Manifesting
ʻĀina Momona

An Agricultural Master Plan for

Keawanui Fishpond & Cultural Learning Center

Kaʻamola Ahupuaʻa, Molokaʻi, Hawaiʻi

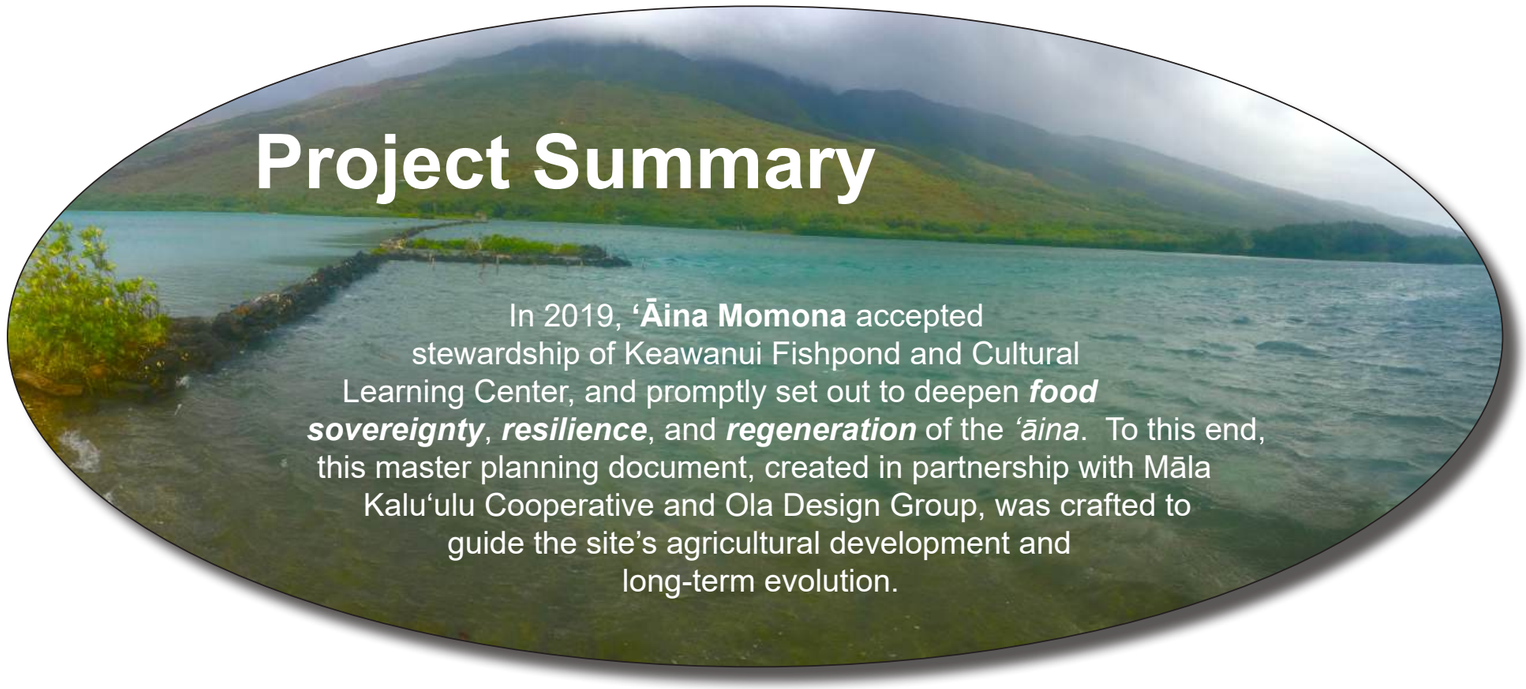
ʻĀINA MOMONA

He’e mahola
was envisioned as
the unifying theme for the
design and implementation of
strategy at Keawanui. The *he‘e* as
Kanaloa acknowledges Anakala Walter
Ritte’s central role and activism roots
at Kaho‘olawe. The unfurling tentacle is
reminiscent of the emerging *kupukupu* ferns,
indicating new growth and restoration surging
forth. The *he‘e mahola* refers specifically to the
octopus when used in healing sickness, causing
the ailment to flee (*he‘e*) and disperse (*mahola*).
The many armed *he‘e* moves quickly across
land and water to accomplish many tasks,
and like the *alahe‘e* can rapidly spread out
to encompass great areas. The history and
vision of Keawanui, grounded in *aloha
‘āina*, seeks the spreading healing of
the *he‘e mahola* for our land and
our people.

‘Āina Momona: Agricultural Master Plan

Keawanui Fishpond & Cultural Learning Center

Ka‘amola, Moloka‘i, Hawai‘i



Project Summary

In 2019, **‘Āina Momona** accepted stewardship of Keawanui Fishpond and Cultural Learning Center, and promptly set out to deepen ***food sovereignty***, ***resilience***, and ***regeneration*** of the *‘āina*. To this end, this master planning document, created in partnership with Māla Kalu‘ulu Cooperative and Ola Design Group, was crafted to guide the site’s agricultural development and long-term evolution.

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Land Planning Team:

Māla Kalu‘ulu Cooperative

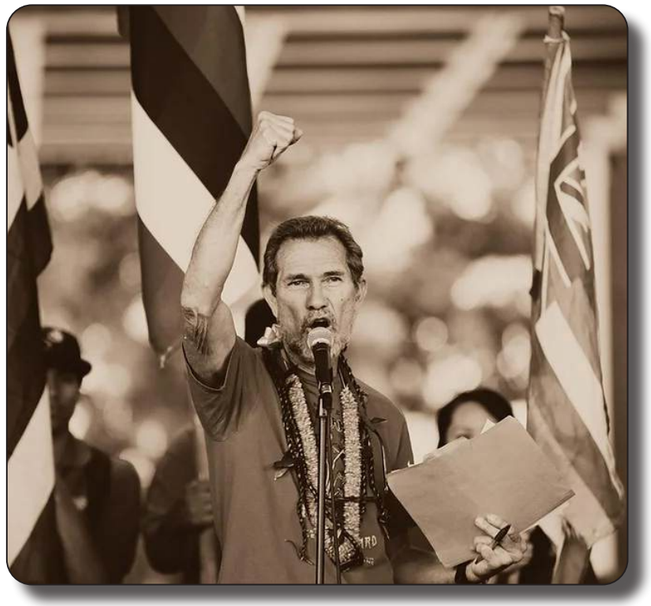
Ola Design Group

Additional design assistance from Mr Rico Zook, of **Itinerant Permaculture.**

‘ĀINA MOMONA

Organizational Overview

‘Āina Momona is a 501(c)(3) non-profit organization founded and directed by Anakala Walter Ritte, a prominent Native Hawaiian activist and one of the Kahoʻolawe Nine of 1976. The organization's land base is located at **Keawanui Fishpond and Cultural Learning Center**, in the Kaʻamola *ahupuaʻa* (land section), on the island of Moloka'i.



Keawanui Fishpond

‘Āina Momona has evolved in recent years to integrate the efforts of *Hui o Kuapā,* a Molokaʻi based non-profit organization whose principal focus for the past three decades has been resurrecting the *loko iʻa* (fishponds) of Hawaiʻi — beginning with Keawanui, a *loko kuapā* (closed wall fishpond). in order to educate the local and global *lāhui* on cultural practices that could be utilized for *ʻāina* stewardship and food sovereignty. Through decades of research, the organization became a respected leader in fishpond agroecology, empowering communities across Hawaiʻi with the knowledge of this ingenious indigenous technology.

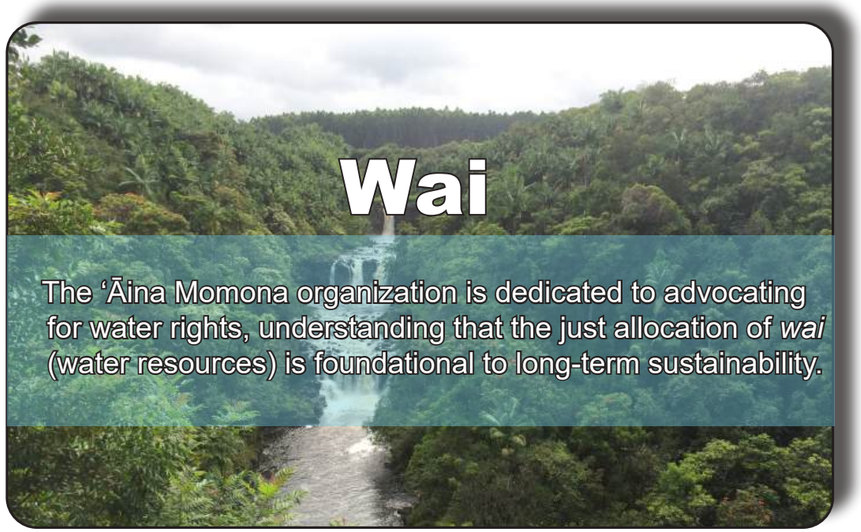
Like their founder, the ‘Āina Momona organization is dedicated to advocating for the rights, sovereignty, and social and physical well-being of the Native Hawaiian people through *ʻāina* minded activism and by educating communities in vital cultural values and practices.

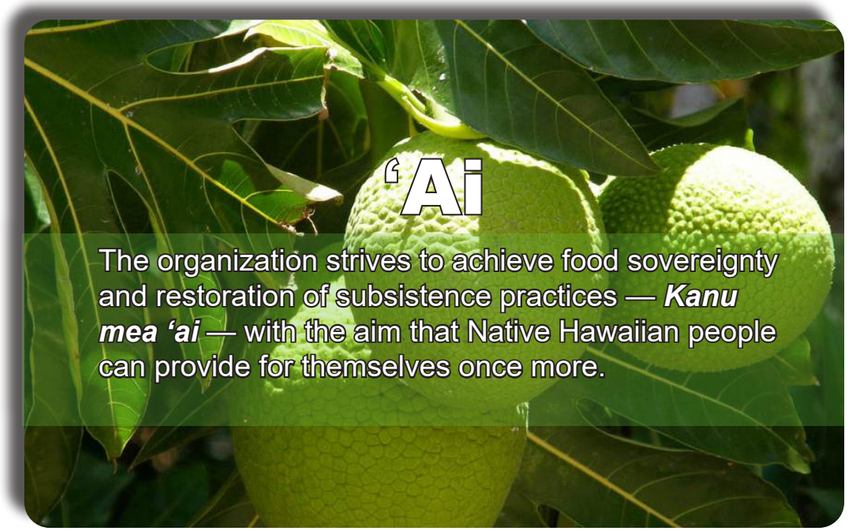
‘Āina Momona is led by a board of Native Hawaiian Ph.D.'s, and supported by a dedicated staff, all of whom are passionate about grassroots strategies for wider systemic change across Hawaiʻi and beyond.

Organizational Overview

Program Areas

‘Āina Momona strives to **restore fragile ecosystems**, **promote cultural rights and practices**, **enhance the well-being of Hawai‘i communities,** and **advocate for native rights and social justice**. The organization achieves this through **four areas of focus**.





