

Abutilon menziesii HCP 2019-2020 Status Report



Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife
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I. Introduction

The *Abutilon menziesii* Habitat Conservation Plan (HCP) was initiated in 1996 when a population of Ko'oloa'ula was discovered within the proposed construction zone of several projects in Kapolei, Oahu. This species is federally and state listed as endangered and this plan was initiated to mitigate for the effects of development on this population. The HCP outlined the measures planned over 20 years from 2001-2021. Specifically, the conservation goal of the HCP has been to represent as much of the original genetic diversity of this site as possible within three newly created populations within protected areas on Oahu. The Incidental Take License (ITL) was issued to Hawaii Department of Transportation (HDOT) and other ewa development partners (i.e. UH West Oahu, Honolulu Authority for Rapid Transportation [HART], Department of Hawaiian Homelands [DHHL], etc.) while the HCP mitigative efforts were contracted out to Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR DOFAW).

Fiscal year 2020 presented this project with new developments. As dedicated HCP funding were used up in January of this year, DLNR DOFAW the lost the only employee dedicated to this project. This left a significant hole in the work that needed to be accomplished over this year. With no dedicated staff member on this project there has been very little maintenance at most of the established reintroduction sites and very little new propagation of this species. Incorporation of this species into other DOFAW restoration activities has been the focus of this year's efforts. At the end of this FY20 DOFAW also completed a full monitoring of all the management sites.

With the depletion of funding for this HCP, DOFAW and the DLNR HCP office met with the ITL holder HDOT. Due to the failure of this project to meet the success criteria described in the HCP, some major decisions are pending regarding the continuance or termination of the ITL and the current HCP. The determination of the future of this project is dependent on the presence of the ITL holder, HDOT, at future Endangered Species Recovery Committee (ESRC). The DLNR HCP office stated the following at the recent meeting:

HCP mitigation status:

- The short-term success criteria in the HCP has not been met and it is unlikely the long-term success criteria can be met by the expiration of the ITL and HCP.
- Because the terms of the HCP have not been fulfilled, no take of the plants in the Contingency Reserve Area (CRA) may occur under the current ITL.
- The initial funds provided by HDOT are expended and would not be sufficient to continue the mitigation activities.
- Initial estimate by DOFAW staff is 3-6 years to meet the success criteria as currently described in the HCP.

HDOT as the ITL holder is responsible for meeting the HCP obligations. DOFAW staff and the ESRC are available for technical assistance and recommendations and will work closely with HDOT to assist in this process.

II. Funding and Projected Project Completion

As discussed in previous yearly reports for this project (2017, 2018, 2019) the funds were expected to be spent some time during FY20. In the first half of January 2020 the remaining funds were spent and the only dedicated staff on the project was lost. This was a huge loss to the program and essentially brought this project to a halt.

The project funding history is outlined below in Table 1 (same as reported in FY19 report). Due to the spending level per year beyond the HCP budget, the work was supplemented by other project funds supporting the employee during FY18, and FY19. This meant the employee was working only part-time on this HCP during those years. As this project is without a dedicated funding source DOFAW has been incorporating this species into some of the ongoing restoration work.

Table 1. Abutilon HCP funds

Funding Source	Amount	Dates
DOT	\$250,000	Mar-01
DOT	\$750,000	Oct-04
DOT	\$200,000	Oct-05
DHHL	\$120,000	Jan-06
City and County of Honolulu	\$30,000	Sep-06
UH West Oahu	\$50,000	Feb-07
HART	\$50,000	Mar-14
Revenue Total	\$1,450,000	
Current balance	0\$	Jan-2020

III. Changes to reporting numbers in 2020

Due to the loss of the long-term employee on this project in January of 2020, some information on the reporting has changed and will reflect some changes to the populations compared to previous years. However, no significant changes to any of the populations have been documented.

Over the years there have been 133 different wild founders from the original Kapolei site. Approximately 26 original founders have been lost due to assorted reasons, including the original movement of plants from the road construction site into the Contingency Reserve Area (CRA) in Kapolei. Currently there are 107 original founders that are still represented at the various sites. The genetic representation number reported is the percentage of the currently available founders found at that site ($x/107$). See Table 2 for current genetic representation at each site and Figure 16 for all of the currently known wild and outplanted *Abutilon menziesii* sites on Oahu.

