huiMAU:

Ka Maha ʻUlu o Koholālele

Final Revision

ʻĀina Regeneration Plan + Agroforestry Designs

May 16, 2023

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PROJECT —
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FINAL REVISION

Ka Maha ʻUlu o Koholālele

REVISIONS —
Revision 1 ..... 05/06/2022
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

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'Āina Regeneration Plan
+ Agroforestry Designs

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The farmscape plan was deeply informed by keyline design, an integrated framework that guided the placement of farm infrastructure (e.g., ponds, roads, vegetation, buildings, fencing, etc.). Organized with culturally important viewsheds in mind, the farmscape plan will help re-establish systems of abundance that have been lost through decades of attempted erasure.

LEGEND

- IRRIGATION POND
- WETLAND RESTORATION
- PAVED ROAD (EXISTING)
- PAVED ROAD (PROPOSED)
- GRAVEL ROAD (EXISTING)
- GRAVEL ROAD (PROPOSED)
- PEDESTRIAN TRAIL
- PAVILION / TENT
- PALI COASTAL GATHERING AREA
- MAHA 'ULU ALLEY CROPPING
- ETHNOBOTANICAL KĪPUKA (MA KAI)
- LIVING FUELBREAK MĀLA
- ETHNOBOTANICAL KĪPUKA (KULA)
- PĀ KUKUI POLLARD
- WOODY COPPICE BIOMASS
- LONG TERM TIMBER ALLEE
- LONG TERM TIMBER BLOCK
- SHORT STATURE TIMBER
- GULCH ZONE TYP.
- COASTAL NIU + 'ULU SILVOPASTURE
- POLLINATOR HABITAT

NORTH

0' 100' 300' 500'

1" = 150'

Contour interval shown is 10'-0".
Derived from LiDAR on March 7, 2022.

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Master Plan

Ka Maha 'Ulu o Koholālele

REVISIONS —

Revision 1	05/06/2022
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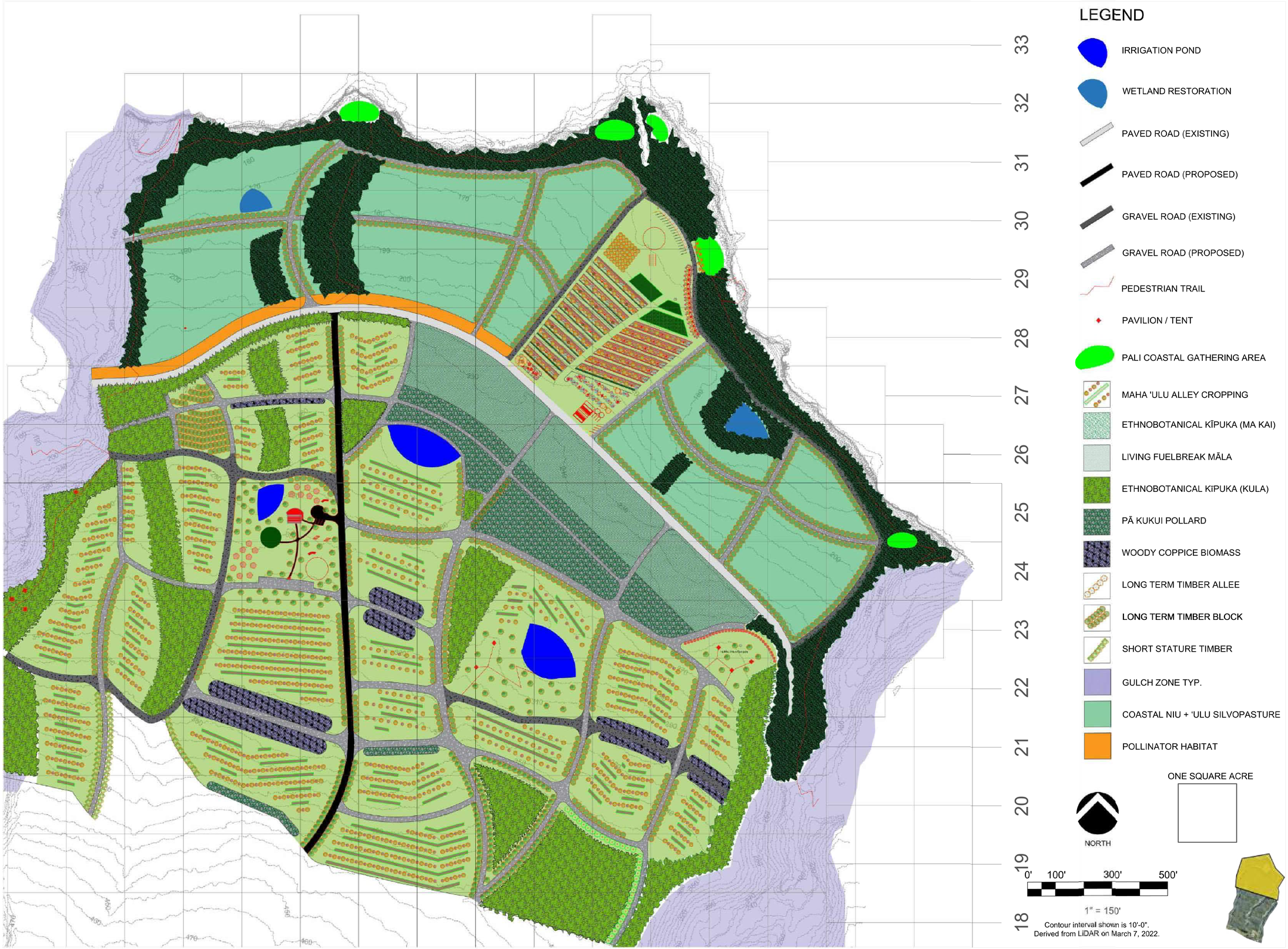

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'Āina Regeneration Plan & Agroforestry Designs

Master Plan
(w/ 1-acre overlays)

Ka Maha 'Ulu o Koholālele

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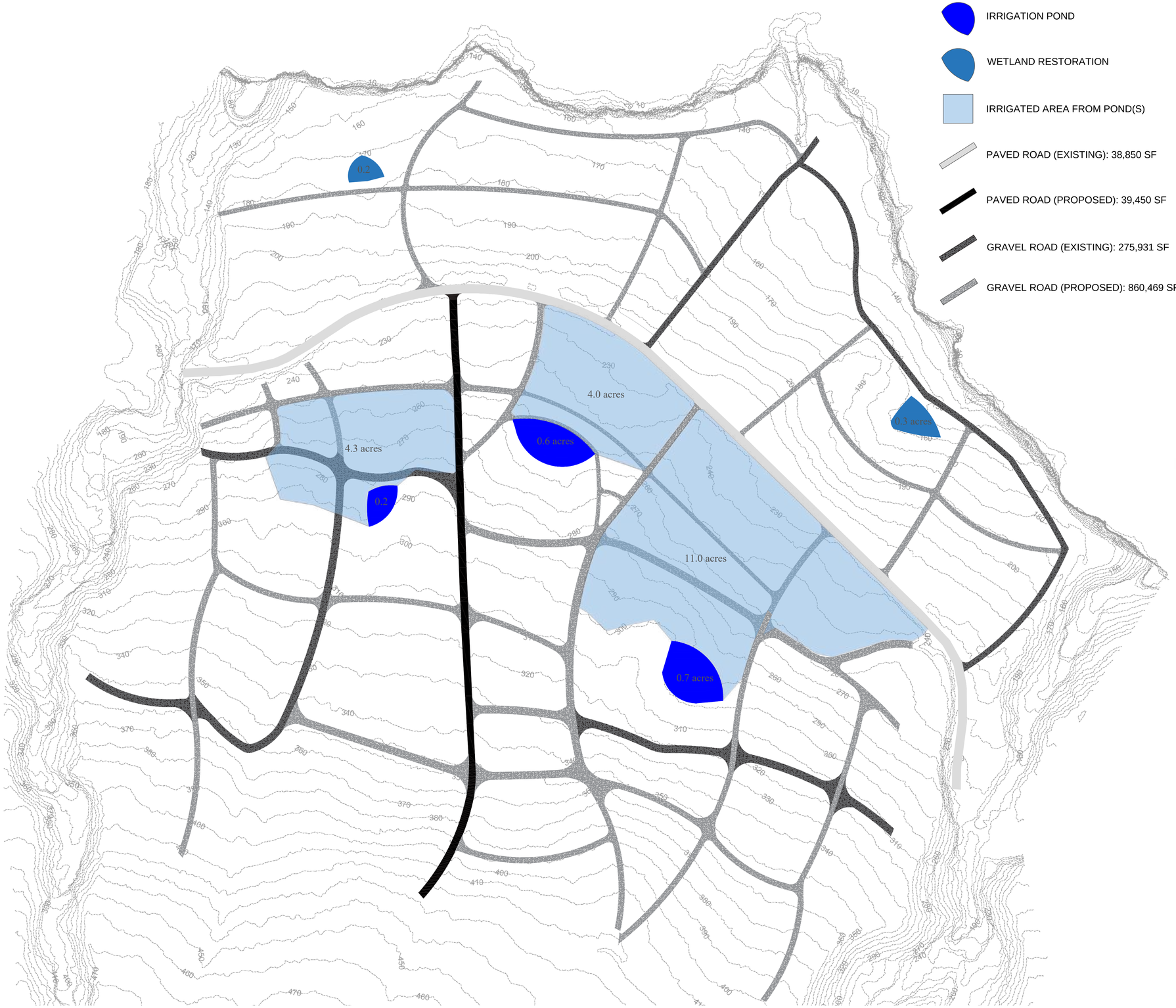

LEGEND

- IRRIGATION POND
- WETLAND RESTORATION
- IRRIGATED AREA FROM POND(S)
- PAVED ROAD (EXISTING): 38,850 SF
- PAVED ROAD (PROPOSED): 39,450 SF
- GRAVEL ROAD (EXISTING): 275,931 SF
- GRAVEL ROAD (PROPOSED): 860,469 SF

The new intra-farm roadway layouts (routed principally along either the ridgelines or on-contour) are minimally erosive, while also efficiently demarcating the farm's production blocks. These new routes complement the site's existing (plantation era) roads, which are revitalized for capturing surface runoff that is fed to adjacent planting blocks.

Irrigation ponds, strategically situated within the farmscape, harvest surface runoff from further mauka, which can be routed to select planting areas further makai.

Revitalized wetland zones serve as a final stormwater catchment sink, facilitating a broad diversity of coastal ethnobotanical plants to re-inhabit this 'āina.

NORTH

0' 100' 200' 300'

1" = 150'

Contour interval shown is 10'-0".
Derived from LiDAR on March 7, 2022.

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Roads & Water Storages

Ka Maha 'Ulu o Koholālele

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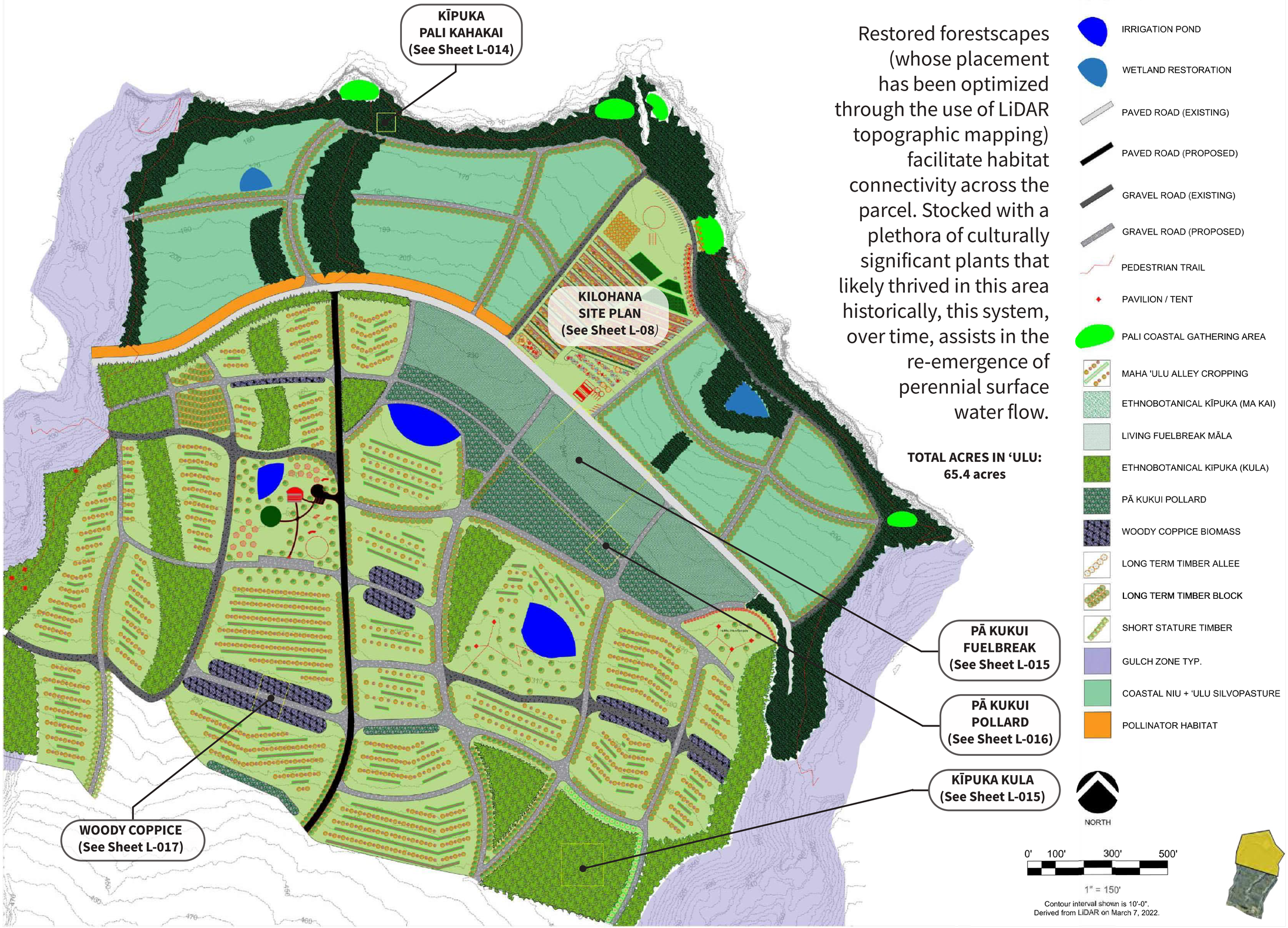

Restored forestscapes (whose placement has been optimized through the use of LiDAR topographic mapping) facilitate habitat connectivity across the parcel. Stocked with a plethora of culturally significant plants that likely thrived in this area historically, this system, over time, assists in the re-emergence of perennial surface water flow.