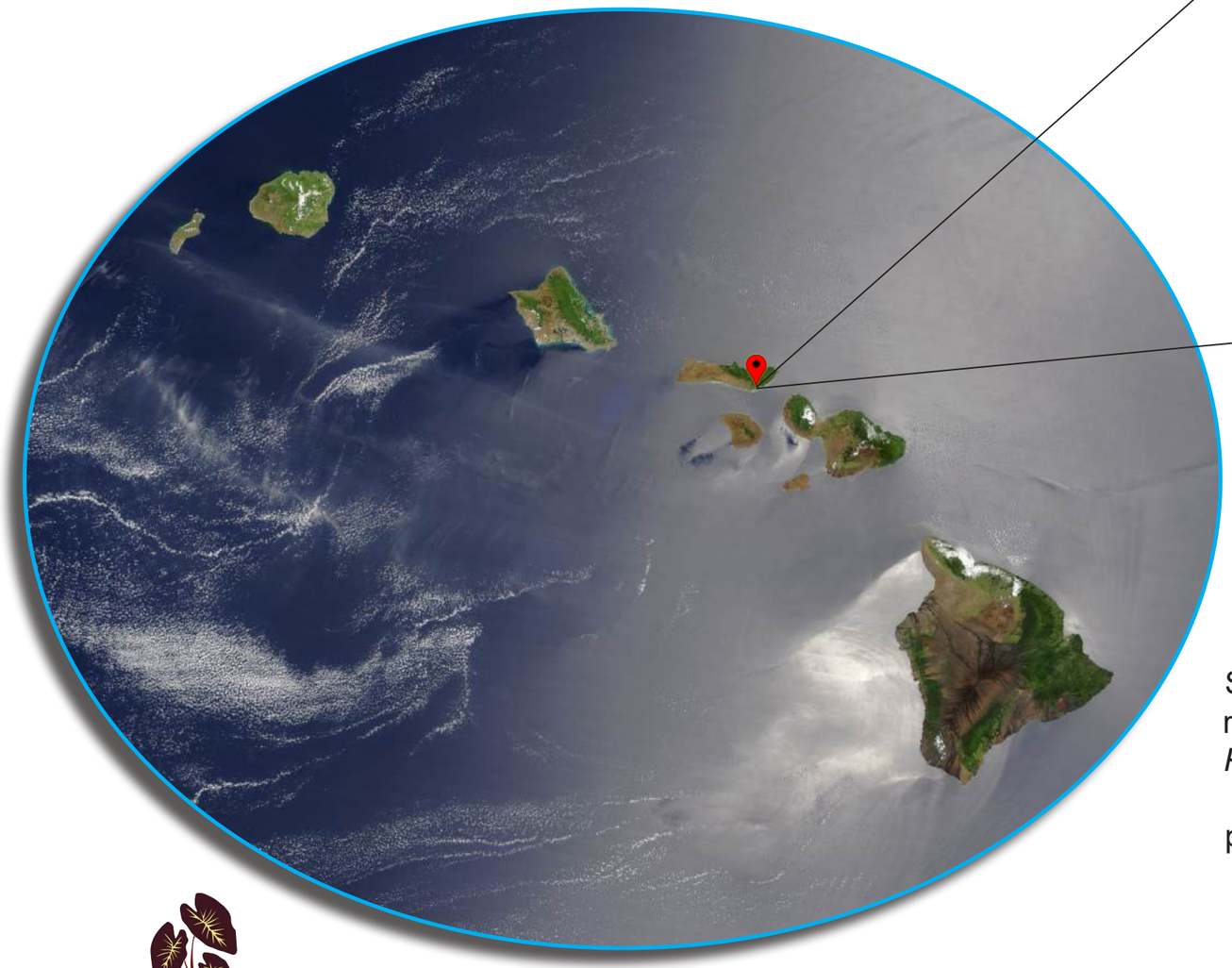
Master Plan Goals Summary

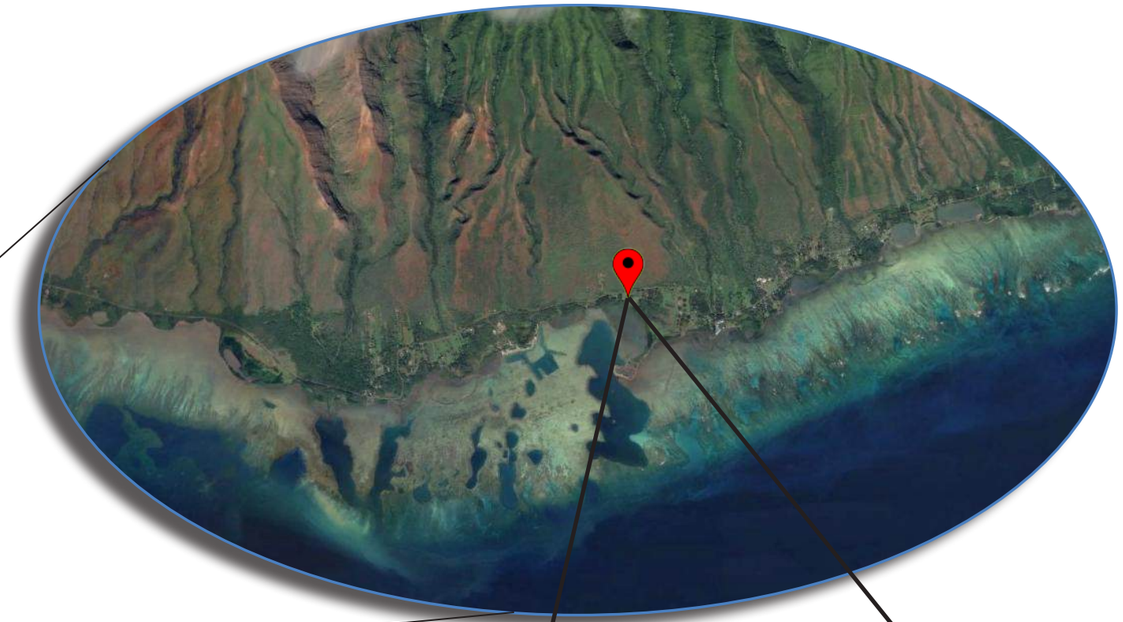
ʻĀina Momona's land base,
Keawanui Fishpond & Cultural Learning Center, is
renowned for its *onipaʻa* – a steadfast effort for island resilience and
ʻāina regeneration. As a grassroots, community-based organization engaging
in land management to create *ʻāina momona* for human and environmental health,
our activities are informed by ancestral ecological knowledge and Hawaiian cultural values,
blended with modern science.

We aim to be a *kumu* – a strong foundation of knowledge and action from which the revitalization of our people and *ʻāina* may grow. We envision that Keawanui serves as a springboard for restoring the wider *Kaʻamola ahupuaʻa* to demonstrate the abundance and resilience of *mauka* to *makai* land management, while educating and inspiring others to work towards our rights to self-determination and goal of sustainability.

Combining indigenous restoration practices with cutting edge regenerative strategies, this agricultural plan integrates food and resource production and processing, native habitat zones, and educational and social gathering spaces. The design expresses the unique essence of the *Kaʻamola ahupuaʻa*, which guides the site's adaptations to a rapidly changing world.

Regional Context





Keawanui Fishpond & Cultural Learning Center is situated on Moloka‘i‘s leeward South Shore, within the Kamalo fringing reef — the longest such reef in the *Pae ‘Āina (*Hawaiian archipelago) — amidst a necklace of 60+ other pre-contact Hawaiian fishponds. The islands of Lana‘i and Maui reside to the southwest and southeast, respectively The northeast tradewinds are channeled between the East Moloka‘i mountains and the West Maui mountains, causing strong easterly winds across the region.

Ecological + Social Context

Geological History
(1.5 to 1.3 million years ago)

East Moloka‘i Volcanics
Consisting of Ho‘olehua silty clay – well drained with high runoff potential – the site adjacent to Keawanui Fishpond is primarily alluvium material deposited atop old bedrock and coral beds. There is moderately high subterranean groundwater flow through coral caves.

Native Vegetation Establishment

Over the subsequent millions of years, indigenous & endemic plants colonized the landscape, resulting in a lowland dry forest and shrub ecosystem, exemplified by **coastal sandalwood** *(S. ellipticum)*, ***naio*** *(M. sandwicense)*, ***olopua*** *(N. sandwicensis)*, ***alahe‘e*** *(P. odorata)*, ***ho‘awa*** *(P. sp.)*, ***lama*** *(D. sandwicensis)*, ***‘ōhi‘a*** *(M. polymorpha)*, and ***wiliwili*** *(E. sandwicensis)*, ***kulu‘i*** *(N. sandwicense)*, and ***‘ākia*** *(W. oahuensis)*.

Arrival of First Polynesians in Hawai‘i
(circa 1000 C.E.)

Human arrival was accompanied by the introduction of new plant and animal species, the clearing of lowland forests for agriculture and settlement, and other alterations of the native habitat.

Keawanui Fishpond Construction
(circa 1200 C.E.)

One of more than 60 pre-contact *loko i‘a* (traditional fishponds) along Moloka‘i's South Shore, the 55-acre *loko i‘a* of Keawanui was believed to produce more than 400 pounds of fish per acre annually.

Ecological + Social Context

Arrival of First Europeans in Hawai‘i
(1778 C.E.)

Arrival of Europeans caused significant decline of Native Hawaiian population and upending of social structures as well as ecosystem management practices.

Introduction of Ungulates to Moloka‘i
(mid-1800‘s)

Unfettered expansion of cattle ranching through the 19th and 20th century resulted in substantial loss of native plants and expansion of invasive plants, increased sediment runoff and deposition in the nearshore environment.

Establishment of Bernice Pauahi Bishop’s Trust
(1884)

The last direct descendent of the Kamehameha lineage passes away, placing her considerable land holdings, including *Ka’amola ahupua‘a*, into an education trust, contemporarily referred to as **Kamehameha Schools**.

Founding of Hui o Kuapā
(1989)

Moloka‘i based non-profit championing Native Hawaiian fishpond aquaculture, through restoration, education, & research.

Stewardship of Keawanui area transferred to ‘Aina Momona
(2019)

The 501(c)(3) assumes the short-term lease to Keawanui and the surrounding lands owned by Kamehameha Schools.

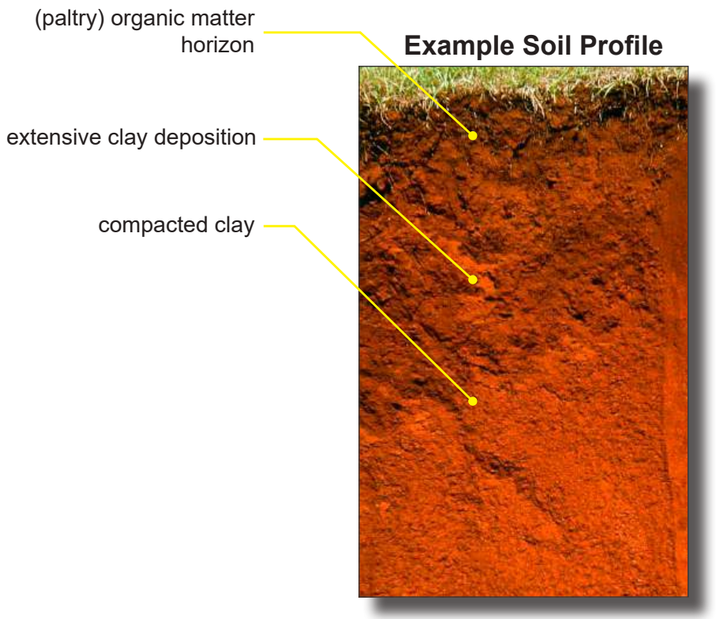
Moloka‘i is often referred to as the “last Hawaiian island,” being the most rural and having the highest percentage of Native Hawaiians of the populous islands. Many residents still practice subsistence lifestyles and a barter economy. The tightly-knit community desires to be sustainable and part of the global economy.