IV. General Observations for All Sites

The lack of natural recruitment has been the crucial point of discussion for this HCP and the foremost reason why the project has not met the success criteria. Trying to understand all aspects involved is essential in coming up with solutions to this problem. There have been several factors identified that likely have all contributed to the current state of this HCP. They include: climate change and variability, human land use/development, species planting vs ecological restoration, and direct seed predation by introduced species.

Climate Change Factors

During the wet season, *Abutilon menziesii* at all sites are generally healthy and produce many flowers and fruit. Consistent rains are necessary for any young plants to make it to maturity. DOFAW has observed that seedlings were observed at the three older HCP sites (Pouhala Marsh, Diamond Head, and Honouliuli Wildlife Refuge) only in years of higher rainfall, notably 2009-2010 and 2011-2012. This is when many more seedlings were observed to germinate and a high percentage of them survived into the following season (see figure 2). The HCP success criteria are aimed at getting the seedling recruitment at each site to be successful enough to replace any senescing mature adults, thus creating a stable, long-term population. It is clear that without irrigation, this dry shrubland species cannot reproduce without favorable rainfall conditions. Climate change predictions for Hawaii show a reduced consistency in rainfall and a drying trend for the leeward lowlands of Oahu [Fortini pers com. 2019, <https://www.sciencebase.gov/catalog/item/581d3463e4b08da350d6e114> (Lucas Fortini, and Kevin Brinck, 20160930, Modeled suitable habitat for SPECIES based on TIMEREF.)].

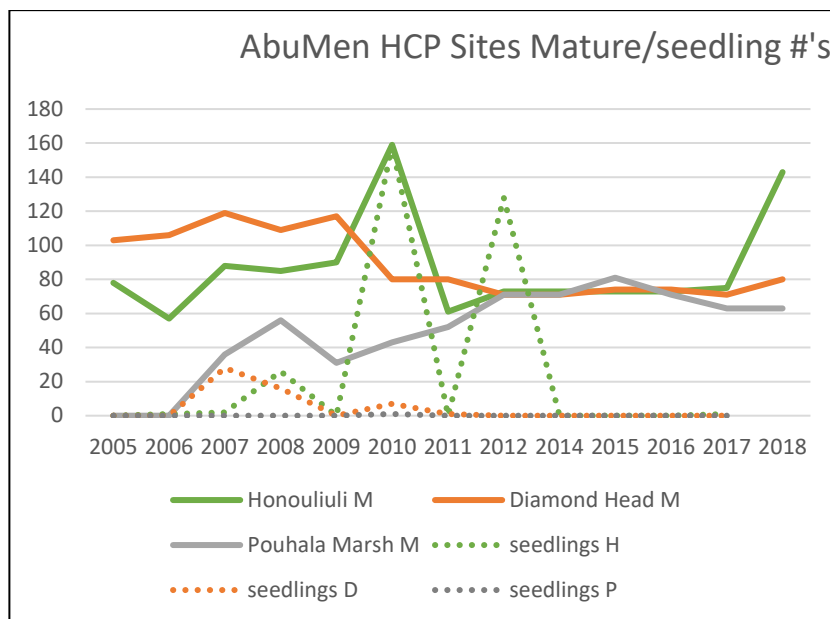


Figure 2. Seedling recruitment at three HCP *Abutilon menziesii* sites (2005-2018) see previous reports for this data.

Land Use Changes; Impacts to *Abutilon menziesii*

Through this project beginning in 2001, DOFAW has had the opportunity to observe this species over a changing land use in the Ewa/Kapolei area and in the HCP mitigation sites. This species seems to prefer an open, dry shrubland, of low elevation, leeward Oahu. This area was previously undeveloped or utilized for agriculture. The soil in the Ewa area, which includes the CRA, is alluvial, washed down from the Kunia plains through Koloi Gulch and is prime agricultural land. However, this area has undergone a drastic transformation in the last 20 years. The human population in the area has gone from 6,000 in the year 2000 to over 21,000 in 2020 (censusviewer.com, worldpopulationreview.com). The construction of the Kualakai Parkway (i.e. north/south road), UH, West Oahu, HART transit center, DHHL housing projects, etc. have altered the landscape not only above ground but in groundwater movement. The construction of the Kaloi Gulch detention ponds adjacent to the CRA (and elsewhere within Ewa) have essentially dried out the soil. This was a focused series of actions intended to dry out the soil and reduce the flood potential in order to improve the area for human development. See <https://files.hawaii.gov/dlnr/meeting/submittals/120323/K-OCCL-Submittals-K1.PDF> And https://www.wrrc.hawaii.edu/research/project_liu/kaloi.shtml

