FLORA AND FAUNA SURVEY AND RESTORATION PLAN
ʻĀINAKŪKOʻA O WAIOHULI KAI, MAUI

Prepared For:
ʻĀINAKŪKOʻA O WAIOHULI KAI PROJECT

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INTRODUCTION

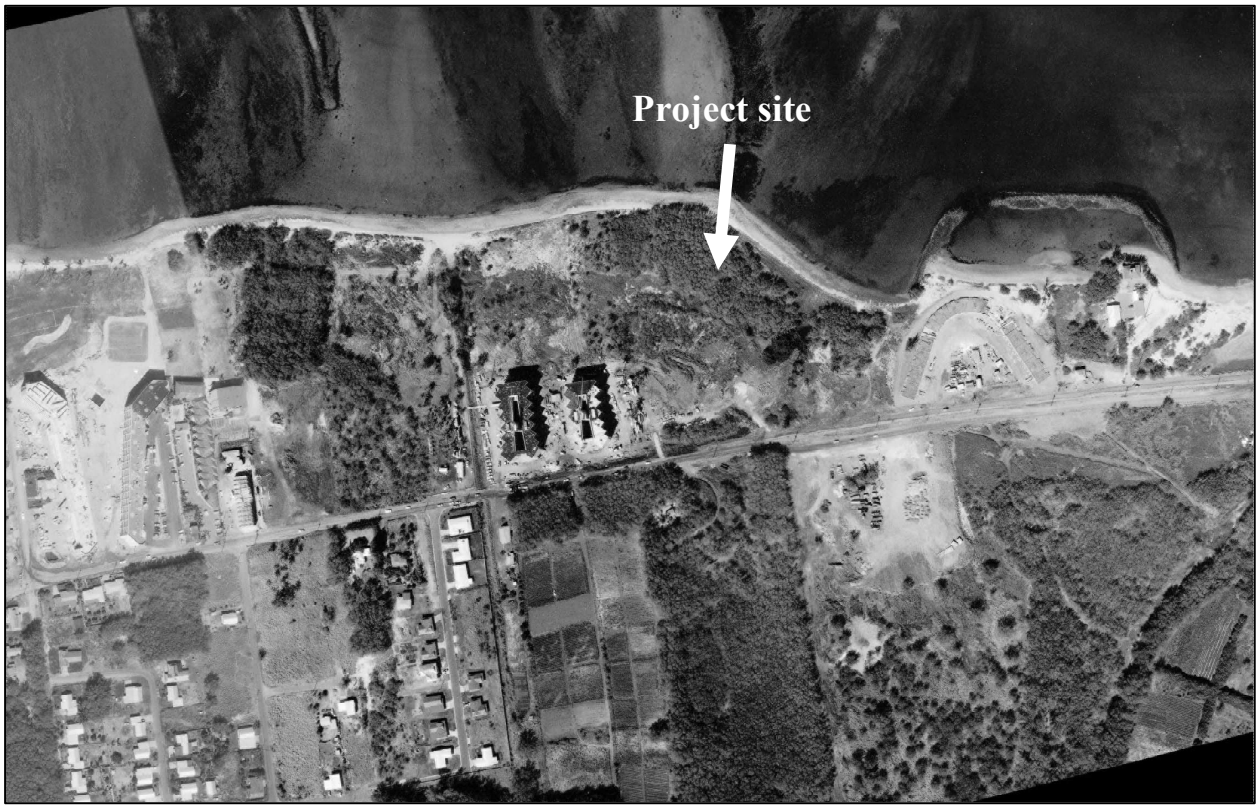
The project area encompasses about 5 acres on TMK 390010010000 owned by the County of Maui. The site is located along the coast, on the south shore of East Maui. The bulk of the surrounding property is condominiums and houses. The goal of this survey was to inventory the flora and fauna in the area, and to develop recommendations for restoration of the project area.

SITE DESCRIPTION

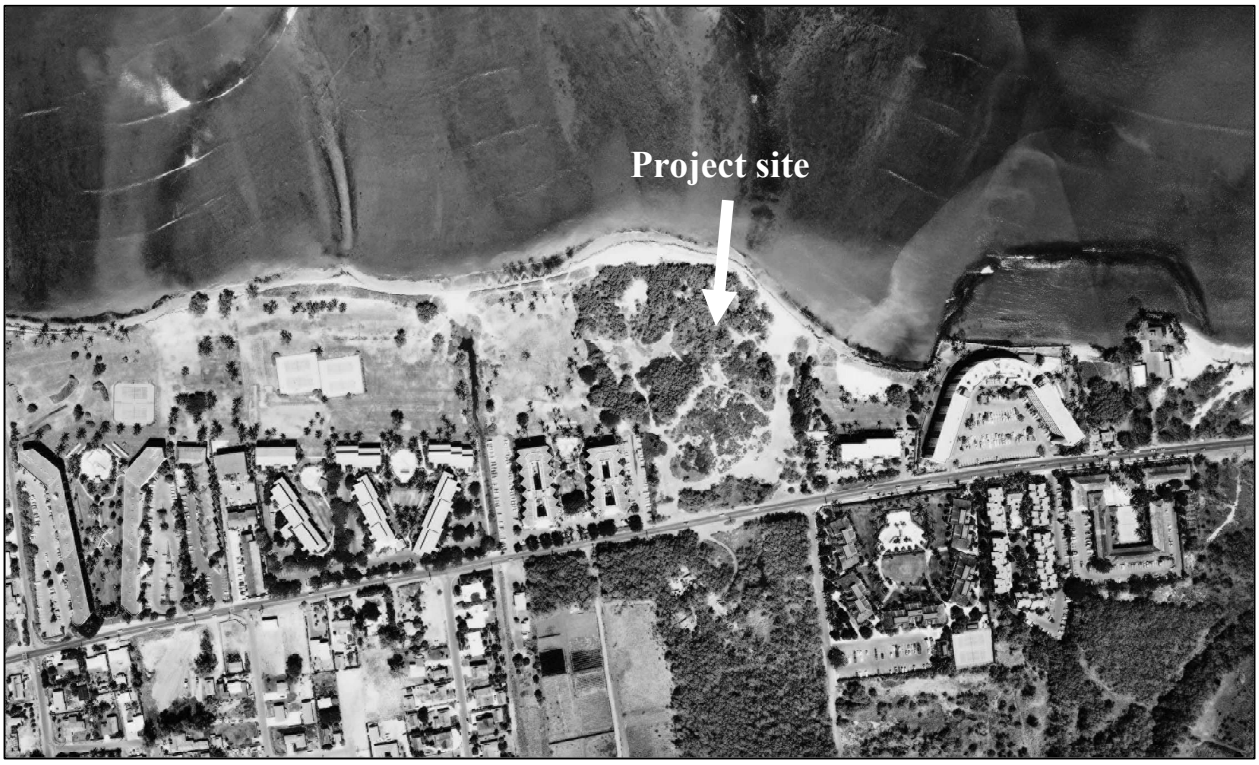
The project site is undeveloped and mostly flat with low growing, windswept vegetation and a few trees. There is an ephemeral wetland in the southern portion of the site, and a permanent wetland on the north boundary. The soil is mostly unconsolidated sand, with some dirt and gravel near the eastern edge of the site. Below is the project area surveyed. The pages that follow are a series of aerial images showing changes on the site and nearby areas since 1949. As can be seen, this is currently one of the last undeveloped sections of this part of the island.

Project area surveyed. Google image.

Aerial image of area in 1949, SOEST image.



Aerial image of area in 1975, SOEST image.



Aerial image of area in 1987, SOEST image.

Aerial image of area in 2019, Google image.

‘Āinakūko‘a o Waiohuli Kai project site.

RESTORATION GOALS

The text below, taken from a proposed management plan / vision document for ‘Āinakūko‘a o Waiohuli Kai, is the lens that the restoration recommendations in this report are made through.