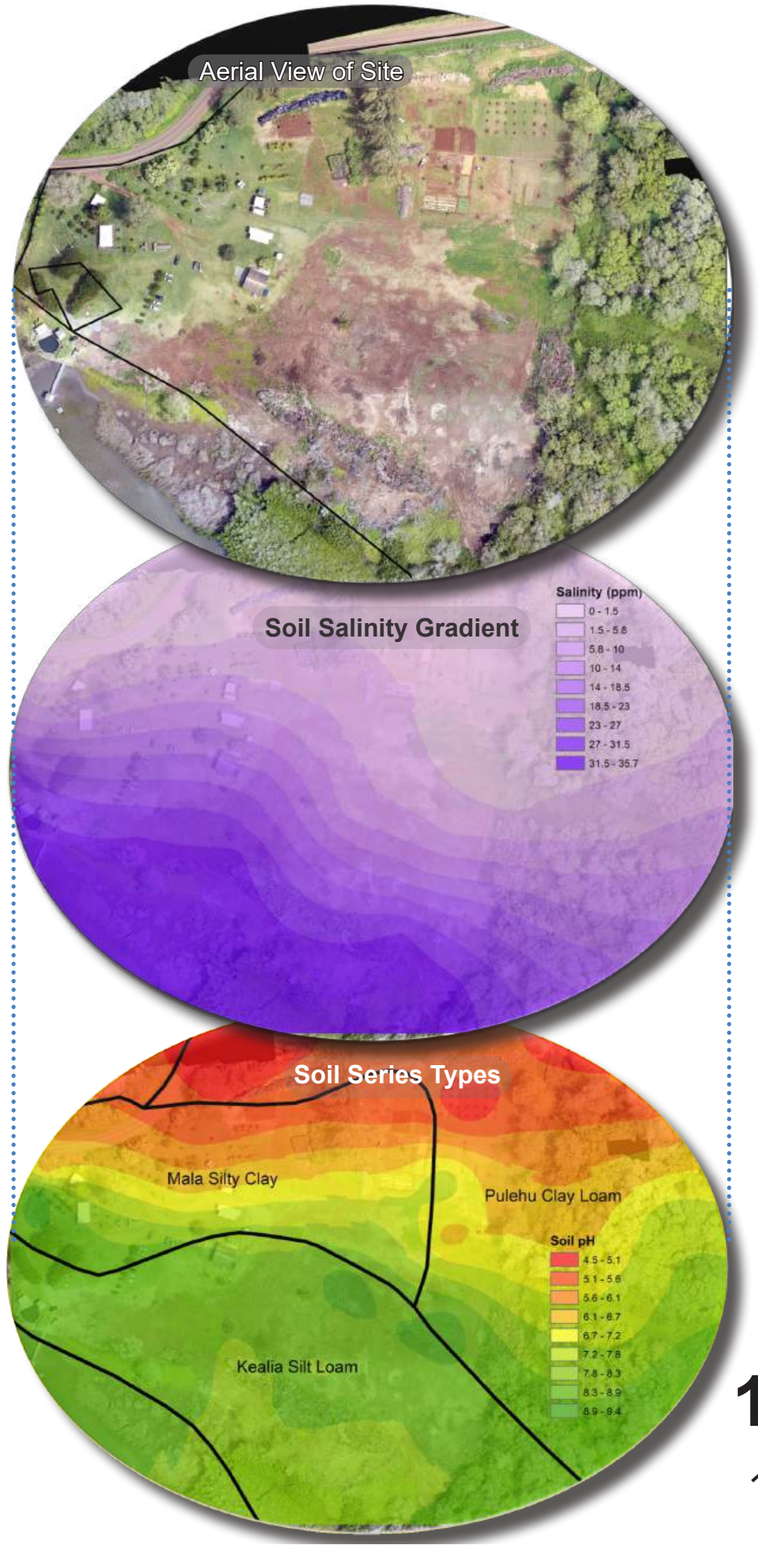
The parcel’s *makai* areas (i.e., lower elevations) are now blanketed by thick growth of wild basil *(O. gratissimum)*, mixed lantana *(L. camara)*, and salt bush (*A. canescens*) beneath an overstory of kiawe *(P. pallida)* and koa haole *(L. leucocephala)*. The coastal edge environments are dominated by *‘ākulikuli (S. portulacastrum)* where land is inundated, and mangrove *(R. mangle)* in the shallow ocean.

Site Analysis: Soils

At Keawanui, sampling was conducted throughout the property to assess soil resources. Being dominantly alluvium deposits from the uplands, the site's soils are best thought of in two classes:

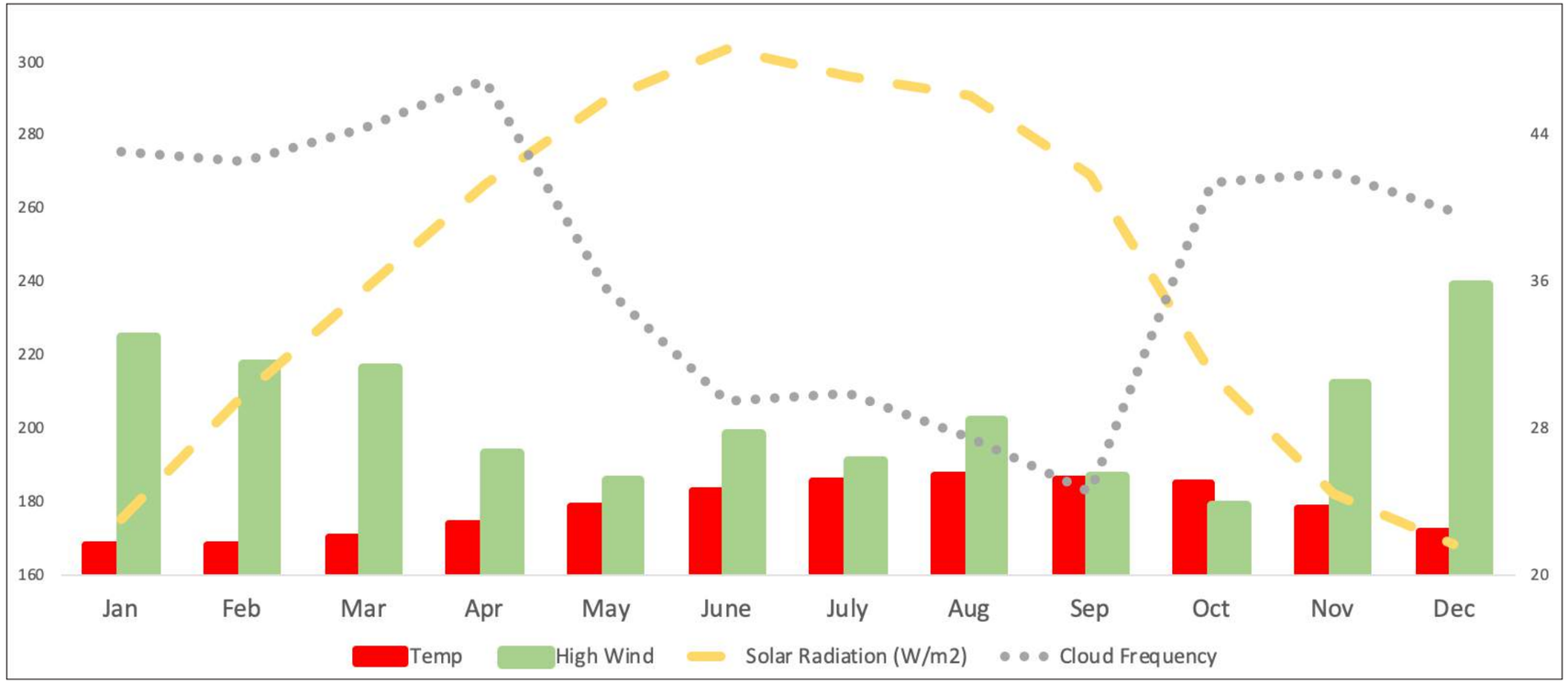
- Mauka of the access road are well drained **Pulehu clay loams** atop basalt. However, here the soils become quite acidic which can reduce the availability of nutrients and create difficult conditions for many crops. Fortunately, **these soils are well drained and will respond well to management** — in particular, to increased organic material to raise pH and nutrient holding capacity.
- Below the access road, **Kealia silt loams** sit atop buried coral limestone. These poorly drained soils are subject to salt water intrusion, and are highly alkaline due to salt content. Anaerobic conditions persist not far below the surface, with **a strong salinity gradient** from nearly pure seawater to ~25% seawater near the center of the property. Crops in this area will need exceptional salt tolerance as well as the ability to have “wet feet." **Once there is slope, however, the salinity challenges vanish.**

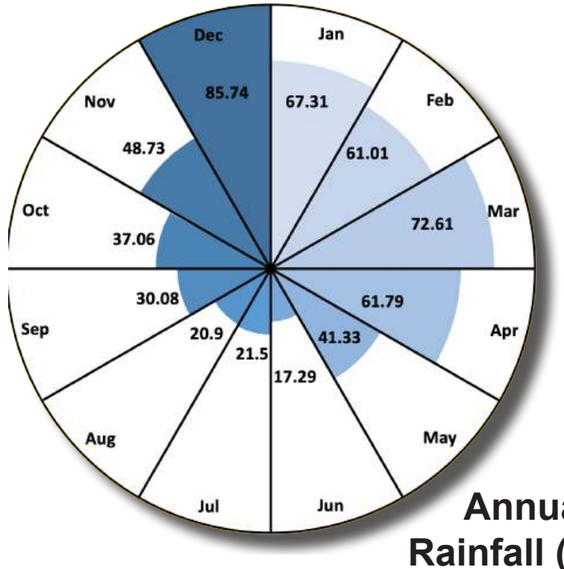




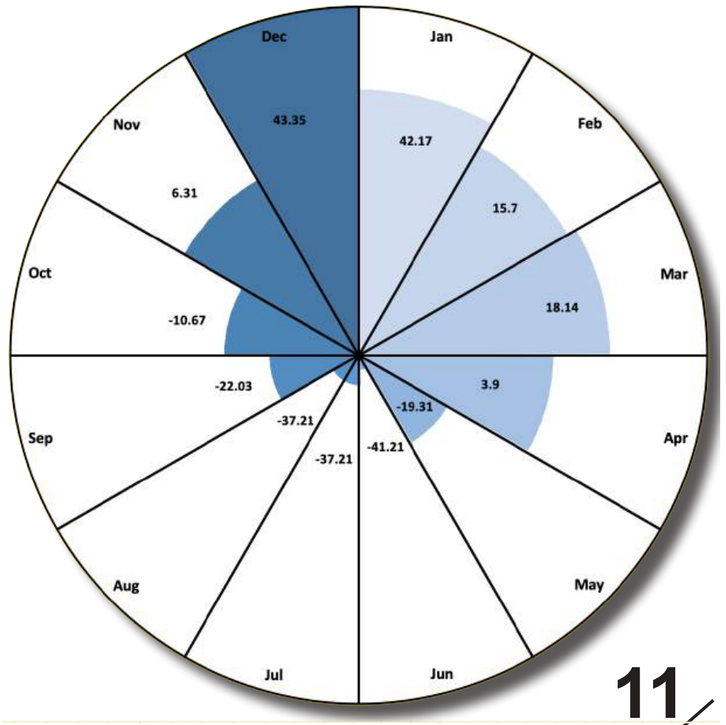
Site Analysis: Weather & Climate

This plan considers the seasonal weather patterns in the implementation and management of sustainable agriculture. Annual weather patterns at Keawanui follow the general patterns of windward locations in Hawai‘i, with **drier summers and wetter winters**. The rainy season starts in November and concludes by April.