DOFAW employees observed that these actions and alterations to the landscape have made this site much less habitable to *Abutilon menziesii*. This species appears to prefer some level of moisture in the deep soil and without irrigation the CRA does not seem to hold enough moisture for this species to survive and reproduce. At the Ewa Villages Golf Course, immediately adjacent to the CRA, DOFAW has observed the *Abutilon menziesii* on irrigation being extremely healthy while long established plants in the CRA have dried out. This has not happened in HCP mitigation areas like Honouliuli Wildlife Refuge and Pouhala Marsh where ground water is readily available. The *Abutilon* planted adjacent to these wetlands are thriving.

A similar land use change has occurred within the Diamond Head crater. This area used to flood regularly and contained wetland obligate species such as *Cyperus trachysanthos* (see Figure 3). With the construction of DOD bunkers and climate change this wetland has not been observed in recent years. The planting of *Abutilon menziesii* within the crater was suggested due to the plots adjacent location to the seasonal wetland. Now that the wetland does not occur regularly, it is possible this site is becoming less suitable for *Abutilon*.



Figure 3. Historical 1928 photo of Leahi/Diamond Head Crater showing seasonal wetlands.

Other direct impacts to this species due to human development have been an increase in invasive species (plants, animals), increase in fire, and direct vandalism in the form of trash and breaking of plants within the CRA from adjacent housing developments and human vagrants. A recent fire, July 18, 2020 burned 11 *Abutilon menziesii* individuals planted in the Ewa Villages Golf Course. These have all adversely impacted this species and the habitat it requires to survive in its native landscape.

Species Planting vs Ecological Restoration

The ESRC has made several recommendations to incorporate landscape level ecological restoration into the mitigation efforts for *Abutilon menziesii*. This strategy has been adopted with great success in other lowland dry shrubland sites. Some work has been done to this effect at all of the HCP sites. The CRA has some common native species planted in across the 23 acres in both rows and kipuka (groupings) of plants that can be seen on google earth maps (see Figure 4). These special configurations have both helped both the rare and common species survivorship. DOFAW has seen some success in utilizing an ecological

approach to the species survivorship. Future efforts in this type of habitat would benefit from this approach.



Figure 4. Satellite imagery showing common native plantings by DOFAW within the CRA in attempt to provide ecological habitat for *Abutilon menziesii*.

Reproductive lifecycle research needed

The flowers of *Abutilon menziesii* are assumed to be pollinated by many native and non-native species. The bright red/orange flowers are perfect (have both male and female parts on the same flower) and are openly presented, though it is not known what native species were originally native pollinators. The species appears to have the capacity to produce copious amounts of seeds each flowering season.

The seed viability of *Abutilon menziesii* has been documented to be reduced by at least one invasive insect, *Niesthrea louisianica*. This species has been used as a biological control agent for other *Abutilon* species in North America. It has been documented in Hawaii on other rare taxa in Malvaceae. The impact of this species on the reproductive capacity of *Abutilon menziesii* is assumed to be high. Seed viability has ranged from 0-88% with most seed lots tests ranging from 20-40% viable.

<https://link.springer.com/article/10.1007/BF02373178>

More research is needed to determine how to overcome this and other seed predators for this species in the field.

V. Population Summaries

Table 2. Status of *Abutilon menziesii* HCP populations

	Wild Sites					Other Sites				Total
	Diamond Head	Honouliuli Reserve	Pouhala Marsh	Makua Keaau	Waianae Kai	CRA	Koko Head	Hamakua Marsh	Ewa Villages Golf	
2020 Mature (Reproductive) Plants	91	116	67	60	45	29	139	42	39	628

2020 % Genetic Represe ntation	52%	49%	50%	unk	unk	15%	63%	18%	32%	100%
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A. Diamond Head

This *Abutilon* population was established with clones of wild Kapolei stock in 2004. The site was initially on irrigation with heavy weed control. Irrigation was turned off approximately 5 years after establishment. The status of this population has been stable over the last year (see Figure 4). Even though maintenance at this site has been on hold the population has remained stable. Last year reported 68 individuals but this year a more careful count was made and we are adjusting our numbers to report that there are 91 individuals. This does not represent a natural or recruited increase but rather a more accurate representation of what was planted. These plants represent 52% of the total wild genetic stock that was originally found in the Kapolei development area.

