.Gray) D.D.Keck	SOC	N	0.0%
<i>Exocarpos gaudichaudii</i> A.DC.	SOC	N	0.0%
<i>Haplostachys haplostachya</i> (A.Gray) H.St.John	E	N	0.0%
<i>Kadua coriacea</i> (Sm.) W.L.Wagner & Lorence	E	N	0.0%
<i>Melanthera subcordata</i> (A.Gray) W.L.Wagner & H.Rob.	SOC	N	0.0%
<i>Melicope hawaiiensis</i> (Wawra) T.G.Hartley & B.C.Stone	SOC	N	0.0%
<i>Portulaca sclerocarpa</i> A.Gray	E	N	0.0%
<i>Ranunculus hawaiiensis</i> A.Gray	C	N	0.0%
<i>Schiedea hawaiiensis</i> Hillebr.	SOC	N	0.0%
<i>Silene hawaiiensis</i> Sherff	T	N	0.0%
<i>Silene lanceolata</i> A.Gray	E	N	0.0%
<i>Solanum incompletum</i> Dunal	E	N	0.0%
<i>Spermolepis hawaiiensis</i> C.F.Wolff	E	N	0.0%
<i>Stenogyne angustifolia</i> A.Gray	E	N	0.0%
<i>Tetramolopium arenarium</i> (A.Gray) Hillebr.	E	N	0.0%
<i>Zanthoxylum hawaiiense</i> Hillebr.	E	N	0.0%

Fire Management

Fire is an infrequent part of Hawaii's natural history, and apart from lava flows and lightning, humans are the major cause of ignition. The increased frequency of fire in native ecosystems can radically change the structure and composition of the vegetation. Repeated burning can eventually eliminate fire-intolerant native species and produce a community that is dominated by fire adapted grasses such as fountain grass. Reduction of feral animals may increase the short-term fire risk due to increases in non-native grass cover with reduced grazing.

Fire is a high risk at this site. In the long-term, this project will reduce the threat of fire to the area by promoting native tree and shrub cover. Woody vegetation will likely reduce grass cover (the primary source of fine fuel that promote intense fires), increase moisture at ground level (through increased fog interception), and reduce wind velocity near ground level. Although fires will not be prevented by increasing the cover of woody species, fire behavior and the probability of intense and frequent burning will likely decline.

In the short-term, however, this project will develop strategies to prevent and minimize the impacts of fires. These include ways of managing vegetation by creating fuel breaks, reducing fuel-loading capacity and increasing capability for fire detection, prevention, and suppression (e.g. water catchment). Existing roads need to be maintained and improved to ensure access throughout the restoration areas. Dry grasses along roads can also present an extreme fire risk, and grass control along major access routes will be necessary. Control of fountain grass will also be a critical management activity. We need to get several 14,000 gallon water tanks with catchment roofs to use for fire response, weed control and irrigation of reforestation areas. KS is currently developing a fire response plan, increasing fire suppression capacity and improving coordination with neighboring landowners and fire response agencies such as DOFAW.

Fire Plan – DOFAW Watershed Funding. Identify fuel break areas,

Other Potential Management Actions

As additional funding becomes available plans will be developed for increased predator control, palila re-introduction, and further invasive plant control.

Monitoring

Monitoring is essential in any restoration effort to assess the landscape conditions, to measure the effectiveness of the methods used, and to quantify results. Monitoring for this project will be done on several scales and with several techniques.

Landscape monitoring will be the primary tool to assess landscape level conditions. Photo documentation will be used as a visual record to show changes in the landscape, plots, and general forest types. In addition, USGS has established transects across an elevational range

and conducted baseline monitoring of mamane to assess the suitability of the site for palila reintroduction. This monitoring can be repeated to assess changing forest conditions.

Reforestation will incorporate monitoring of the survival and growth of planted seedlings to assess the success of planting efforts. Plot specific monitoring will be conducted to evaluate results from specific trials that may be conducted (e.g. seed scatter trials, natural recovery with grass control etc).