TOTAL ACRES IN 'ULU: 65.4 acres

LEGEND

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- PAVED ROAD (PROPOSED)
- GRAVEL ROAD (EXISTING)
- GRAVEL ROAD (PROPOSED)
- PEDESTRIAN TRAIL
- PAVILION / TENT
- PALI COASTAL GATHERING AREA
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- ETHNOBOTANICAL KĪPUKA (MA KAI)
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Acreage Per Planting Block

Ka Maha 'Ulu o Koholālele

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The syntropic agroforestry inspired Maha 'Ulu agroecosystem at Kilohana generates an abundance of 'ai (i.e., food) for the larger huiMAU 'ohana, as well as ample biomass for feeding back to the 'āina. Additionally, the agroforestry system's diversity of plant material is utilized for expanding Ka Maha 'Ulu o Koholālele agroforestry systems further mauka.

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Kilohana Site Plan

Ka Maha 'Ulu o Koholālele

REVISIONS —
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PLANT SCHEDULE KILOHANA

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	ALE MOL	Aleurites moluccanus / Candlenut Tree	1 gal.	Pot	102	In-row spacing (syntropic): 40'-0"
	ART ALT	Artocarpus altilis / 'Ulu / Breadfruit	1 gal.	Pot	137	In-row spacing: syntropic @ 30'-0"; 'Ulu wa'a @ 15'-0"
	CAL INO	Calophyllum inophyllum / True Kamani	1 gal.	Pot	21	In-row spacing: 80'-0"
	COC MAL	Cocos nucifera 'Malayan Dwarf' / Niu / Dwarf Coconut Palm	5 gal.	Pot	3	
	COR SUB	Cordia subcordata / Kou	1 gal.	Pot	19	Between-row spacing: 40'-0"
	DIO SAN	Diospyros sandwicensis / Lama	1 gal.	Pot	15	In-row spacing: 80'-0"
	DOD HOP	Dodonaea viscosa / 'A'ali'i	1 gal.	Pot	27	
	ERY SAN	Erythrina sandwicensis / Wiliwili	1 gal.	Pot	22	Between-row spacing: 80'-0"
		Erythrina sandwicensis / Wiliwili	10 gal.	Pot	1	Singular specimen tree
	GLI SEP	Gliricidia sepium / Madre de Cacao	1 year	cutting (2" diameter)	103	In-row spacing: 40'-0"
	ING EDU	Inga edulis / Ice Cream Bean	forestry dibble	Seedling	120	In-row spacing: 40'-0"
	MET POL	Metrosideros polymorpha / 'Ōhi'a lehua	1 gal.	Pot	4	
	MOR OLE	Moringa oleifera / Moringa / Kalamungai	0.5"	Seedling	60	In-row spacing: 16'-0" (i.e., 8'-0" on either side of each 'ulu)
	NES SAN	Nestegis sandwicensis / 'Olopua	1 gal.	Pot	3	In-row spacing: varies
	PRI LAN	Pritchardia lanigera / Loulu Palm	1 gal.	Pot	25	In-row spacing: varies
	PSY HAW	Psychotria hawaiiensis / Kopiko	1 gal.	Pot	23	In-row spacing: 80'-0"
	PSY ODO	Psydrax odorata / Alahe`e	1 gal.	Pot	19	In-row spacing: 80'-0"
	SAN PAN	Santalum paniculatum / 'Iliahi / Sandalwood	forestry dibble	Pot	12	In-row spacing: 80'-0"
	SAP OAH	Sapindus oahuensis / Lonomea	1 gal.	Pot	14	
	SYZ MAL	Syzygium malaccense / 'Ōhi'a 'ai	1 gal.	Pot	2	
	THE POP	Thespesia populnea / Milo	1 gal.	Pot	18	In-row spacing: 80'-0"

SHRUBS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	CAP SAN	Capparis sandwichiana / Mai'apilo	1 gal.	Pot	43	
	CAR WA3	Carex wahuensis / O'ahu Sedge	4"	Pot	124	Spacing: 18" O.C.
	CHR SU2	Chrysopogon zizanioides 'Sunshine' / Sunshine Vetiver Grass	4"	Pot	14,650	In-row spacing: 3"
	COR FRU	Cordyline fruticosa / Ti Plant	1 gal.	Pot	46	
	HIB ARN	Hibiscus arnottianus / Koki'o ke'oke'o	1 gal.	Pot	16	
	HIB BRA	Hibiscus brackenridgei / Ma'o hau hele	1 gal.	Pot	5	
	HIB FUR	Hibiscus furcellatus / 'Akiohala	1 gal.	Pot	45	
	MUS PAR	Musa x paradisiaca / Banana	1 gal.	Pot	239	in-row spacing: 20'-0"
	PIP MET	Piper methysticum / 'Awa	1 gal.	Pot	1,244	in-row spacing: 3'-0"
	PIP ALB	Pipturus albidus / Māmaki	0.5` Ht.	dibble	653	in-row spacing: 3'-0"
	SCA TAC	Scaevola taccada / Naupaka Kahakai	1 gal.	Pot	55	Spacing: 8'-0" O.C.
	SOR XDR	Sorghum x drummondii / Sudan grass	0.5` Ht.	dibble	928	in-row spacing: 1.5'
	WIK UVA	Wikstroemia uva-ursi / 'Ākia	1 gal.	Pot	60	Spacing: 5'-0" O.C.

SHRUB AREAS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	COL ES2	Colocasia esculenta / Green Taro	0.5` Ht.	huli	5,702	in-row spacing: 2.25'
	PLU ZE2	Plumbago zeylanica / 'Ilihe'e	1 gal.	Pot	208	Spacing: 3'-0" O.C.

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Kilohana
Plant Schedule

Ka Maha 'Ulu
o Koholālele

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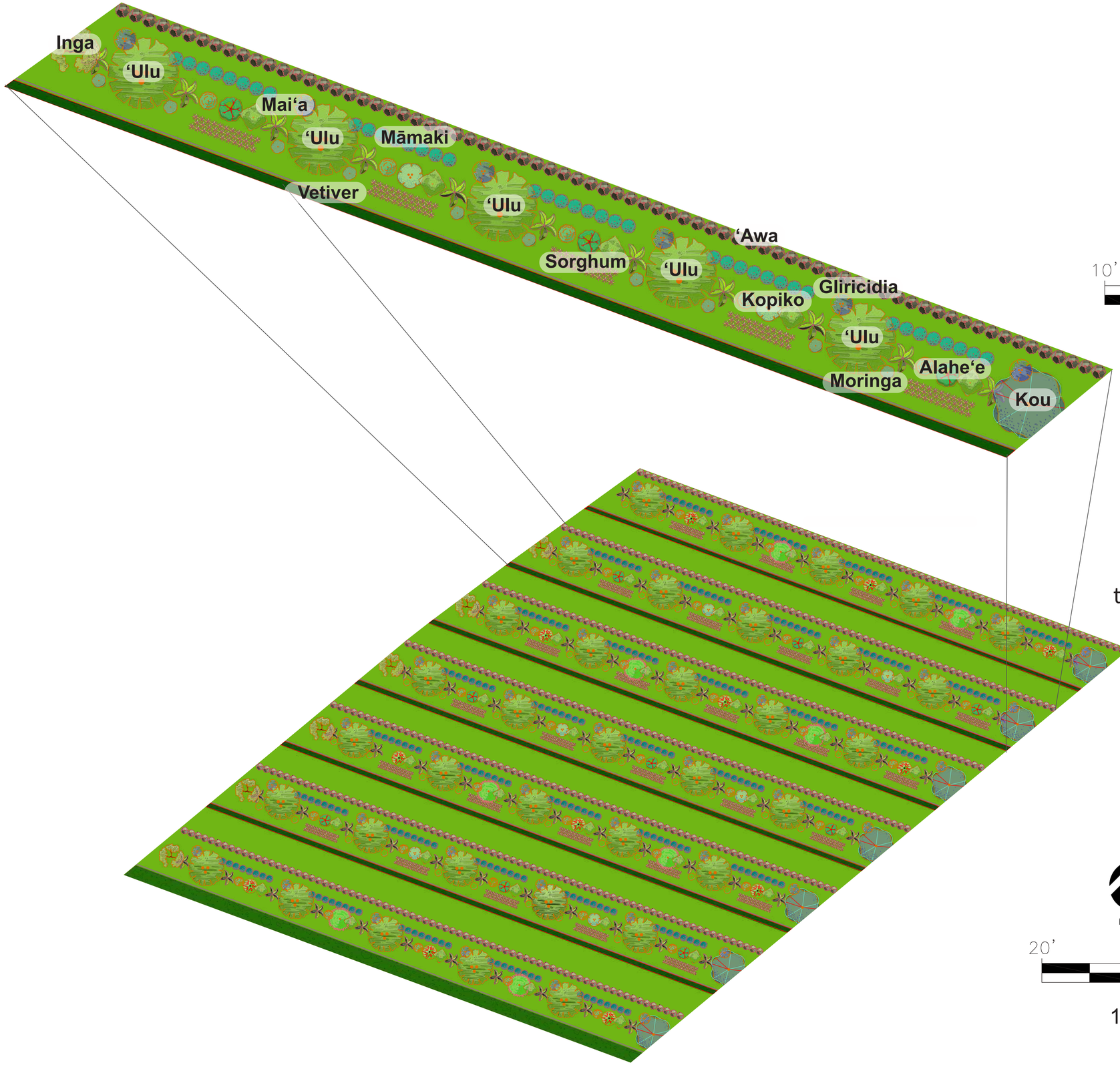

NORTH

10' 0 10'

1" = 10'

The syntropic agroforestry inspired Maha 'Ulu agroecosystem at Kilohana (illustrated here in a 1-acre block, with a zoomed in row of plantings) generates an abundance of 'ai (i.e., food) for the larger huiMAU 'ohana, as well as ample biomass for feeding back to the 'āina. Additionally, the agroecosytem's diversity of plant material is utilized for expanding Ka Maha 'Ulu o Koholālele agroforestry systems further mauka.

NORTH

20' 0 20'

1" = 20'

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1-acre Syntropic Agrof.

Ka Maha 'Ulu o Koholālele

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PLANT SCHEDULE: 1-ACRE-SYNTROPIC-AGROFORESTRY

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	ALE MOL	Aleurites moluccanus / Candlenut Tree	1 gal.	Pot	35	In-row spacing: 40‘-0"
	ART AL2	Artocarpus altilis / ‘Ulu / Breadfruit	1 gal.	Pot	36	In-row spacing: 30‘-0"
	CAL INO	Calophyllum inophyllum / True Kamani	1 gal.	Pot	6	In-row spacing: 80‘-0"
	COR SUB	Cordia subcordata / Kou	1 gal.	Pot	7	Between-row spacing: 40'-0"
	ERY SAN	Erythrina sandwicensis / Wiliwili	1 gal.	Pot	6	Between-row spacing: 80'-0"
	GLI SEP	Gliricidia sepium / Madre de Cacao	1 year	cutting (2" diameter)	42	In-row spacing: 40‘-0"
	ING EDU	Inga edulis / Ice Cream Bean	forestry dibble	Seedling	34	In-row spacing: 40‘-0"
	MOR OLE	Moringa oleifera / Moringa / Kalamungai	0.5"	Seedling	60	In-row spacing: 16'-0" (i.e., 8'-0" on either side of each 'ulu)
	PSY HAW	Psychotria hawaiiensis / Kopiko	1 gal.	Pot	8	In-row spacing: 80'-0"
	PSY ODO	Psydrax odorata / Alahe`e	1 gal.	Pot	12	In-row spacing: 80‘-0"
	THE POP	Thespesia populnea / Milo	1 gal.	Pot	9	In-row spacing: 80‘-0"

SHRUBS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	CHR SU2	Chrysopogon zizanioides 'Sunshine' / Sunshine Vetiver Grass	4"	Pot	6,299	In-row spacing: 3"
	MUS PAR	Musa x paradisiaca / Banana	1 gal.	Pot	77	in-row spacing: 20'-0"
	PIP MET	Piper methysticum / 'Awa / Kava	1 gal.	Pot	525	in-row spacing: 3'-0"
	PIP ALB	Pipturus albidus / Māmaki	0.5` Ht.	dibble	280	in-row spacing: 3'-0"
	SOR XDR	Sorghum x drummondii / Sudan grass	0.5` Ht.	dibble	928	in-row spacing: 1.5'

SHRUB AREAS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	COL ES2	Colocasia esculenta / Green Taro	0.5` Ht.	huli	872	in-row spacing: 2.25‘