This site has occasionally had some natural recruitment in wet years, confirming that the site has been appropriate for this species. However, monitoring and maintenance has not been consistent at this site over the past couple of years due to reduced *Abutilon* HCP funding available. DOFAW has not been able to determine if any new recruits have occurred because of these reduced actions.

There has been some recruitment of plants to adult size at this site, though overall recruitment has been lower than anticipated considering the size and health of the existing plants. During the wet season, the *Abutilon* are healthy and produce a large amount of seeds. The low recruitment may be due to the lack of consistent winter rains and the lower soil moisture as compared to other sites. The substrate at this site seems to dry out faster than soil at other locations. It is hard to predict the natural progression of *Abutilon* at this location. With semi-annual weed control, this population could be sustained for the next 20-30 years with a likely slow decline in health and viability unless site enhancement is done. Site enhancement that would increase the survival time of this population include outplanting new plants, adding other native species to the site, and installing a perimeter weed free zone.

There has been essentially no change over the past year at this site. Mature plants continue to survive and produce flowers and fruit. No monitoring of recruitment was done over the past year but the numbers of mature plants is stable. See Figure's 5 and 6 to see that the plants look dry but stable.

The MOU between State Parks and Hawaii National Guard was created but never finalized with signatures. The DLNR HCP office is assisting with the finalization of this MOU between DOFAW and State Parks for the long-term management of *Abutilon menziesii* at this site.



Figure 5. A picture of the *Abutilon menziesii* at Diamond Head in August of 2019.



Figure 6. Mature plants within the Diamond Head Crater planting site, August 2020.

B. Honouliuli

The Honouliuli outplanting site is located along the western edge of the West Loc of Pearl Harbor and was established in 2002 and 2003. This site is within three to four miles of the original population and is well protected. The site itself is part of the Oahu National Wildlife Refuge Complex. The refuge consists of 37 acres of fenced land, much of which is occupied by two ponds. The land is still under Navy

ownership but USFWS has a cooperative agreement with the Navy to manage the site as a refuge in perpetuity. This site was unexpectedly successful. There are more than 60 mature adults that have been recruited from the seed bank. Recruitment at the site is dependent on favorable winter weather, repeated Kona storm events. There have only been two to three favorable winter weather patterns over the lifespan of this site; which has led to the successful recruitment (see Fig 2). It is not fully understood why the recruitment is so high at this site when other nearby sites that have had very little recruitment. The substrate and slope may contribute to the success. The soil is likely alluvial in origin and quite rich. The successful area at this site is situated on the top and sides of a large mound with sloping sides. The steepness of the mound allows for soil to move downslope and cover seeds that have fallen from the *Abutilon* above enhancing recruitment. Other factors that contribute to the success of this site may include the relatively low weed pressure, a favorable micro climate created by the tree canopy and adjacent body of water, and a shallow water table (i.e. less than 20 feet).

A large portion of the plants are located along the perimeter fence line. Due to this, there is some likelihood of *Abutilon* migration outside the refuge boundary. This site could be enhanced by incorporating other native plant species and regular application of gypsum to reduce salt loads in the soil. This may also increase recruitment. No significant changes have been observed at this site compared to last year. Figures 8 and 9 below show the differences in moisture availability between 2019 and 2020.

Changes in management within the Oahu National Wildlife Refuge Complex have meant that DOFAW is being asked to renew the special use agreement for this project 2 years early. This may affect access to this site. However, with the loss of dedicated staff, DOFAW has not done, planting, weed control or monitoring beyond the recent population census recorded in Table 2.

Over the past 18 years, there have been 62 seedlings that have survived and grown to maturity and lived longer than five years. Although all plants at this site produce seeds, a large percentage of the plants are also reproducing vegetatively by mounding (i.e. lower branches root on contact with the ground). As of 2020, there are a total of 116 adult plants representing 49% of the genetic stock available.



Figure 7. Mature plants at Honouliuli, Pearl Harbor National Wildlife Refuge, August 2019.



Figure 8. Mature plants at Honouliuli Wildlife Refuge August 2020.