Remote Sensing - Remote sensing can provide valuable information on tree height and volume, species richness, topography, invasive species, and rare species distribution and will be more efficient and cost-effective than traditional methods on a large landscape-scale. Remote sensing work will be done by either Carnegie Airborne Institute (CAI) and/or Resource Mapping depending on our success at leveraging funding and determining what type of technology can best address our priorities. Both CAI and Resource Mapping have projects underway with TMA partners, and the TMA is in the process of determining which entity could provide a product that best suits our needs. CAI has developed cutting edge technology that combines an advanced form of LiDAR sensor with an enhanced hyperspectral sensor. Resource Mapping Hawai'i has recently developed a methodology with TNC and USGS-BRD that uses very-high resolution digital imagery and expert image analysis to identify and map selective invasive plant species.

Initial monitoring has focused on various activities including conducting baseline surveys for bird and plant species so Kamehameha Schools could develop a Safe Harbor Agreement (SHA) for the project area lands relative to the habitat management and species reintroduction efforts they would like to conduct in the Lupea Project area. Safe Harbor Agreements in Hawai'i are under the jurisdiction of both the U.S. Fish and Wildlife Service and the State of Hawai'i Department of Land and Natural Resources, and are developed in conjunction with the Hawai'i Endangered Species Recovery Committee which advises both agencies on the biological aspects of SHA proposals (State of Hawai'i 1996, U.S. Fish and Wildlife Service 2004).

- need to re-establish transects that were put in for baseline surveys.
- Redo bird surveys for SHA (data lost or with Tonnie Casey).

Education and Public Outreach

KS is committed to using its lands for educational opportunities and teaching children the cultural and environmental significance of the native Hawaiian flora and fauna. Education will be a key component of the project and students and the community can play vital roles in research, nursery experiments, and on-site projects such as tree-planting. Site improvements on a modest scale (e.g. base camp, communications, water tanks) will foster safe, effective educational and public involvement.

TIMETABLE

- Year 1-2 *Complete Environmental Assessment (EA) and federal compliance (environmental, archeological, etc.)* - The partnership will determine the fence alignment and contract consultants to do the compliance work and prepare the EA.
Construct and Maintain Fence - Fence construction will be completed.
Control Feral Animals – Initiate after fence completed. Animals will be reduced to very low numbers in the first year of control efforts.
Invasive Plant Control – Map distribution of priority weeds and develop a control and monitoring strategy. Initiate control using herbicide or manual methods.
Fire Management- Complete fire plan. Increase suppression capability with construction of 2-3 water catchment systems.
Reforestation/Forest Improvement – Map priority reforestation areas (heavily grazed, open areas) vs. areas with high potential for natural regeneration.
Monitoring - Photo documentation. Monitor results of animal control.
- Years 2-5 *Construct and Maintain Fence* – Quarterly fence inspection and maintenance.
Control Feral Animals – Complete control to zero levels with fenced enclosure.
Invasive Plant Control – Continue control using herbicide or manual methods.
Continue annual weed monitoring and monitoring of control efforts.
Fire Management - Create fuel breaks and reduce fuel-loading capacity by controlling fountain grass and dry grasses along roads.
Reforestation/Forest Improvement – Determine limiting factors for natural regeneration and implement management (e.g. seed predator control, control of invasive grasses, seed scatter). Develop experimental demonstration plots for reforestation plantings (common native species) and begin outplanting rare and endangered native plants into more intact forest.
Monitoring – Continue photo documentation and annual transect monitoring. Monitor reforestation and experimental plantings or natural recovery experiments.
- Years 5-10 *Construct and Maintain Fence* - Quarterly fence inspection and maintenance.
Control Feral Animals – Monitor unit for animal ingress.
Invasive Plant Control – Continue control using herbicide or manual methods.
Continue annual weed monitoring and monitoring of control efforts.
Fire Management – Maintain fuel breaks and continue reducing fuel-loading capacity by controlling fountain grass and dry grasses along roads.
Reforestation/Forest Improvement – Expand demonstration reforestation plots to larger-scale in strategic locations to promote natural forest regeneration and create vegetative fire breaks. Maintain plantings with weed control.
Monitoring - Continue photo documentation and annual transect monitoring. Monitor reforestation and experimental plantings or natural recovery experiments. Assess overall habitat improvement for possible palila release.