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Syntropic (1-ac.) Plant Schedule

Ka Maha ‘Ulu o Koholālele

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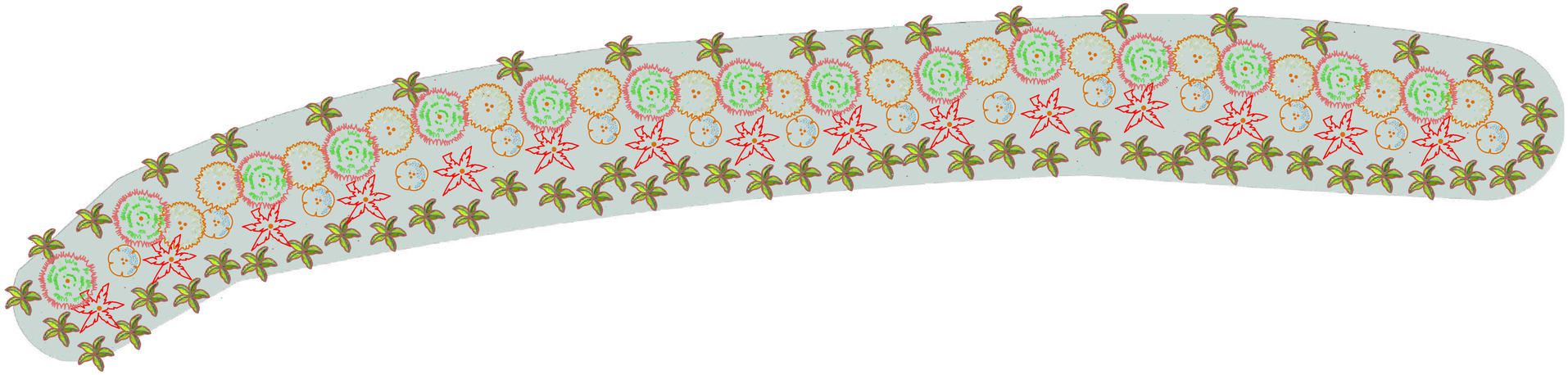

PLANT SCHEDULE: KILOHANA WINDBREAK

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY
	CAL INO	Calophyllum inophyllum / True Kamani	1 gal.	Pot	15
	DOD HOP	Dodonaea viscosa / ‘A‘ali‘i	1 gal.	Pot	15
	PRI LAN	Pritchardia lanigera / Loulu Palm	1 gal.	Pot	15
	PSY HAW	Psychotria hawaiiensis / Kopiko	1 gal.	Pot	15

SHRUBS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY
	MUS PAR	Musa x paradisiaca / Banana	1 gal.	Pot	61

GROUND COVERS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY
		COASTAL COVER CROP MIX			7,201 sf
	CRO JUN	Crotalaria juncea 'Tropic Sun' / 'Tropic Sun' sunn hemp	seed		1,800 sf
	FAG ESC	Fagopyrum esculentum / Buckwheat	seed		1,800 sf
	HEL TED	Helianthus annuus / Sunflower	seed		720 sf
	LOL MUL	Lolium multiflorum / Annual ryegrass	seed		1,800 sf
	VIG UNG	Vigna unguiculata / Cowpea	seed		1,080 sf

A multipurpose windbreak (installed all at once, in an “instant succession” pattern) intentionally affords some air movement through the plantings, while still buffering the site from the bulk of the tradewinds.

This windbreak focused plant palette can be installed in virtually any microclimate across the entire Koholālele ahupua‘a.

10' 0 10'

1" = 10'

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Kilohana Windbreak

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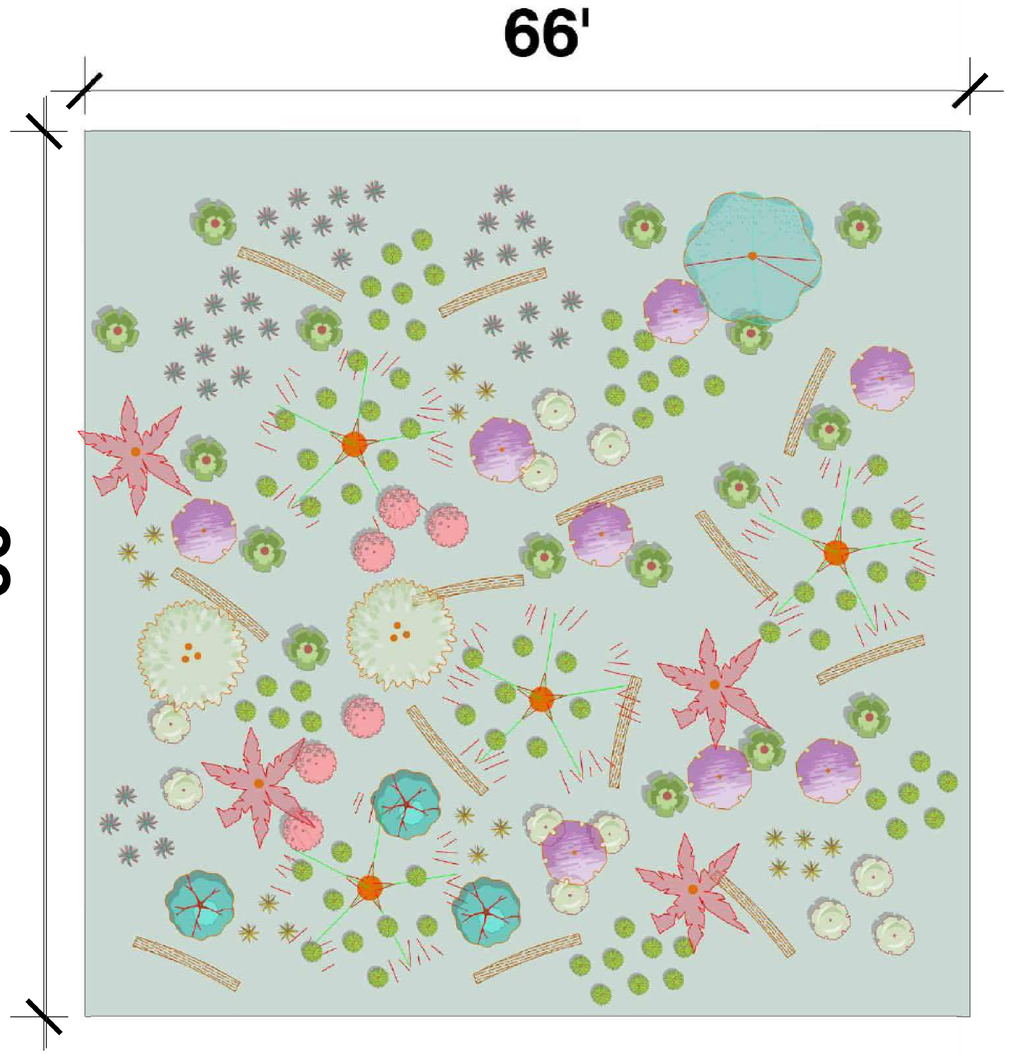

PLANT SCHEDULE: PALI KAHAKAI KĪPUKA

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	DOD HOP	Dodonaea viscosa / ʻAʻaliʻi	1 gal.	Pot	2	
	MET POL	Metrosideros polymorpha / ʻŌhiʻa lehua	1 gal.	Pot	8	
	PAN TEC	Pandanus tectorius / Hala	5 gal.	Pot	4	
	PRI LAN	Pritchardia lanigera / Loulu Palm	1 gal.	Pot	4	In-row spacing: varies
	SAP OAH	Sapindus oahuensis / Lonomea	1 gal.	Pot	1	
	THE POP	Thespesia populnea / Milo	1 gal.	Pot	3	In-row spacing: 80'-0"

SHRUBS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	CAR WA2	Carex wahuensis / Oʻahu Sedge	4"	Pot	73	
	CHE OAH	Chenopodium oahuense / ʻĀweoweo	1 gal.	Pot	11	
	CYP JAV	Cyperus javanicus / Ahu`awa	4"	Pot	17	
	DIA SNA	Dianella sandwicensis / ʻUkiʻuki	4"	Pot	34	
	SCA TAC	Scaevola taccada / Naupaka Kahakai	1 gal.	Pot	16	Spacing: 8'-0" O.C.
	WIK UVA	Wikstroemia uva-ursi / ʻĀkia	1 gal.	Pot	6	Spacing: 5'-0" O.C.

GROUND COVERS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
		COASTAL COVER CROP MIX			4,356 sf	
	CRO JUN	Crotalaria juncea 'Tropic Sun' / 'Tropic Sun' sunn hemp	seed		1,089 sf	
	FAG ESC	Fagopyrum esculentum / Buckwheat	seed		1,089 sf	
	HEL TED	Helianthus annuus / Sunflower	seed		436 sf	
	LOL MUL	Lolium multiflorum / Annual ryegrass	seed		1,089 sf	
	VIG UNG	Vigna unguiculata / Cowpea	seed		653 sf	

NORTH

1' 0 2' 4' 6' 10'

3/16" = 1'

Intensive, biodiverse plantings of endemic & indigenous flora, well adapted to the salty, windswept coastline, thrive and expand out from this native nexus. Felled eucalyptus and ironwood trees serve as nurse log habitat for these preferred native plants.

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Ethnob. Kīpuka (Ma Kai)

Ka Maha ʻUlu o Koholālele

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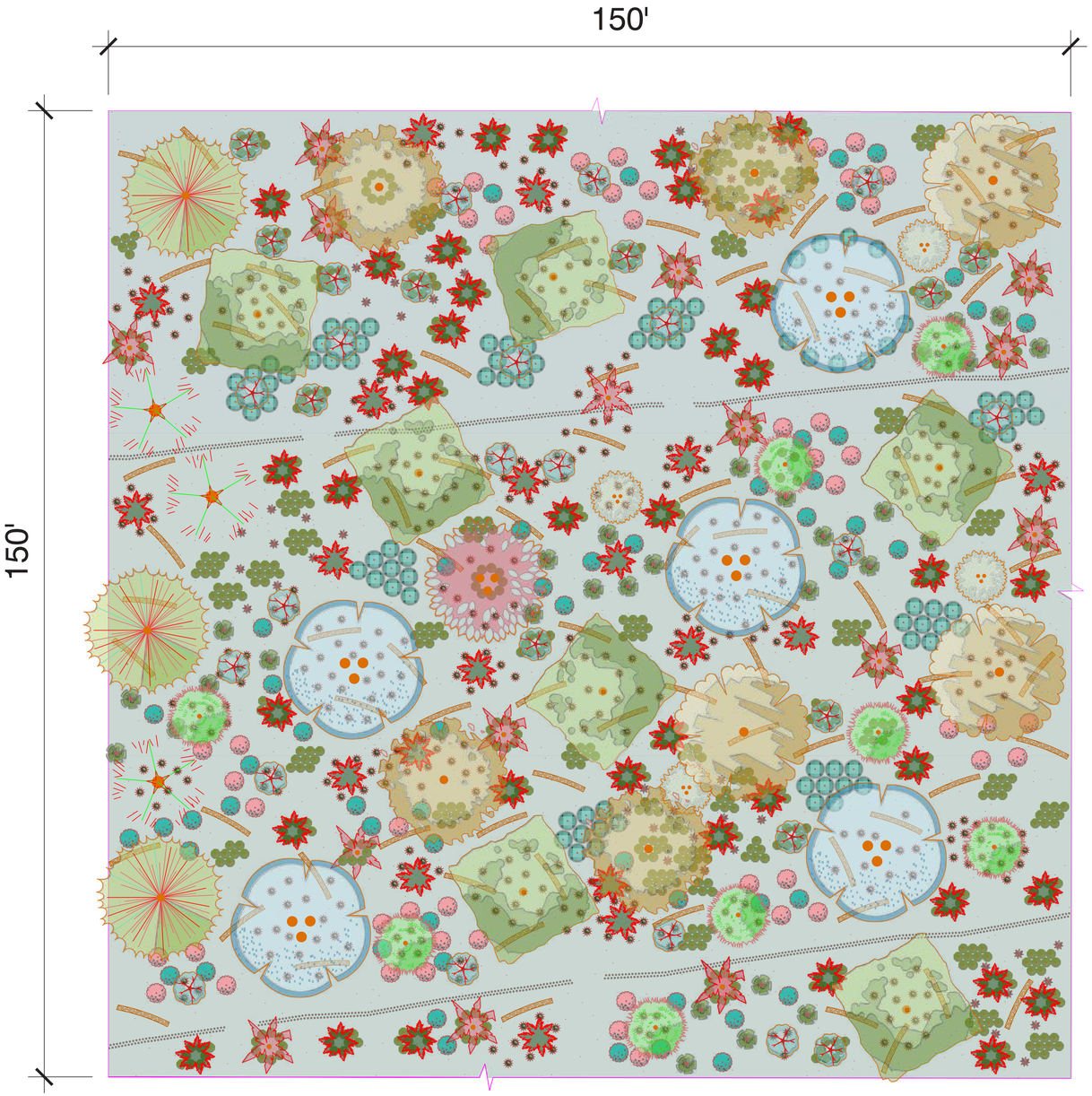

NORTH

10' 0 10'

SCALE: 1' = 10'-0"

PLANT SCHEDULE ETHNOBOTANICAL KIPUKA (KULA LANDS)

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	ACA KO2	Acacia koaia / Koai'a	4"	dibble	3	
	ALE MO4	Aleurites moluccanus / Candlenut Tree	1 gal.	Pot	7	
	BAM VUL	Bambusa vulgaris / 'Ohe Hawai'i	5 gal.	Pot	3	
	CAL IN3	Calophyllum inophyllum / True Kamani	1 gal.	Pot	5	
	CIB GLA	Cibotium glaucum / Hapu'u Pulu Tree Fern	4` Ht.	B.R.	59	
	DOD HOP	Dodonaea viscosa / 'A'ali'i	1 gal.	Pot	4	
	MET POL	Metrosideros polymorpha / 'Ōhi'a lehua	1 gal.	Pot	30	
	NES SAN	Nestegis sandwicensis / 'Olopua	1 gal.	Pot	4	In-row spacing: varies
	PAN TEC	Pandanus tectorius / Hala	5 gal.	Pot	3	
	PRI LAN	Pritchardia lanigera / Loulu Palm	1 gal.	Pot	16	In-row spacing: varies
	PSY HAW	Psychotria hawaiiensis / Kopiko	1 gal.	Pot	8	In-row spacing: 80'-0"
	SYZ MAL	Syzygium malaccense / 'Ōhi'a 'ai	1 gal.	Pot	1	

SHRUBS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
	CAR WA3	Carex wahuensis / O'ahu Sedge	4"	Pot	915	Spacing: 18" O.C.
	CHR SU2	Chrysopogon zizanioides 'Sunshine' / Sunshine Vetiver Grass	4"	Pot	1,102	In-row spacing: 3"
	COR FRU	Cordyline fruticosa / Ti Plant	1 gal.	Pot	47	
	MIC STR	Microlepia strigosa / Palapalai	4"	Pot	86	spacing: 3'-0" O.C.
	NEP CRL	Nephrolepis cordifolia / Kupukupu Fern	4"	Pot	455	spacing: 18" O.C.
	PIP ALB	Pipturus albidus / Māmaki	0.5` Ht.	dibble	54	in-row spacing: 3'-0"
	SCA TAC	Scaevola taccada / Naupaka Kahakai	1 gal.	Pot	29	Spacing: 8'-0" O.C.
	WIK UVA	Wikstroemia uva-ursi / 'Ākia	1 gal.	Pot	48	Spacing: 5'-0" O.C.

