

STATE OF HAWAII
HAWAII COMMUNITY DEVELOPMENT AUTHORITY
Heeia Community Development District

November 7, 2018

**SUBJECT: Update by Townscape, Inc. on the Heeia Community
Development District (“CDD”) Plan**

Background:

On July 8, 2011, Act 210 was signed into law creating the Heeia Community Development District (“CDD”). The HCDA was designated as the local redevelopment authority of the district to facilitate culturally appropriate agriculture, education, and natural-resource restoration and management of the Heeia wetlands.

Pursuant to Hawaii Revised Statutes (“HRS”) Chapter 206E-5, *Designation of community development districts, community development plans*, the Authority shall develop a community development plan for the designated district. The plan shall include but not be limited to, community development guidance policies, district-wide improvement program and community development rules.

At its meeting of June 7, 2017, the Authority approved the expenditure of funds to retain a consultant to develop a plan and administrative rules for the Heeia CDD. On September 12, 2017, a consultant contract was executed between the HCDA and Townscape, Inc. to prepare the Heeia CDD Plan and Rules.

Discussion:

Project consultant Townscape, Inc. has prepared a Working Draft of the Heeia CDD Plan (“Working Draft Plan”) which is based on background research of Heeia and the Heeia ahupuaa; analysis of site resources and constraints; and consultations with stakeholders, community members, and government agencies including the He`eia CDD Task Force, Kaneohe, Kahaluu and Kailua Neighborhood Boards. The Working Draft Plan is consistent with development guidance policies of HRS Chapter 206E-203, Heeia Community Development District, Policies to Guide Development. A copy of the Working Draft Plan is provided as Exhibit A.



The He'eia Community Development District Plan & Rules

**DRAFT REPORT
OCTOBER, 2018**

Prepared by:
TOWNSCAPE, INC
Prepared for:
HAWAII COMMUNITY DEVELOPMENT AUTHORITY

Prefatory Remarks on Language and Style

A Note about Hawaiian and other non-English Words:

This report recognizes that the Hawaiian language is an official language of the State of Hawai'i. Therefore, Hawaiian words are not italicized. However, other non-English and non-Hawaiian words are italicized. Hawaiian words are parenthetically translated or defined in the text at first mention.

List of Acronyms

AIS	Archaeological Inventory Survey
AMSL	Above Mean Sea Level
BLNR	Board of Land and Natural Resources
CSH	Cultural Surveys Hawai'i, Inc.
CZM	Coastal Zone Management
CWB	Hawai'i State Department of Health's Clean Water Branch
DLNR	Department of Land and Natural Resources
DOH	Department of Health
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographical Information Systems
HAR	Hawai'i Administrative Rules
HIMB	Hawai'i Institute of Marine Biology
HRS	Hawai'i Revised Statutes
KEEP	K-12 Estuary Education Program
KPSCP	Ko'olau Poko Sustainable Communities Plan
KPWMP	Ko'olau Poko Watershed Management Plan
LCAs	Land Commission Awards
NERR	He'eia National Estuarine Research Reserve
NOAA	National Oceanic and Atmospheric Administration
NRCS	U.S. Department of Agriculture, Natural Resources Conservation Service
PRCP	Polluted Runoff Control Program
SFHA	Special Flood Hazard Area
SHPD	State Historic Preservation Division
SMA	Special Management Area
SWMP	System Wide Monitoring Program
TMK	Tax Map Key
TSI	Townscape, Inc.
TOTE	Teachers on the Estuary
WWII	World War II

EXECUTIVE SUMMARY

This report, The He'eia Community Development District Plan and Rules, represents the roadmap to guide the long-term development and management of the He'eia Community Development District (He'eia CDD), to achieve the overarching vision: "*Recognizing the value of ahupua'a management principles, promote, and cultivate 'āina momona (abundance) in these lands of He'eia for present and future generations, through culturally appropriate agriculture, education, and natural resources restoration and management.*" In 2011, the state legislature established the He'eia Community Development District and designated the Hawai'i Community Development Authority (HCDA) as its redevelopment authority through Hawai'i Revised Statute (HRS) Chapter 206E-201. This policy also required the development of a master plan and rules to govern the He'eia CDD. Therefore, this report also serves to satisfy the requirements of this legislative mandate.