> *‘Āinakūko’a, Ahupua’a o Waiohuli, Moku o Kula, Mokupuni o Maui.*
>
> *The goal of this rehabilitation project is to reintroduce native and Polynesian introduced species to this property in order to increase ecosystem services, particularly regulating and provisioning functions by reducing the impact of coastal disturbances and to provide both medicinal (la’au lapa’au) and other culturally useful plant material.*
>
> *The restoration process will aim to replace invasive plant species with culturally important, indigenous and Polynesian introduced plants in a way that reduces coastal erosion, protects the integrity of the palustrine wetlands (which provides habitat for endangered Hawaiian waterbirds), and increases the resilience of the property to anticipated impacts of climate change.*
>
> *Along the coastal strand particular plant species (‘Aki ‘Aki and Pōhuehue) will be used because of their particular psammophytic (sand dune adapted) properties, and their ability to minimize dune shearing and erosion. These particular species will be planted in the area where the dunes transition into the tidal inundation zone.*
>
> *Immediately behind these coastal strand species, higher statured shrubs, such as Pohinahina and Naupaka Kahakai will be planted in order to absorb wave overwash and wave energy. Immediately behind these species trees such as Hala and Lo’ulu will be planted in order to provide the best defense to the site during periods of intense storms and inundation.*
>
> *The wetlands species will focus on the enhancement of species already found in the wetlands, particularly ‘Ākulikuli and Kaluha, and will be supplemented by other species reasonably believed to have once occupied this site, and that are*

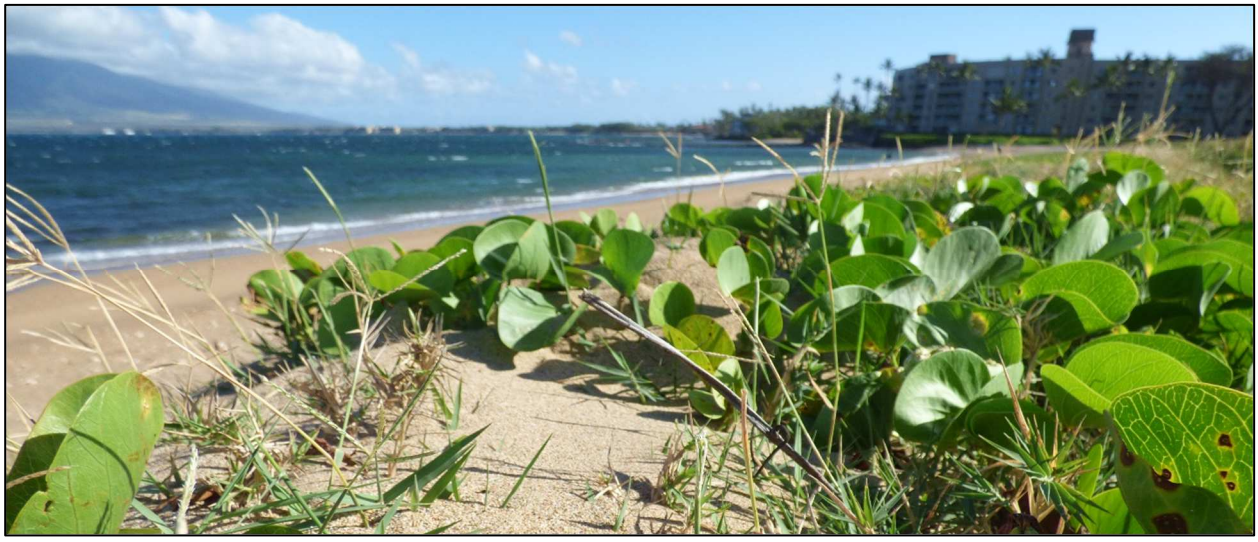
now found close by, such as Makaloa. Makaloa will be particularly emphasized due to its importance to traditional Native Hawaiian (Kanaka Maoli) cultural practices.

In areas protected by the layered native species mentioned above, a suite of other culturally important plants will be introduced to the site. These will include such species as ʻUlu (Breadfruit) and Noni, the former being an important food crop, while the latter serving an important medicinal (la'au lapa'au) role to the community.

Planting will follow the seasonal planting patterns established through ʻike kupuna (ancestral wisdom), generally following the ho'oilo (wet season)/kauwela (summer) divide. Planting will take place during the ho'oilo, while clearance of invasive species, and (appropriate) collection of appropriate native plants will take place during the kauwela.

The goal of this project lies in healing the land by rehabilitating the native and culturally important species to this area. This will entail both clearing and planting at appropriate times, and will not involve any movement of soil, and will therefore not pose any threat to the nearby coral reefs or nearshore waters.

Measures will be taken to enhance coastal resilience, provide direct and immediate benefits for the local community, and serve as an inspiration to what can be accomplished through the core values of ʻike kupuna (ancestral wisdom), kuleana (responsibility) aloha ʻaina (love of the land). Each of these values will contribute to the realization of our goal to care for the land (malama ʻaina) we all depend on."



Native Pōhuehue (*Ipomoea pes-caprae*) vine on sand dunes at ʻĀinakūkoʻa o Waiohuli Kai.

SURVEY OBJECTIVES

The objectives of the survey were to:

- Document what plant and animal species occur on the site or may likely occur in the existing habitat, and the status and abundance of each.

- Provide general recommendations and best management practices to support flora/fauna enhancements and the re-establishment of native flora and fauna throughout the project site.

SURVEY METHODS

The project site was surveyed in April, 2020. A walk-through survey method was used. The entire project area was surveyed. Notes were made on plant and animal species, distribution and abundance. Extra emphasis was placed on areas with high diversity and areas where restoration and management was most likely.

Additionally, we walked the site with ʻĀinakūkoʻa o Waiohuli Kai project members Cody and Kaimana, who shared their knowledge of the site, visions for the future of the site, questions they had about the flora and fauna of the area, and information they wanted included in this report.

Taking notes on vegetation during walk-through survey of ʻĀinakūkoʻa o Waiohuli Kai.

FLORA

The project site is a mix of common native and non-native low-growing coastal species. There is a surprising amount of native plant cover for this part of the island, some of the largest native patches left in South Maui. No endangered plant species were encountered on the project site.

The most dominant native plant is ʻakiʻaki grass (*Sporobolus virginicus*), which can be found on any part of the site. The native succulent ʻākulikuli (*Sesuvium portulacastrum*) is prevalent in the ephemeral wetland on the south part of the site. The native beach morning glory vine or pōhuehue (*Ipomoea pes-caprae*) is scattered across the site, especially the north portion.

There are also scattered native and Polynesian introduced trees across the site, including coconuts or niu (*Cocos nucifera*), hala (*Pandanus tectorius*), and milo (*Thespesia populnea*). And patches of the shrub naupaka (*Scaevola taccada*).

Dominant non-native plants at the site are mostly grasses, including buffel grass (*Cenchrus ciliaris*), Bermuda grass (*Cynodon dactylon*), and giant panic grass (*Panicum antidotale*).

There are some shrub trees of kiawe (*Prosopis pallida*). Other non-native shrubs scattered across the site include fleabane (*Pluchea* spp.), koa haole (*Leucaena leucocephala*), crown flower (*Calotropis procera*), and tree tobacco (*Nicotiana glauca*).

The bulk of the project site is a mixed open grassland / herbland with scattered trees.

PLANT RESTORATION DISCUSSION

Overview

ʻĀinakūkoʻa o Waiohuli Kai is a gem in the rough, ready to be polished. Restoration of this site will take a lot of effort over a long time. In many ways, the work will never be done. The large size, combined with the aggressive non-native species present, will require persistent diligence to achieve the goals outlined in the project vision statement.

That said, this site has many advantages for restoration, including easy access, moderate terrain, and vast areas of existing native plants able to prosper if given the opportunity.

In this report, the main habitat types are discussed. For each, the dominant native and non-native plants are mentioned, along with restoration options. Selected individual species are also discussed, including general locations on the site, cultural connections, and restoration options.

All native species found on the site are discussed. Additionally, native species not observed on the site, but occurring in similar sites elsewhere on Maui, are listed. Also discussed are general restoration concepts including erosion control, weed control, and selection of native plants.

Before starting, obtain any necessary permits, given the sensitive nature of the sand dunes and wetlands, and the site location in a Shoreline Management Area. This will help avoid costly delays and potential fines. Work that may require permits include using heavy machinery, construction of structures, grubbing the parking area, and placing gravel or large stones. This report may be used for flora/fauna sections of permit applications for the next five years.

ʻĀinakūkoʻa o Waiohuli Kai restoration site.

Vegetation Map

The map below is a rough approximation of the main vegetation/habitat types found at the site. Each of these has a unique mix of plants, soil, and water conditions. Restoration techniques will be similar, but slightly modified to suite each area.

These vegetation types are each discussed further in the text that follows.

Map of main vegetation/habitat types at ʻĀinakūkoʻa o Waiohuli Kai.

Coastal Fringe

The western part of the property abuts the ocean, in a long stretch of coastal fringe. This area, where the ocean meets the land, is dynamic and constantly changing. The plants here are mostly native species, as the harsh environment of wind, salt, sun, and sand make it difficult for most other species to survive. The low-lying dunes are occasionally overwashed by the ocean.

The most common native plants in this section include ʻakiʻaki (*Sporobolus virginicus*) and beach morning glory or pōhuehue (*Ipomoea pes-caprae*). There is also ʻākulikuli (*Sesuvium portulacastrum*) and scattered patches of naupaka (*Scaevola taccada*) further inland.

Bermuda grass (*Cynodon dactylon*) is one of the only non-native plants to survive in this area, along with shrubs of kiawe (*Prosopis pallida*) and koa haole (*Leucaena leucocephala*).

Not much needs to be done for restoration of this area. Perhaps the greatest help will come from keeping vehicles and excessive foot traffic off the dunes. Though hardy, dune vegetation will succumb to trampling, resulting is erosion of the sand dunes. Be very careful when working in this area, to minimize erosion of the sand dunes.

Mix of native and non-native plants along coastal fringe of ʻĀinakūkoʻa o Waiohuli Kai.

‘Aki‘aki/Pōhuehue Flats

The bulk of the site is a mix of native and non-native grasses, especially the native ‘aki‘aki grass (*Sporobolus virginicus*) and pōhuehue or beach morning glory vine (*Ipomoea pes-caprae*). The non-native buffel grass (*Cenchrus ciliaris*) is also common.