Annual Rainfall (mm)



Water Balance (mm)

Seasonal differences in rainfall are amplified by increased temperatures and radiation in the summer, leading to **negative water balance** in May through October each year.

These site specific dynamics deeply informed this **agricultural plan** for ‘Āina Momona.

Site Analysis: Legal Stipulations

The 59.61 acre parcel is owned by Kamehameha Schools, **zoned for agricultural use** by the State of Hawai‘i (§205-4.5, HRS), County of Maui (19.30A), Moloka‘i Community Plan (Exhibit A, below), and located within a Special Management Area (MC-12, Ch. 302). A third party holds a long-term lease on the eastern portion, while ‘Aina Momona operates on an annual, renewable MOA (Memorandum of Understanding) for the western portion. The center of the property is currently fallow and the boundary of the two tenants remains ambiguous. Relevant permitted activities include agriculture, agricultural education, and buildings supporting these activities. The SMA requires a 150' shoreline setback and a use permit for all activities. Also, any buildings and other development within the FEMA flood hazard zone (which extends across much of the project site) will require a permit.

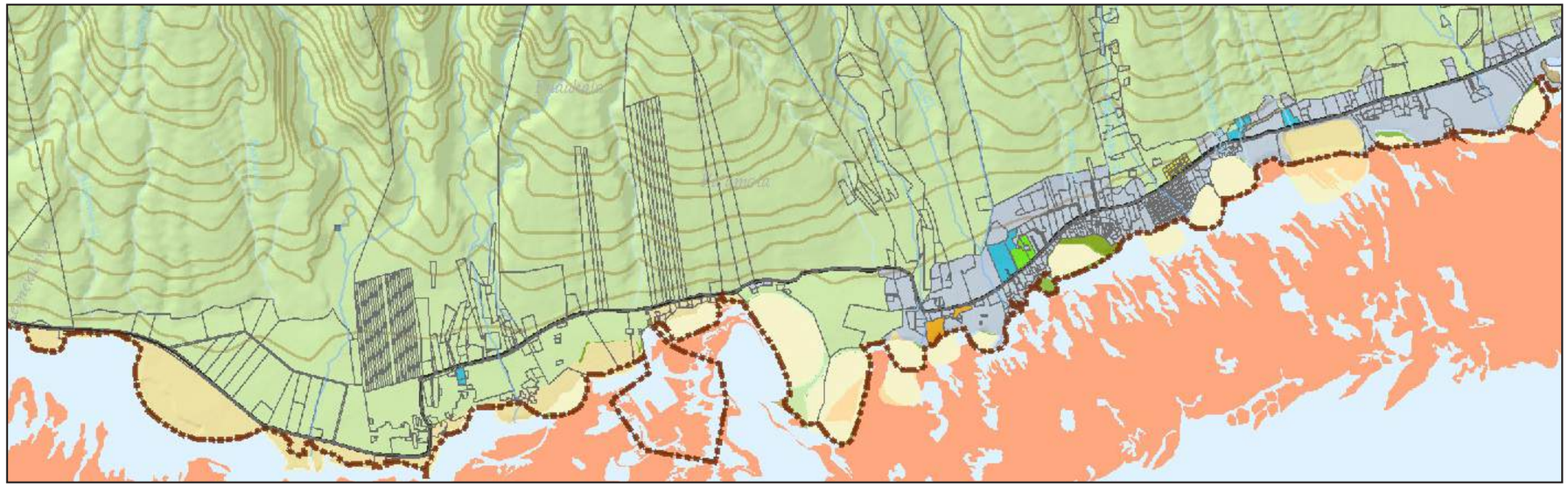
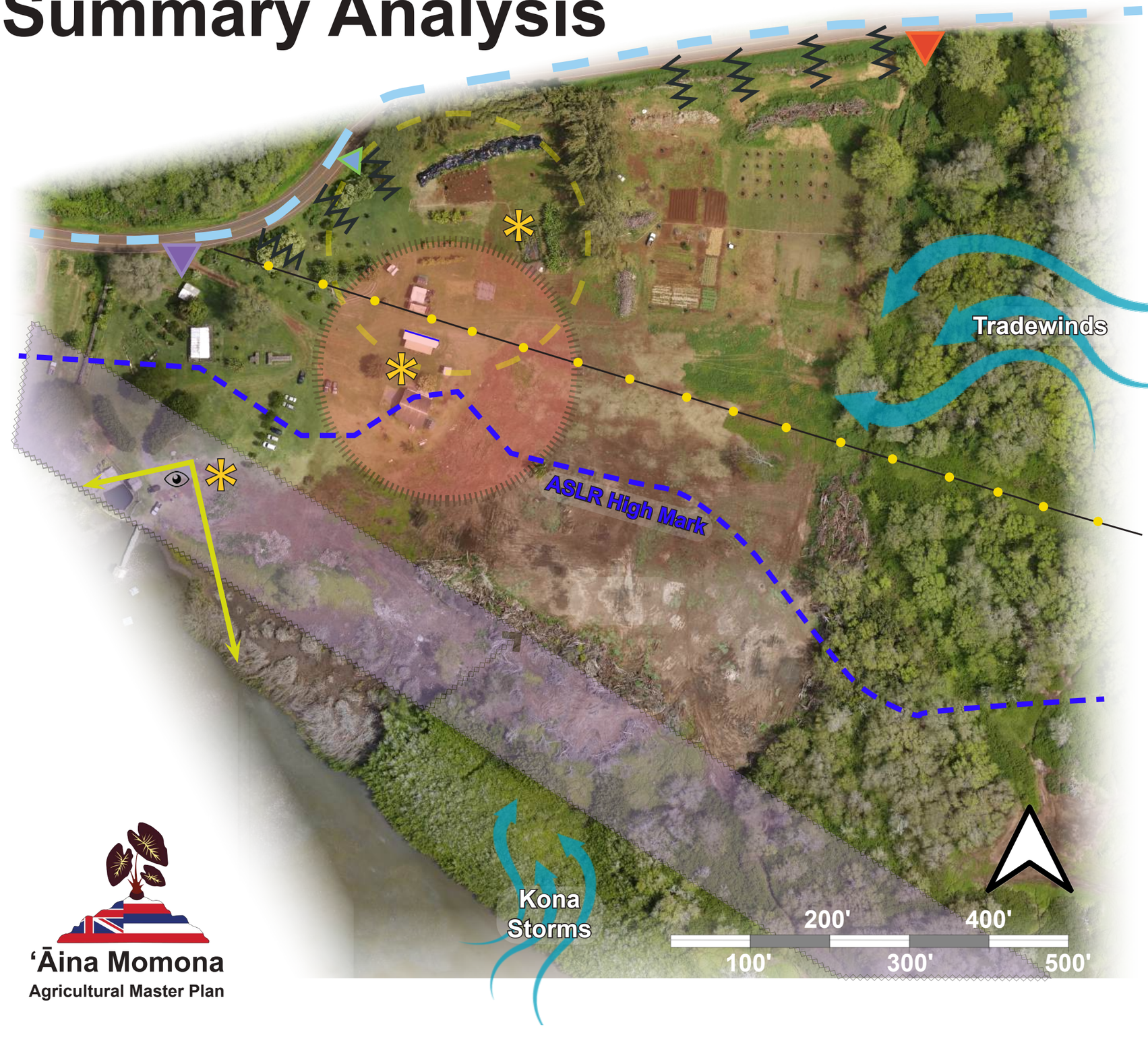


Exhibit A: GIS Map of Moloka‘i's South Shore (Source: 2018 Moloka‘i Community Plan)

Summary Analysis

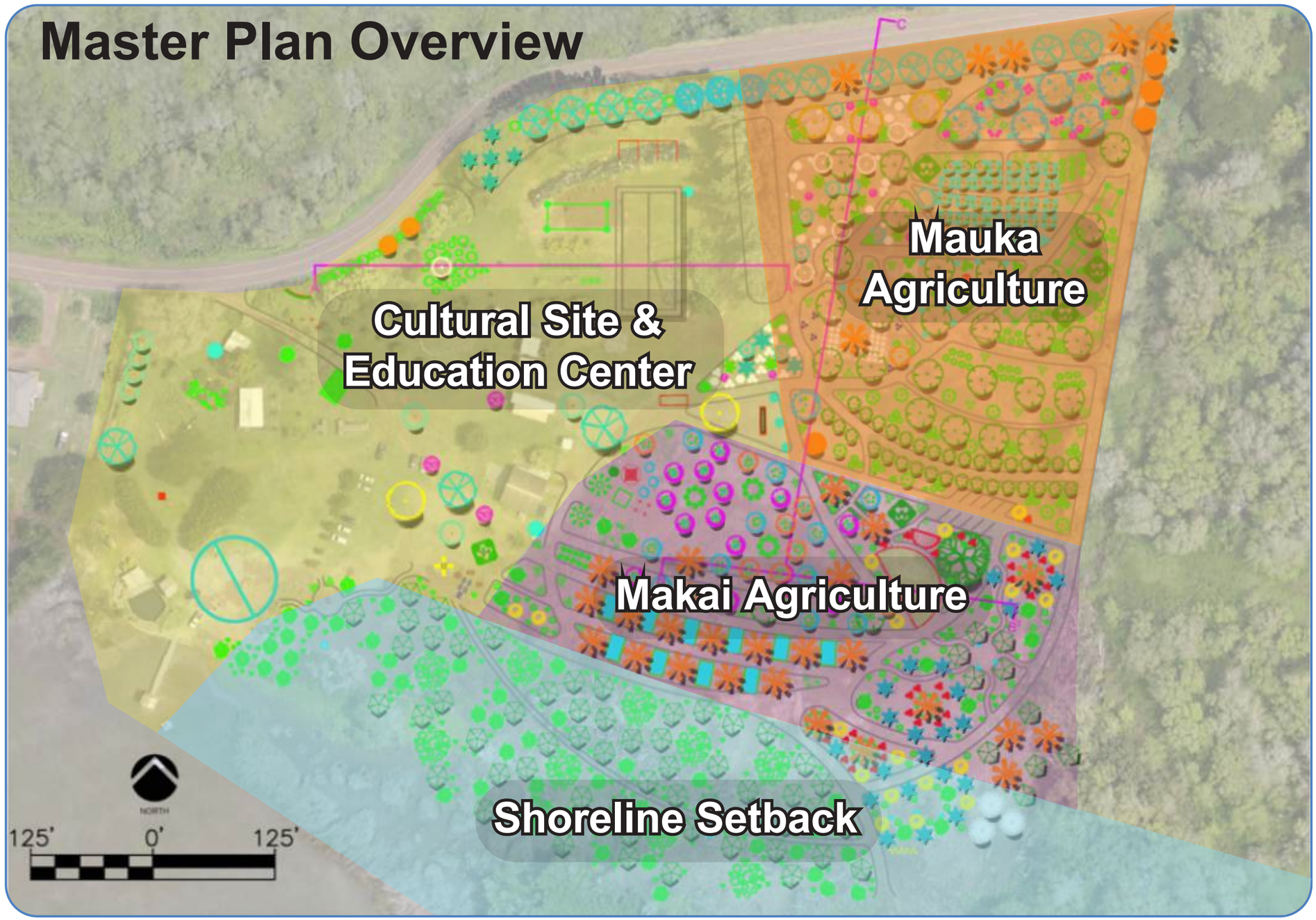


LEGEND

- Kamehameha V Highway
- Powerlines
- Views to Maintain
- Views to Screen
  For aesthetics and security of operations.
- Cultural Learning Center Entry
- Farm Entry
- Secondary Entrance
  Discreet secondary entrance from Kamehameha V Highway.
- Activity Nodes
- ASLR (Anthropogenic Sea Level Rise) High Mark
- Shoreline Setback (150')
- *Lua* (Toilet) Food Safety Setback (200')
- Food Safety Setback from Incinerating Toilet (200')

‘Āina Momona
Agricultural Master Plan

Master Plan Overview



Infrastructure & Material Flows

This diagram illustrates the integrated, closed loop systems within this farm design.