The He'eia CDD consists of 409 acres of prime agricultural lands with a rich history and culture unique to He'eia Ahupua'a, as well as an important and prominent wetland system with significant ecosystem value on the windward side of the Island of O'ahu. This plan highlights the existing conditions, value, and opportunities of the District, as well as challenges that may limit the ability to achieve the vision for the land. Consultations with local communities, kūpuna, state agencies, and important stakeholders of He'eia indicate that the He'eia CDD can potentially support agricultural practices to restore food security to the region; serve as an invaluable venue for place-based education and research; support and provide opportunities for the practice and perpetuation of traditional Native Hawaiian culture; and also promote and support the restoration and management of the He'eia Wetlands to serve as a model for ahupua'a-based management. However, community members were concerned that the Urban District designation of the He'eia CDD, could potentially undermine the vision and goals for the District in the long-term and recommended that the property be protected for agriculture in perpetuity.

To achieve the vision and goals for the He'eia CDD, this plan proposes a land use plan that re-classifies the District into three main land divisions or zones with appropriate uses for each zone. The process of re-zoning the land considered the physical characteristics of the land, the State Land Use (SLU) District boundaries, as well as maximizing the ability to support priority activities for the District of agriculture, cultural practices, education, and resource management activities. The plan also proposes an infrastructure plan to guide infrastructure development to support facilities and activities within the District, such as roadways, potable water supply, sewer system, electrical system, and telecommunications. The infrastructure plan includes a budget and implementation plan.

Finally, the plan recommends pursuing an Agricultural Conservation Easement for the He'eia CDD to provide additional protection for the lands of the District against urban development and to ensure the long-term protection of the District for the priority activities for the land, as proposed in HRS Chapter 206E. The easement would restrict specific urban development activities in the District in the long-term.

Table of Contents

EXECUTIVE SUMMARY

1	INTRODUCTION	8
1.1	Background.....	8
1.2	Purpose	9
1.3	Vision and Goals.....	10
1.4	Planning Process.....	10
1.4.1	Background Research	11
1.4.2	Consultations	11
2	CONTEXT.....	14
2.1	Regional Setting.....	14
2.1.1	Project Area Location	14
2.1.2	He'eia Ahupua'a and Watershed	14
2.1.3	Population and Socio-Economic Profile	14
2.1.4	Major Landowners.....	17
2.1.5	State Land Use District.....	17
2.1.6	Zoning	17
2.1.7	Special Management Area (SMA).....	17
2.2	Consistency with Regional Policies and Plans	17
2.2.1	Ko'olau Poko Sustainable Communities Plan (KPSCP)	17
2.2.2	Ko'olau Poko Watershed Management Plan (KPWMP).....	19
2.2.3	He'eia National Estuarine Research Reserve	19
3	PHYSICAL ENVIRONMENT.....	23
3.1	Overview	23
3.2	Topography & Geology.....	23
3.3	Soil	23
3.4	Vegetation.....	26
3.5	Protected Species and Habitat.....	26
3.5.1	'Alae 'Ula or Hawaiian gallinule (Figure 9)	27
3.5.2	Koloa or Hawaiian Duck (Figure 10)	27
3.5.3	'Alae Kea or Hawaiian Coot (Figure 11).....	27
3.5.4	Ae'o or Hawaiian Stilt (Figure 12).....	27
3.6	Hydrology.....	28