Coconut trees (*Cocos nucifera*) are scattered across the site. There is also a small grove of hala (*Pandanus tectorius*), and a young milo (*Thespesia populnea*). Patches of naupaka (*Scaevola taccada*) occur near the coast, and are spreading onto the site from nearby private properties.

There are also scattered shrubs of non-native kiawe (*Prosopis pallida*), koa haole (*Leucaena leucocephala*), crown flower (*Calotropis procera*), and tree tobacco (*Nicotiana glauca*).

This is the largest portion of the site, and is likely where the bulk of the restoration will occur. The first step will be removing non-native plants. Focusing in areas already dominated by native plants will provide the greatest reward. Simply removing the aggressive non-native plants will allow the natives room to breath and spread out.

Additional planting of native and Polynesian plants will help add diversity to the site. Plantings of most species not currently found on the site will likely be more successful in this part of the property, compared to the more extreme environments found in the wetlands and coastal fringe.

Broad flats of mixed native and non-native low-growing plants at ‘Āinakūko‘a o Waiohuli Kai.

ʻĀkulikuli Ephemeral Wetland

On the southern portion of the site lies a broad area that occasionally floods after heavy rains. This dynamic ephemeral wetland is covered with predominantly the native succulent ʻākulikuli (*Sesuvium portulacastrum*), which comes as goes as the flooding allows.

The native ʻakiʻaki grass (*Sporobolus virginicus*) can be found on the margins, along with non-native giant panic grass (*Panicum antidotale*), buffel grass (*Cenchrus ciliaris*), and Bermuda grass (*Cynodon dactylon*). Additionally, there is a non-native ʻākulikuli or verrucose sea purslane (*Sesuvium verrucosum*), which is scattered among the almost indistinguishable native ʻākulikuli.

Restoration of this site won't take much in the most flooded sites, as the native plants seem poised to recolonize the area quickly, and any non-native plants that do colonize the area are seemingly killed when the site floods with water.

Controlling non-native plants on the margins will help assure new seedlings in the area are predominantly native. Non-native plant species with the greatest potential to dominate the site include pickleweed (*Batis maritima*) and fleabane (*Pluchea* spp.).

Planting and promoting additional wetland adapted native species along the margins will help add native diversity to the site. Additionally, other native species may appear on their own from seeds in the soil, and with some help, could thrive here.

Ephemeral wetland on south part of the project site. Native ʻākulikuli (*Sesuvium portulacastrum*) is dominant here, and comes and goes as the flooding allows.

Permanent Wetland

On the north part of the project site is a permanent wetland with water year-round. This wetland collects runoff from nearby areas and is occasionally open to the ocean. The vegetation in and near the wetland is mostly aggressive non-native plant species.

The species with the greatest potential to change this wetland are the red mangrove (*Rhizophora mangle*), which are beginning to grow on the banks. Left unchecked, these mangrove could become large thickets making access to the wetland virtually impossible.

Non-native fleabanes (*Pluchea* spp.) are also present in the wetland and will push out any native plants attempting to grow there. A few plants of button mangrove (*Conocarpus erectus*) are present on the margins of the wetland near the highway. These were likely intentionally planted, and may spread, but are less aggressive than the previously mentioned species.

Removing aggressive non-native plants will allow existing native plants room to spread, and perhaps new ones will germinate from a seed bank. Planting of native wetland sedges, such as makaloa (*Cyperus laevigatus*) and kaluhā (*Bolboschoenus maritimus*), along with ʻakiʻaki grass (*Sporobolus virginicus*), ʻākulikuli (*Sesuvium portulacastrum*), and pōhuehue (*Ipomoea pes-caprae*), would help add diversity and stabilize areas where non-native plants are removed.

Year-round wetland on the northern part of ʻĀinakūkoʻa o Waiohuli Kai.

Future Parking Lot

The area where a future parking lot is proposed is covered in predominantly non-native plants, especially kiawe (*Prosopis pallida*) and Indian fleabane (*Pluchea indica*). There are also quite a few tree tobacco (*Nicotiana glauca*) in this section.

Despite the disturbed nature of this section, there are a few scattered native plants including kīpūkai (*Heliotropium curassavicum*) and ʻākulikuli (*Sesuvium portulacastrum*). Both of these are quick to colonize disturbed ground near the coast.

The ground has signs of previous gravel and other fill that has been brought in over the years, and shows signs of chronic vehicle use. Yard trimmings have also been dumped here.

All the native plants found in this section are common, and not of conservation concern. However, the non-native tree tobacco can be a host plant for the endangered Blackburn's Sphinx Moth (*Manduca blackburni*). The tree tobacco plants were searched for signs of this native moth, and none were found. That said, additional surveys will need to be done before any disturbance to the tree tobacco occurs. And Shoreline Management Area and other permits may be required before using heavy machinery to grub, lay gravel, dig holes, or place stones.

Future parking area at ʻĀinakūkoʻa o Waiohuli Kai.

Native Plants

The following are native plants found on the site. For each species there is a brief note about the species in general and within the project area. There is also an image for each species. The images are not all from the project area, but show the species in similar habitats.

Heliotropium curassavicum **(Nena, Kīpūkai)**

Nena is an ephemeral succulent native that is quick to arrive to open ground, but is eventually overtaken by more hardy species. It occurs near the coast and in the wetlands, coming and going in different locations as other vegetation allows.

Culturally, kīpūkai were dried and tea was brewed as a tonic.

In the project site, a few small plants were found in the hard pan area near the parking lot and ephemeral wetland. In areas that are recently cleared, being able to identify the young plants of this native species will help allow it to colonize the area until more longer lived natives establish.

Kīpūkai at Lā‘ie, Maui.

***Ipomoea pes-caprae* (Pōhuehue, Beach Morning Glory)**

Pōhuehue or beach morning glory is found on coastal shores across the world, where the vines quickly colonize open ground and help with dune stabilization.

Pōhuehue had several cultural uses. The vines were used as a bushy rope and attached to each of the sticks in bag netting. They were used to drive fish into nets, and made into lei. Roots and leaves were used as famine food, though it was also a cathartic, making it dangerous. Even so, young leaf buds were sometimes eaten by women just prior to birth to hasten delivery.

At the project site, pōhuehue is found across broad areas, with many nice patches, and gnarly old roots attesting to the age of the specimens.

Pōhuehue will fill in nearby areas cleared of non-native plants by its own. In areas far from existing pōhuehue patches, it can be planted. It propagates both from seed and cuttings.

There are two fungal pathogens commonly found on the foliage of this species, white rust and leaf spot. These pathogens are at the project site and are highlighted on the following page.

Pōhuehue at ʻĀinakūkoʻa o Waiohuli Kai.

White rust (*Albugo ipomoeae panduratae*). This fungus is unsightly, but won't kill the plants.

Leaf spot (*Cercospora*). This pathogen can be mistaken for herbicide damage. Again, unsightly but not fatal.

Pandanus tectorius **(Hala)**

Hala is a native coastal tree in Hawai‘i and across the pacific that has significant cultural uses.

Hala were often planted near hale, at the edges of villages, and in groves. The flowers were used in lei, and for dying kapa. Leaves were woven into useful items, such as mats, baskets, thatch and canoe sails. Male flower bracts, or hīnano, were used for clothing. Aerial roots yield cordage. Wood of male trees was used in construction of hale. It was also used as medicine.

In the project area, there were a few trees near the permanent wetland that appeared planted and had rat guards on the trunks.

The existing trees seem well established in a spot where they are able to survive on the site. If folks want more hala at the site, planting them near the existing trees would make sense.

Hala at ‘Āinakūko‘a o Waiohuli Kai.

***Scaevola taccada* (Naupaka)**

Naupaka is a common native coastal shrub in Hawai‘i and across the Pacific.

Culturally, naupaka fruit were sometimes eaten on canoe voyages or in times of famine. Fruit and flowers were used as lei. Medicinally, fruit or bark was mixed with salt and used for cuts, wounds, or skin diseases. Local divers are also known to use the fruit or leaves to rub inside their diving masks to prevent fogging.

At the project site, naupaka occurs as scattered patches near the coast and inland, especially along the boundary of the homes, where it appears to have been planted and is spreading.

Though native, and useful in some restoration situations, care should be taken when planting this species as it can quickly outgrow the planting area and overwhelm other less hardy native species, open spaces, and shoreline access. The existing patches near the houses will likely continue to spread out onto the project site unless otherwise checked.

Naupaka on Laysan Island, Northwestern Hawaiian Islands.

***Sesuvium portulacastrum* (‘Ākulikuli)**

‘Ākulikuli is a common succulent on seashores and along wetlands across the globe.

Culturally, ‘ākulikuli flowers can be made into lei and the salty leaves can be eaten.

On the southern part of the project site, there is a large stand of native ‘ākulikuli in an ephemeral wetland. These patches come and go as the wetland floods and then dries out.