C. Pouhala Marsh

Pouhala Marsh is part of an actively managed DOFAW wildlife sanctuary. This is a thriving native plant restoration site. The *Abutilon menziesii* are doing well here despite the very low recruitment numbers of successful recruits at this site. Many of the plants are reproducing vegetatively through mounding. This type of asexual reproduction could lead to the long-term presence of plants at the site. There is a lot of open habitat at this site and many more individuals of this species could be planted here. The main threat at this location are invasive weeds such as kiawe trees and California grass growing along the stream bank. Weed pressure is relatively low except for the mauka western side where the grass and trees are present. Future management could include soil amendments like gypsum to improve soil structure and reduce the salt load. Future pond and wildlife enhancement may lead to increased viability of this site. If the dredge of the pond restoration could be used to enhance or create future *Abutilon* habitat. The “successful” Honouliuli site is growing on the same type of substrate, i.e. pond spoils. There are currently 67 mature plants at this location representing 50% of the genetic variation available from the Kaloi Gulch founders in Kapolei.



Figure 9. Mature Abutilon at Pouhala Marsh Aug 2020.

D. Makua Keaau Forest Reserve

The Makua Keaau site was originally established to protect a wild population of the endangered plant species, *Gouania vitifolia*. However, this site has been the focus of dry forest restoration efforts for several rare plant species including *Abutilon menziesii*. Even though a fire swept through the area in August of 2018, the site remains viable for dry forest species and recruitment of native common and rare plant species has been observed. Currently, there are 60 *Abutilon menziesii* planted at this site. The plants are not on irrigation, however water by catchment is available. Plants planted in 2019 and 2020 are surviving on very little maintenance. The present summer conditions are extremely harsh at this site with virtually no rainfall in July or August. Plants will be re-monitored after the fall rains. As this site continues to be managed DOFAW hopes to incorporate this species into the long-term plan for the area.



Figure 8. *Abutilon menziesii* at Makua Keaau dry forest restoration site, 2019.

E. Waianae Kai

This site was initiated in the 2017-2018 year within the Waianae Mountains Watershed Partnership (WMWP) and DOFAW Forestry restoration area in Waianae Kai. This site is well established with a variety of native dry shrubland species and is actively managed and funded by DOFAW Forestry. The site is regularly weeded and monitored by WMWP volunteer groups and WMWP staff as well as DOFAW staff. The restoration area is acting as a green barrier for fire as well as a site for community involvement. It is easily accessible for fire prevention and weed control. There are currently 45 *Abutilon menziesii* at this site. This site is ideal for long-term incorporation into DOFAW dry shrubland management. This would ensure that this species is managed as a component of a remnant dry forest ecosystem that also receives regular maintenance and watering.

However, a major concern for this site is the frequency of wildfire. DOFAW is working with the community and the restoration site is supported as a “green break” to act as a fire pre-suppression barrier on the landscape. Figure 10 shows plants in their second year in the restoration area.



Figure 10. *Abutilon menziesii* planted Waianae Kai restoration area 2020.

F. Kapolei Contingency Reserve Area (CRA)

The wild Kapolei (Kalo'i Gulch) population was the first to be discovered on Oahu and originally contained >80 individuals. Due to the large development plans for the area, a portion of wild individuals were conserved within the 21-acre Contingency Reserve Area (CRA) within Kapolei. The thought behind the creation of the CRA being that once the requirements of the HCP were met (i.e. 3 newly established, protected, off-site populations established within the 20-year time frame) then the CRA would also be available for development. The Incidental Take License (ITL) issued to Hawaii Department of Transportation (and Ewa Development Partners to include: UH West Oahu, DHHL, etc.) will expire July 31, 2021.

During 2005-2006, 35 plants were moved to the CRA. Once the plants were moved, a perimeter fence was installed by the Department of Transportation contractors around the CRA site. A firebreak was also installed prior to the construction of the fence. The firebreak consists of a weed free gravel barrier. The perimeter fence and firebreak require regular and consistent weed control. In 2018, the HCP project was reduced to a single ½ time employee working at all *Abutilon* sites. Therefore, the CRA has had little maintenance or monitoring over the past 2 years. The fire break is in severe need of maintenance as well as the planting area within the CRA. The whole area is overgrown with non-native Buffle grass, *Cenchrus ciliaris*, which is also fire prone. Due to the degraded maintenance of this field site a fire, presumably set by vagrants (DOFAW pers. Comm.), burned into the CRA in July 2020. If the maintenance were conducted regularly at this site the fire would not have entered the CRA or burned into the Ewa Villages Golf Course where *Abutilon menziesii* were killed (see figure 11).

