Department of Health Clean Water Branch

Maui Land & Pineapple Co. Inc

Pu‘u Kukui Watershed Partnership
An Ahupua‘a Approach to Watershed Best Practices in West Maui, HI

Quarter 3
July 01, 2022 – September 30, 2022

Top of Wao kele o Honolua ridge with Pu‘u ‘o Honolua pictured in the background.

Overview:

Maui Land & Pineapple Company (ML&P) is an established advocate of watershed management. The largest privately-owned nature preserve in the State of Hawai‘i, created in 1988 by Maui Land & Pineapple Company, transferred 8,600+ acres into a conservation easement, thus creating Pu‘u Kukui Watershed Preserve. The easement is held by The Nature Conservancy (TNC) and managed by the conservation department within Maui Land & Pineapple. In July of 2017, Maui Land & Pineapple signed its fourth contract with the State of Hawai‘i Natural Area Partnership Program (NAPP) to continue management of the Pu‘u Kukui Watershed Preserve. Implementation projects under this contract are outlined in the Pu‘u Kukui Watershed Preserve Long Range Management Plan. This plan details management of the upper watersheds of four streams listed as impaired in the 2016 State of Hawaii Water Quality Monitoring and Assessment Report: Honokowai, Kahana, Honokahua, and Honolua Watersheds. List of impairments are different for each watershed, but all have critical water quality issues of turbidity, Total Suspended Solids, and nutrients.

Pursuant to existing efforts by Pu‘u Kukui Watershed Preserve and identified in the 2016 West Maui Watershed Plans the crucial progressive needs include addressing storm water at multiple levels within the ahupua’a. The goal of this project is to prevent, stabilize, and treat sediment inputs and storm water from entering the stream, being mobilized by heavy rains, and entering the nearshore environment affecting human health, native biota, and precious coral reef ecosystems.

Outcome: Ma uka (mountains side) and ma kai (ocean side) connectivity through Ahupua‘a scale management and implementation of Best Management Practices will treat stormwater at multiple levels within the ahupua‘a, known as a treatment train, will allow these individual projects to act synergistically to improve water quality.

Project Effectiveness Monitoring Plan and Activities

Summary:

In the third quarter (Q3) of Fiscal Year 2022 (FY22), the Puʻu Kukui Watershed (PKW) Preserve staff continued to progress in efforts to fulfill and execute PKW Best Management Practices. During this reporting period, over 988,000 native seeds were collected and processed, 100 koa potted, and necessary infrastructures for advancing to the next phase of native hydroseeding for stream and bank stabilization were constructed. 1.8 new acres of loʻi kalo were successfully opened in Honolua and newly planted kalo have taken root. In the quarter, PKW engaged in four fence checks monitoring a total of 4,755 meters. A total of 475 snares were checked and a total of 8 feral pigs *(Sus scrofa)* were captured, dispatched, and removed. The hunting program this quarter has removed 54 feral pigs and in total 62 feral pigs have been removed. Nearly 15 acres of invasive weed species have continuously been maintained. PKW staff facilitated 16 outreach events and 1 presentation, equating to a total of 2,238 hours invested in education and outreach and having engaged with approximately 350 volunteers. The work accomplished in Quarter 3 continues to guide PKW in making successful progress to fulfill the best management practices outlined in this report.

Best Management Practices (BMPs)

1. Push Pile Stabilization
2. Establishment of Native Plant Nursery and Seed Bank
3. Landscape Restoration
4. Stream and Gulch Bank Restoration
5. Loʻi Restoration
6. Conservation Fence Maintenance
7. Feral Ungulate Management
8. Invasive Plant Management

Push Pile Stabilization:

During the third quarter of this reporting period, the push piles continue to be monitored due to the shifting location and sizes of the stabilization sites that have been caused as a direct result of the changing flux of weather and storms we have been experiencing in the months since the second quarter. Though weather conditions have altered the identified push pile sites, PKW staff has utilized this quarter to monitor the changes and strategize implementation methods when optimal conditions prompt work to commence.