Compost System

200' BUFFER (incinerating toilet)

200' BUFFER (toilet)

Finished Compost

Agricultural Products

Wash Pack Station

Food Safe Crops

Food Safe Crops

Agricultural Products

Value-Added Foodstuffs

Marketable Farm Goods

Storage & Distribution Area

(FOR FARM FOOD SAFETY)

Value Added Food Processing Systems

Solar Dehydrator

Imu

Smokehouse

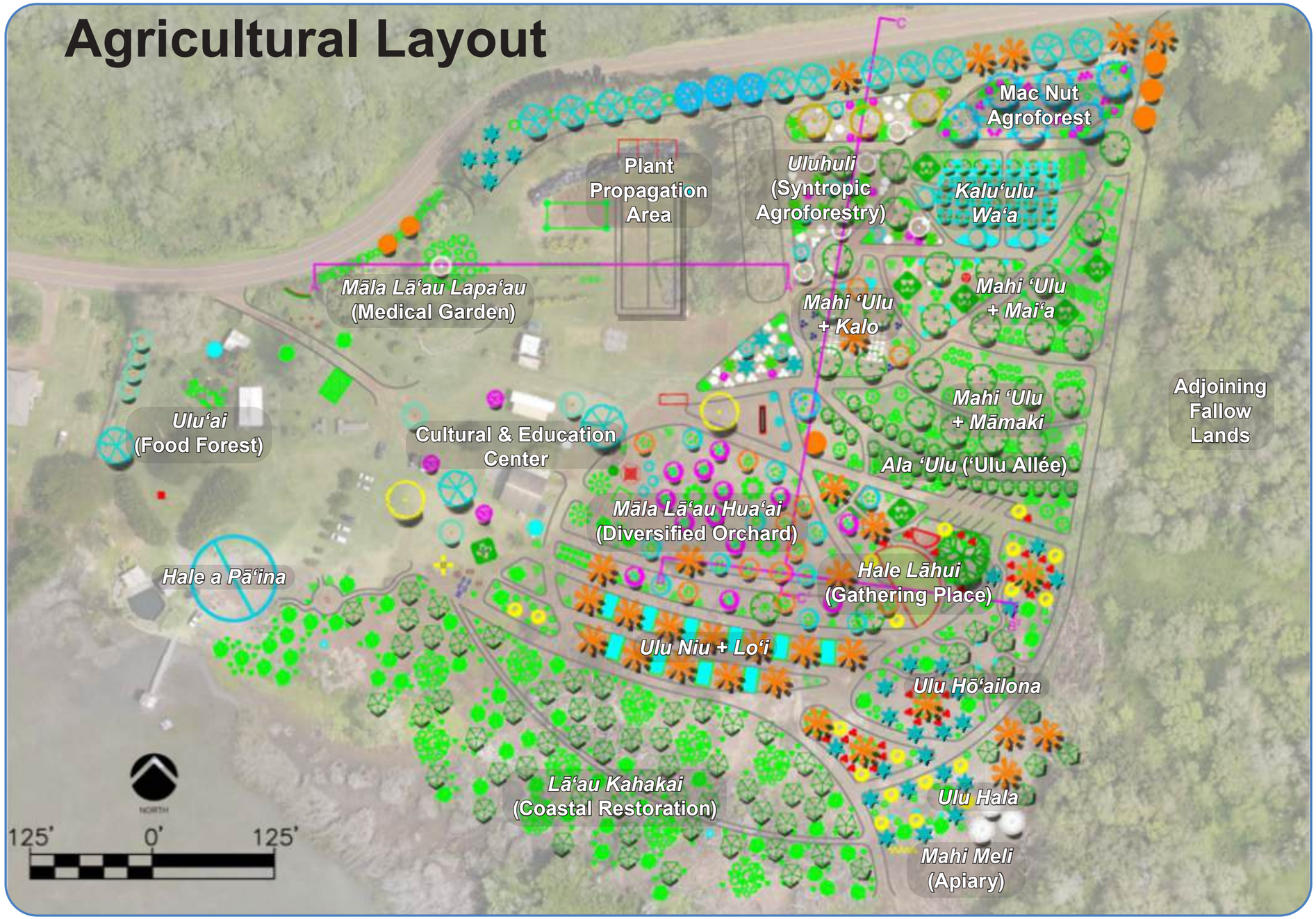
Salt Pans

Anaerobic Digestor

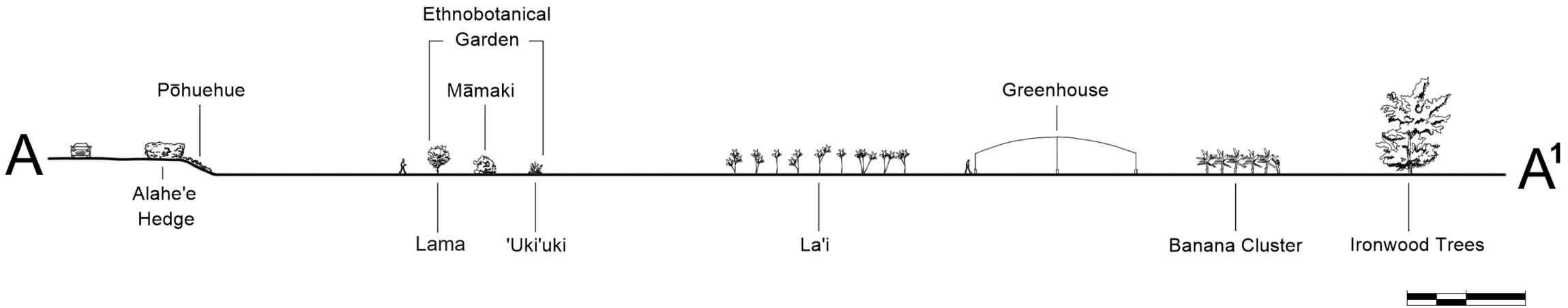
NORTH

125' 0' 125'

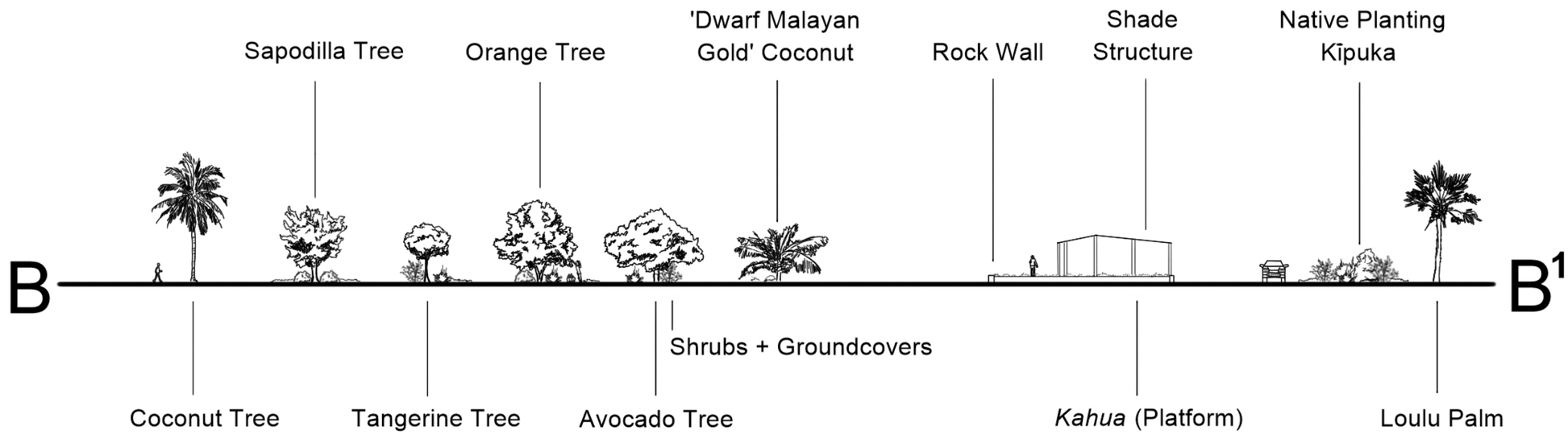
Agricultural Layout



Cross Section A: Medical Garden + Greenhouse

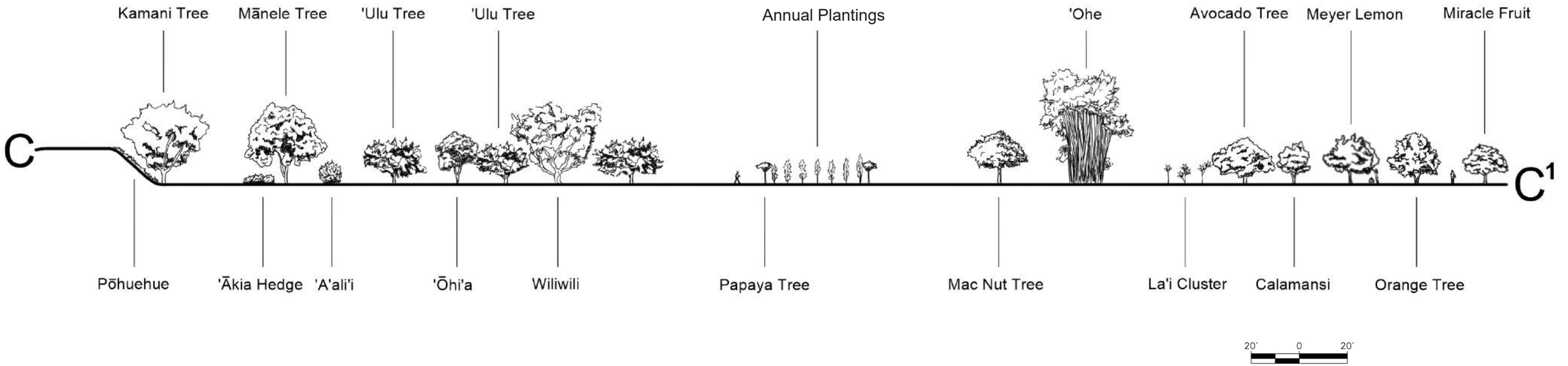


Cross Section B: Diversified Orchard + *Kahua* (Platform)



20' 0 20'

Cross Section C: Diversified Orchard + Native Kīpuka



<u>Appropriate Technology Infrastructure</u>: ***Nā Mole Wai*** (Water Resources)

The following technologies seek to maximize the efficiency and self-reliance of water resources on the Keawanui site.