GROUND COVERS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY	REMARKS
		COVER CROP MIX (KULA LANDS)			22,604 sf	
	CRO JUN	Crotalaria juncea 'Tropic Sun' / 'Tropic Sun' sunn hemp	seed		5,651 sf	
	FAG ESC	Fagopyrum esculentum / Buckwheat	seed		5,651 sf	
	HEL TED	Helianthus annuus 'Teddy Bear' / Teddy Bear Sunflower	seed		2,260 sf	
	LOL MUL	Lolium multiflorum / Annual ryegrass	seed		5,651 sf	
	VIG UNG	Vigna unguiculata / Cowpea	seed		3,391 sf	
		Felled Eucalyptus log			82	nurse log function

Ethnobotanical kīpuka (i.e., islands of vegetation), populated with kula plantings, help to re-establish pre-contact riparian corridors that will yield an abundance of non-timber (and timber) forest products, further perpetuating place-based maoli culture, while buffering the wider landscape from climate disruptions. A biodiverse mix of endemic, indigenous, and otherwise useful flora, these clustered habitat plantings (consisting of ground covers, shrubs, trees, and nurse logs) minimize maintenance while maximizing ecological function.

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PROJECT —
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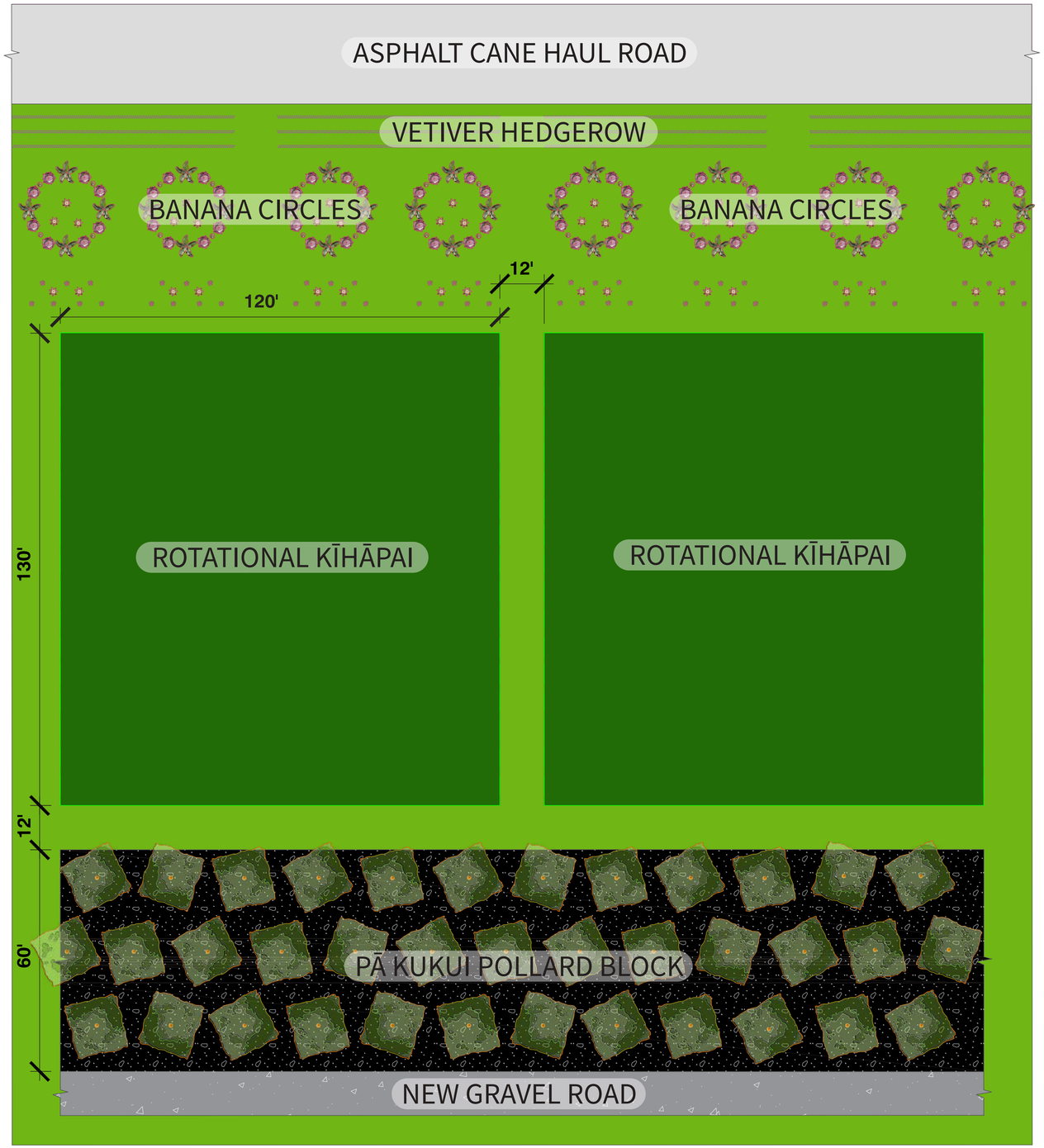
Ethnob. Kīpuka (Kula)

Ka Maha 'Ulu o Koholālele

REVISIONS —
Revision 1 ..... 05/06/2022
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-014

PLAN VIEW



4' 0 4' 8' 12' 20' 28'

1/16" = 1'-0"

PLANT SCHEDULE: LIVING FUELBREAK

SHRUBS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	SPACING	QTY
	CAJ CAJ	Cajanus cajan / Pigeon Pea N-fixer; biomass; pol. habitat	0.5` Ht.	dibble	9" o.c.	1
	CAP FRU	Capsicum frutescens / Hawaiian Chili Pepper aromatic pest confuser	4"	Pot	36" o.c.	64
	CHR SU2	Chrysopogon zizanioides 'Sunshine' / Vetiver Grass In-row spacing: 3"	4"	Pot	3" o.c.	2,814
	COR FRU	Cordyline fruticosa / Ti Plant biomass; cultural functions	1 gal.	Pot	18" o.c.	56
	CUC AEM	Cucurbita moschata 'Seminole' / Seminole Pumpkin food; living mulch	4"	Pot	30" o.c.	41
	MUS PAR	Musa x paradisiaca / Banana	1 gal.	Pot	72" o.c.	32
	SES SES	Sesbania sesban / Egyptian Riverhemp N-fixer; biomass; pol. habitat	0.5` Ht.	dibble	18" o.c.	32

A series of kīhāpai (dimensions: 120’ wide x 130’ long apiece), focused on annual crops such as kalo, palaʻai, and ʻolena, serve as a living fuelbreak for possible future (tradewind induceddist) fires from the northeast. These kīhāpai, lining much of the paved roadʻs mauka length, can also be flood irrigated from the adjacent pond(s). The adjacent pā kukui pollarding block grows mulch / biomass that can be readily cut and applied to the kīhāpai beds.

A multipurpose hedgerow of highly productive (and high water content) plantings (which include maiʻa / banana circles, Hawaiian chili pepper, and lāʻī / tī patches), are installed on the north side of the kīhāpai, further buffering the mauka lands from fire danger, while casting shade away from the sun-loving annual plantings.

Vetiver hedgerows, installed on-contour directly mauka of the paved road, halt stormwater runoff, sequester carbon, and yield a fungally rich mulch, while also building soil over the long term.

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PROJECT —
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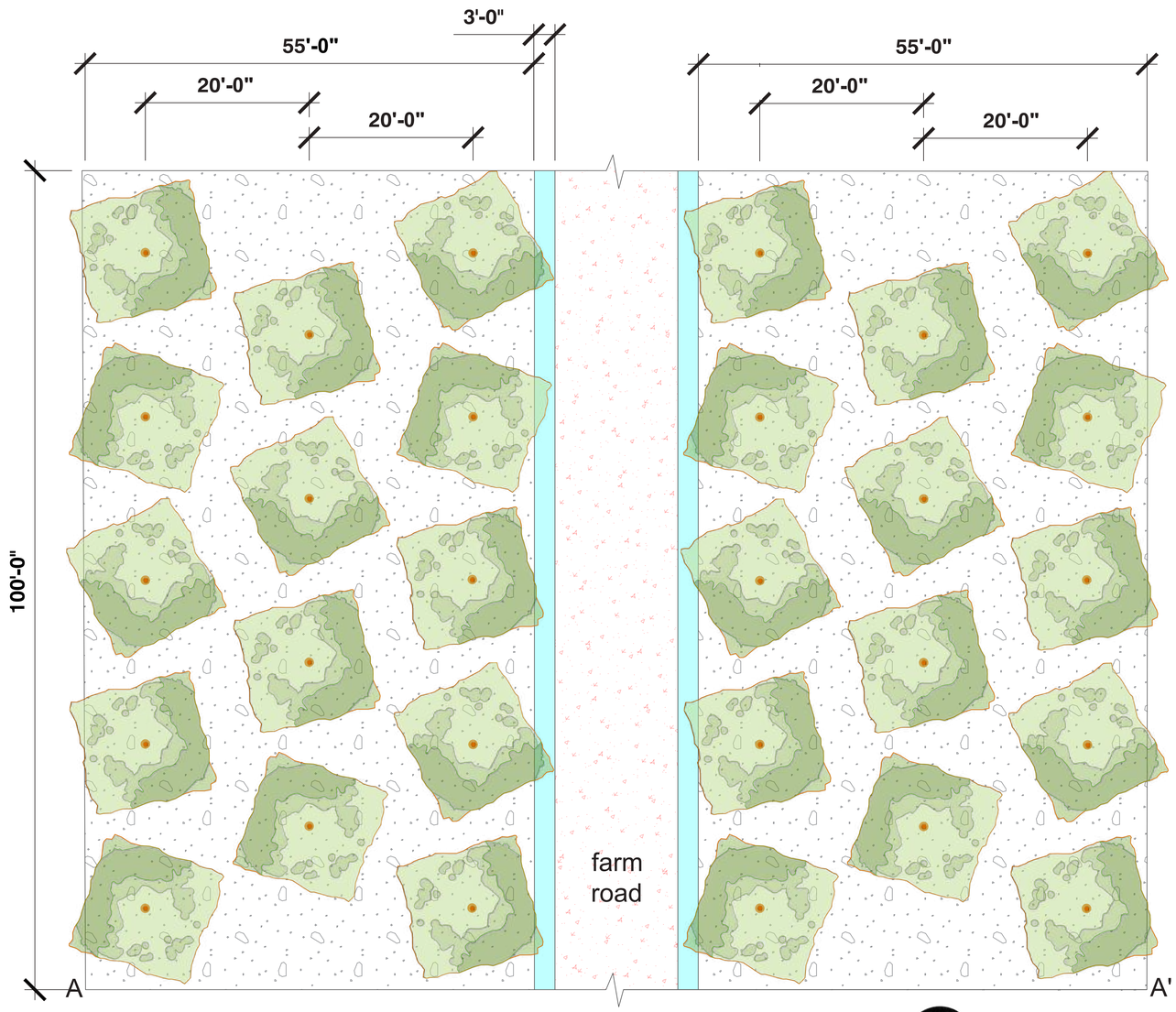
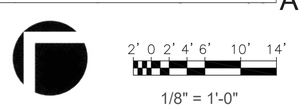
Pā Kukui Living Fuelbreak