3.6.1	Surface Water	28
3.6.1	Groundwater	32
3.6.2	Flooding	32
3.6.3	Water Quality	32
3.7	Climate Change	33
3.8	Sea Level Rise (SLR)	33
3.9	Recommendations	35
4	CULTURAL ENVIRONMENT	38
4.1	Kūpuna Reflections of He‘eia	39
4.2	Wahi Pana (Place Names) and Mo‘olelo (Stories).....	42
4.3	Cultural Sites of He‘eia	44
4.4	Historical Time Line at He‘eia since 1780	44
4.4.1	Kuleana Parcels	48
4.5	Recommendations	48
5	PRINCIPLES OF LAND USE FOR HE‘EIA	50
5.1	Overview	50
5.2	Natural Systems Restoration	50
5.2.1	Ahupua‘a: Traditional Management System.....	50
5.2.2	Models for Ahupua‘a-based Management	51
5.2.3	Vegetation Restoration.....	52
5.2.3.1	<i>Invasive Vegetation Removal</i>	52
5.2.4	Restore Stream ‘Auwai in the District	52
5.3	Climate Change & Sea Level Rise	53
5.4	Economic Programs.....	53
5.4.1	Value-Added Products	54
5.4.2	Agroforestry.....	54
5.4.3	Agritourism	55
5.5	Social Programs.....	55
5.5.1	Culture.....	55
5.5.2	Education and Research.....	56
5.5.3	Community Engagement	57
6	LAND USE PLAN AND DEVELOPMENT GUIDELINES	60
6.1	Overview	60
6.2	Land Use Plan.....	60

6.2.1	Description of Land Use Division Zones and Uses	62
6.2.2	KULA UKA (Uplands)	62
6.2.3	KULA KAI (Lowlands).....	65
6.2.4	LOKO I'A KALO (Wetlands)	67
6.3	Development Guidelines	67
6.3.1	Lo'i and Loko I'a Design Framework.....	67
6.3.2	Roadways Guidelines.....	69
6.3.3	Sustainable Site Development Guidelines.....	69
7	INFRASTRUCTURE [To be fill in once Infrastructure plan is done].....	71
7.1	Roadways	71
7.2	Drainage.....	71
7.3	Potable Water Supply	71
7.4	Sewer System	71
7.5	Electrical System	71
7.6	Telecommunications	71
8	RECOMMENDATIONS AND IMPLEMENTATION	71
8.1	Regulatory Coordination and Approvals	71
8.2	Project Phasing.....	71
9	REFERENCES	71

1 INTRODUCTION

1.1 Background

The Legislative Act 210 of 2011 established the He'eia Community Development District, hereafter referred to as the He'eia CDD or the District, through Hawai'i Revised Statute (HRS) Title 13, Chapter 206E-201. The District consists of 409 acres of land in He'eia of which 406 acres were acquired by the Hawai'i Community Development Authority (HCDA) in 1991 through a land exchange with the Bishop Estate. HRS Chapter 206E-201 also established the HCDA as the local redevelopment authority of the District to facilitate culturally appropriate agriculture, education, and natural-resource restoration and management of the He'eia wetlands, in alignment with the Honolulu Board of Water Supply's most current "Koolau Poko Watershed Management Plan" and the City and County of Honolulu's "Koolau Poko Sustainable Communities Plan." The following lists the provisions of HRS Chapter 206E:203 to guide development in the District:

- Development shall be in accordance with the He'eia Master Plan, except as it conflicts with the Hawaii State Constitution and the Hawaii Revised Statutes;
- With the approval of the governor, and in accordance with law, the authority, upon the concurrence of a majority of its voting members, may modify and make changes to the He'eia master plan to respond to changing conditions; provided that prior to amending the He'eia master plan, the authority shall conduct a public meeting pursuant to Chapter 92 to inform the public of the proposed changes and receive public input;
- The authority shall provide, to the extent feasible, maximum opportunity for the restoration and implementation of sustainable, culturally appropriate, biologically responsible, or agriculturally beneficial enterprises;
- The authority may engage in planning, design, and construction activities within and outside the District; provided that activities outside the District shall relate to infrastructural development, area-wide drainage improvements and sediment transport mitigation, roadway realignments and improvements, and other activities the authority deems necessary to carry out redevelopment of the District and implement this part. Studies or coordinating activities may be undertaken by the authority in conjunction with the county and appropriate federal and state agencies and may address infrastructural systems, natural-resource systems, and other activities;
- Planning, replanning, rehabilitation, development, re-development, and other preparations for the restoration of cultural practices, education, natural resources, and agriculture related activities shall be pursued;
- Hawaiian archaeological, historic, and cultural sites shall be preserved and protected to the extent feasible while allowing for continued use of the property for cultural activities, education, agricultural and economic pursuits, and natural-resource restoration;
- Endangered species of flora and fauna shall be preserved and protected to the extent feasible;
- Land use and redevelopment activities within the District shall be coordinated with and, to the extent possible, complement existing County and State policies, plans, and programs affecting the District;

-
- Public facilities within the District shall be planned, located, and developed to support the redevelopment policies established by this part for the district, the master plan approved by the governor, and rules adopted pursuant to this chapter; and
 - Special management area permit administration for the District shall be under the authority of the City and County of Honolulu.

Traditionally, the lands of He'eia Ahupua'a was known as among the most agriculturally productive lands on the island of O'ahu (Handy and Handy 1972). The frequent rainfall, ample streams, broad valley bottoms, and flatlands between the mountains and the sea, provided ideal conditions for agriculture in He'eia. Although extensive salt marshes that were unsuitable for agriculture characterized the immediate inland areas of the fishponds along the coast, vast terraces of lowland flats fringed these marshes. These flats flanked both sides of He'eia Stream where land was irrigated for lo'i cultivation. Prior to the arrival of Captain Cook, battles of conquest were fought, suggesting that these lands were highly desired because of the abundance of food afforded by large walled fishponds and expansive taro lands.

The rich agricultural production of He'eia likely attracted and supported the establishment of a significant population center where a unique cultural heritage developed, as evidenced by He'eia's many cultural sites (Handy and Handy 1972:272). The richness of the region was attributed to a functioning water system that flowed throughout the ahupua'a from the valleys of Ha'ikū and 'Ioleka'a, through the marshes of He'eia, to Kāne'ohe Bay. Over time, these lands went through various cycles of agricultural cultivation of kalo, sugarcane, pineapple, rice, and cattle grazing particularly between the 1800s to 1900s. Changes in the socio-political environment in Hawai'i since the Great Māhele, also contributed to practices that have significantly changed the ecology of the lands of He'eia and impacted the health of its water system. Today, erosion, flooding, and increased runoff during heavy rain events, as well as the replacement of native species by invasive alien vegetation and fauna, have threatened the health and productivity of sites downstream of He'eia Stream. Modern boundaries have also demarcated this system into separate land units with numerous land owners and uses making it challenging to implement traditional ahupua'a-based land management strategies that were once highly effective.

Despite the many changes that time has brought to He'eia, kalo has remained an important element in the identity and memories of its people. Kūpuna and lineal descendants of He'eia, described the landscape of He'eia as a rural place where people worked the land and common practices consisted of taro cultivation, cattle ranching, and raising livestock. "Everything was lo'i, pastures, and farms.... This place was full of lo'i," a kupuna of He'eia recalled. Consultations with members of the He'eia community revealed that deep aloha for the land is shared by many who dedicate their lives to creating a legacy of stewardship of the lands of He'eia for future generations. Many expressed that they would like to see lo'i terraces characterize the He'eia landscape once again and become a center for kalo production and agriculture, bringing back food abundance and security to the region.

1.2 Purpose

The purpose of the He'eia Community Development District Plan is to fulfill the provisions of HRS Chapter 206E which requires that a master plan is developed following the establishment of the He'eia Community Development District. This plan is intended to serve as a roadmap to guide

the long-term development and the management of the District. The plan states the vision and goals for the District; characterizes past and existing conditions of the District; highlights the priority uses for the District; and proposes strategies for achieving the District's vision and goals.