Rainwater Catchment + Storage

- A useful, redundant source of potable water
- Water can be safely stored far into the future
- Decreases dependence on public water supply

Shallow Well (& Pump)

- Inexpensive construction costs
- Ease of maintenance
- On-demand water supply
- An additional, redundant water source
- Decreases dependence on public water supply
- Must acquire appropriate permitting from Maui Board of Water Supply

<u>Appropriate Technology Infrastructure</u>: ***Ka Malu o ka ʻAi Mahi*** (Farm Food Safety)

These technologies are essential for appropriate food related sanitation and managing potential food born illnesses.

Ka Hale Hoʻomākaukau Meaʻai
(Wash Pack Station)

- Essential for ensuring appropriate food safety and reduction of food born illnesses
- Removes soil and other sources of contamination from food.
- Streamlined process of cleaning, packaging, and storing produce.
- Assists in achieving GHP and GAP (Good Agricultural Practices) certification.

Ka Hale Hoʻāhu Meaʻai
(Farm Food Storage)

- Can be simple or complex
- May include refrigeration
- Essential for ensuring safe storage of food away from pests and other contaminants

Appropriate Tech. Infrastructure: ***Ka Hana Mea‘ai Hawai‘i Kahiko*** (Traditional Haw'n Food Processing)

These technologies are essential for traditional methods of food preparation.

Ka Hale Imu (Underground Oven)

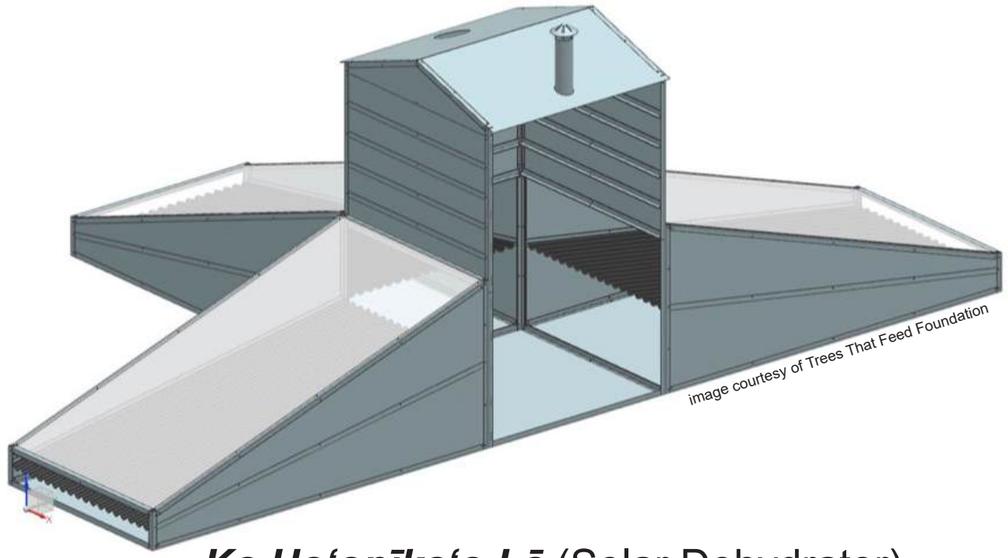
- Facilitates food focused cultural practices
- Temporary installation that can easily be relocated
- Can be incorporated into agriculture soils as biochar

Nā Kāheka Lā (Solar Salt Pans)

- Passive creation of high quality *pa‘akai* (salt), through the solar evaporation of seawater
- Multipurpose preservative
- Product works with other suggested technologies (smoker, dehydrator)
- Potential for high export value
- Works with other products from site (fish, meat, dried fruit)
- Can be coupled with collection of potable or irrigation water

Appropriate Tech. Infrastructure: ***Ka Hana Meaʻai Hoʻokāʻoi*** (Value Added Food Processing)

The following technologies are efficient means to engage in food preservation in food safe ways.



Ka Hoʻopīkaʻo Lā (Solar Dehydrator)

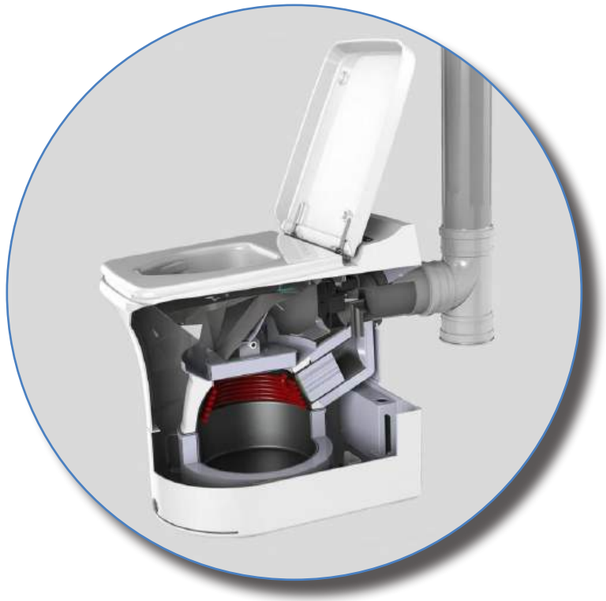
- Yields long-term food storage
- Inexpensive assembly and maintenance
- Economic benefit for consumption of out-of-season fruits and vegetables
- Extensive list of foods that can be dried

Ka Hale Uahi (Smoke House)

- Simple technology for food preservation and value addition
- Leverages exotic mesquite (kiawe) resources
- Compatible with a wide range of foodstuffs (e.g., salt, fish, meat)

<u>Appropriate Technology Infrastructure</u>: **Nā Kumu Meaola** (Biological Resources)

The following technologies will transform biological by-products often thought of as "waste", into usable, nutrient rich resources for on-farm use.



Lua‘ā (Incinerating Toilet)

- Eliminates need for water supply and a drainage connection
- Requires minimal space
- Eliminates waste handling and odors
- Eliminates use of potentially harmful chemicals

Ka Ho‘owali Pelapela (Methane Biodigester)

- Converts pre-existing "waste" into a valuable energy resource
- Reduces reliance on public waste disposal methods
- Small scale design minimizes visual and odor issues
- Reduces greenhouse gas emissions
- Substantially decreases harmful pathogens
- Improves on-farm nutrient cycling

<u>Appropriate Technology Infrastructure</u>: ***Hale*** (Buildings)

The following are essential farm buildings to ensure safety and efficiency of the working agricultural environment.

Ka Hale Hoʻāhu (Small Equipment Shed)

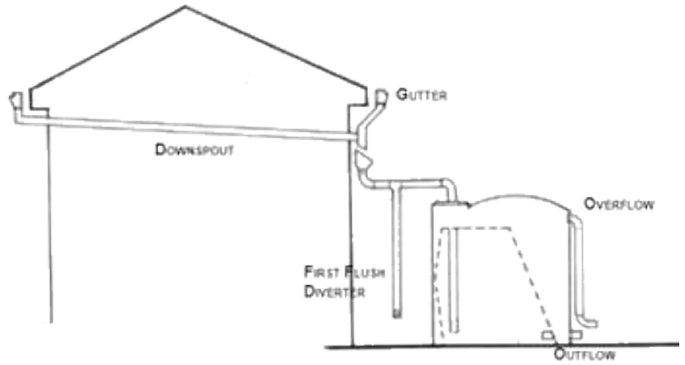
- Assists in appropriate management for achieving GHP (Good Handling Practices) and GAP (Good Agricultural Practices) certifications.

Wahi Pāʻina (Gathering & Educational Areas)

- Important for farm worker health and safety
- Incorporates educational opportunities
- Locations to display essential information and house safety equipment

Design Details: *Ke Kahua Ki'i Wai Lani* (Rainwater Catchment Systems)

Design Detail A:
Rainwater Catchment Schematic



A rooftop catchment apparatus should include a diversion pipe to send off the first flush of rainwater from the roof, which may contain high concentrations of sediment and animal waste.

Design Details: *Ka Hale Hoʻokipa* (Place of Welcoming)

Basis of Design

The ***Ka Hale Hoʻokipa*** space is shaped to pay homage to the iconic Keawanui Fishpond. The selected stones will be set in the ground in the shape of a circle with a line of stones dividing it through the center.

- A The **eastern semi-circle** represents the sustenance-providing ***loko kuapā*** **(closed wall fishpond)**.
- B The **central rock line** is symbolic of the **rock wall** constructed centuries ago that is essential to the functionality of the fishpond.
- C The **western semi-circle** represents the **great ocean** beyond the pond's wall.

In line with this concept, the inset patterns will be constructed with stones of distinct colors that outline the shape of the ***Ka Hale Hoʻokipa*** space. *See* ***Design Detail B****.*

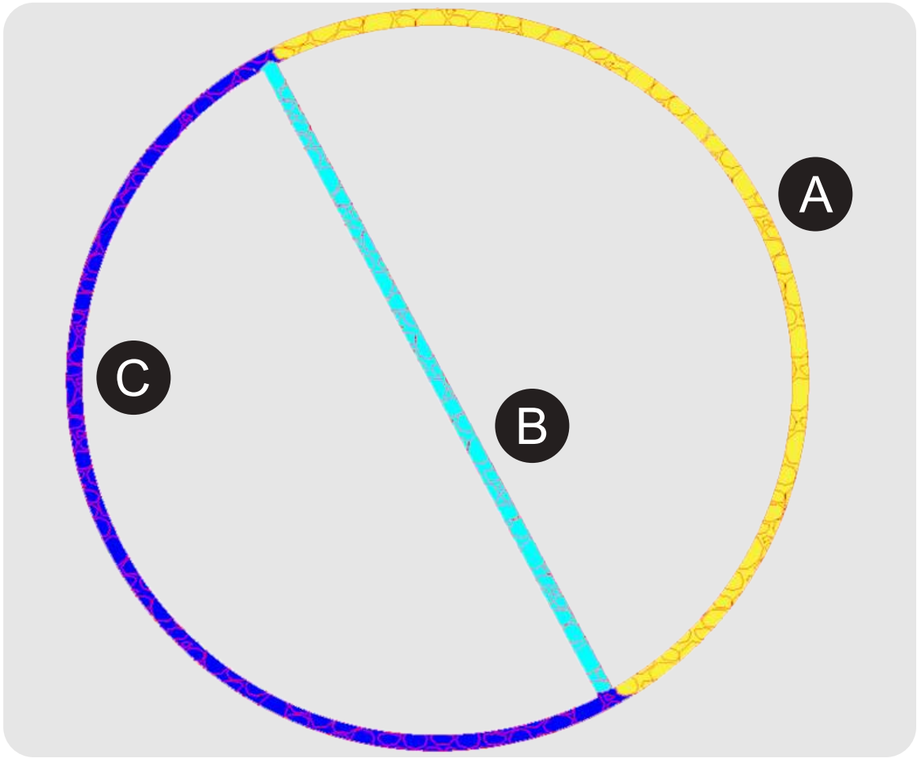
Example of Inset Rocks

Rock Types

Eastern Semi-Circle: Coral

Western Semi-Circle: Dark Blue Rock

Center Rock Line: Blue Rock



Design Detail B (Aerial View)