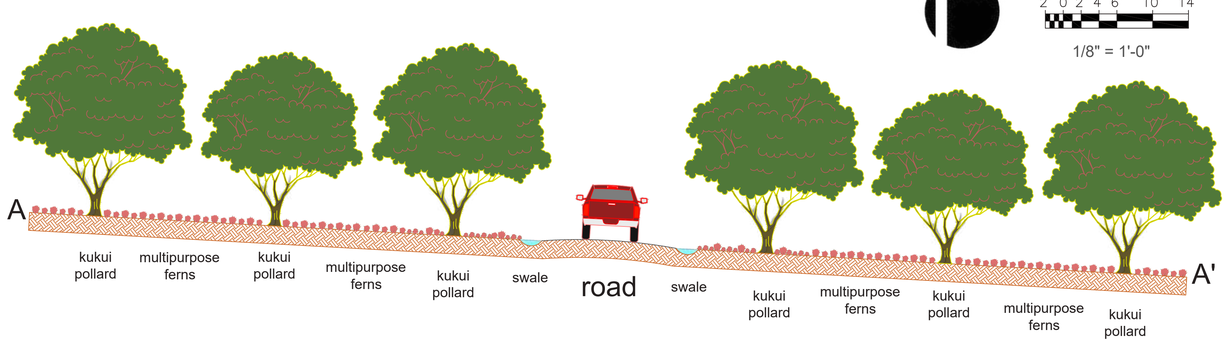
Ka Maha ʻUlu o Koholālele

REVISIONS —
Revision 1 ..... 05/06/2022
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-015







Pā Kukui Agroforestry Pollard: ELEVATION VIEW

PLANT SCHEDULE: KUKUI AGROFORESTRY POLLARD

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER		QTY
	ALE MO3	Aleurites moluccanus / Candlenut Tree	1 gal.	Pot		28

SHRUB AREAS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	SPACING	QTY
		NATIVE FERN GROUND COVER MIX				10,982 sf
	DIP WAR	Diplazium esculentum / Warabi Fern	4"	Pot	15% @ 36" o.c.	1,647 sf
	DIP OUW	Diplazium sandwichianum / ho'io	4"	Pot	15% @ 36" o.c.	1,647 sf
	MIC ST2	Microlepia strigosa / Palapalai Fern	4"	Pot	30% @ 36" o.c.	3,295 sf
	NEP CR2	Nephrolepis cordifolia / Kupukupu Fern	4"	Pot	40% @ 18" o.c.	4,393 sf

A traditional Polynesian agroecosystem, the pā kukui is managed, through pollarding (i.e., intermittent delimbing of trees' upper branches), principally as a biomass harvesting zone for mulching the adjoining annual kīhāpai areas. Additional yields from this multi-layered forest system include culturally important ground cover ferns for food, medicine, fiber, and lei po'o, as well as an abundance of pepeiao *(Auricularia cornea)*, a choice edible polypore mushroom that once grew prolifically on many of the kukui trees across the Koholālele ahupua'a.

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Pā Kukui Pollard

Ka Maha 'Ulu o Koholālele

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Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-016

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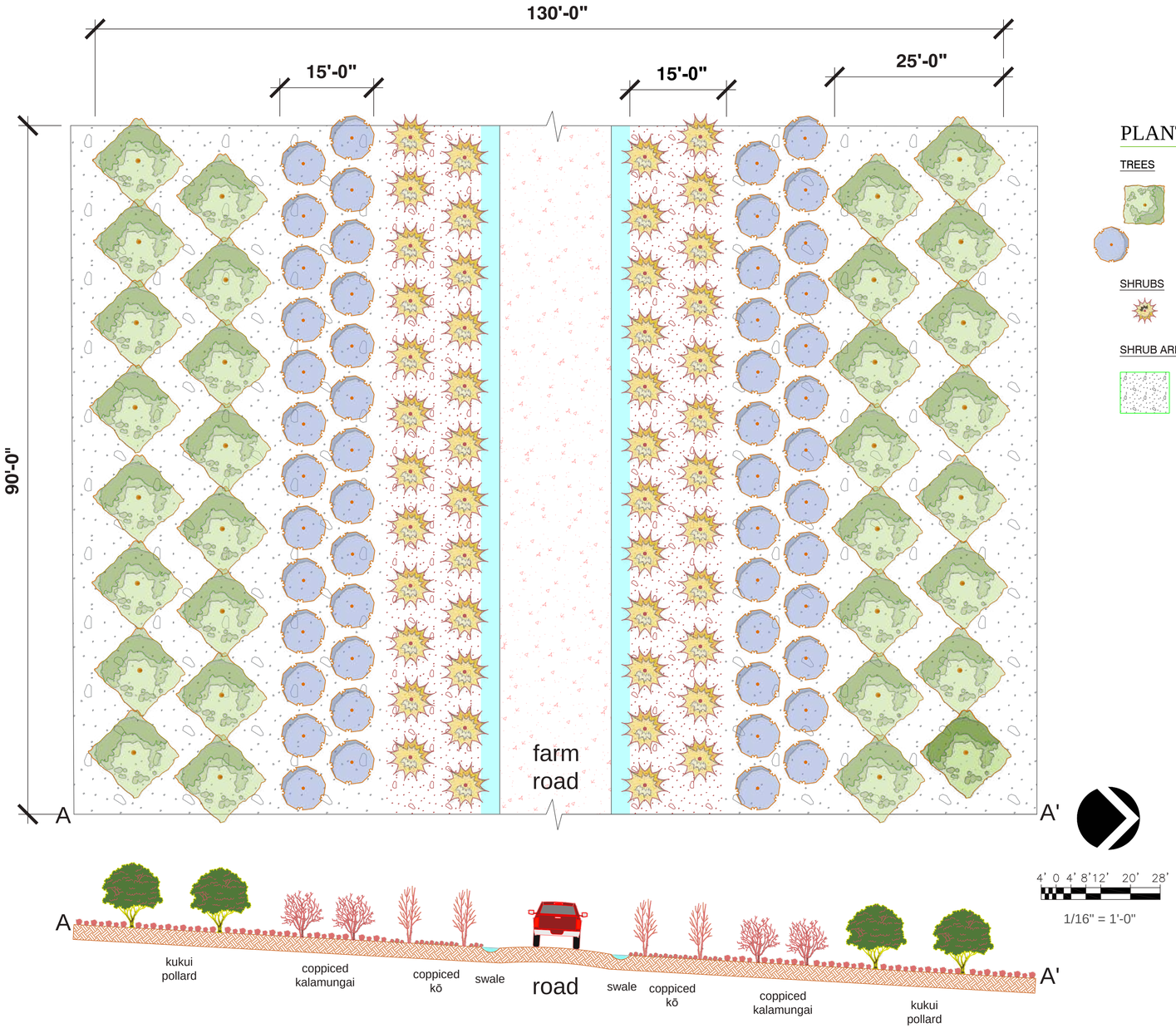

Woody Biomass Plantings: ELEVATION VIEW

PLANT SCHEDULE: WOODY COPPICE BIOMASS

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER		QTY
	ALE MO3	Aleurites moluccanus / Candlenut Tree In-row spacing for pollarding: 10'-0"	1 gal.	Pot		33
	MOR OLE	Moringa oleifera / Moringa / Kalamungai In-row spacing for coppice: 7'-0"	#1	Seedling		52
SHRUBS	**CODE**	**BOTANICAL / COMMON NAME**	**SIZE**	**CONTAINER**	**SPACING**	**QTY**
	SAC SU2	Saccharum officinarum / Sugar Cane in-row spacing for coppice: 8'-0"	1 gal.	Pot	78" o.c.	48
SHRUB AREAS	**CODE**	**BOTANICAL / COMMON NAME**	**SIZE**	**CONTAINER**	**SPACING**	**QTY**
		NATIVE FERN GROUND COVER MIX				7,687 sf
	DIP WAR	Diplazium esculentum / Warabi Fern	4"	Pot	15% @ 36" o.c.	134
	DIP OUW	Diplazium sandwichianum / ho'io	4"	Pot	15% @ 36" o.c.	134
	MIC ST2	Microlepia strigosa / Palapalai Fern	4"	Pot	30% @ 36" o.c.	267
	NEP CR2	Nephrolepis cordifolia / Kupukupu Fern	4"	Pot	40% @ 18" o.c.	1,421

Long-lived tree and shrub plantings, installed along on-contour farm roads, are managed as coppice (i.e., cuttable) material, generating a wide diversity of on-farm products (e.g., compost, biochar, mulch, basketry materials, etc.), while also sequestering carbon in their root systems over the long term.

Kukui, installed optionally in the outer rows, can be pollarded (i.e., delimbed) intermittently for biomass. The coppice / pollard block will also be underplanted with a wide diversity of ferns (e.g., kupukupu, palapalai, warabi, hoʻio, lauaʻe) for use in lei poʻo, food/medicine, and other cultural practices. Organized at a 50% tighter within-row spacing than the dedicated pā kukui system, lessons learned from this kukui block will be instructive for future plantings further mauka.

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Woody Coppice

Ka Maha ʻUlu o Koholālele

REVISIONS –
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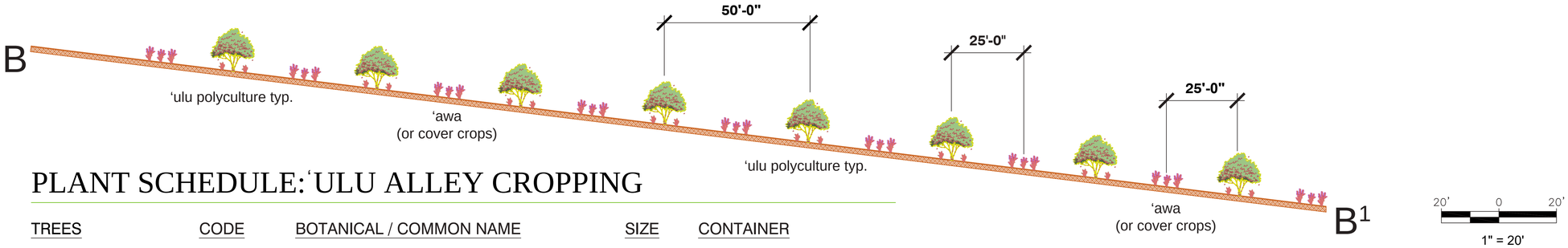
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-017