Establishment of Native Plant Nursery and Seed Bank:

In Quarter 3, crew members progressed in efforts to establish PKW's native plant nursery and seed bank through the acquisition of native seeds collected from various units throughout the preserve, the reconnaissance and monitoring of plant growth and seed availability of targeted native and rare plant species, the maintenance and upkeep of PKW's nursery, as well as the dedication of time put towards outgrowing native seeds and plants for the continued growth and health of PKW's seed bank.

A total of 986,000 ʻaʻaliʻi *(Dodonaea viscosa)* seeds were gathered throughout the quarter. Utilizing PKW's outreach and education commitment to engage Maui's own native ʻōpio (youth) in environmental and cultural resource management, 132 Kamehameha Schools Freshmen students and kumu (teachers) of the ʻAʻapueo Maui Campus joined hands with PKW staff to gather mature ʻaʻaliʻi seeds at Wao kele o Honolua during the height of the season when conditions were prime and seeds most readily available in Honolua. In a single day, students learned of the significance of native forests and received hands-on experience in gathering ʻaʻaliʻi. Just short of a million seeds were collected by hand in the afternoon, equating to a total of 916,000 seeds. During another outreach event of smaller scale in the quarter, PKW staff and volunteers later returned to Wao kele o Honolua to collect the remaining available ʻaʻaliʻi seeds of the season. A total of 70,000 seeds were collected at this time.

Kamehameha Schools Maui ʻAʻapueo Freshmen Students gathering ʻaʻaliʻi seeds by hand at Wao kele o Honolua.


PKW staff sharing with volunteers how to process and gather ʻaʻaliʻi seeds.

In addition to growing PKW's collection of ʻaʻaliʻi seeds, the field crew gathered a variety of other native seeds. Seeds include the following species and amounts: 2,263 ʻūlei *(Osteomeles anthyllidifolia)*, 101 ʻiliahialoʻe *(Santalum ellipticum)*, and 80 olonā *(Touchardia latifolia)*. All seeds were collected by hand and gathered from Wao kele o Honolua and Kahana Valley. The seeds gathered from each species were processed and stored to be added to PKW's native nursery.


PKW field crew members processing ʻaʻaliʻi seeds.

During the quarter, crew members also maintained and continued to grow out PKW's huli (taro slips) bank. Kalo, Hawaiʻi's staple crop, both in terms of its nutritional sustenance and cultural significance, is cared for by PKW staff and included in our efforts to establish a nursery for native varieties of kalo. Staff members regularly weeded and mulched PKW's huli bank throughout the

quarter. When the crop reaches full maturity, the kalo will be cultivated and the huli prepared to be replanted in PKW's various loʻi restoration sites of which include Honolua valley.

PKW's huli bank after having been mulched and weeded.

While the acquisition of native seeds and the upkeep of the nursery is essential in order to meet the goals of this objective, PKW also ensures to take a proactive approach to grow out the desired native plant nursery and seed bank. A part of this approach includes regular monitoring of native and rare plant species throughout the various units of the preserve. Regular observance of the plant's growth allows crew members the ability to track the optimal time to collect its seeds. During the quarter, PKW field crew surveyed and monitored the plant growth and stages of flora species, including varieties of ʻōhia *(Metrosideros ploymorpha).* Crew members scouted and surveyed ʻōhiʻa, noted its plant growth, and GPS mapped its location. Proactive monitoring in this way helped crew members understand the health of select plants and identify the best candidates to source seeds.

ʻŌhia mamo, ʻōhia lehua, and ʻōhiʻa ʻalani identified and GPS mapped as seed sources.

Landscape Restoration:

During this reporting period, PKW crew worked on restoring the dry-mesic forest known as Wao kele o Honolua. A total of 456 hours was dedicated to restoration efforts in the area. Work consisted of clearing existing and new areas of highly populated Guinea grass *(Megathyrsus maximus)* and Formosan Koa (*Acacia confusa)*, Iron wood *(Casuarina equisetifolia)*, Clidemia *(Clidemia hirta)*, Eucalyptus *(Eucalyptus globulus)*, Blue Snakeweed *(Stachytarpheta jamaicensis)*, and Octopus tree *(Schefflera actinophylla)*. The landscape was cleared utilizing gas-powered weed whackers to thin out densely populated areas of invasive species. After clearing the restoration site with weed whackers, PKW crew followed with pickaxes to extract and remove the Guinea grass root systems by hand. We have found this tactic, thinning the landscape with weed whackers followed by the complete extraction of root systems to be an effective method to minimize and prevent regrowth of the main target species in the restoration site.