Design in Context

Existing *Ulu‘ai* (Food Forest)

Scientific Name	Common Name	Cultivar	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Shrubs						
Abelmoschus manihot	Edible hibiscus		Mounding	6’ x 3’	Medium	Full Sun
Alpinia galanga	Galangal		Clumping	6’ x 3’	Medium	Full Sun - Part. Shade
Cajanus cajan	Pigeon pea		Upright	3’ x 3’	Low/Medium	Full Sun
Cnidoscolus chayamansa	Chaya		Non-Woody/Upright	6’ x 3’	Medium	Full Sun
Hibiscus acetosella	Cranberry hibiscus		Upward Branching	5‘ x 3’	Medium	Full Sun - Part. Shade
Manihot esculenta	Cassava		Compact/Upright	4’ x 4’	Low	Full Sun - Part. Shade
Moringa oleifera	Moringa		Narrow	10’ x 15’	Low	Full Sun
Opuntia spp.	Spineless Nopale Cactus		Uright/Wide Branching Pads	5’ x 5’	Low	Full Sun
Papaya carica	Papaya	Shorter Mexican Cultivar	Upright/Semi-Fountain	6’ x 3’	Medium	Full Sun
Sauropus androgynus	Katuk		Clumping	5’ x 5’	Medium/High	Part. Shade
Ground covers						
Basella alba	Malabar spinach		Spreading / Climbing	1’ x 3’	Medium/High	Full Sun
Gynura crepioides	Okinawan spinach		Spreading	1’ x 3’	Low/Medium	Full Sun - Part. Shade
Ipomoea batatas	*‘Uala* / Sweet Potato		Spreading / Climbing	0.5’ x 6’	Low/Medium	Part. Sun
Tetragonia tetragonioides	New Zealand spinach		Spreading	1’ x 6’	Low	Full Sun
Tropaeolum majus	Nasturtium		Spreading / Climbing	1’ x 3’	Low	Full


Cranberry Hibiscus

Plant Palette


‘Uala / Sweet Potato

Expanded Medical Garden
(Mala Lā‘au Lapa‘au)


Ko‘oko‘olau


Noni

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Dye Plants					
Dianella sandwicensis	*‘Uki‘uki*	Non-Woody / Spread‘g	2’ x 3’	Medium	Full Sun
Curcuma longa	*‘Olena*	Clumping	3’ x 6’	Medium	Part. Sun
Hibiscus clayi	*Koki‘o ula*	Woody / Massing	4’ x 4’	Low	Full Sun
Fiber Plants					
Gossypium tomentosum	*Ma‘o*	Woody / Massing	3’ x 7’	Low	Full / Part. Sun
Heteropogon contortus	*Pili Grass*	Clumping	2’ x 4’	Low	Full Sun
Ipomoea cairica	*Koali'ai*	Vining	1’ x 20’	Low	Full Sun
La‘au Lapa‘au					
Cordia subcordata	*Kou*	Oval / Round	15’ x 20’	Low	Full Sun
Morinda citrifolia	*Noni*	Round / Oval	6’ x 6’	Low	Full Sun
Pipturus albidius	*Māmaki*	Highly Variable	5’ x 5’	Low	Part. Sun

Uluhuli (Syntropic Agroforestry)

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Artocarpus altilis	‘Ulu / Breadfruit	Oval / Rounded	15’ x 15’	Medium	Full / Partial Sun
Musa spp.	*Mai‘a* / Banana	Upright / Fountain	30’ x 30’	Low	Full Sun
Metrosideros polymorpha	*‘Ōhi‘a*	Spreading Low/High Canopy Oval/Rounded	variable	Low	Full Sun
Gliricidia sepium	Madre de Cacao	Woody / Upright	10’ x 10’	Medium	Partial Sun
Colocasia esculenta	*Kalo* / Taro	Non-woody / Upright	3’ x 3’	Low/Medium	Full / Partial Sun
Crysopogon zizanioides	Vetiver	Upright / Fountain	3’ x 3’	Low/Medium	Full / Partial Sun
Nephrolepis cordifolia	*Kupukupu*	Spreading	2’ X 4’	Medium	Full / Partial Sun

Plant Palette

Mac Nut Agroforest

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Macadamia heterophylla	Mac Nut	Round	20’ x 20’	Medium	Full Sun
Cajanus cajan	Pigeon Pea	Upright	3’ x 3’	Low/Medium	Full Sun
Flemingia macrophylla	Flemingia	Woody	5’ x 5’	Low/Medium	Full Sun - Part. Shade
Wikstroemia uva-ursi	*‘Ākia*	Sprawling	4’ x 5’	Low	Full Sun

Kalu‘ulu Wa‘a (‘Ulu Canoe Grove)

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Banana Circles					
Capsicum annuum	Hawaiian Chili Pepper	Variable	4’ x 2’	Low	Full Sun
Sesbania sesban	Egyptian River Hemp	Woody		Low/Medium	Full Sun
Musa spp.	*Mai‘a* / Banana	Upright/Fountain	10’ x 10’	Low/Medium	Full Sun
Saccharum officinarum	*Kō* / Sugarcane	Upright/Grassy	6’ x 6’	Medium/High	Full Sun
‘Ulu Blocks					
Artocarpus altilis	*‘Ulu* / Breadfruit	Oval/Rounded	15’ x 15’	Medium	Part. Sun / Full Sun
Cajanus cajan	Pigeon Pea	Upright	3’ x 3’	Low/Medium	Full Sun
Flemingia macrophylla	Flemingia	Woody	5’ x 5’	Low/Medium	Full Sun - Part. Shade
Pipturus albidius	*Māmaki*	Highly Variable	5‘ x 5’	Low	Part. Sun
Saccharum officinarum	*Kō*	Clumping / Grassy	6’ x 6’	Medium/High	Full Sun

Plant Palette

‘Ulu + *Kalo* Agroforest

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Artocarpus altiilis	*‘Ulu /* Breadfruit	Oval/Rounded	15‘ x 30‘	Medium	Part. Sun / Full Sun
Citrus nucifera	*Niu /* Coconut	Upright/Fountain	10’ x 30’	Medium	Full Sun
Colocasia esculenta	*Kalo* / Taro	Upright	3’ x 3’		
Flemingia macrophylla	Flemingia	Woody	5’ x 5’	Low/Medium	Full Sun - Part. Shade
Hibiscus acetosella	Cranberry Hibiscus	Upward Branching	5‘ x 3’	Medium	Full Sun - Part. Shade
Saccharum officinarum	*Kō /* Sugarcane	Upright/Grassy	6’ x 6’	Medium/High	Full Sun

‘Ulu + *Mai‘a* Agroforest

Scientific Name	Common Name	Cultivar	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Banana Circles						
Capsicum annuum	Hawaiian Chili Pepper		Variable	4’ x 2’	Low	Full Sun
Sesbania sesban	Egyptian river hemp		Woody		Low/Medium	Full Sun
Musa spp.	*Mai‘a* / Banana	'Manini' / "Ae‘ae'	Upright/Fountain	10’ x 10’	Low/Medium	Full Sun
Saccharum officinarum	*Kō* / Sugarcane		Upright/Grassy	6’ x 6’	Medium/High	Full Sun
Artocarpus altilis	*‘Ulu /* Breadfruit		Oval/Rounded	30‘ x 30‘	Medium	Part. Sun / Full Sun

‘Ulu + *Māmaki* Agroforest

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Artocarpus altilis	‘Ulu / Breadfruit	Oval/Rounded	30‘ x 30‘	Medium	Part. Sun / Full Sun
Pipturus albidus	*Māmaki*	Highly Variable	5‘ x 5’	Low	Part. Sun
Waltheria indica	*‘Uhaloa*	Prostrate/Semi-Woody	2’ x 3’	Low	Part. Sun / Full Sun
	Biomass Plants*				

Mala Lā‘au Hua‘ai (Diversified Orchard)

Scientific Name	Common Name	Cultivar	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Carica papaya	Papaya	'Indian Dwrf'	Upright/Semi-Fountain	10’ x 3’	Medium	Full Sun
Citrus aurantifolia	Lime		Upright/Rounded	15‘ x 15‘	Medium	Full Sun
Citrus australiasica	Finger Lime (Small)		Upright/Rounded	15‘ x 15‘	Low	Full Sun - Part. Shade
Citrus x lemon	Meyer Lemon		Upright/Rounded	15‘ x 15‘	Low	Full Sun
Citrus paradisi	Jabong		Upright/Rounded	15‘ x 15‘	Medium	Full Sun
Citrus x paradisi	Grapefruit		Upright/Rounded	15‘ x 15‘	Medium/High	Full Sun
Citrus reticulata	Tangerine		Upright/Rounded	15‘ x 15‘	Medium	Full Sun
Citrus x sinensis	Orange	'Valencia'	Upright/Rounded	15‘ x 15‘	Low	Full Sun
Cocos nucifera	Coconut		Upright/Fountain	10’ x 30’	Medium	Full Sun
Macadamia heterophylla	Mac Nut		Upright/Rounded	20‘ x 20‘	Medium	Full Sun
Mangifera indica	Dwarf Mango		Upright/Rounded	10‘ x 10‘	Medium	Full Sun
Manilkara sapota	Chicosapote / Sapodilla		Upright/Rounded	15‘ x 15‘	Low	Full Sun
Persea americana	Avocado		Upright/Rounded	15‘ x 15‘	Medium	Full Sun
Mangifera indica	Mango		Upright/Rounded	15‘ x 15‘	Medium	Full Sun
Psidium guajava	Dessert Guava	'Indonesian'	Upright/Rounded	15‘ x 15‘	Low/Medium	Full Sun

Plant Palette

Ulu Niu (Coconut Grove)

Scientific Name	Common Name	Cultivar	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Cocos nucifera	Dwarf Coconut	'Dwarf Malayan Gold'	Upright/Fountain	10’ x 30’	Medium	Full Sun
Colocasia esulenta	*Kalo* / Taro		Upright/Non-Woody/ Clumping	4’ x 4’	Varibale	Variable
Cyperus javanicus	*‘Ahua‘awa*		Non-Woody/Clumping	2’ x 2.5’	High	Part. Sun / Full Sun
Eurphorbia celastroides	*‘Akoko*		Variable	variable	Low	Part. Sun
Pandanus tectorius	*Hala*		Oval/Rounded	15’ x 15’	Low	Full Sun
Vigna marina	*Nanea*		Woody/Spreading	3’ x 5’	Medium	Part. Sun / Full Sun
Portulaca spp.	Purslane		Non-Woody/Spreading	2’ x 2’	Low	Full Sun
	Conservation Setback*					

Lā‘au Kahakai (Coastal Restoration)