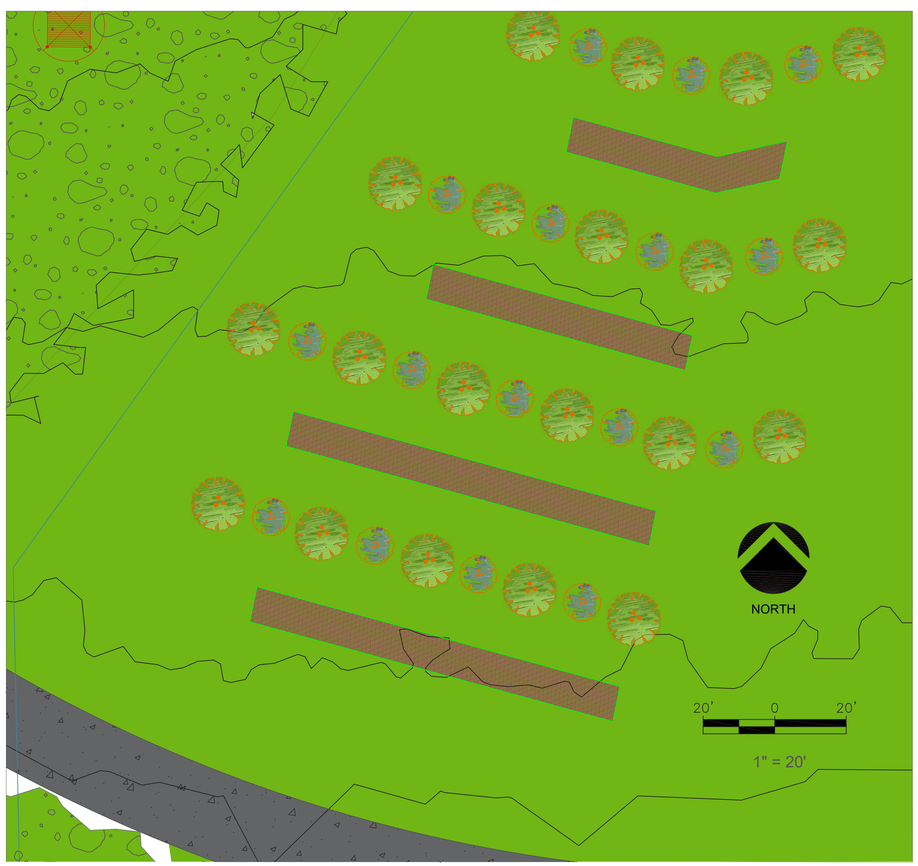


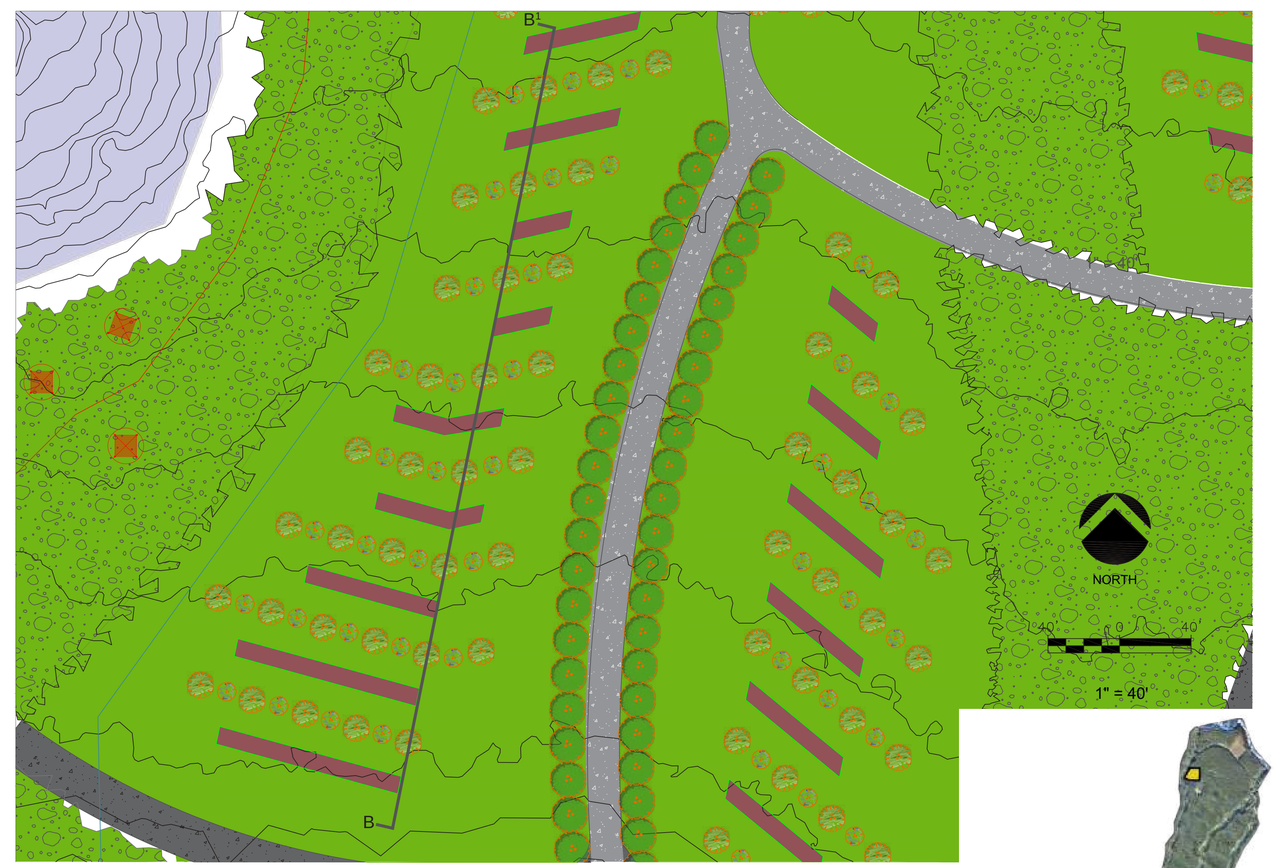
PLANT SCHEDULE: 'ULU ALLEY CROPPING

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER
	ART ALT	Artocarpus altilis / 'Ulu / Breadfruit In-row spacing: syntropic @ 30'-0"; 'Ulu wa'a @ 15'-0"; alley cropping @ 30'-0"	1 gal.	Pot
	GLI SE2	Gliricidia sepium / Madre de Cacao In-row spacing: 30'-0"	1 year	cutting (2" diameter)

SHRUB AREAS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER
	PIP ME2	Piper methysticum / 'Awa	1 gal.	Pot

'Awa is intercropped in the alleys between the long lived 'ulu belts. Over time, the soil tilth in the interrow between the 'ulu is improved through cover cropping + fallowing during intervening years.





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PROJECT —
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'Ulu Alley Cropping

Ka Maha 'Ulu o Koholālele

REVISIONS —
Revision 1 ..... 05/06/2022
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-018

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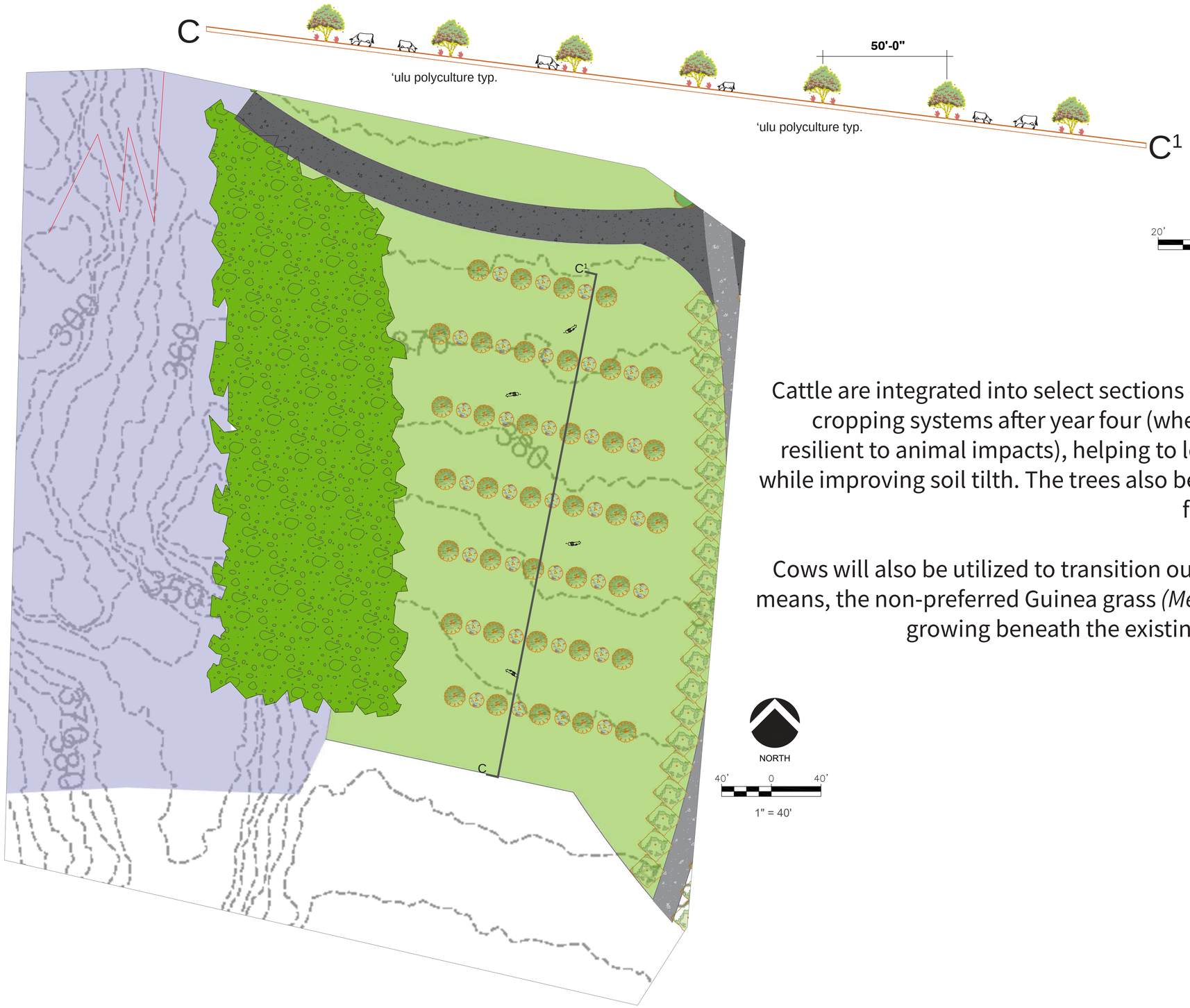

Cattle are integrated into select sections of the site's 'ulu alley cropping systems after year four (when the trees are more resilient to animal impacts), helping to lessen weed pressure while improving soil tilth. The trees also benefit from the cows' fertility rich manures.

Cows will also be utilized to transition out, through biological means, the non-preferred Guinea grass *(Megathyrsus maximus)* growing beneath the existing Eucalyptus stands.

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'Ulu Silvopasture

Ka Maha 'Ulu o Koholālele

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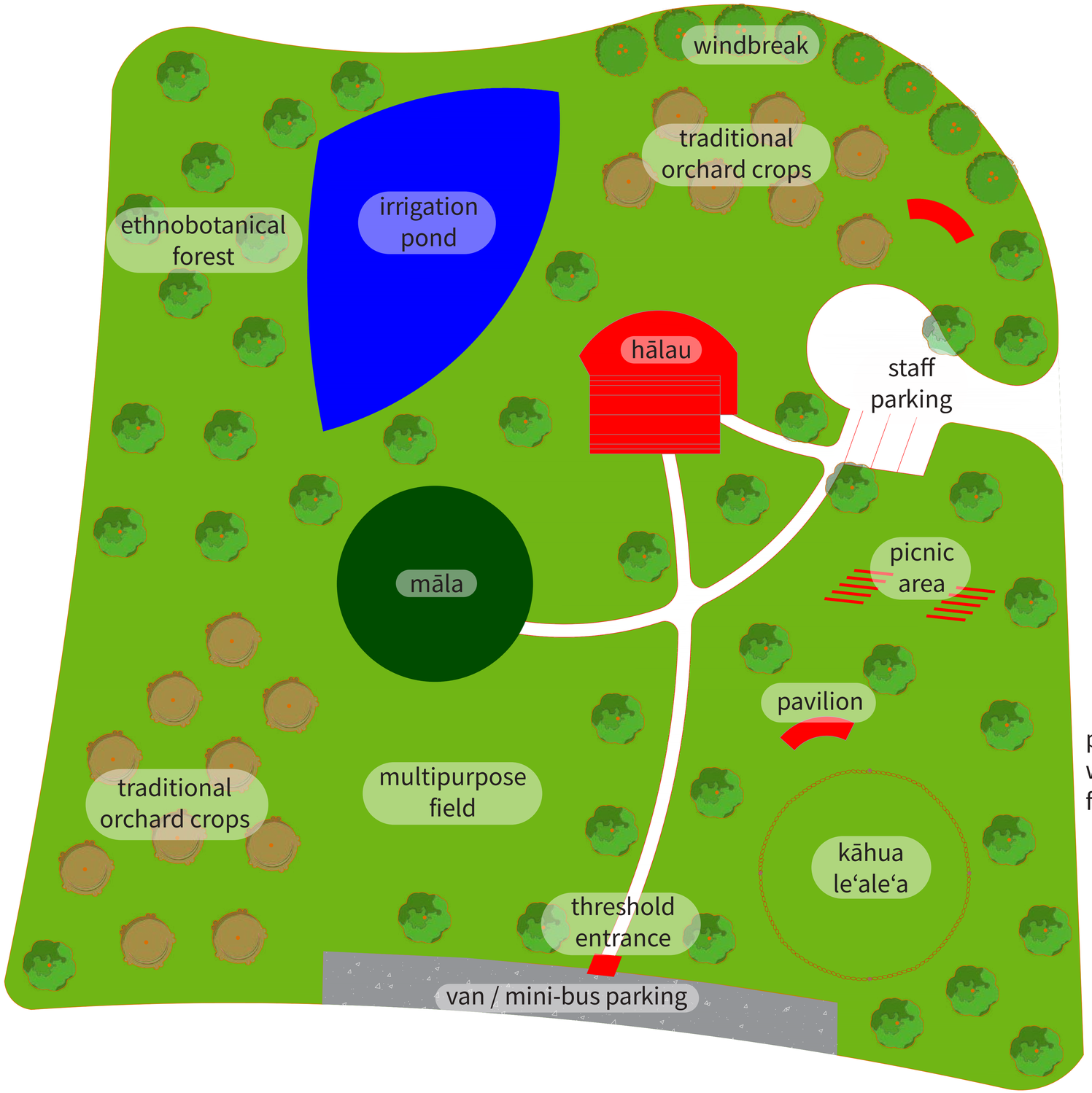
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-019

SHEET 19 OF 28



example Marae complex, from Aotearoa
(image courtesy: http://maorilifestyles.blogspot.com/)

The centrally located hālau complex, informed by traditional 'ōiwi lifeways, serves as a convivial piko for education, food preparation, and other 'ōiwi cultural practices.

perimeter wooden fence

NORTH

20' 0 20'

1" = 20'

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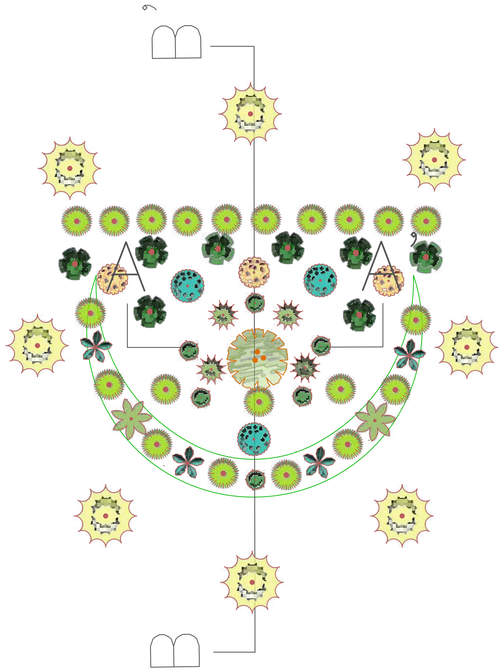
Hālau Complex

Ka Maha 'Ulu o Koholālele

REVISIONS —
Revision 1 ..... 05/06/2022
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

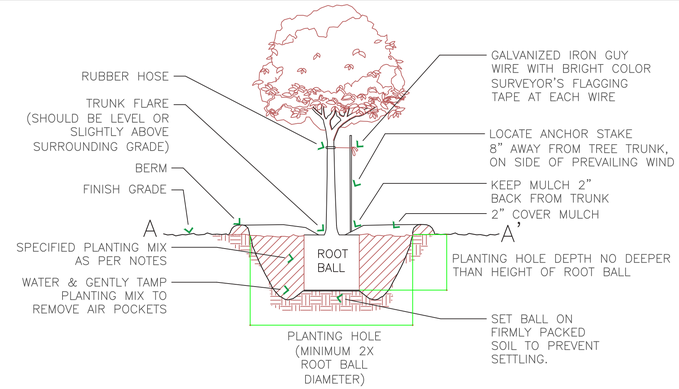
L-020

SHEET 20 OF 28



2 POLYCULTURE PLANTING DETAIL: PLAN VIEW

NOT TO SCALE

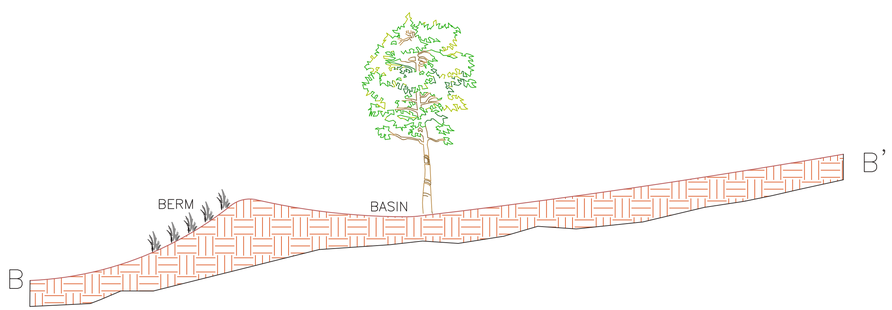


NOTES:

1. PRE–SOAK ALL POTTED TREES IN A CATTLE WATERING TROUGH (TYP.) TO FULLY HYDRATE THE PLANTS PRIOR TO INSTALLATION.
2. SPECIFIED PLANTING MIX: 40% NATIVE SOIL; 30% CINDER; 10% COMPOST; 10% INOCULATED BIOCHAR; 10% OTHER AMENDMENTS (E.G., GRADE B SPIRULINA, MUSHROOM COMPOST, TANKAGE RESIDUES)
3. SET TOP OF ROOT BALL FLUSH TO GRADE. DO NOT COVER THE TOP OF THE ROOT BALL WITH SOIL.
4. WATER THE PLANTING HOLE THOROUGHLY SUBSEQUENT TO INSTALLATION (I.E., TWICE WITHIN THE FIRST 48 HOURS)
5. DEEPLY WATER EACH PLANTING HOLE 1X/WK FROM A MOBILE POLY TANK ATOP A FARM TRUCK.