There is a non-native ‘ākulikuli (*Sesuvium verrucosum*) that is also found on the site, and is difficult to distinguish from the native. Control may or may not be deemed necessary depending on goals, resources, and ability to distinguish the two species. Ways to distinguish the two species is discussed in the *Sesuvium verrucosum* write up in the non-native plant section.

‘Ākulikuli can be propagated most easily by cuttings, and can be planted in areas where non-native are removed, especially near wetlands and on sand dunes. It will also often just appear in areas that have recently been cleared, as it likely persists as seeds in the soil here.

‘Ākulikuli at Kaukaukapapa, Kaho‘olawe.

***Solanum americanum* (Pōpolo)**

Pōpolo is a relatively common native "weed" in many parts of Hawai‘i.

Culturally, pōpolo was one of the most important herbs for Hawaiians. It was considered one of the visible embodiments of Kāne, and when obtaining it, a prayer was often given to Kāne. Raw leaves and ripe berries were used for disorders of the respiratory tract, skin eruptions, sprains, sore joints, and cuts. Tender young leaves at tips were steeped with salt to tone up the digestive tract. A dye from the fruits was made. It was also used for food, both flowers and berries were eaten, and leaves were used as greens with pork or fish.

On the project site, a few plants of pōpolo were observed on a pile of yard debris that had been dumped in the area proposed for a parking lot.

Once considered non-native to Hawai‘i, pōpolo can be invasive, especially the first year or two after a site has been cleared to bare soil. However, once other species such as ‘aki‘aki grass (*Sporobolus virginicus*) fill in beneath it, it tends to become less common.

Though not the most charismatic plant, being aware of and including pōpolo in restoration efforts will help provide accessible lā‘au lapa‘au material at this site.

Pōpolo at ‘Āinakūko‘a o Waiohuli Kai.

***Sporobolus virginicus* (‘Aki‘aki)**

‘Aki‘aki is a native, creeping grass occurring along sand dunes and wetlands in Hawai‘i and other places around the world. It is often the closest plant to the ocean.

Leaves, culms, and roots were used medicinally, mixed with other plants for thrush and childhood weakness (pā‘ao‘ao). Spiny plants like ‘aki‘aki were also used to ward off evil spirits.

At the project site, some of the largest stands of ‘aki‘aki on Maui are thriving. It is one of the more dominant native plants at the site, with many fine stands.

This species will be a valuable tool in restoration here, one of the "warrior" species that does well in a variety of habitats. This grass is good at helping stabilize sand dunes, keeping weeds at bay, and preserving the open vistas. It also provides habitat for native moths.

‘Aki‘aki is best propagated by cuttings and could be planted in large numbers in areas cleared of non-native plants. It will also spread by itself into adjacent areas.

‘Aki‘aki grass at ‘Āinakūko‘a o Waiohuli Kai.

***Thespesia populnea* (Milo)**

Milo is found on coasts around the world, including Hawai‘i.

Culturally, milo wood was used for food bowls (‘umeke lā‘au, ‘umeke ai) as the wood does not impart flavor, and in canoe making. Flowers were used for lei, and fruits yielded a yellow dye. Bark was used for cordage, and oils and gums were used medicinally.

One small tree of milo was observed at the project site and appeared to have been trimmed to keep it short, perhaps so the view could be kept for adjacent landowners. Given the chance to grow up, these can make nice shade trees, with temperatures much cooler beneath them.

Though milo makes for a nice shade tree, care should be taken not to plant them near wetlands, as the numerous seedlings from milo can become overly aggressive in that environment.

Milo at Kanahā Beach, Maui.

***Waltheria indica* (‘Uhaloa)**

Common over Hawai‘i and much of the world in dry, disturbed sites.

Culturally, the bark of the root of ‘uhaloa was used in lā‘au lapa‘au for sore throats, as a pain killer, and for asthma. Leaves were also pounded and used for filling cracks in canoes.

At the project site, a few small plants of ‘uhaloa were encountered. This species is able to quickly colonize sites that have been cleared to bare earth, and likely will occasionally germinate on its own in areas where restoration occurs.

‘Uhaloa at Keālia Pond, Maui.

Non-Native Plants

The following are a subset of the non-native plants found on the site. For each species there is a brief note about the species in general and within the project area, along with an image. The images are not all from the project area, but show the species in similar habitats.

***Batis maritima* (Pickleweed)**

Pickleweed is an aggressive weed of wetlands. At the north edge of the project site, there is a relatively small patch of pickleweed growing on the south side of the permanent wetland / canal.

This small patch could be removed before it continues to spread and take over the site.

Nearby native plants, including ʻakiʻaki (*Sporobolus virginicus*), ʻākulikuli (*Sesuvium portulacastrum*), and pōhuehue (*Ipomoea pes-caprae*), will likely fill the spots where pickleweed is removed by themselves, or could be planted.

Pickleweed at Kanahā Beach, Maui.

***Calotropis procera* (Small Crown Flower)**

Small crown flower is one of two species of crown flower known from Hawai‘i. Both are used in lei and are host species for the caterpillars of the Monarch Butterfly.

This particular species is aggressively spreading in dry disturbed sites, such as Kahului and Kaho‘olawe. At the project site, only a few small plants were observed among the buffel grass.

Folks could leave them if they were interested in using it for lei or providing non-native Monarch Butterfly habitat. If it became aggressive and folks were no longer interested in keeping it, then it could be removed.

The milky sap of this plant is toxic and care should be taken when handling it.

Small crown flower at ‘Āinakūko‘a o Waiohuli Kai.

***Cenchrus ciliaris* (Buffel Grass)**

Buffel grass is a widespread grass in Hawai‘i, occupying vast areas of dry coastal and lowland sites across the state.

At the project site, buffel grass, as shown on the right in the photo below, forms a thicket that can crowd out native plants, such as the ‘aki‘aki (*Sporobolus virginicus*) and pōhuehue (*Ipomoea pes-caprae*) shown on the left.

Plants at the leading edge could be removed, allowing the native plants to move into the newly opened area. Care should be taken to not remove too large an area all at once, to reduce soil erosion potential, and allow the native plants time to fill in the areas.

Given room to breath, the native plants will move into the area that the buffel grass currently occupies. These same native plants can also be planted in cleared areas to accelerate the process.

Buffel grass at ‘Āinakūko‘a o Waiohuli Kai.

***Cynodon dactylon* (Bermuda Grass)**

Bermuda grass is a low-growing grass common in the project site, especially near the coast and by the wetlands. It is used as a lawn grass in Hawai‘i, and readily escapes into nearby wild areas.

This species is displacing native plants at the site. However, this grass is difficult to control, especially without herbicide. Additionally, it provides dune stabilization services in the most coastal sections of the site, where it is often intertwined with native plants.

Small scale control trials in different habitat types will help bring to light the best ways and locations to address this species on the site. In some situations, a do nothing approach may end up being most pragmatic, especially given the difficulty in distinguishing this grass from ‘aki‘aki (*Sporobolus virginicus*), and the delicate dunes some of the patches grown in.

Bermuda grass near ephemeral wetland at ‘Āinakūko‘a o Waiohuli Kai.

Bermuda grass in coastal dunes at ‘Āinakūko‘a o Waiohuli Kai.

***Leucaena leucocephala* (Koa Haole)**

Koa haole is an invasive shrub to small tree common in the lowlands of Hawai‘i. At the project site a few small stands were scattered here and there. Most plants appear to have been cut recently, presumably by landowners nearby wishing to keep their views of the ocean.

The few stands could be removed, though a seed bank will likely persist in the soil and may require follow up to control new seedlings. Establishing a thick mat of ‘aki‘aki grass (*Sporobolus virginicus*) and other natives will help reduce germination by weeds such as koa haole.

Koa haole at Kanahā Beach, Maui.

***Nicotiana glauca* (Tree Tobacco)**

Tree tobacco is a small tree found in dry areas of Hawai‘i. While an invasive weed, it's also a host plant for the larvae of the endangered native Hawaiian Sphinx Moth (*Manduca blackburni*).

At the project site, quite a few plants of this species were observed at the entrance of the property, where the parking area is proposed. We did not observe any eggs or larvae on the plants during our survey. But they have the potential to have this native moth on them.

If folks wanted to help the native moth and were willing to have an invasive weed on the site, the tree tobacco could be preserved to provide habitat for the native moth.

If folks did not want to have this plant on the site, such as where the parking lot is proposed, additional surveys will need to be done before any control work of tree tobacco begins, to assure this endangered native moth isn't harmed.

Tree tobacco at ‘Āinakūko‘a o Waiohuli Kai.

***Panicum antidotale* (Giant Panic Grass)**

Giant panic grass was introduced to Hawai‘i as a forage grass and is now naturalized. A large patch of this tall clumping grass is present in the project site near the ephemeral wetland.

The photo below shows one edge of that patch, where it is competing with a stand of native ‘aki‘aki grass (*Sporobolus virginicus*).

Giant panic grass could be removed using similar methods as for buffel grass (*Cenchrus ciliaris*), where clumps within and on the margins of the natives are removed, taking care not to open up more area than can be maintained. The native plants will then expand into the open space, or they can be planted to accelerate the process.

Giant panic grass at ‘Āinakūko‘a o Waiohuli Kai.