Years 10 – 20

- assess suitability of site for palila re-introduction
- develop a SHA for re-introduction of T&E species

TOTAL PROJECT COSTS

The rough lava flows, remote location, rough roads, lack of water, and lack of existing on-site infrastructure in this area greatly increase the costs of this large landscape-scale project. The cost of materials and construction of a mouflon-proof fence is also very high. Fencing and animal control are the most critical aspects of the project as well as the highest cost management activities.

We will be seeking the maximum level available from Forest Stewardship to implement the management activities outlined above (\$75,000/year x ten years = \$750,000 total). U.S. Fish and Wildlife Service (Landowner Incentive Program and Private Stewardship Program) has provided \$682,625 for compliance, fencing and ungulate control. KS is currently spending approximately \$50,000/year on management in this general area such as ungulate control, alien plant control, fire management and monitoring.

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Appendix 1. Plant species observed during the survey of the Lupea Project area in 2003 - 2004.

Taxon	Common Name	¹ Origin	² Status	Family	Notes
<u>Ferns</u>					
<i>Asplenium adiantum-nigrum</i> L.	'iwa 'iwa	ind		Aspleniaceae	
<i>Asplenium aethiopicum</i> (Burm.f.) Bech.	'iwa 'iwa a Kane	ind		Aspleniaceae	
<i>Asplenium peruvianum</i> Desv.	pūnana manu	end	E	Aspleniaceae	
<i>Asplenium polyodon</i> G.Forst.	'oali 'i	ind		Aspleniaceae	
<i>Asplenium trichomanes</i> L.	ka 'ape 'ape, 'ahina kuahiwi	end		Aspleniaceae	
<i>Cyrtomium caryotideum</i> (Wall.) C.Presl		ind		Dryopteridaceae	
<i>Dryopteris wallichiana</i> (Spreng.) Hyl.	'i'o nui, laukahi	ind		Dryopteridaceae	
<i>Lepisorus thunbergianus</i> (Kaulf.) Ching	pakahakaha, 'ēkaha	ind		Polypodiaceae	
<i>Pellaea ternifolia</i> (Cav.) Link	'akōlea, pua 'a kuhimia kalamoho lau li 'i, laukahi, kalamoho	ind		Pteridaceae	
<i>Polypodium pellucidum</i> Kaulf.	'ae, 'ae lau nui	end		Polypodiaceae	
<i>Polystichum hillebrandii</i> Carruth.	ka 'upu, papa 'oi	end		Dryopteridaceae	
<i>Pteridium aquilinum</i> (L.) Kuhn	kīlau, kīlau pueo, pai 'a, bracken fern	end		ae Dennstaedtiac eae	
<i>Pteris cretica</i> L.	'ōali, cretan brake	ind		Pteridaceae	
<u>Monocots</u>					
<i>Agrostis sandwicensis</i> Hillebr.		end		Poaceae	
<i>Anthoxanthum odoratum</i> L.	sweet vernal grass	X		Poaceae	
<i>Bromus catharticus</i> Vahl	rescue grass	X		Poaceae	

<i>Bulbostylis capillaris</i> (L.) C.B. Clarke	X	Cyperaceae
<i>Carex wahuensis</i> C.A.Mey.	end	Cyperaceae
<i>Deschampsia nubigena</i> Hillebr.	end	Poaceae
<i>Dianella sandwicensis</i> Hook. & Am.	ind	Liliaceae
<i>Ehrharta stipoides</i> Labill.	X	Poaceae