Wao kele o Honolua before and after the removal of Guinea grass in the field.

In the previous quarter, 583 native plants consisting of ʻaʻaliʻi *(Dodonaea viscosa)*, koa *(Acacia koa)*, and māmaki *(Pipturus albidus)* were out-planted in Wao kele o Honolua in April. During this reporting period, PKW crew have continued to maintain the planting site by regularly weeding and watering. Plants are hand-watered by filling buckets and bottles collected by the two 300-gallon water tote catchment systems installed on the field by PKW staff in the previous quarter. Since the out-planting, the plants have taken root and significantly grown within the 4 months of having been planted. Having intentionally been planted with a 4-foot spacing between one another along with active weeding, the plants during this reporting period have grown out, and in the months to come, is anticipated to begin to form a canopy which will help to shade out the ground cover and prevent new invasive species to sprout. The field crew's continued work to remove targeted invasive species, followed by out-planting native flora species and its upkeep continues to propel PKW's efforts to restore the natural and environmental integrity of Wao kele o Honolua to a native forest of which captures and retains our waters.

Progress of the plant growth at Wao kele o Honolua after 4 months of being planted. Pictured left: ʻaʻaliʻi planted in Q 2. Pictured right: current status of ʻaʻaliʻi nearing 4 feet

A new area approximating about 0.25 acres was cleared of guinea grass and formosan koa in preparation for reforestation. During the quarter, PKW staff welcomed one of Hawaiʻi's voyaging canoes, Hōkūleʻa and its crew members as they sailed from Oʻahu, making a stop at Honolua Bay before continuing their travels to Hawaiʻi Island. The relationship between Honolua and Hōkūleʻa traces back to the peak of Hawaiʻi's resurgent awakening for culture, language, and history. During this time of the Hawaiian Renaissance in 1976, Hōkūleʻa departed from Honolua to embark on their voyage to Tahiti relying on traditional knowledge and techniques, placing ancestral intellect and a heightened sense of cultural consciousness to the forefront. The relationship between Honolua, Hōkūleʻa, and the traditional voyaging canoes to have been birthed since, have been intertwined from that celebrated moment in Hawaiʻi's history. This relationship is sustained continually through PKW's recognition of this history as caretakers of Honolua Valley.

Hōkūleʻa and escort boat anchored in Honolua Bay.

10 Hōkūleʻa crew members and 7 community members worked alongside PKW staff to plant 15 koa in the newly cleared area at Wao kele o Honolua. Each koa was planted with a 25-foot buffer. Holes were dug and worm compost was added to each individual planting site to increase the nutrient content of organic matter and promote beneficial microbes in the soil. We have found that the extra input of organic matter has helped to maximize the health and enrich the growing productivity of the newly planted native species.

PKW staff, Hōkūleʻa crew members, and young ʻōpio help reforest Honolua by planting koa.

Under the leadership of Captain Archie Kalepa, Hōkūleʻa crew members took part in this planting to commemorate the large outplanting event, Ola ʻo Maui Nui, that took place at Wao kele o Honolua in 2017 after Hōkūleʻa returned home from the Mālama Honua Worldwide Voyage. In 2013, Hōkūleʻa circumnavigated the globe to connect with indigenous communities around the world sharing, advocating, and inspiring sentiments and commitments of aloha ʻāina. Upon their return home, Hōkūleʻa crew members, PKW staff, and thousands of community members reforested acres of Wao kele o Honolua with native plants. The koa planted this quarter by Hōkūleʻa crew and community members commemorated the 2017 Mālama Honua Worldwide Voyage return home and as Captain Kalepa proclaimed, is intended to root seeds of commitment to look onward to begin planning a second Worldwide Voyage and the continued restoration of Honolua Valley and other ʻāina alike.