***Pluchea* spp. (Fleabane)**

Fleabanes can be aggressive in wetland areas, outcompeting most other plants.

The most common fleabane at the project site is Indian fleabane (*Pluchea indica*). This small-leaved species dominates the margins of the permanent wetland on the site. Also present is sourbush (*Pluchea carolinensis*), with larger, fuzzier leaves. A few plants of this were found in the broad flat area. The two species also spontaneously hybridize, resulting in marsh fleabane (*Pluchea* x *fosbergii*). This hybrid was not observed, but could be at the site at times.

Control of these species is generally quite doable with just hand tools. Care should be taken to not disturb the sand dunes or river banks too much when doing removal work. And only clear small sections at a time.

Hardy native plants will begin to colonize the site afterwards, especially in areas where they are growing nearby, or occur as a seed bank in the soil. Additionally, other native plants could be planted. The sedges kaluhā (*Bolboschoenus maritimus*) and makaloa (*Cyperus laevigatus*) would be good to try to establish in the locations currently dominated by fleabane.

Fleabane along banks of wetland at ʻĀinakūkoʻa o Waiohuli Kai.

***Prosopis pallida* (Kiawe)**

Kiawe is a spiny tree widespread in lowland areas of Hawai‘i.

At the project site, there is a fair amount of shrub kiawe forming thickets in the proposed parking area. With lesser amounts scattered about the rest of the site.

The kiawe appear to be cut to about 1 meter tall by adjacent landowners, to keep the view plane to the ocean open. If folks prefer to not have kiawe at the site, given the spines that hurt when stepped on barefoot, they can be removed and used for firewood.

On the other hand, if folks want kiawe for ongoing firewood or other uses, then letting the existing thickets grow will result in more kiawe.

Shrub kiawe along coast at Honokanai‘a, Kaho‘olawe.

***Rhizophora mangle* (Red Mangrove)**

Red mangrove is well established on multiple Hawaiian Islands and can transform wetlands from open to tree covered, often making the wetland impenetrable.

At the project site, young mangrove plants are present along the banks of the permanent wetland. The plants appear to be regularly chopped back to about 1 meter tall, presumably by nearby landowners to retain their view. Complete removal will offer a more permanent solution.

If not addressed when young, mangrove can quickly get to the point that professionals are necessary to remove the large trees. Additionally, regular sweeps for new seedlings should occur, thankfully the seedlings are easy to pull up.

A combination of sedges and other native coastal and wetland plants will quickly colonize the site once mangrove is removed. They can also be planted to accelerate the process.

Mangrove at Lā‘ie, Maui.

***Sesuvium verrucosum* (Verrucose Sea Purslane)**

Verrucose sea purslane looks and acts very similar to the closely related native succulent ʻākulikuli (*Sesuvium portulacastrum*). It is common, but often overlooked in many areas across the state of Hawaiʻi. At the project site, Verrucose sea purslane is found most commonly near the parking lot area, along the path to the ocean, and intermixed with the native ʻākulikuli.

Distinguishing the native and non-native *Sesuvium* species can be challenging, as they are closely related and can each assume many forms depending on the growing conditions. The main difference is that the stems and leaves of verrucose sea purslane are densely papillate, with little crystalline-like globules making the plants appear grayish. In contrast, ʻākulikuli doesn't have those, and appears less grayish. Additionally, the flowers of ʻākulikuli seem less dark purple, and ʻākulikuli is more prone to rooting at the nodes of stems, and seems to grow less erect.

If folks wanted to have 100% native plants, and were able to confidently distinguish the two species, then control could probably be accomplished through hand pulling, though this species would likely continue to come back from a seed bank in the soil.

Alternatively, if folks have a hard time distinguishing the two or don't have the resources to get the site to 100% native plant status, then this may be a species to just accept, or only control in a subset of high priority sites.

Verrucose Sea Purslane at Lāʻie, Maui.

Where To Start Restoration

The entire site would respond well to restoration, and restoration could begin anywhere. That said, some of the most rewarding and effective places to start restoration are in the largest patches of existing native plants, and along their borders.

The large patch of ʻakiʻaki (*Sporobolus virginicus*) and pōhuehue (*Ipomoea pes-caprae*) that covers the bulk of the broad flats could use help against the encroaching buffel grass (*Cenchrus ciliaris*) and other weeds creeping in from the margins.

The ʻākulikuli (*Sesuvium portulacastrum*) patch in the ephemeral wetland is also naturally doing well and could use some help along the margins from encroaching grasses. The permanent wetland on the north part of the property is also a natural focus of restoration.

Along the northern part of the coast, it is almost 100% native plant cover closest to the ocean by the river mouth. Working back from this position of strength is another good restoration candidate, with the native plants providing an anchor that restoration can work out from.

Trial and error, learning from the land, will steer you towards the best restoration locations.

Stretch of virtually 100% native plant cover at the project site, a potential anchor for future restoration.

Non-native Vegetation Management

When removing non-native plants, try to not remove too much at once. This will reduce the amount of bare ground and erosion, and helps not overwhelm folks trying to keep up with weeding and planting over a large area. Going slow at first also helps folks determine the best methodologies for the site, which may change over time.

Mechanical control involves hand pulling, cutting, and digging up of plants. Many species can be effectively controlled using this method, though others are difficult to control using this method. As mentioned previously, if heavy machinery is used, permits may be necessary.

Chemical control involves using herbicide. This technique can be effective over broad areas and can work on tougher to kill species. There are drawbacks though, including not everyone likes herbicide, and there is the potential for non target impacts to native plants from drift.

Cultural control involves using other management techniques to tilt the balance towards the native plants. An example is focusing on areas where the natives are already thriving. Controlling weeds will be easier with native plants nearby to fill the empty spaces. Another approach is assuring the native plants have access to the bright sun, wind, and salt air, to which they are naturally adapted and have a competitive advantage over other plants in this location.

Combining all these into a holistic approach is integrated pest management. Adaptive management is the optimizing of these approaches over time, especially as work begins in earnest and folks become more familiar with the nuances of the site and management techniques.

Again, the land will tell you what is, and what is not, working. Listen and adapt.

Discussing the boundary between native and non-native plants and management options at the project site.

What to Plant

The best plants are the plants already on the site. They have the local genetics, and are acclimated to the area. In many cases just removing the non-native plants will allow the natives to thrive and spread out, without additional planting.

In cases where the natives are absent or languishing, additional plant material can be added.

Each restoration project will have their own preference for how far from the site propagative material should come from. In many cases, especially for the common native species currently at the site, material from the same island is usually the most pragmatic approach. That said, there are no legal restrictions, it is a personal preference, and one that often evolves over time.

The main restoration species here are likely to be ʻākulikuli (*Sesuvium portulacastrum*), ʻakiʻaki (*Sporobolus virginicus*), pōhuehue (*Ipomoea pes-caprae*), and naupaka (*Scaevola taccada*).

Within and around these "warrior" or "matrix" species, other less common species can be planted. A long, but not exhaustive, list of native plant species not currently found on the site, but that could potentially grow there is included below.

ʻĀkulikuli and naupaka getting ready for planting, Midway Atoll, Northwestern Hawaiian Islands.

What to Plant: Other Native Plants

Below is a list of other native plants growing in coastal areas of Maui that may do well at the site. Some of these, such as ʻaeʻae, kaluhā, and pycreus were observed growing nearby the project site, and may at times occur within the site as well. Not all of these will thrive, but some should be able to establish. Along with adding diversity, most of these have cultural connections.

- *Bacopa monnieri* (ʻAeʻae) →
- *Boerhavia repens* (Alena)
- *Bolboschoenus maritimus* (Kaluhā)
- *Chenopodium oahuensis* (ʻĀweoweo)
- *Cordia subcordata* (Kou)
- *Cuscuta sandwichiana* (Kaunaʻoa)
- *Cyperus javanicus* (ʻAhuʻawa)
- *Cyperus laevigatus* (Makaloa)
- *Cyperus polystachyos* (Pycreus)
- *Dodonaea viscosa* (ʻAʻaliʻi)
- *Eragrostis variabilis* (Kāwelu)
- *Erythrina sandwicensis* (Wiliwili)
- *Fimbristylis cymosa* (Mauʻu ʻakiʻaki)
- *Gossypium tomentosum* (Maʻo) →
- *Heliotropium anomalum* (Hinahina)
- *Hibiscus tiliaceus* (Hau)
- *Ipomoea indica* (Koali ʻawa)
- *Jacquemontia sandwicensis* (Pāʻū o Hiʻiaka)
- *Lycium sandwicense* (ʻŌhelo kai)
- *Myoporum sandwicense* (Naio)
- *Portulaca lutea* (ʻIhi)
- *Portulaca molokiniensis* (ʻIhi)
- *Plumbago zeylanica* (ʻIlieʻe)
- *Pritchardia* spp. (Loulu)
- *Rauvolfia sandwicensis* (Hao)
- *Santalum ellipticum* (ʻIliahi) →
- *Scaevola coriacea* (Dwarf naupaka)
- *Sesbania tomentosa* (ʻOhai)
- *Sida fallax* (ʻIlima) →
- *Solanum nelsonii* (Pōpolo)
- *Vitex rotundifolia* (Pōhinahina)

What to Plant: Cultural Plants

One goal of the project is to have plants that can be utilized for cultural purposes. Additionally, there is a desire to replicate a remnant of what it looked like back in Hawaiian times. This can be accomplished by promoting an array of native and non-native plants that were present then.