Taxon	Common Name	Origin	Status	Family	Notes
<i>Eragrostis brownei</i> (Kunth) Nees ex Steud.	sheepgrass	X		Poaceae	
<i>Eragrostis deflexa</i> Hitchc.	lovegrass	end	SOC	Poaceae	
<i>Eragrostis leptophylla</i> Hitchc.	lovegrass	end		Poaceae	
<i>Fimbristylis dichotoma</i> (L.) Vahl		ind		Cyperaceae	
<i>Lachnagrostis filiformis</i> Trin.	he'upueo	ind		Poaceae	Synonym: <i>Agrostis avenacea</i>
<i>Luzula hawaiiensis</i> Buchenau	wood rush	end		Juncaceae	
<i>Melinis repens</i> (Willd.) Zizka	natal redtop, natal grass	X		Poaceae	
<i>Morelotia gahniformis</i> Gaudich.		end		Cyperaceae	
<i>Panicum tenuifolium</i> Hook. & Am.	mountain pili	end		Poaceae	
<i>Pennisetum clandestinum</i> Hochst. ex Chiov.	Kikuyu grass	X		Poaceae	
<i>Pennisetum setaceum</i> (Forssk.) Chiov.	fountain grass	X		Poaceae	
<i>Setaria parviflora</i> (Poir.) Kerguelen	yellow foxtail, perennial foxtail, mau' Kaleponi	X		Poaceae	
<i>Sisyrinchium acre</i> Mann	mau' u la 'ili, mau' u hō'ula 'ili	end	SOC	Iridaceae	
<i>Sporobolus africanus</i> (Poir.) Robyns & Tournay	smutgrass, African dropseed, rattail grass	X		Poaceae	
<i>Trisetum glomeratum</i> (Kunth) Trin.	pili uka, he'upueo (Hawai'i), mountain pili	end		Poaceae	
<i>Vulpia myuros</i> (L.) C.C.Gmel.	rattail fescue	X		Poaceae	

Dicots

Taxon	Common Name	Origin	Status	Family	Notes
<i>Acacia koa</i> A.Gray	koa			Fabaceae	
<i>Achillea millefolium</i> L.	common yarrow, milfoil	X		Asteraceae	
<i>Ageratina riparia</i> (Regel) R.M.King & H.Rob.	Hamakua pamakani, spreading mist flower maile	X		Asteraceae	
<i>Alyxia stellata</i> (J.R.Forst. & G.Forst.) Roem. & Schult.		ind		Apocynaceae	
<i>Anagallis arvensis</i> L.	scarlet pimpernel, poor man's weatherglass	X		Primulaceae	
<i>Argemone glauca</i> (Nutt. ex Prain) Pope	pua kala, kala, naule, pōkalakala	end		Papaveraceae	
<i>Bidens menziesii</i> (A.Gray) Sherff	ko 'oko 'olau, ko 'olau	end		Asteraceae	
Taxon	Common Name	Origin	Status	Family	Notes
<i>Bidens pilosa</i> L.	Spanish needle, beggartick, kī, kī nehe, kī pipili, nehe bittercress	X		Asteraceae	
<i>Cardamine flexuosa</i> With.	bitter herb, European centaury	X		Brassicaceae	
<i>Centaurium erythraea</i> Raf.		X		Gentianaceae	
<i>Chamaesyce olowaluana</i> (Sherff) Croizat & O.Deg.	'akoko, koko, 'ekoko, kōkōmalei	end	SOC	Euphorbiaceae	
<i>Chenopodium murale</i> L.	goosefoot, pigweed, lamb's quarters, 'aheahea	X		Chenopodiaceae	
<i>Chenopodium oahuense</i> (Meyen) Aellen	'aheahea, 'ahea, 'ahewahewa, alaweo, alaweo huna (Ni 'ihau), 'aweowo, kaha 'iha 'i	end		Chenopodiaceae	
<i>Cirsium vulgare</i> (Savi) Ten.	bull thistle, pua kala	X		Asteraceae	
<i>Cocculus orbiculatus</i> (L.) DC.	huehue, hue, hue 'ie, 'inalua	ind		Menispermaceae	
<i>Conyza canadensis</i> (L.) Cronquist	horseweed, lani wela, ilioha, 'awī'awī, pua mana	X		Asteraceae	