Three generations of the ʻohana planting a koa tree at Wao kele o Honolua.

Stream/Gulch Bank Restoration:

In Quarter 3, PKW facilitated volunteer workdays with our program partners such as the Andaz Hotel Hoʻolana Program. PKW staff lead community volunteers to plant native species along Honolua stream. 48 ʻaʻaliʻi *(Dodonaea viscosa)* were planted along Honolua stream in efforts to stabilize the loose soil on the banks and prevent runoff into Honolua stream. Following PKW's planting tactics, ʻaʻaliʻi were planted 4 feet apart to form an eventual canopy. Holes were dug for each planting site and worm compost was added to each hole in order to promote beneficial microbes in the soil to maximize the health and productivity of the newly planted species. The planting sites were mulched to suppress the growth of new weeds and were watered on a regular basis.

PKW staff led community volunteers to outplant ʻaʻaliʻi along Honolua Stream.

As described in the "Establishment of Native Plant Nursery and Seed Bank" section of this report, PKW field crew increased efforts in gathering native seeds. Over 988,000 seeds were collected in the quarter. While a portion of the seeds will be potted and grown out in PKW's native nursery for future out-planting, a great majority of the seeds collected during the quarter and the quarters prior will be used for hydroseeding the eroded hillsides of Wao kele o Honolua. Outlined as a tactic to fulfill the best management practice, hydroseeding will be utilized as an innovative approach to reforestation practices as it was proven successful in PKW's work having pioneered the practice of hydroseeding native seeds back in 2016. The native, site-specific seed stock generated in this quarter will be used to stabilize the north and south facing slopes of Honolua to prevent soil erosion and sediment input into Pāpua Gulch and Honolua Stream. Along with increasing the native seed stock, the field crew made preparations to move forward in the next phase for hydroseeding by

constructing and installing two 300-gallon water catchments on the ridge where the hydroseeding will take place. These catchments proved successful and are now full of water.

PKW field crew installing the water catchment on Honolua ridge.

Loʻi Kalo Restoration:

During the quarter, PKW continued work restoring the loʻi kalo (terraced taro patches) in Honolua Valley. Field crew members cleared and re-established an additional 1.8 acres of terraces within the valley since the last quarter. Primary target species in the area that were removed during this quarter are shoebutton ardisia *(Ardisia elliptica)*, yellow ginger *(Zingiber zerumbet)*, java plum *(Syzygium cumini)*, mango *(Mangifera indica)*, guava *(Psidium guajava)*, christmas berry *(Schinus terebinthifolius)*, Indonesian cinnamon *(Cinnamomum burmannii)* and avocado *(Persea americana)*. During the quarter, invasive species were removed with hand saws, machetes, gas-operated chainsaws, and pickaxes. Pickaxes were used to remove the root systems of weeds to prevent regrowth. All species removed in the previous quarter were left in place and stacked into mulch piles to decompose. In Quarter 3, PKW field crew collected the decomposed foliage that broke down from these piles and utilized the nutrient-rich matter to fertilize the soil in preparation to plant.

Wood piles of invasive trees after having been cleared from the restoration site.

Pictured Left: Large tree stumps and ginger in loʻi before removal. Pictured Bottom Right: After crew cut and removed tree stumps and weeds. Pictured Top Right: Loʻi after being mulched.

After removing the large stands of trees from within the terrace complexes and digging out the root systems of weeds, PKW crew and volunteers tilled the loʻi soil. In Quarter 3, 120 huli were planted.

PKW crew and volunteers clear the loʻi terraces of invasives and begin planting huli.

Regularly throughout the quarter, field crew mulched the newly planted loʻi to help capture and retain the water and nutrients of the soil to ensure optimal growth of the kalo in the valley. We have found that spreading mulch around both planting sites and newly cleared lands is an effective method to naturally suppress weeds and prevent new invasive weeds from sprouting. During this period, PKW field crew upkeep the loʻi through regular weeding and water.

PKW crew and volunteers mulch the newly planted loʻi and remove any new weeds.