Population numbers at this site have been reported this year at just 29 remaining individuals (see figure 12). Some of which are wild and some of which have been planted. The cause for this decline is related to

both the land use changes in soil moisture from the Kaloi Gulch Detention Pond projects (discussed in section IV above) but also is also related to the lack of funding for this HCP project. With regular maintenance (weed control, fire break control, common native planting, etc.), survivorship at this site would likely have been higher. This is presumably because of high levels of competition and very dry conditions. This is a very fertile site and the weeds are abundant. This means the site needs to be hand weeded or sprayed every six weeks. There has been no *Abutilon* recruitment at this site in over ten years. This site does, however, have thousands of native plants established that are being used for fire restoration seed collections.



Figure 11. A wild fire caused by vagrants moved into the CRA in July 2020 due to the lack of maintenance in the firebreak. It is unknown if *Abutilon menziesii* were burned in this fire as no plant tags were found in the debris records of exact locations were not all retained from last year.



Figure 12. One of only 29 surviving *Abutilon menziesii* within the CRA. Non-native shrubs and grasses need to be controlled at this site.

G. Koko Crater Botanical Garden

The plants at Koko Crater were established as an ex situ representation of the Kapolei genetic stock rather than a wild, reproducing site. These plants are the most robust of any site. There are several factors that favor this site as a long-term ex situ site for *Abutilon*. For example, there is controlled access to the site, regular irrigation, and weed management which reduces the fire threat. The plants at Koko Crater Botanical Garden are thriving. There are 139 plants representing 63% of the original Kapolei genetic stock. No new plants were outplanted during the reporting period. With no dedicated staff DOFAW has only done one annual census at this site. However, more maintenance is needed. The plants located at Koko Crater Botanical Garden are an invaluable source of working material for the program, (i.e. cuttings, seeds, etc), see Figure 13.



Figure 13. Koko Crater living collection site for *Abutilon menziesii*, 2020.

H. Hamakua Marsh

The Hamakua Marsh outplanting site is located on the windward side of Oahu on State DLNR DOFAW land managed for wetland birds and dry forest restoration. The site contains an active dry shrubland restoration site that involves DOFAW staff and community support from volunteers and school groups. The suggestion to add *Abutilon menziesii* to this site was made during an informal ESRC visit in 2017. There are currently 42 individuals planted at this site, representing 18% of the original Kapolei/Kaloi Gulch stock. In FY2020 DOFAW wildlife assisted with weed control, common native outplanting, and monitoring. This is not considered one of the HCP wild sites at this time but is experimentally included in reporting.

With DOFAW's long term commitment to this site for wildlife management and dry forest restoration as well as the high level of community involvement and interest, Hamakua is still a good option for maintaining a viable population of *Abutilon menziesii*. Figures 14 and 15 show the growth of plants over the past year at this site. With the low level of staff commitment time available (due to lack of directed funding for this HCP) DOFAW decided to use weed mat to control grass around the plants. This has allowed the plants to thrive with little weed control, however, it inhibits any natural regeneration beneath the plants. This site has a large ant infestation, possibly due to the weed mat. The ants are farming scale

on all of the restoration plantings and this will also affect the ability of any species at this site to survive and reproduce.



Figure 14. Dry forest shrubland restoration site with *Abutilon menziesii* at Hamakua Marsh, 2019.



Figure 15. *Abutilon menziesii* at Hamakua Marsh DOFAW refuge in August 2020.

I. Ewa Villages Golf Course

The Ewa Villages Golf Course planting was established while active restoration at the CRA was being done as a comparison due to the high level of irrigation and landscape maintenance available on the golf course. This site has done consistently well because of the maintenance and irrigation. It is not

considered a wild site and seedling recruitment has not been monitored. Currently there are 39 individuals representing 32% of the original Kapolei/Kaloi Gulch genetic stock.

These plants are large and healthy but 11 individuals were burned in the July 2020 fire and represented 4 original founders. No unique genetic stock was lost and the site contains no unique genetic lines (i.e. all remaining founders are represented at other sites). Honolulu BWS has a water main near these plants and has asked DOFAW to remove those near the water lines. This may take place over the next year.