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Trees					
Cordia subcordata	*Kou*	Oval/Round	15’ x 20’	Low	Full Sun
Hibiscus tiliaceus	*Hau*	Spreading/Sprawling	5’ x 8’	Low	Full Sun
Morinda citrifolia	*Noni*	Round/Oval	6’ x 6’	Low	Full Sun
Pandanus tectorius	*Hala*	Oval/Rounded	15’ x 15’	Low	Full Sun
Pritchardia aylmer-robinsonii	*Loulu hiwa*	Fan Palm Shape	30’ x 10’	Low/Medium	Part. Sun / Full Sun
Thespesia populnea	*Milo*	Umbrella-Like	20’ x 20’	Low	Full Sun


Loulu palm


Naupaka


‘Uhaloa

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Shrubs					
Capparis sandwhichiana	*Maiapilo*	Sprawling/Short Canopy	6’ x 6’	Low	Full Sun
Chenopodium oahuense	*‘Āweoweo*	Clumping/Spreading	2’ x 10’	Low	Full Sun
Cladium jamaicense	*‘Uki* / Sawgrass	Clumping/Narrow	5’ x 1’	Low	Full Sun
Cyperus javanicus	*‘Ahu‘awa*	Clumping	1’ x 2’	Low	Full Sun
Cyperus laevigatus	*Makaloa*	Clumping/Spreading	2’ x 6’	Medium	Full Sun
Hibiscus furcellatus	*‘Akiohala* / Rosemallow	Massing	6’ x 6’	Medium	Full Sun
Lycium sandwicense	*‘Ōhelokai*	Woody/Sprawling	3’ x 6’	Low	Full Sun
Scaevola taccada	*Naupaka kahāwai*	Massing/Spreading	2’ x 10’	Low	Full Sun
Schoenoplectus juncoides	*Kaluhā*	Clumping/Spreading	2’ x 6’	High (In Water)	Full Sun
Schoenoplectus tabernaemontana	*‘Aka‘aka*	Clumping/Spreading	2’ x 8’	High (In Water)	Full Sun
Waltheria indica	*‘Uhaloa*	Prostrate/Semi-Woody	2’ x 3’	Low	Part. Sun / Full Sun

Lā‘au Kahakai (Coastal Restoration), cont'd

Plant Palette

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Ground Covers					
Argemone glauca	*Puakala*	Clumping	3’ x 4’	Low	Full Sun
Bacopa monnieri	*‘Ae‘ae*	Clumping/Spreading	1’ x 2’	Medium	Full Sun
Carex echinata	Star Sedge	Clumping	2’ x 2’	Medum	Full Sun
Cyperus odoratus	*Pu‘uka‘a*	Clumping	1’ x 1’	Low	Full Sun
Erogrostis variabilis	*Kāwelu*	Clumping	1’ x 2’	Low	Full Sun
Fimbristylis cymosa	*Mau’u ‘Aki’aki*	Clumping	1’ x 1’	Low	Full Sun
Heliotropium curassavicum	*Kīpūkai* / Seaside Heliotrope	Spreading/Prostrate	1’ x 5’	Low	Full Sun
Ipomoea pes-caprae	*Pōhuehue*	Non-Woody/Spreading	3’ x 10’	Low	Full Sun
Jacquemontia ovalifolia	*Pa’u-o-Hi’iaka*	Spreading	1’ x 8’	Low	Full Sun
Lipochaeta succulenta	*Nehe*	Non-Woody/Spreading	1’ x 6’	Low	Part. Sun / Full Sun
Plumbago zeylanica	*Ilie‘e*	Spreading	1’ x 10’	Low	Full Sun
Portulaca lutea	*‘Ihi*	Non-Woody/Spreading	3’ x 1’	Low	Full Sun
Rhychnospra spp.	*Pu‘ukoa*	Spreading/Massing	5’ x 10’	Medium	Full Sun
Sesuvium portulacastrum	*‘Ākulikuli*	Spreading	1’ x 4’	Low	Full Sun
Sporobolus virginicus	‘Aki‘aki / sand couch	Cumping/Spreading	1’ x 5’	Low	Full Sun
Tribulus cistoides	*Nohu*	Spreading	1’ x 6’	Low	Full Sun
Vigna marina	*Nanea*	Woody/Spreading	3’ x 5’	Medium	Part. Sun / Full Sun


Pōhuehue


‘Ae‘ae


Nanea

Hedgerow / Visual Screen

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Ipomoea pes-caprae	*Pōhuehue*	Non-Woody / Spreading	3’ x 5’	Low	Full Sun
Calophyllum inophyllum	*True kamani*	Oval/Rounded / Wide	35’ x 30’	Low	Full Sun
Psydrax odorata	*Alahe‘e*	Vase	variable	Low	Full Sun

Plant Palette

Apiary

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Argemone glauca	*Puakala*	Non-Woody/Clumping	3' x 4'	Low	Full Sun
Capparis sandwichiana	*Maiapilo*	Sprawling/Short Canopy	6’ x 6’	Low	Full Sun
Lipochaeta integrifolia	*Nehe*	Non-Woody/Spreading	1’ x 6’	Low	Part. Sun / Full Sun
Pandanus tectorius	*Hala*	Oval/Rounded	15’ x 15’	Low	Full Sun
Waltheria indica	*‘Uhaloa*	Prostrate/Semi-Woody	2’ x 3’	Low	Part. Sun / Full Sun
	Conservation Setback*				

Plant Palette

Biomass Plants

Biomass plants, for on-farm applications, can serve as mulch material for enhancing the soil's fertility and water retention.

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Cordyline fruticosa	*Kī / Lā‘i / Tī*	Narrow / Fountain	6‘ x 3‘	Low/Medium	Full Sun - Part Shade
Moringa oleifera	Kalamungai / Malungai / Moringa	Narrow	10’ x 15’	Low	Full Sun
Saccharum officinarum	*Kō* / Sugarcane	Upright/Grassy	6’ x 6’	Medium/High	Full Sun
Tithonia diversifolia	Mexican Sunflower	Upright/Massing	4‘ x 4‘	Low	Full Sun

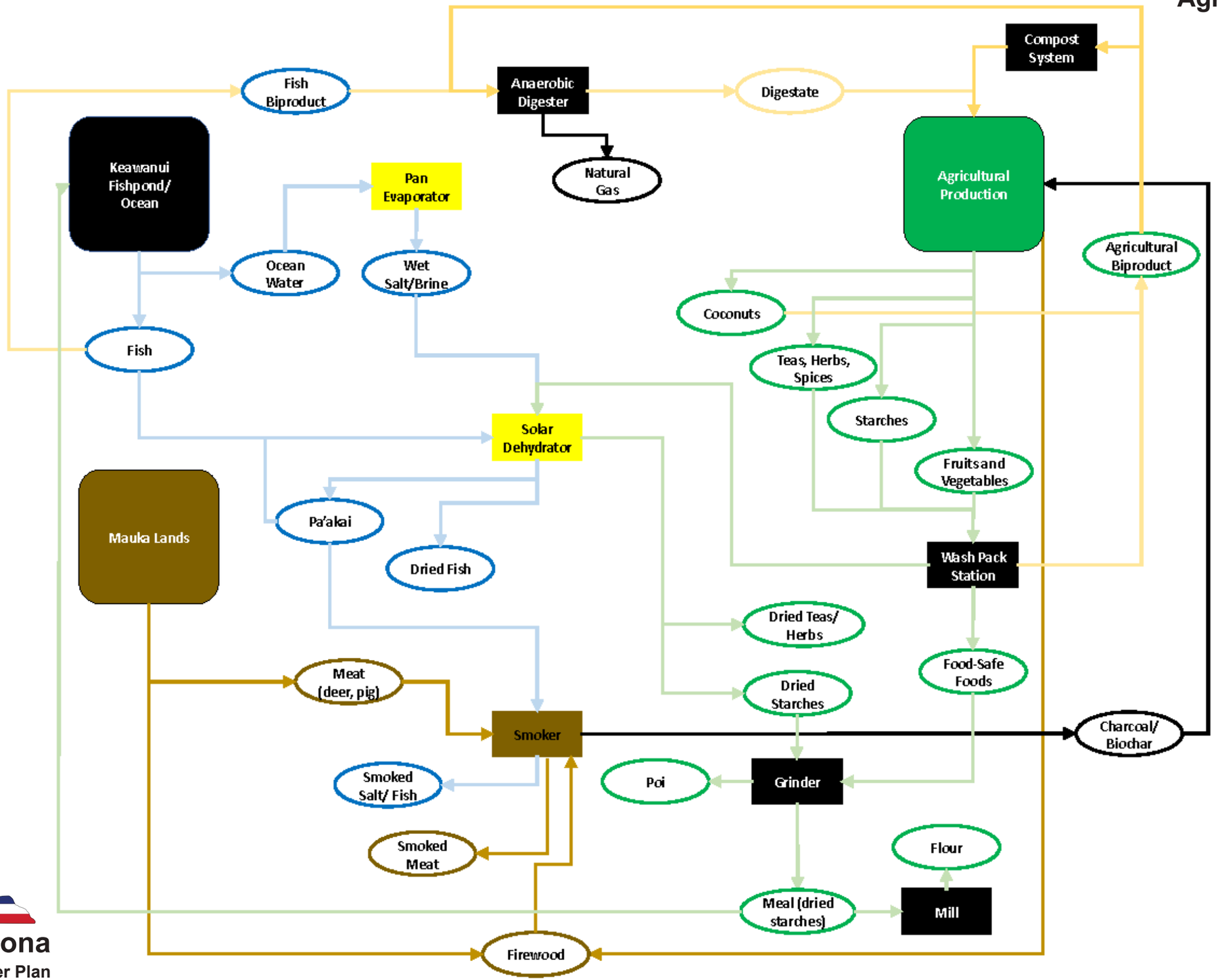
Trellises

This plant list includes species that are well-acclimated to an upward trellis-supported growing habit. Trellis structures can help plants receive better sunlight, allowing them to grow more efficiently while increasing food yield. Food produced from trellis plants are often of better quality, and require less maintenance.

Scientific Name	Common Name	Form / Habit	Ht x W	Water Needs	Sun Tolerance
Dioscorea spp.	*Uhi* / Yam	Spreading / Climbing	6‘ x 6‘	Medium	Part. Sun
Lablab purpureum	Lablab	Spreading / Climbing	6‘ x 6‘	Medium	Full Sun - Part. Shade
Phaseolus coccineus	Scarlet Runner Bean	Spreading / Climbing	6‘ x 6‘	Low/Medium	Full Sun
Phaseolus spp.	Perrenial Lima Bean	Spreading / Climbing	6‘ x 6‘	Medium	Full Sun
Psophocarpus tetragonobolus	Winged Bean	Spreading / Climbing	6‘ x 6‘	Low	Full Sun
Sechium edule	Pipinola / Chayote	Spreading / Climbing	6‘ x 6‘	Medium	Full Sun

Agricultural Processing Flow Diagram

This diagram illustrates the integrated aspirations of the Keawanui farm operation: ideally, very few inputs will be needed for long-term farm viability.



Mauka to *Makai* Connectivity Diagram

Over the coming years and decades, as *ʻāina momona* is once more manifested across the *Kaʻamola ahupuaʻa*, systems of regeneration will be fully infused within this restored land division.