Many plants that would have been familiar to the Hawaiians of old exist on the site, including all the naturally occurring native plants. Additionally, many of the trees planted at the site were also prevalent back then, including coconut or niu (*Cocos nucifera*), hala (*Pandanus tectorius*), and milo (*Thespesia populnea*).

Other plants currently not on the site that the project would like to see added include breadfruit or ʻulu (*Artocarpus altilis*), which was a staple, and noni (*Morinda citrifolia*) that was used for lāʻau lapaʻau. As mentioned in the vision document, these plants will likely do best in the more protected parts of the project area, closer to the highway.

Kou (*Cordia subcordata*) is a native tree used for carving that would likely do well at the site. Hau (*Hibiscus tiliaceus*) would also likely do well, though it should be planted with caution, as it could do too well and begin to dominate parts of the site.

Trial and error with these and other cultural plants will determine which do best at this site, in which locations, and what sort of maintenance and care is required.

Kou tree at Kīlauea Point National Wildlife Refuge, Kauaʻi.

When to Plant / Irrigation

If irrigation is present, plants can be planted at any time. However, in most restoration projects, irrigation is usually minimal. Each site is different. This part of Maui is dry most of the year, and receives the bulk of rain in the winter months, often with Kona storms from the south.

Lono is the rain that falls from the Kona direction. He is the god of fertility and the god of agriculture. He reestablishes the vitality of the land and nourishes the garden of the people.

Timing plantings with these winter rains during the wet season will result in the highest establishment rates. This local knowledge is recognized in the program vision statement.

> *"Planting will follow the seasonal planting patterns established through ʻike kupuna (ancestral wisdom), generally following the hoʼoilo (wet season)/kauwela (summer) divide. Planting will take place during the hoʼoilo, while clearance of invasive species, and (appropriate) collection of appropriate native plants will take place during the kauwela."*

Another approach we have not tried, but could possibly be realized at this site, is timing plantings with the Hawaiian Moon Calendar.

Once established, the native Hawaiian plants will not need any further irrigation.

Offerings and chants at summit ahu on Kahoʻolawe before winter planting.

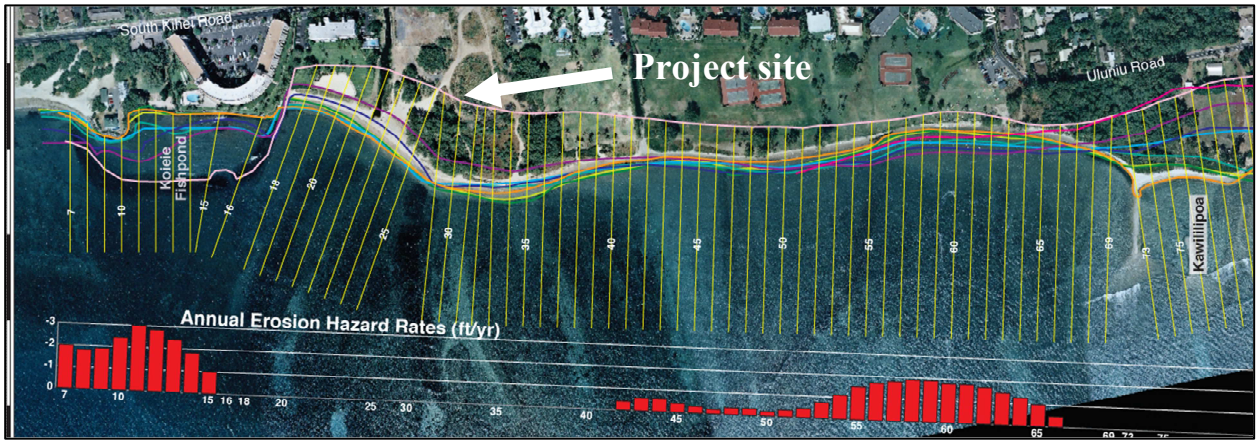
Erosion Control

The unconsolidated sand and strong winds at the site can result in erosion of the sand dunes. The current main source of erosion seems to stem from destruction of the dune vegetation by human foot traffic, as vehicles seem to rarely access the site now.

As mentioned, thoughtful restoration techniques can minimize the amount of open ground while native plants are becoming re-established. Additionally, minimizing the amount of vegetation trampled by human foot traffic will help retain and increase the stability of the sand dunes. And of course, keeping vehicles off the sand dunes and native plants is critical.

Below is a map showing long-term coastal erosion trends along this coastline. Red bars indicate more erosion. Interestingly, the dunes at the project site are one of the only sections showing no erosion. This may be due to the large fish pond offshore protecting the area and collecting sand.

Main path to the beach at the project site, showing signs of past vehicle use, human trampling and erosion.



Map of shoreline erosion over time in this stretch of coast. Red bars indicate more erosion. From SOEST.

Paths

Having a series of designated paths will help keep folks from unknowingly trampling the dune vegetation, leading to loss of native plants and increasing erosion. For this site, current demand seems to want one main path to the beach from the parking lot, and a less travelled path that parallels the ocean. Ideally, these paths would be in areas where excessive vegetation damage and erosion is least likely to occur.

Placing sticks or other objects along the path usually works to define the preferred route. If foot traffic were to increase dramatically at this site, additional signage, ropes, or even barricades along the path may be needed. In the most urban situations, drift fencing and boardwalks may be necessary to protect the vegetation and sand dunes from excessive human trampling.

Example of a path at the project site that seems to be handling the current foot traffic well enough.

Example of a path at the project site that is prone to erosion and should probably be relocated.

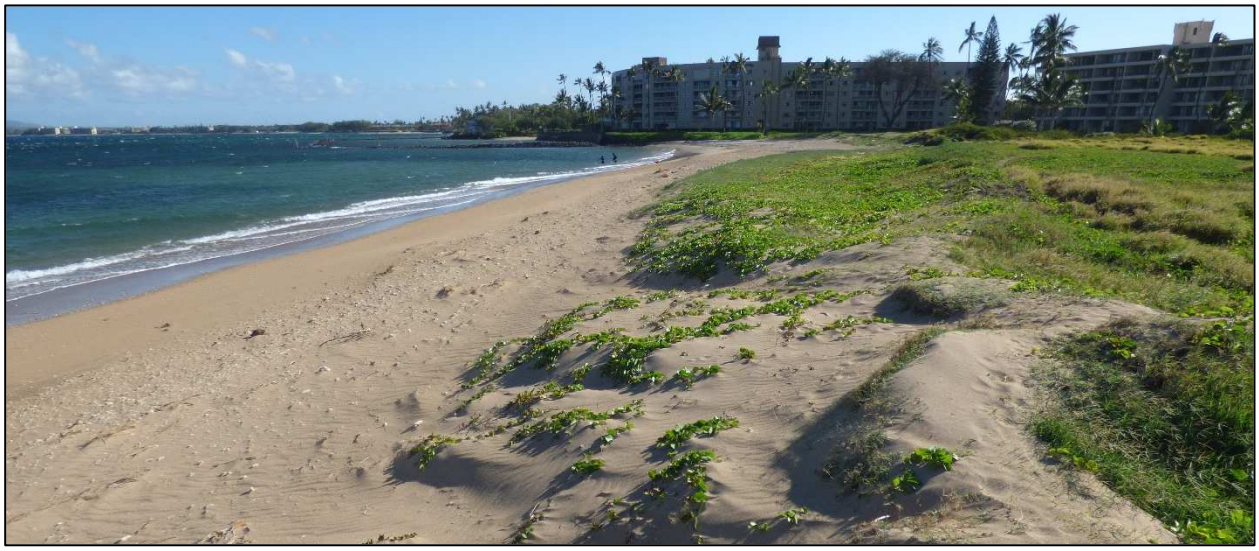
PLANT CHECKLIST

Following is a checklist of vascular plant species inventoried during the survey.

- Scientific Name
- Common Name
- Nativity
  - Endemic - Native to Hawai‘i only, not native elsewhere.
  - Indigenous - Native to Hawai‘i and native elsewhere.
  - Polynesian - Not native to Hawai‘i. Brought to Hawaii by Polynesians.
  - Non-native - Not-native to Hawai‘i. Brought to Hawaii after Western contact.
- Abundance within the project area
  - Dominant - Forming a major part of the vegetation within the area.
  - Common - Widely scattered throughout the area.
  - Occasional - Sparsely scattered throughout the area.
  - Rare - Only a few individuals within the area.