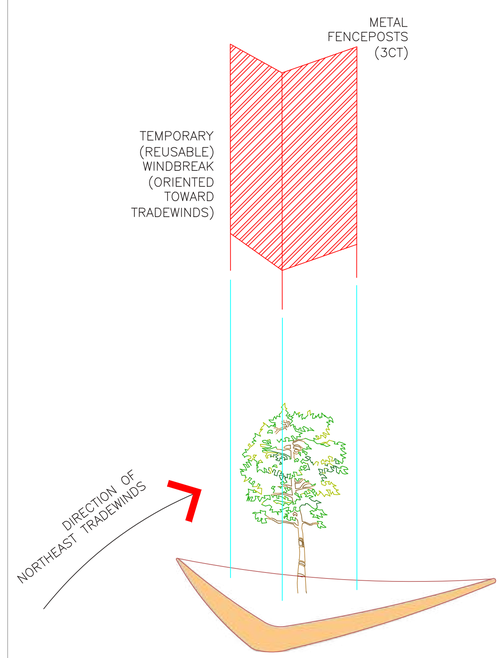
1 TREE PLANTING DETAIL: SECTION–ELEVATION B–B'

NOT TO SCALE



3 TREE PLANTING DETAIL: SECTION A–A'

NOT TO SCALE



NOTES:

REUSABLE WINDBREAK CONSTRUCTED OF LANDSCAPE FABRIC (WOVEN, HEAVY DUTY TYP.)

METAL FENCEPOSTS (48" LONG, EACH SECURED WITH 4CT HEAVY DUTY (REUSABLE) 14" ZIPTIES

4 TREE PLANTING & WINDBREAK DETAIL

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Tree Planting Details

Ka Maha 'Ulu o Koholālele

REVISIONS –
Revision 1 ..... 05/06/2022
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-021

PLANT SCHEDULE: FULL SITE

TREES	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY
		LONG TERM TIMBER TREES			
	CAL INO	Calophyllum inophyllum / True Kamani In-row spacing: 80'-0"	1 gal.	Pot	1,085
		GENERAL FARMSCAPE TREE			298
		GENERAL ORCHARD TREE			17
	ACA KO2	Acacia koaia / Koai'a	4"	dibble	3
	ALE MO3	Aleurites moluccanus / Kukui In-row spacing for pollarding: 10'-0"	1 gal.	Pot	1
	ART ALT	Artocarpus altilis / 'Ulu / Breadfruit In-row spacing: syntropic @ 30'-0"; 'Ulu wa'a @ 15'-0"; alley cropping @ 30'-0"	1 gal.	Pot	743
	BAM VUL	Bambusa vulgaris / 'Ohe Hawai'i	5 gal.	Pot	3
	CAL IN3	Calophyllum inophyllum / True Kamani	1 gal.	Pot	5
	CAL INO	Calophyllum inophyllum / True Kamani In-row spacing: 80'-0"	1 gal.	Pot	21
	CIB GLA	Cibotium glaucum / Hapu'u Pulu Tree Fern	4` Ht.	B.R.	59
	COC MAL	Cocos nucifera 'Malayan Dwarf' / Niu / Dwarf Coconut Palm	5 gal.	Pot	3
	COR SUB	Cordia subcordata / Kou Between-row spacing: 40'-0"	1 gal.	Pot	19
	DIO SAN	Diospyros sandwicensis / Lama In-row spacing: 80'-0"	1 gal.	Pot	15
	DOD HOP	Dodonaea viscosa / 'A'ali'i	1 gal.	Pot	33
	ERY SAN	Erythrina sandwicensis / Wiliwili Between-row spacing: 80'-0"	1 gal.	Pot	22
		Erythrina sandwicensis / Wiliwili Singular specimen tree	10 gal.	Pot	1
	GLI SE2	Gliricidia sepium / Madre de Cacao In-row spacing: 30'-0"	1 year	cutting (2" diameter)	551
	GLI SEP	Gliricidia sepium / Madre de Cacao In-row spacing: 40'-0"	1 year	cutting (2" diameter)	103
	ING EDU	Inga edulis / Ice Cream Bean In-row spacing: 40'-0"	forestry dibble	Seedling	120
	MET POL	Metrosideros polymorpha / 'Ōhi'a lehua	1 gal.	Pot	42
	MOR OLE	Moringa oleifera / Moringa / Kalamungai In-row spacing: 16'-0" (i.e., 8'-0" on either side of each 'ulu)	0.5"	Seedling	60
		Moringa oleifera / Moringa / Kalamungai In-row spacing for coppice: 7'-0"	forestry dibble	Seedling	52
	MUS BAN	Musa acuminata / Banana	1 gal.	Pot	36

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Plant Schedule (Full Site)

Ka Maha 'Ulu o Koholālele

REVISIONS —
Revision 1 ..... 05/06/2022
Revision 2 ..... 11/13/2022
FINAL 05/16/2023

L-022

NES SAN	Nestegis sandwicensis / ‘Olopua In-row spacing: varies	1 gal.	Pot	7
PAN TEC	Pandanus tectorius / Hala	5 gal.	Pot	7
PRI LAN	Pritchardia lanigera / Loulu Palm In-row spacing: varies	1 gal.	Pot	45
PSY HAW	Psychotria hawaiiensis / Kopiko In-row spacing: 80'-0"	1 gal.	Pot	31
PSY ODO	Psydrax odorata / Alahe`e In-row spacing: 80'-0"	1 gal.	Pot	19
SAN PAN	Santalum paniculatum / ‘Iliahi / Sandalwood In-row spacing: 80'-0"	forestry dibble	Pot	12
SAP OAH	Sapindus oahuensis / Lonomea	1 gal.	Pot	15
SYZ MAL	Syzygium malaccense / ‘Ōhi‘a ‘ai	1 gal.	Pot	3
THE POP	Thespesia populnea / Milo In-row spacing: 80'-0"	1 gal.	Pot	21

SHRUBS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	QTY
	ALT SIS	Alternanthera sissoo / Sissoo Spinach food crop; living mulch	4"	Pot	8
	BID MIC	Bidens micrantha / Ko‘oko‘olau medicinal crop; pollinator habitat	4"	Pot	3
	CAJ CAJ	Cajanus cajan / Pigeon Pea N-fixer; biomass; pol. habitat	0.5` Ht.	dibble	4
	CAP SAN	Capparis sandwichiana / Mai‘apilo	1 gal.	Pot	43
	CAP FRU	Capsicum frutescens / Hawaiian Chili Pepper aromatic pest confuser	4"	Pot	64
	CAR WA2	Carex wahuensis / O‘ahu Sedge	4"	Pot	1,112
	CHE OAH	Chenopodium oahuense / ‘Āweoweo	1 gal.	Pot	11
	CHR SU2	Chrysopogon zizanioides 'Sunshine' / Vetiver Grass In-row spacing: 3"	4"	Pot	18,566
	COR FRU	Cordyline fruticosa / Ti Plant biomass; cultural functions	1 gal.	Pot	153
	CUC AEM	Cucurbita moschata 'Seminole' / Seminole Pumpkin food; living mulch	4"	Pot	41
	CYM CIT	Cymbopogon citratus / Lemongrass food crop; biomass; living mulch	4"	Pot	21
	CYP JAV	Cyperus javanicus / Ahu`awa	4"	Pot	17
	DIA SNA	Dianella sandwicensis / 'Uki'uki	4"	Pot	34
	HIB ARN	Hibiscus arnottianus / Koki‘o ke‘oke‘o	1 gal.	Pot	16
	HIB BRA	Hibiscus brackenridgei / Ma'o hau hele	1 gal.	Pot	5
	HIB FUR	Hibiscus furcellatus / ‘Akiohala	1 gal.	Pot	45
	MIC STR	Microlepia strigosa / Palapalai spacing: 3'-0" O.C.	4"	Pot	86

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PROJECT —
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Plant Schedule
(Full Site, Cont.'d)

Ka Maha ‘Ulu
o Koholālele

REVISIONS —
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L-023

	MUS PAR	Musa x paradisiaca / Banana in-row spacing: 20'-0"	1 gal.	Pot		271
	NEP CRL	Nephrolepis cordifolia / Kupukupu Fern spacing: 18" O.C.	#1	Pot		4
		Nephrolepis cordifolia / Kupukupu Fern spacing: 18" O.C.	4"	Pot		455
	PIP MET	Piper methysticum / 'Awa in-row spacing: 3'-0"	1 gal.	Pot		1,244
	PIP ALB	Pipturus albidus / Māmaki in-row spacing: 3'-0"	0.5` Ht.	dibble		707
	SAC SU2	Saccharum officinarum / Sugar Cane in-row spacing for coppice: 8'-0"	1 gal.	Pot		48
	SCA TAC	Scaevola taccada / Naupaka Kahakai Spacing: 8'-0" O.C.	1 gal.	Pot		100
	SES SES	Sesbania sesban / Egyptian Riverhemp N-fixer; biomass; pol. habitat	0.5` Ht.	dibble		40
	SOR XDR	Sorghum x drummondii / Sudan grass in-row spacing: 1.5'	0.5` Ht.	dibble		928
	SYM B14	Symphytum x uplandicum 'Bocking 14' / Bocking 14 Comfrey biomass; living mulch	0.5` Ht.	B.R.		6
	VIG MAR	Vigna marina / Nanea nitrogen fixer; pollinator habitat; living mulch	0.5` Ht.	dibble		2
	VIT ROT	Vitex rotundifolia / Pōhinahina slope stabil.; pollinator habitat; living mulch	0.5` Ht.	Pot		4
	WIK UVA	Wikstroemia uva-ursi / ‘Ākia Spacing: 5'-0" O.C.	1 gal.	Pot		114
SHRUB AREAS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	DENSITY	QTY
		NATIVE FERN GROUND COVER MIX				33,797 sf
	DIP WAR	Diplazium esculentum / Warabi Fern	4"	Pot	0.1/sq.ft.	588
	DIP OUW	Diplazium sandwichianum / ho‘io	4"	Pot	0.1/sq.ft.	588
	MIC ST2	Microlepia strigosa / Palapalai Fern	4"	Pot	0.1/sq.ft.	1,173
	NEP CR2	Nephrolepis cordifolia / Kupukupu Fern	4"	Pot	0.5/sq.ft.	6,245
	COL ES2	Colocasia esculenta / Green Taro in-row spacing: 2.25‘	0.5` Ht.	huli	0.2/sq.ft.	5,702
	PIP ME2	Piper methysticum / ‘Awa	1 gal.	Pot	0.1/sq.ft.	9,288
	PLU ZE2	Plumbago zeylanica / ‘Ilihe‘e Spacing: 3'-0" O.C.	1 gal.	Pot	0.1/sq.ft.	208
GROUND COVERS	CODE	BOTANICAL / COMMON NAME	SIZE	CONTAINER	SPACING	QTY
		COASTAL COVER CROP MIX				29,804 sf
	CRO JUN	Crotalaria juncea 'Tropic Sun' / 'Tropic Sun' sunn hemp	seed			7,451 sf
	FAG ESC	Fagopyrum esculentum / Buckwheat	seed			7,451 sf
	HEL TED	Helianthus annuus / Sunflower	seed			2,980 sf
	LOL MUL	Lolium multiflorum / Annual ryegrass	seed			7,451 sf
	VIG UNG	Vigna unguiculata / Cowpea	seed			4,471 sf
	LOL MUL	Lolium multiflorum / Annual ryegrass	seed			12,774 sf

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Plant Schedule (Full Site, Cont.’d)