<i>Coprosma ernodeoides</i> A.Gray	'aiakanēnē, kūkaenēnē, leponēnē, nēnē, pūnēnē, pilo, hupilo	end	Rubiaceae
<i>Coprosma menziesii</i> A.Gray	pilo, hupilo	end	Rubiaceae
<i>Coprosma montana</i> Hillebr.	pilo, hupilo	end	Rubiaceae
<i>Daucus pusillus</i> Michx.	American carrot	X?	Apiaceae
<i>Delairea odorata</i> Lem.	German ivy, Italian ivy	X	Asteraceae
<i>Dodonaea viscosa</i> Jacq.	'a'ali'i, 'a'ali'i kū makani, 'a'ali'i kū ma kua, kūmakani	ind	Sapindaceae
<i>Dubautia ciliolata</i> (DC.) D.D.Keck	na 'ena'e, kūpaoa	end	Asteraceae
<i>Dubautia scabra</i> (DC.) D.D.Keck	na 'ena'e, kūpaoa	end	Asteraceae
<i>Emilia fosbergii</i> Nicolson	pualele (Ni'ihau)	X	Asteraceae
<i>Gamochaeta purpurea</i> (L.) Cabr.	purple cudweed	X	Asteraceae
<i>Geranium cuneatum</i> Hook.	nohoanu, hinahina	end	Geraniaceae
<i>Geranium homeanum</i> Turcz.	telegraph weed	X	Geraniaceae
<i>Heterotheca grandiflora</i> Nutt.	St. John's wort	X	Asteraceae
<i>Hypericum mutilum</i> L.	pūkiawe, 'a'ali'i mahu, kanehoa, kawa'u (Lana'i, Maui), maiele, maieli, puakeawe, puakiawe, pukeawe, pūpūkiawe	X	Clusiaceae
<i>Leptecophylla tameiameia</i> (Cham. & Schlecht.) C.M.Weiller		ind	Epacridaceae

Synonym: *Styphelia
tameiameia*

Taxon	Common Name	Origin	Status	Family	Notes
<i>Lythrum maritimum</i> Kunth	loosestrife, pūkamole, nīnika, pūkamole lau li 'i, pūkamole lau nui	ind?		Lythraceae	
<i>Marrubium vulgare</i> L.	common horehound, white horehound	X		Lamiaceae	
<i>Metrosideros polymorpha</i> Gaudich.	'ōhi 'a, 'ōhi 'a lehua, lehua	end		Myrtaceae	
<i>Myoporum sandwicense</i> A.Gray	naio, naeo, naieo, bastard sandalwood	ind		Myoporaceae	
<i>Myrsine lanaiensis</i> Hillebr.	kōlea	end		Myrsinaceae	
<i>Myrsine lessertiana</i> A.DC.	kōlea lau nui, kōlea	end		Myrsinaceae	
<i>Opuntia ficus-indica</i> (L.) Mill.	panini, papipi	X		Cactaceae	
<i>Osteomeles anthyllidifolia</i> (Sm.) Lindl.	'ūlei, eluehe (Moloka 'i), u 'ulei	ind		Rosaceae	
<i>Oxalis corniculata</i> L.	yellow wood sorrel, 'ihi 'ai, 'ihi 'awa, 'ihi maka 'ula, 'ihi makole	Pol?		Oxalidaceae	
<i>Passiflora tarminiana</i> Coppens & Barney	banana poka	X		Passifloraceae	
<i>Peperomia cookiana</i> C.DC.	'ala 'ala wai nui	end		Piperaceae	
<i>Physalis peruviana</i> L.	Cape gooseberry, poha, pa 'ina (Hawai 'i)	X		Solanaceae	
<i>Picris hieracioides</i> L.	hawkweed	X		Asteraceae	
<i>Pittosporum hosmeri</i> Rock	hō 'awa, ha 'awa, 'a 'awa, 'a 'awa hua kukui	end		Pittosporaceae	
<i>Pittosporum terminalioides</i> Planch. ex A.Gray	hō 'awa, ha 'awa	end		Pittosporaceae	
<i>Plectranthus parviflorus</i> Willd.	'ala 'ala wai nui, 'ala 'ala wai nui pua kī, 'ala 'ala wai	ind		Lamiaceae	