1.3 Vision and Goals

Vision: *Recognizing the value of ahupua'a management principles, promote, and cultivate 'āina momona (abundance) in these lands of He'eia for present and future generations through culturally appropriate agriculture, education, and natural resources restoration and management.*

To achieve this vision, several goals for the He'eia CDD are summarized in Table 1. These goals are consistent with the provisions of HRS Chapter 206E.

Table 1. Goals for the He'eia Community Development District

Goals: HE'EIA COMMUNITY DEVELOPMENT DISTRICT (GUIDED BY HRS CHAPTER 206E)
Goal 1: Plan land use and redevelopment activities in accordance with and complementing existing County and State policies, plans and programs affecting the District where applicable
Goal 2: Protect and preserve Hawaiian archaeological, historic, and cultural sites, to the extent feasible, while allowing for continued use of the property to achieve the District's vision
Goal 3: Protect and preserve endangered flora, fauna, and their habitats to the extent feasible
Goal 4: Develop public facilities and infrastructure to support the development of the District that are consistent with the District's vision
Goal 5: Provide and support opportunities for enterprises that are sustainable, culturally appropriate, biologically responsible, or agriculturally beneficial
Goal 6: Collaborate with Federal, State, County and other agencies and stakeholders as deemed necessary to carry out the redevelopment of the District, consistent with the District's vision

1.4 Planning Process

In September 2017, the HCDA contracted Townscape, Inc., a private environmental planning firm, to develop the He'eia Community Development Plan and Rules. Townscape adopted a community-based approach and took approximately twelve months to develop the plan. The process of developing the plan consisted of closely following the provisions of HRS Chapter 206E, frequent consultations with HCDA staff and board members, data collection, synthesis of data collected, and writing the plan. Data collection occurred in two phases which consisted of literature research and consultations, described below.

1.4.1 Background Research

Literature research was conducted to understand past and existing conditions of the He'eia CDD. Threats and challenges to existing resources were also identified, as well as opportunities for future development and engagement. Previous research studies, as well as plans and policies relating to the District, such as the Ko'olau Poko Watershed Management Plan and the Ko'olau Poko Sustainable Communities Plan were reviewed, and maps were developed in Geographical Information Systems (GIS) software to better understand and characterize the site. Background research began in September, 2017, and continued over the course of the project.

1.4.2 Consultations

A series of consultations were conducted to collect information about the District through informal talk-story sessions, as well as more formal meetings. Informants came with diverse backgrounds and included kūpuna (elderly) and kama'āina (native) of He'eia, non-profit organizations and government agencies that are associated with He'eia, major land owners and residents of He'eia, taro farmers, as well as experts in the fields of hydrology, flood control, and water quality. Formal meetings consisted of regular meetings with the HCDA He'eia authority members, Kāko'o 'Ōiwi board members, presentations to major stakeholders, as well as the neighborhood boards of Kāne'ohe, Kailua, and Kahalu'u. A community meeting was also held to gather information from the He'eia community about the plan, as well as feedback on preliminary ideas and land use concepts for the District. Approximately 140 individuals participated in consultations.

Consultations revealed strong and unanimous support for the restoration of the lands of the He'eia CDD and goals to bring back agricultural practices that traditionally characterized He'eia. Community members shared important attributes of the lands of the He'eia CDD, the opportunities, and potential of the land to support and improve quality of life in He'eia. Many expressed the desire to protect these lands against development in the long-term. The following are some themes that emerged about the lands of the He'eia CDD:

Values & Opportunities:

- Rich lands historically and culturally;
- Potential to support education and cultural programs;
- He'eia could be a model for implementing ahupua'a-based management;
- Water is the source of richness;
- Strong community stakeholders;
- He'eia can be a land of "āina momona";
- Ideal place to support agriculture and food sovereignty for He'eia and for Hawai'i

Potential threats and concerns were also identified that could undermine the long-term vision of the He'eia CDD. These included pollutants impacting the waters of the He'eia CDD, such as:

- wastewater from cesspools in nearby residential areas;
- heavy metals from Kahekili Highway;
- and pollutants from facilities development on-site.