Scientific name	**Common name**	**Nativity**	**Abundance**
Alternanthera pungens	Khaki weed	Non-native	Rare
Atriplex suberecta	Saltbush	Non-native	Common
Batis maritima	Pickleweed	Non-native	Occasional
Boerhavia coccinea	Boerhavia	Non-native	Rare
Calotropis procera	Small crown flower	Non-native	Rare
Cenchrus ciliaris	Buffel grass	Non-native	Dominant
Cenchrus echinatus	Sand bur	Non-native	Rare
Chenopodium murale	Lamb's quarters	Non-native	Rare
Chloris barbata	Finger grass	Non-native	Occasional
Cocos nucifera	Coconut	Polynesian	Occasional
Conocarpus erectus	Button mangrove	Non-native	Rare
Cynodon dactylon	Bermuda grass	Non-native	Dominant
Cyperus involucratus	Umbrella sedge	Non-native	Rare
Desmanthus pernambucanus	Slender mimosa	Non-native	Occasional
Dysphania carinata	Chenopodium	Non-native	Rare
Emilia sp.	Pualele	Non-native	Occasional
Eragrostis pectinacea	Carolina love grass	Non-native	Occasional
Euphorbia hirta	Hairy spurge	Non-native	Rare
Euphorbia hypericifolia	Graceful spurge	Non-native	Rare
Heliotropium curassavicum	Nena, Kīpūkai	Indigenous	Occasional
Ipomoea pes-caprae subsp. brasiliensis	Pōhuehue	Indigenous	Dominant
Lantana camara	Lantana	Non-native	Rare
Leucaena leucocephala	Koa Haole	Non-native	Occasional

Scientific name	Common name	Nativity	Abundance
Neonotonia wightii	Glycine	Non-native	Rare
Nicotiana glauca	Tree tobacco	Non-native	Occasional
Pandanus tectorius	Hala	Indigenous	Rare
Panicum antidotale	Giant panic grass	Non-native	Common
Paspalum vaginatum	Seashore paspalum	Non-native	Occasional
Phoenix dactylifera	Date palm	Non-native	Rare
Pluchea carolinensis	Sourbush	Non-native	Occasional
Pluchea indica	Indian fleabane	Non-native	Common
Pluchea x fosbergii	Marsh fleabane	Non-native	Occasional
Portulaca oleracea	Pigweed	Non-native	Rare
Prosopis pallida	Kiawe	Non-native	Common
Rhizophora mangle	Red mangrove	Non-native	Occasional
Ricinus communis	Castor bean	Non-native	Rare
Samanea saman	Monkeypod	Non-native	Rare
Scaevola taccada	Naupaka	Indigenous	Occasional
Sesuvium portulacastrum	ʻĀkulikuli	Indigenous	Common
Sesuvium verrucosum	Verrucose sea purslane	Non-native	Common
Solanum americanum	Pōpolo	Indigenous	Rare
Sporobolus virginicus	ʻAkiʻaki	Indigenous	Dominant
Stenotaphrum secundatum	St. Augustine grass	Non-native	Occasional
Thespesia populnea	Milo	Indigenous	Rare
Verbesina encelioides	Golden crown beard	Non-native	Occasional
Waltheria indica	ʻUhaloa	Indigenous	Occasional
Washingtonia sp.	California fan palm	Non-native	Occasional



Native coastal plants at ʻĀinakūkoʻa o Waiohuli Kai.

FAUNA RESTORATION DISCUSSION

The bulk of the fauna encountered on the site was all non-native. No endangered animals were found on the site. The different faunal groups that occur on the site or could potentially occur on the site are discussed below, along with ways to help them through restoration.

BATS

Hawaiian Hoary Bats or ʻŌpeʻapeʻa (*Aeorestes semotus*) are known to transit along the coasts, such as at this site. They also could potentially be attracted to insects at lights on nearby condominiums and houses at night. And they could roost in trees on the site. There are a few trees in the project area taller than 15 ft. tall. Hawaiian Hoary Bats roost and give birth to their young in tall trees.

There aren't many specific recommendations for restoration of bats. Providing trees that they can roost in, and doing predator control in the area could also potentially help them. The main thing is to not cut trees during the summer pupping months.

While tree trimming activities are not incompatible with bats, they have the potential to impact juvenile bats unable to fly away from a tree that is cut during the summer pupping season. For this reason, the U.S. Fish and Wildlife Service advises that trimming woody plants more than 15 ft. tall should not occur between June 1 and September 15.

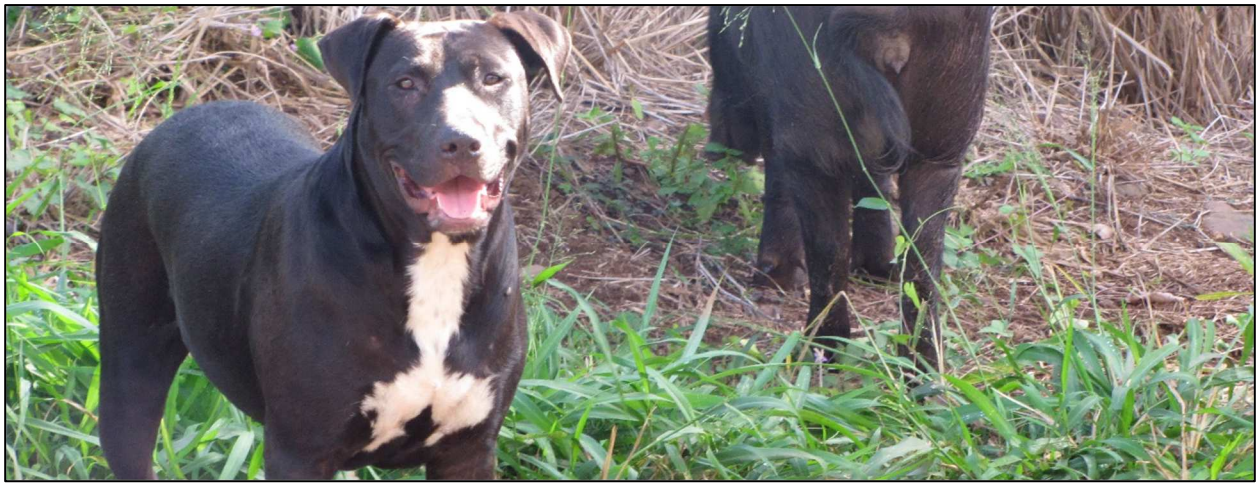
ʻŌpeʻapeʻa in Olinda, Maui.

NON-NATIVE MAMMALS

The only non-native mammals observed within the project area were dogs (*Canis familiaris*). The dogs were all associated with folks walking though the property and were observed both on and off leashes. No attempt was made to corral dogs off leashes when they approached us.

Though leash laws exist, many folks choose not to follow them, and allow their dogs to roam as they wish at the site. This may be fun for the dogs, but birds utilizing the site, such as seabirds, shorebirds, and wetland birds, will have to flee the site, or risk getting killed. A single dog can kill an entire seabird colony in a short period of time, just for fun. Dogs are also capable of digging up sea turtle nests and harassing turtles and monk seals on the beach. Signage may help.

Other non-native mammals that were not observed but likely occur in the project area include feral cats (*Felis domesticus*), rats (*Rattus* spp.), mice (*Mus domesticus*), and mongooses (*Herpestes auropunctatus*). These can also negatively affect seabirds and other wildlife, and are much harder to control. There is additional discussion on predator control in the bird section.



Unleashed dog in Waihee, Maui.

Cat with bird in mouth, South Maui.

BIRDS

The only birds observed on the site during surveys were non-native passerines. There is however the potential for native wetland birds to utilize the wetland areas of the site, and for native shorebirds to forage along the coast and in open areas of the site. No endangered birds were observed on the site, though they could occasionally be present.

Passerines (Perching Birds)

Non-native passerines were the only birds observed on the site. Species encountered include Java Sparrow (*Lonchura oryzivora*) and African Silverbill (*Euodice cantans*), Warbling White-eye (*Zosterops japonicus*) and numerous doves.

None of these species are of conservation concern at the site, and no native passerines are expected to be able to utilize the site, given the lack of habitat and presence of mosquitoes.

For restoration, a variety of habitats and plant types will increase the diversity of perching birds, though they will all be non-native. That said, for many people, any birds are better than no birds.

Java Sparrow at ʻĀinakūkoʻa o Waiohuli Kai.

African Silverbill at ʻĀinakūkoʻa o Waiohuli Kai.

Seabirds

No seabirds were observed at the site during the survey. However, they can be found in waters offshore, may fly overhead at night, and could potentially nest and breed at the site.

The site is capable of supporting many seabirds, most notably Wedge-tailed Shearwaters or ʻUaʻu Kani (*Ardenna pacifica*). However, this is unlikely to occur until the unleashed dog activity is addressed and a predator control program is implemented. Successful examples of this approach exist in South Maui, including Wailea Point and Kamaole III Beach Park.

Less intensive efforts to help the birds include using downward facing lights at night, and having folks familiar with this species survey the area before any ground disturbance during the shearwater breeding season (March-November).

The most extreme management measures, which seem beyond the scope of this project, would include constructing a predator-proof fence to protect the birds in the area, along with decoys and social calls of the target species to lure them into safe breeding areas.

ʻUaʻu Kani at Midway Atoll, Northwestern Hawaiian Islands.

Shorebirds

No shorebirds were observed at the site during the survey, but likely are there at times, especially along the coast, in the wetland, and in low or open vegetation.