nui wahine, spurflower

Taxon	Common Name	Origin	Status	Family	Notes
<i>Pluchea carolinensis</i> (Jacq.) G. Don	sourbush, marsh fleabane	X		Asteraceae	
<i>Polycarpon tetraphyllum</i> (L.) L.		X		Caryophyllaceae	
<i>Pseudognaphalium sandwicense</i> (Gaudich.) A. Anderb.	'ena'ena, pūheu (Ni'ihau)	end		Asteraceae	
<i>Rubus hawaiiensis</i> A. Gray	'akala, 'akalakala, kala	end		Rosaceae	
<i>Rubus niveus</i> Thunb.	hill raspberry, Mysore raspberry	X		Rosaceae	
<i>Rumex acetosella</i> L.	sheep sorrel	X		Polygonaceae	
	Common Name	Origin	Status	Family	Notes
<i>Rumex giganteus</i> W. T. Aiton	pawale, uauhakō	end		Polygonaceae	
<i>Santalum paniculatum</i> Hook. & Arn.	'iliahi, sandalwood	end		Santalaceae	
<i>Senecio madagascariensis</i> Poir.		X		Asteraceae	
<i>Sicyos macrophyllus</i> A. Gray	'anunu	end	C	Cucurbitaceae	Tentative ID
<i>Sida fallax</i> Walp.	'ilima	ind		Malvaceae	
<i>Solanum americanum</i> Mill.	glossy nightshade, pōpolo, 'olohua, polopolo, pōpolohua	ind?		Solanaceae	
<i>Sophora chrysophylla</i> (Salisb.) Seem.	mamane, mamani	end		Fabaceae	
<i>Stenogyne microphylla</i> Benth.		end		Lamiaceae	
<i>Stenogyne rugosa</i> Benth.	ma'ohi'ohi	end		Lamiaceae	
<i>Tagetes minuta</i> L.	stinkweed, 'ōkole'oi'oi	X		Asteraceae	
<i>Tetramolopium consanguineum</i> (A. Gray) Hillebr.		end	SOC	Asteraceae	

<i>Tetramolopium humile</i> (A.Gray) Hillebr.		end	Asteraceae
<i>Trifolium glomeratum</i> L.		X	Fabaceae
<i>Vaccinium reticulatum</i> Sm.		end	Ericaceae
<i>Verbascum thapsus</i> L.	'ōhelo, 'ōhelo 'ai woolly mullein, common mullein, flannel plant, velvet plant	X	Scrophulariaceae
<i>Verbena litoralis</i> Kunth	vervain, ōwī, oī, ha 'uoi (Ni 'ihau), ha 'uōwī (Ni 'ihau)	X	Verbenaceae
<i>Veronica plebeia</i> R.Br.	trailing speedwell, common	X	Scrophulariaceae
<i>Wahlenbergia gracilis</i> (G.Forst.) A.DC.		X	Campanulaceae
<i>Wikstroemia phillyreifolia</i> A.Gray	'akia, kauhi	end	Thymelaeaceae

¹Origin: end = endemic; ind = indigenous; pol = Polynesian introduction; X = alien species; ? = uncertain

²Status: E = Endangered; C = Candidate; SOC = rare, species of concern