The greatest community concern expressed was the Urban District designation of the He'eia CDD. In the 1960s, urban development plans were proposed to turn the He'eia Wetlands into a

marina and resort that would mimic the existing marina at Hawai'i Kai. The issue prompted significant opposition from communities in He'eia and Ko'olau Poko who came together and successfully fought for the protection of the wetlands from urban development. Therefore, this history has shaped strong sentiments for the protection of the He'eia Wetlands against urban development among communities of He'eia and Ko'olau Poko. Therefore, many community members feared that the urban designation of the majority of the property leaves room for possible urban development in the District in the future. Many wanted the He'eia CDD to remain a site for agriculture and recommended that the property be protected for agriculture in perpetuity.

CHAPTER 2:

The Context



2 CONTEXT

2.1 Regional Setting

2.1.1 Project Area Location

The He'eia Community Development District, is located in the ahupua'a and watershed of He'eia, in the district of Ko'olau Poko, on the windward side of the island of O'ahu (Figure 1 and Figure 2). The District consists of approximately 409 acres of land situated on Tax Map Key (TMK) parcel numbers: 4-6-16:001; 4-6-16:002; 4-6-16:004; 4-6-16:011; 4-6-16:012; and 4-6-16:017. The District is bounded on the east by Kamehameha Highway, on the south by Crown Terrace subdivision, Kahekili Highway to the west, and parcels of private property in the north. He'eia Fishpond and the He'eia State Park are located adjacent to the District on the makai (seaward) side of Kamehameha Highway. Located on lowland flats, the Project area is approximately 15 to 24 meters (50 to 80 feet) above mean sea level.

2.1.2 He'eia Ahupua'a and Watershed

He'eia Ahupua'a is one of 11 ahupua'a that make up the district of Ko'olau Poko and is one of the nine ahupua'a of the district bordering Kāne'ohe Bay. He'eia Ahupua'a is approximately 4,200 acres and extends from the ridges of the Ko'olau Mountains above the valleys of Ha'ikū and 'Ioleka'a, to the northwestern portion of Mōkapu Peninsula on Moku o Lo'e (Coconut Island). Thus, the ahupua'a is unique in that it includes portions of Moku o Lo'e across Kāne'ohe Bay. He'eia Ahupua'a is bounded by Kāne'ohe Ahupua'a to the west and Kahalu'u Ahupua'a to the east. The He'eia Watershed is slightly smaller than He'eia Ahupua'a and consists of 2,240 acres or 3.5 square miles which extends from the peaks of the Ko'olau mountains, including the valleys of Ha'ikū and He'eia, to Kāne'ohe Bay, as shown in Figure 2 (Parham et al. 2008).

2.1.3 Population and Socio-Economic Profile

He'eia is a relatively small place with an older, educated, and affluent population compared to the rest of the Hawai'i. In 2017, He'eia's population was 4,536 (2017). In 2016, the population of He'eia decreased by 8.6% since 2010 and population density in 2017 was 1,736 people per square mile. The median age in He'eia was 52.8 years old with more than half (54.5%) of its residents 50 years and older. Approximately 16.4 % of the population was less than 20 years of age. In the same year, the average family size was 3.3. Approximately 96% of the He'eia population graduated from high school and about 44% of residents obtained a Bachelor's degree. The median household income in He'eia was approximately \$110,250 which exceeded both the median household income in the State of Hawai'i (\$71,977) and the United States (\$55,322). Only 1.4 % of the He'eia population was in poverty.