VI. Conclusions

The *Abutilon menziesii* HCP project is now in its final year (ITL to be void on July 31, 2021). The HCP funds were spent out in January 2020. The project had been only partially funded between 2018-2020 and subsidized by other projects within DOFAW in order to continue work during the HCP timeframe. Consequently, there has been no official HCP work done for this project by DOFAW since January 2020 other than census reporting at each site this summer.

The success criteria outlined in the HCP are summarized in Table 3. For the short-term criteria 1) has been met, with >25% of the full genetic lineages surviving in a population for greater than 2 years without irrigation. This has been met at all three of the wild sites (Honouliuli, Diamond Head, and Pouhala Marsh). Short-term success criteria 2a) recruitment of seedlings through the dry season within the first 5 years was possibly but not definitively met at the Honouliuli site but monitoring was not consistent with this determination. Short-term success criteria 2b) was most likely met at all three of the wild sites as plants mature quickly and seed was likely set during this time but monitoring was not consistent with this determination.

Long-term success criteria 1) Each of 3 established populations will contain at least 80 reproducing adult plants. This criterion has been met at 2 of the 3 sites (Honouliuli, and Diamond Head). Long-term success criteria 2) Recruits must replace or exceed senescing adult plants. This criterion may need to be re-assessed as the seedling recruitment at each site has been lower than expected due to several factors explained above. As written, only Honouliuli may have reached this criterion. However, the expansion of the populations via clonal growth (mounding, suckers) was not included as a measure of success. Some of the older mature plants may have 5-7 (10) clonal stems that cover >2 m sq. Given the described measures there is no way to account for this large expansion of original plants planted.

Overall success criteria: None of the three long-term wild sites have met both of the long-term success criteria. Due to the failure to meet these criteria and according to the HCP additional management is required.

DOFAW recommends that the HDOT, the ITL holder, be responsible for the mitigative efforts that are needed to continue. The direct and indirect take of this population has already happened due to the construction of the north/south road/Kualakai Parkway and by the construction of the Kaloi Gulch Detention Ponds.

Even though the short and long term success criteria have not been fully met, this project has been successful in other ways. Many new insights have been gained into an endangered plant species. Very few Hawaiian plant species have received this level of funding and direct attempts at restoration. This population has been well represented in situ as well as ex situ (via botanical gardens and seed storage facilities). Currently, 99 wild individuals of *Abutilon menziesii* from the Kapolei/Kaloi Gulch population

are represented by 628 plants across the following sites: Koko Crater Botanical Garden, Pearl Harbor National Wildlife Refuge; Honouliuli Unit, Lē‘ahi/Diamond Head State Park, Pouhala Marsh Wildlife Sanctuary, Hamakua Marsh Wildlife Sanctuary, Mākua Kea‘au Forest Reserve, Ewa Villages Golf Course, the CRA in Kapolei, and the Vegetative Firebreak in the Wai‘anae Kai Forest Reserve. There are only 6 founders that are unrepresented at any restoration site, and an additional 2 founders that are no longer represented by plantings but have seeds stored at the Lyon Arboretum Seed Conservation Laboratory.

Future efforts could include continuation of work at the new restoration sites in Makua Keaau Forest Reserve, Waianae Kai Vegetative Firebreak, and Hamakua Marsh Wildlife Sanctuary. As well as continuing to add plants to the Pouhala Marsh Wildlife Sanctuary, where success criteria are close to being met. Seed collection and banking efforts are required for a number of founders, with special attention to those at a single location and ones not regularly irrigated at a botanical garden. It may also be prudent to collect from as many individuals as possible, regardless of their current status in a seed bank, since several collections are nearing 20 years of age.

Table 3. Summary of Success Criteria from original *Abutilon menziesii* HCP.

	Success criteria
Measurable Short-Term success criteria	<p>1) At least 25% of the full complement of lineages outplanted in a population must survive for 2 years after irrigation is ceased.</p> <p>2) During the first 5 years after each wild population is established there must be (a) recruitment of seedlings that survive through the dry season, and (b) seed production by at least 25 % of the full complement of outplanted lineages after irrigation is ceased.</p>
Measurable Long-Term Success Criteria	<p>1) At least 80 reproducing adult plants will be present in each population, averaged over a five-year period after irrigation is ceased.</p> <p>2) The number of seedlings recruiting into the mature age class must be greater than the mortality rate of existing adult plants, averaged over a five-year period after irrigation is ceased.</p>
Overall Success Criteria	<p>If both Long-Term Success Criteria are met and there are more than 120 reproducing adult plants present at the end of a 5-year period at a site (including at least 40 plants recruited from the seed bank on site) then no additional management action will be required for that site as part of the HCP and only monitoring need continue over the following 5-year period.</p>