In Quarter 1, PKW crew members identified the old ʻauwai (ditch irrigation system) that was used historically to irrigate water into those wetland taro patches. In Quarter 2, PKW crew began to clear the ʻauwai moving boulders, logs, and debris from the perceived ʻauwai. During this reporting period, crew members made progress in clearing the headwaters of the ʻauwai. In the following quarter, PKW aspires to continue clearing the way for water to begin to flow through the irrigation system.

Before and after clearing the start of the ʻauwai where water moves from Honolua Stream and into the loʻi kalo.

Field crew also surveyed and mapped a new restoration site for loʻi kalo after rediscovering more rock-walled terraces within the valley. No restorative work has been done to this site during this quarter. PKW crew monitored, mapped, and noted rare and native species found in the area. Priority weed species were also noted. Native and rare plants observed include the following species: lama *(Diospyros sandwicensis)*, noni *(Morinda citrifolia)*, ʻohe *(Schizostachyum glaucifolium)*, kukui *(Aleurites moluccana)*, tī *(Cordyline terminalis)*, ʻēkaha *(Asplenium nidus)*, lauaʻe *(Microsorum scolopendria)*, moa *(Psilotum nudum)*, pākahakaha *(Pleopeltis thunbergiana)*, and ʻiwaʻiwa *(Adiantum capillus-veneris)*. Invasive plants include the following: Java plum *(Syzygium cumini)*, mango *(Mangifera indica)*, ginger *(Zingiber zerumbet)*, and octopus tree *(Schefflera actinophylla)*. Utilizing the data gathered from monitoring the site, PKW will begin to plan restoration tactics most fitting of the area and observations made.

Additional loʻi restoration site monitored and surveyed by PKW field crew.

Conservation Fence Maintenance:

This quarter, PKW engaged in four fence checks monitoring a total of 4,755 meters. These fence checks consist of walking, and observing the 8-foot tall Boundary Fence (BF) sections of the preserve, inspecting for various types of damage that could have occurred. This quarter we achieved Boundary Fence sections; 1, 5, 6, and 9. For BF-1 and BF-5, these two fences are well-intact with no damages found. Whereas, BF-6 was found severely damaged from a fallen tree which landed on the stream curtain. This large tree needed to be removed with chainsaws, and the area prepped. Removing debris, and clearing the area is preparation to fly in fence material for the next visit. Lastly, this quarter PKW crew revisited BF-9 to complete the minor repairs to the top-half of the fence. This fence line provides a sturdy front-line to deny access to any ungulate like *Axis deer* and feral pigs into the preserve.

PKW field crew members build the top-half of BF-9.

PKW field crew members use chainsaws to remove fallen tree of BF-6.

Feral Ungulate Management:

This quarter, PKW crew engaged in nine feral ungulate checks. The areas we checked were Honolua Arboretum, Kahana Valley, Māhinahina Valley, Honokōhau Valley, Honolua Valley, Haelāʻau and Kaʻulalewalewa Ridge. A total of 475 snares were checked and a total of 8 feral pigs *(Sus scrofa)* were captured, dispatched, and removed. Seven pigs were captured in Honokōhau, and one in Honolua Arboretum. Historically and evident during PKW's Quarter 3 feral ungulate check; Kahana Valley, Honokohau Valley, and Honolua Arboretum remains to be a place of high pig activity. To remove the pressure off the fence line, the hunting program this quarter has

removed 54 feral pigs and in total 62 feral pigs have been removed. Continued monitoring and ungulate management initiatives will be conducted by PKW to ensure protection of the preserve.