Ka Maha ‘Ulu o Koholālele

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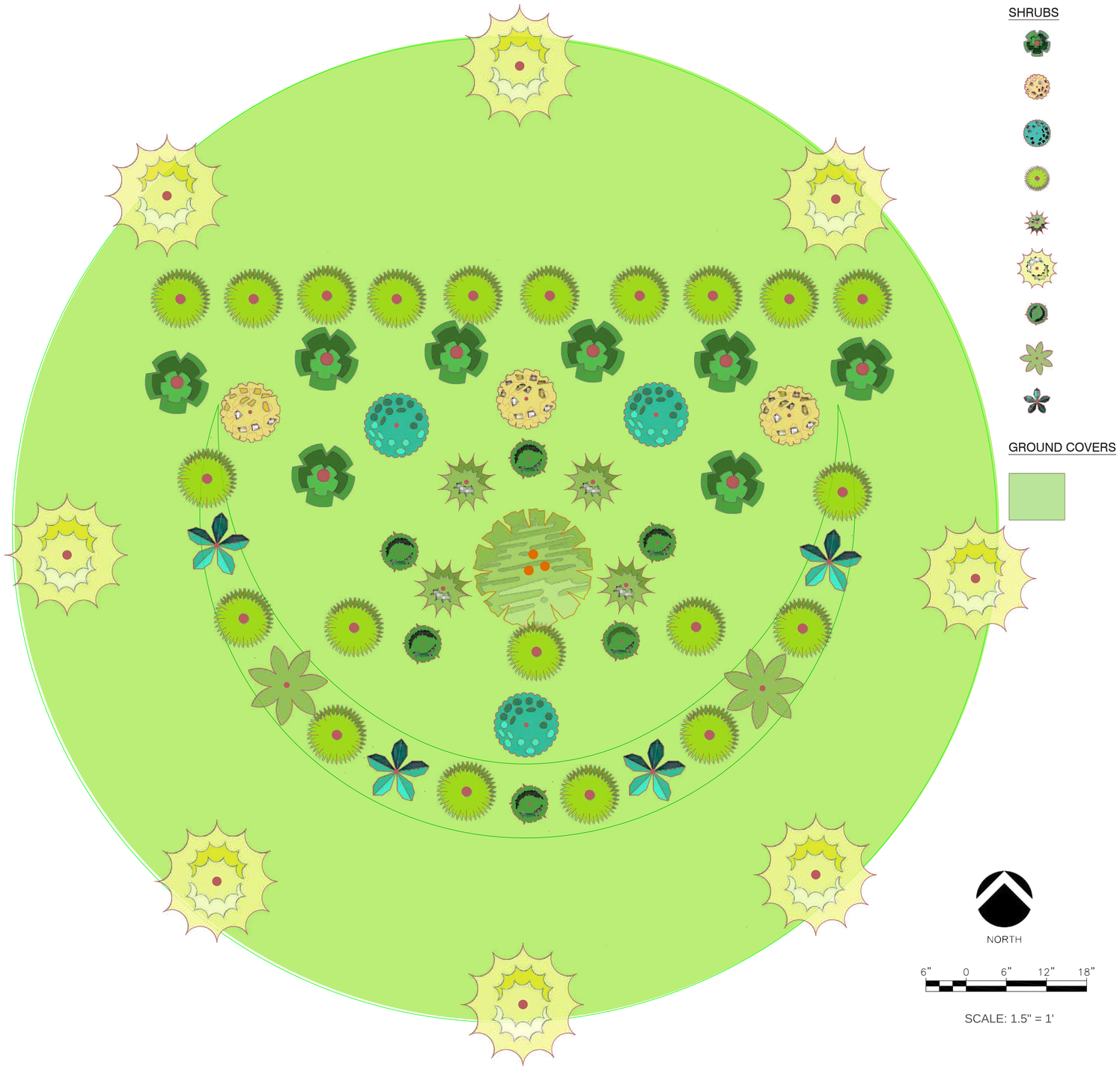
L-024



PLANT SCHEDULE: ULU POLYCULTURE

TREES	CODE	BOTANICAL / COMMON NAME	QTY
	ART AL3	Artocarpus altilis / ‘Ulu / Breadfruit In-row spacing: 40'-0"	1

SHRUBS	CODE	BOTANICAL / COMMON NAME	QTY
	ALT SIS	Alternanthera sissoo / Sissoo Spinach food crop; living mulch	8
	BID MIC	Bidens micrantha / Koʻokoʻolau medicinal crop; pollinator habitat	3
	CAJ CAJ	Cajanus cajan / Pigeon Pea nitrogen fixer; biomass; pollinator habitat	3
	CYM CIT	Cymbopogon citratus / Lemongrass food crop; biomass; living mulch	21
	NEP CRL	Nephrolepis cordifolia / Kupukupu Fern spacing: 18" O.C.	4
	SES SES	Sesbania sesban / Egyptian Riverhemp nitrogen fixer; biomass; pollinator habitat	8
	SYM B14	Symphytum x uplandicum 'Bocking 14' / Bocking 14 Comfrey biomass; living mulch	6
	VIG MAR	Vigna marina / Nanea nitrogen fixer; pollinator habitat; living mulch	2
	VIT ROT	Vitex rotundifolia / Pōhinahina slope stabil.; pollinator habitat; living mulch	4

GROUND COVERS	CODE	BOTANICAL / COMMON NAME	QTY
	LOL MUL	Lolium multiflorum / Annual ryegrass	119 sf

A biodiverse mix of multipurpose flora, this polyculture plant palette can be installed around virtually every new tree planting, anywhere across the Koholālele ahupuaʻa. The fast maturing Egyptian riverhemp quickly bestows shade (and nitrogen) upon the ‘ulu sapling, empowering it to thrive. Other support species within this polyculture facilitate nutrient cycling, low maintenance ground coverage, erosion mitigation, as well as edible/medicinal yields.

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‘Ulu Polyculture Detail / Schedule

Ka Maha ‘Ulu o Koholālele

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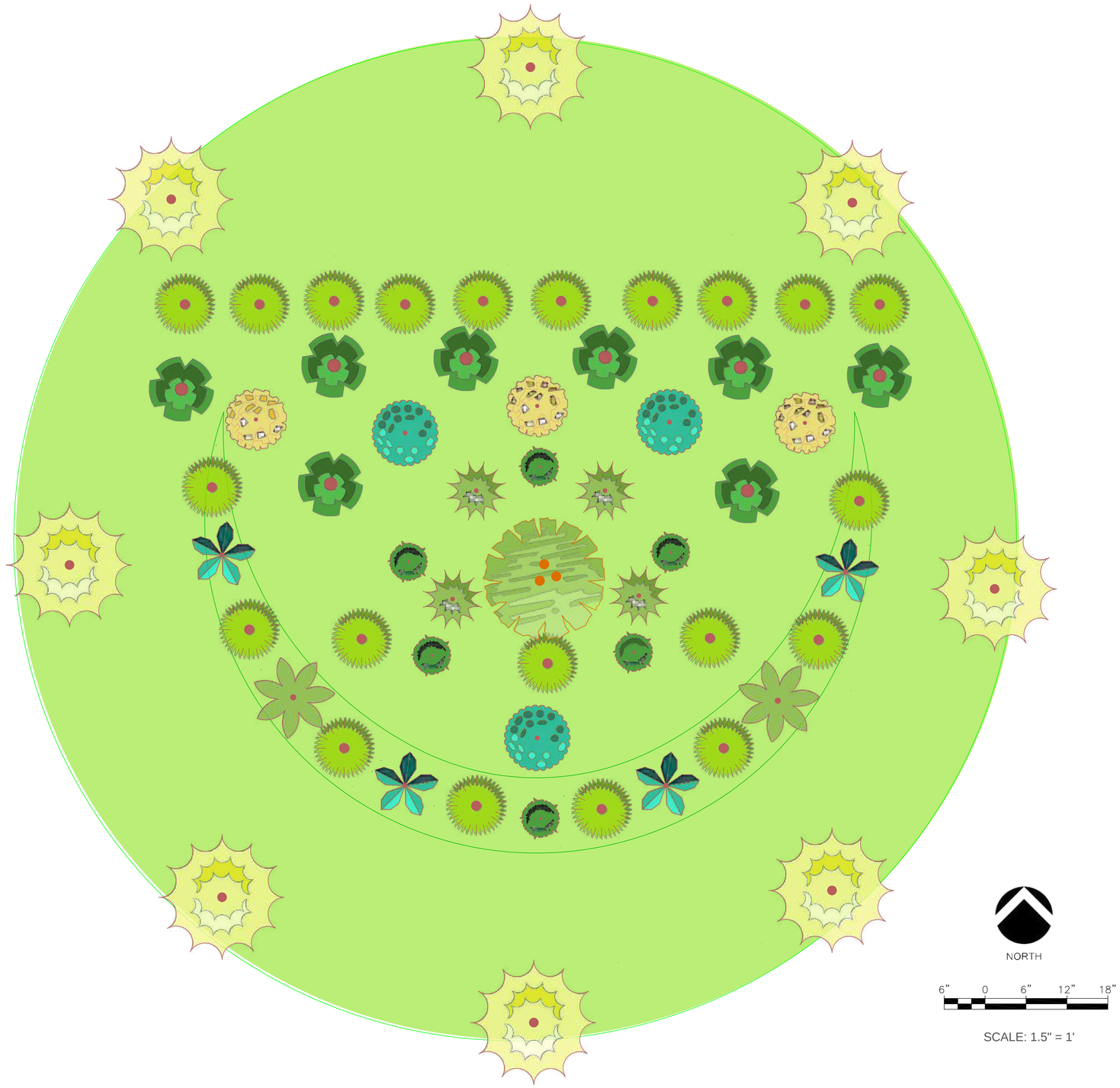

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'Ulu Polyculture (Plan View)

Ka Maha 'Ulu o Koholālele

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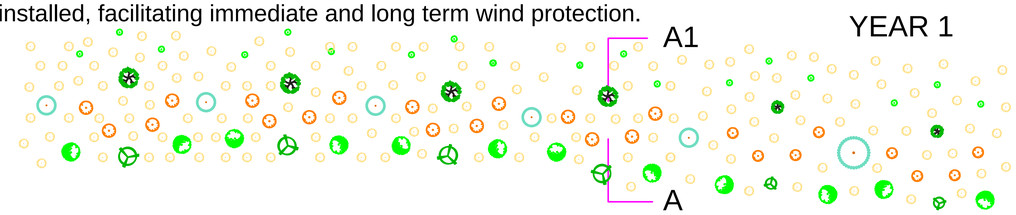
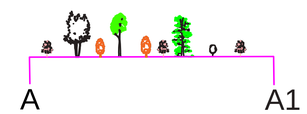
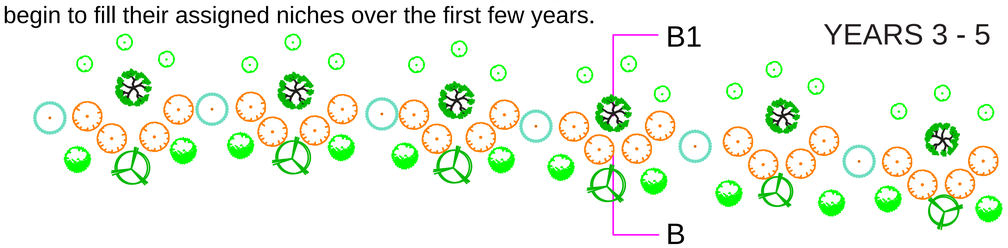
L-026

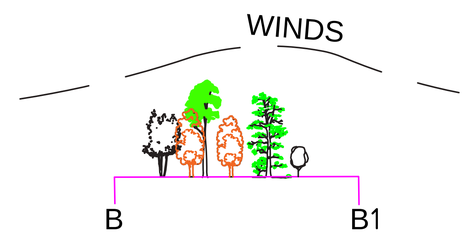
A diversity of pioneer, medium term, and long-lived plants are installed, facilitating immediate and long term wind protection.



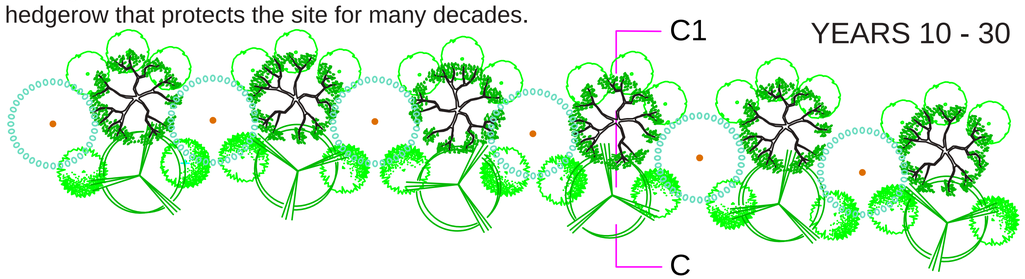


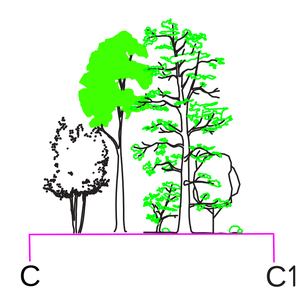
The various species of plants nested within the young windbreak begin to fill their assigned niches over the first few years.



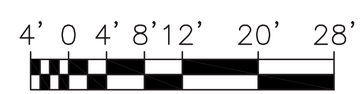


The agroecosystem evolves into a mature multifunctional hedgerow that protects the site for many decades.





Graphic adapted from: “The Resilient Farm & Homestead”, by Ben Falk



1/16" = 1'-0"

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WIndbreak Estab. Schematic

Ka Maha ‘Ulu o Koholālele

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L-027

NORTH

0' 100' 300' 500'

1" = 150'

Contour interval shown is 10'-0".
Derived from LiDAR on March 7, 2022.

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Implementation Timeline

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