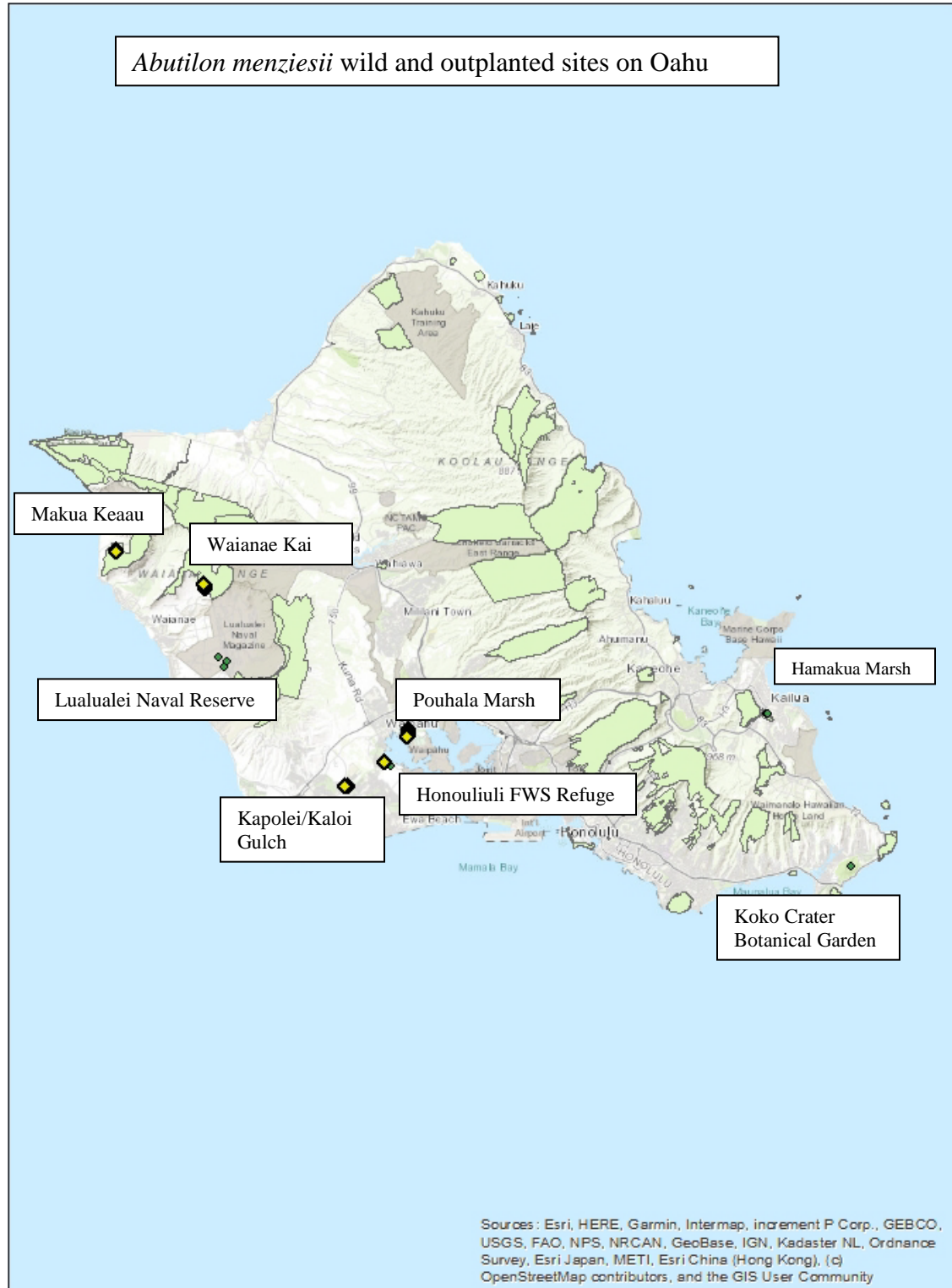


Figure 16. A map of wild and outplanted *Abutilon menziesii* populations on Oahu.