The most common shorebirds in South Maui are the Kōlea or Pacific Golden-plover (*Pluvialis fulva*), ʻŪlili or Wandering Tattler (*Tringa incana*), ʻAkekeke or Ruddy Turnstone (*Arenaria interpres*) and the Hunakai or Sanderling (*Calidris alba*). All of these could occasionally be present at the site in low numbers, especially during the fall and winter.

The less human disturbance and free roaming dogs there are at the site, the more of these shorebirds will find the area a safe place to forage for food and rest.

ʻŪlili at Midway Atoll, Northwestern Hawaiian Islands.

ʻAkekeke and Hunakai at Kanahā Pond, Maui.

Kōlea at Keālia Pond, Maui.

Wetland Birds

No wetland birds were observed at the site, but could potentially utilize it at times, especially the ephemeral ʻākulikuli wetland, the permanent wetland, and open areas with excessive moisture.

The most likely wetland bird to occur at the site would be the Aeʻo or Hawaiian Stilt (*Himantopus mexicanus knudseni*). This lanky bird often visits sites such as this when other pond areas have become to full to forage in shallow water.

The native ʻAukuʻu or Black-crowned Night-heron (*Nycticorax nycticorax*) is another likely potential visitor to the site, especially the permanent wetland on the north part of the site.

Less likely to occur are ʻAlae Kea or Hawaiian Coot (*Fulica alai*). They would be in the permanent wetland.

Restoration efforts to help native wetland birds would focus on minimizing disturbance and doing predator control. If a nest of either Hawaiian Stilts or Coots was discovered, the US Fish and Wildlife Service should be contacted for guidance.

Aeʻo at Kanahā Pond, Maui.

Pueo

No Pueo or Hawaiian Owls (*Asio flammeus sandwichensis*) were observed on the site during the survey, but could potentially forage and nest there, especially in the open grassland sections.

Pueo nest on the ground and are therefore at risk to a variety of predators, including mongoose, cats, and dogs. Additionally, they prefer to avoid humans, looking for areas with least activity.

Restoration efforts could include predator control, keeping dogs on leashes, and minimizing human activity at the site.

Adult Pueo perched in tree on Kahoʻolawe Island.

Pueo nest with eggs, Upcountry, Maui.

Pueo keiki in nest, Upcountry, Maui.

Nēnē

No Nēnē or Hawaiian Goose (*Branta sandvicensis*) were observed on the site during the survey, but could occasionally visit the site, especially the wetlands and low-lying vegetation areas.

For restoration, Nēnē nest on the ground and are therefore at risk from predators like mongooses, cats, and dogs. They also prefer to nest in areas with less human disturbance. If Nēnē were to begin nesting in the area, having a predator control plan in place and minimizing activity at the site would help them.

Do not approach, feed, or harass Nēnē. If Nēnē are observed on the site, let them be. If a Nēnē nest is found, contact the US Fish and Wildlife Service for guidance.

Nēnē at Haleakala National Park, Maui.

TURTLES

No signs of turtles or honu were noticed during the survey. However, they could haul out on the beach to rest, and are known to create nests and lay eggs along sandy beaches.

Keeping the area free of development, keeping vehicles off the beach and sand dunes, promoting healthy dune vegetation, eliminating bright lights facing towards the ocean, and limiting roaming of predators such as unleashed dogs will help provide a safe place for turtles to rest and lay eggs. If turtles are observed, do not approach them.

Honu (*Chelonia mydas*) resting on beach at Midway Atoll, Northwestern Hawaiian Islands.

‘Ea or Hawksbill Sea Turtle (*Eretmochelys imbricata*) nest with eggs at Lipoa, Maui.

SEALS

Hawaiian Monk Seals or ʻĪlioholoikauaua (*Neomonachus schauinslandi*) have become more abundant in the Main Hawaiian Islands in recent years, and may occasionally haul up on the beach at this site to rest, give birth, or molt. As with turtles, they can be disturbed by humans and dogs, depriving them of much needed rest.

Restoration approaches that can help monk seals include allowing the sand dunes to be as natural as possible. Beaches that are too steep, or have thick woody vegetation all the way to the water are not as desirable to seals as gently sloping beaches with relatively soft vegetation they can plow through as they haul up on the beach and foredune.

Do not approach monk seals, they are easily disturbed on land, and can be dangerous to encounter in the ocean, especially during the pupping season.

Young ʻĪlioholoikauaua resting on beach at Laysan Island, Northwestern Hawaiian Islands.

INSECTS

The bulk of the insects observed at the site were common non-native insects, including honey bees (*Apis mellifera*), non-native butterflies such as the Western Pygmy Blue (*Brephidium exilis*) and Bean Butterfly (*Lampides boeticus*), and the beet webworm (*Spoladea recurvalis*).

There was one native insect species observed at the site, Green Darner or Pinau Dragonfly (*Anax junius*). It was observed hunting for insects in the calmer portions of the site. There are undoubtedly more cryptic native insects that more detailed surveys would uncover.

There were tree tobacco (*Nicotiana glauca*) plants on the property, which at times could potentially be host for the endangered Blackburn's Sphinx Moth (*Manduca blackburni*).

Restoration efforts for native insects generally focus on providing a diverse range of native and non-native plants for the target insects to feed on, both as young and adults.

Western Pygmy Blue Butterfly at ʻĀinakūkoʻa o Waiohuli Kai.

Native Pinau Dragonfly at Keālia Pond, Maui.

Blackburn's Sphinx Moth

The Blackburn's Sphinx Moth (*Manduca blackburni*) is an endangered native moth that often feeds on the weedy, non-native tree tobacco (*Nicotiana glauca*). A few plants of tree tobacco were observed on the site. The plants were searched for evidence of Blackburn's Sphinx Moth.

No eggs, larvae, frass, feeding damage or adults of the Blackburn's Sphinx Moth were observed. The only other Solanaceae encountered was pōpolo (*Solanum americanum*), and it showed no signs of this moth. Though Blackburn's Sphinx Moths were not encountered, there are host plants on the site that could support them, and it is probable they could be on the site at times.

Tree tobacco is relatively short lived, usually no more than a few years. It is also capable of quickly colonizing disturbed sites. As a result, locations of tree tobacco will fluctuate over time. Searching for tree tobacco and Blackburn's Sphinx Moth in areas slated for management before that occurs will help assure this endangered moth is not harmed. Allowing the non-native, often weedy, tree tobacco to grow on the property, along with plantings of native Solanaceae (tomato relatives), will help this endangered moth.

Tree Tobacco at ʻĀinakūkoʻa o Waiohuli Kai.

Blackburn's Sphinx Moth brown-morph larva, Kanahā Beach, Maui.

Blackburn's Sphinx Moth green-morph larva, Pu‘u o Kali, Maui.

Blackburn's Sphinx Moth egg, Kahului, Maui.

Blackburn's Sphinx Moth adult, Kahului, Maui.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the survey.

- Scientific name
- Common name
- Nativity
  - Endemic - Native to Hawai‘i only, not native elsewhere.
  - Indigenous - Native to Hawai‘i and native elsewhere.
  - Non-native - Brought to Hawai‘i intentionally or accidentally by humans.
  - Migratory - Spending a portion of the year in Hawai‘i and a portion elsewhere.
- Abundance within the project area
  - Abundant - Many flocks or individuals seen throughout area.
  - Common - A few flocks or well scattered individuals throughout the area.
  - Occasional - Only one flock or several individuals seen within the area.
  - Rare - Only one or two individuals seen within the area.

BIRDS			
Scientific name	**Common name**	**Status**	**Abundance**
Acridotheres tristis	Common Mynah	Non-native	Occasional
Bubulcus ibis	Cattle Egret	Non-native	Occasional
Euodice cantans	African Silverbill	Non-native	Occasional
Francolinus pondicerianus	Gray Francolin	Non-native	Occasional
Geopelia striata	Zebra Dove	Non-native	Occasional
Padda oryzivora	Java Sparrow	Non-native	Occasional
Streptopelia chinensis	Spotted Dove	Non-native	Occasional
Zenaida macroura	Mourning Dove	Non-native	Occasional
Zosterops japonicus	Warbling White-eye	Non-native	Occasional
INSECTS			
Anax junius	Green Darner Dragonfly, Pinao	Indigenous	Rare
Apis mellifera	Honey Bee	Non-native	Occasional
Brephidium exilis	Western Pygmy Blue Butterfly	Non-native	Common
Clastoptera xanthocephala	Spittlebug	Non-native	Occasional
Lampides boeticus	Bean Butterfly	Non-native	Rare
Orthemis ferruginea	Roseate Skimmer	Non-native	Occasional
Phoebis agarithe	Large Orange Sulphur Butterfly	Non-native	Rare
Pieris rapae	Cabbage White Butterfly	Non-native	Rare
Spoladea recurvalis	Beet Webworm	Non-native	Occasional
Teleonemia scrupulosa	Lantana Lace Bug	Non-native	Rare

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"E malama ‘oe i ka ‘āina, e malama ka ‘āina ia ‘oe."
Take care of the land, and the land will take care of you.