Invasive Plant Management:

During Quarter 3, PKW continuously maintained the 10.7 acres of Guinea grass in the Wao Kele o Honolua ma kai restoration site cleared in the previous quarter as well as cleared and continuously maintained over 2 acres of invasive weed species at the Honolua loʻi restoration sites. Additionally, over 2 acres of weed species were cleared on the top of Honolua ridge and its north and south facing slopes that descend into Papua Gulch and Honolua Valley. The primary invasive plant species managed throughout the quarter include: Guinea grass *(Megathyrsus maximus)*, formosan koa *(Acacia confusa*), octopus tree *(Schefflera actinophylla)*, java plum (Syzygium cumini), iron wood *(Casuarina equisetifolia)*, clidemia *(Clidemia hirta)*, mango *(Mangifera indica)*, ginger *(Zingiber zerumbet)*, blue snakeweed *(Stachytarpheta jamaicensis)*, shoebutton ardisia *(Ardisia elliptica)*, eucalyptus *(Eucalyptus globulus)*, guava *(Psidium guajava)*, blackberry *(Rubus argutus)*, Christmas berry *(Schinus terebinthifolius)*, and Indonesian cinnamon *(Cinnamomum burmannii).*

Wao kele o Honolua Scar with the summit of Honolua pictured in the background before and after PKW invasive species control efforts.

Crew used various methods to manage the invasive species specific to the site and terrain of the area. Methods include use of hand sickles, weed trimmers, weed whackers, and pickaxes. While eradicating the targeted invasive species listed previously, PKW field crew also actively monitor, flag, and GPS map rare and native plants when located and identified. In this quarter, crew members located several groves of lama *(Diospyros sandwicensis)*, alaheʻe *(Canthium odoratum)*, and kōpiko *(Psychotria grandiflora)*.

PKW crew girdle large stands of Schefflera actinophylla along Honolua ridge.

Groves of lama and kōpiko were identified and flagged after removing invasive trees.

Education and Outreach:

In Quarter 3, PKW committed a total of 2,238 hours in education and outreach, facilitated 16 events, 1 presentation, and engaged with over 350 people. During the quarter, PKW continued to cultivate the long-standing relationship with partners from Kamehameha Schools ʻAʻapueo Campus, the Hyatt Regency, and the Andaz Hotel.

Kamehameha Schools summer program, Hālau Kapikohānaiāmālama partnered with PKW to become an outdoor classroom for high school students enrolled in the first ever accredited Hawaiian Ethnobotany class. Students were taught by PKW staff and received first-hand field experience learning about native plants, their ethnobotanical usage, as well as their natural and cultural importance to native ecosystems and lifestyle. PKW staff developed curriculum and

implemented lessons to ensure students could learn about native flora species in an engaging way befitting of the outdoor experience. Students were exposed to the significance and value of caring for native and natural environments earning high school credits while also gaining a glimpse into PKW best management practices.

PKW field crew sharing with students about the function and traditional usage of lauhala.

PKW's educational outreach efforts with Kamehameha Schools Maui extended beyond the summer school session and carried over to the regular school year session during the quarter. PKW crew welcomed over 130 Kamehameha Freshmen students and teachers to Wao kele o Honolua teaching students the value of native forests. Collectively, just short of a million ʻaʻaliʻi seeds were gathered.

Kamehameha School Maui Freshmen after collecting ʻaʻaliʻi seeds at Wao kele o Honolua.

Over the quarter, PKW coordinated and facilitated 4 outreach events with participants of the Hyatt Regency and Andaz Hotel Hoʻolana Program. Field crew lead the participants in various work details in an immersive experience learning of the role watersheds play within our island ecosystem. The breadth of work accomplished with the help of Hoʻolana partners, and the topics shared by the PKW staff range from loʻi restoration work, invasive species control, sediment erosion prevention, native reforestation, and many more.

Hoʻolana participants learning of loʻi kalo systems from PKW field crew in Honolua Valley.

PKW finished off the quarter with an educational outreach event with the Maui Visitors Bureau and Hyatt Regency Maui. PKW staff was invited to present and share with 14 Oceania travel agents from Australia and Aotearoa educating them of the unique and precious native ecosystem sustained here on Maui. PKW Conservation Manager, Kainoa Pestana, and PKW Conservation Land and Assets Director, Pōmaikaʻi Kaniaupio-Crozier presented to the group sharing of PKW's role in protecting and preserving the environmental and cultural landscape we hold so dear. Attendees also took part in helping to grow out our native nursery by potting 100 koa dibbles.

Oceania travel agents potting koa seeds into dibbles (Pictured left).
Conservation Manager, Kainoa Pestana, presenting to the group PKW's work (Pictured right).