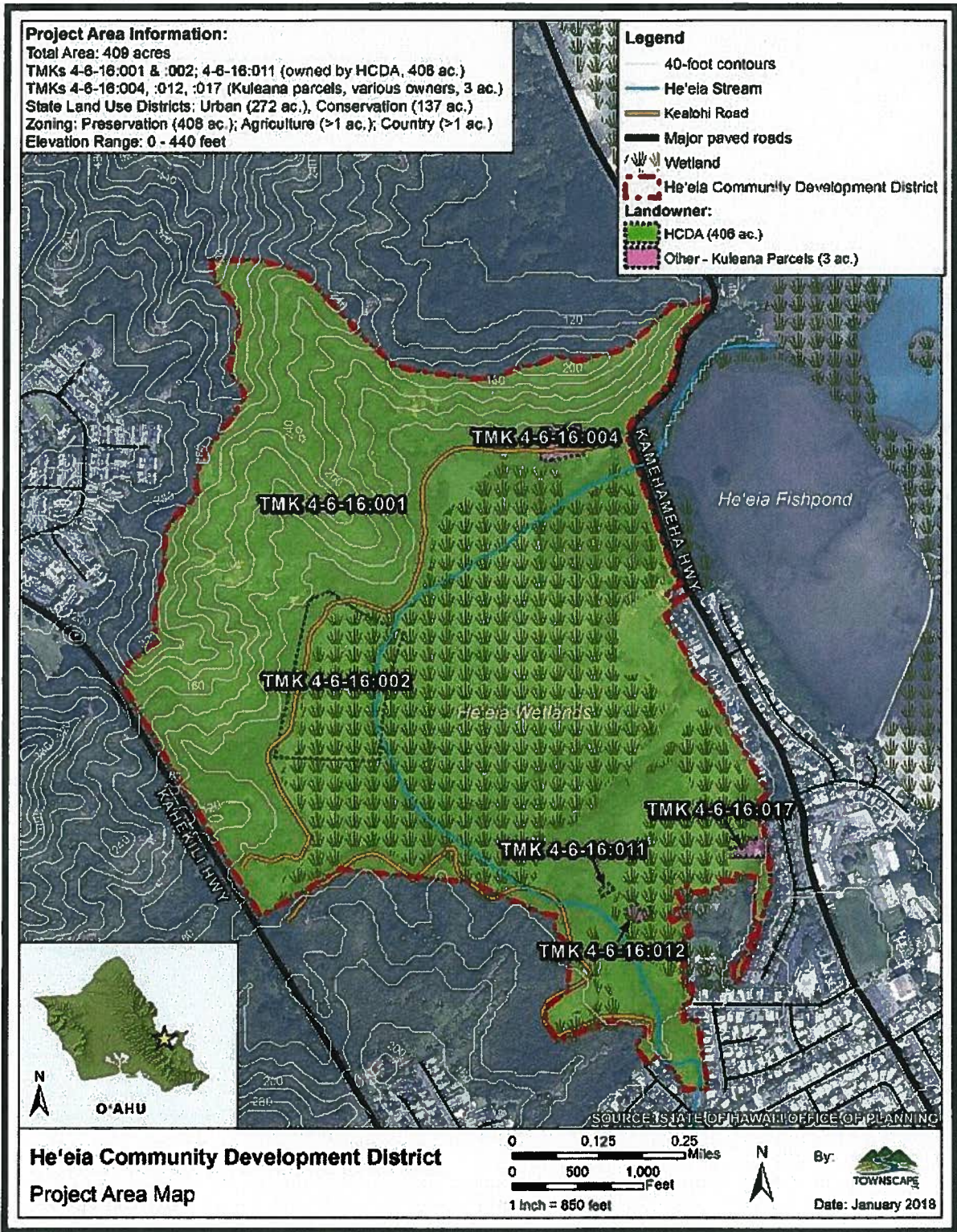


Figure 1. He'eia Community Development District

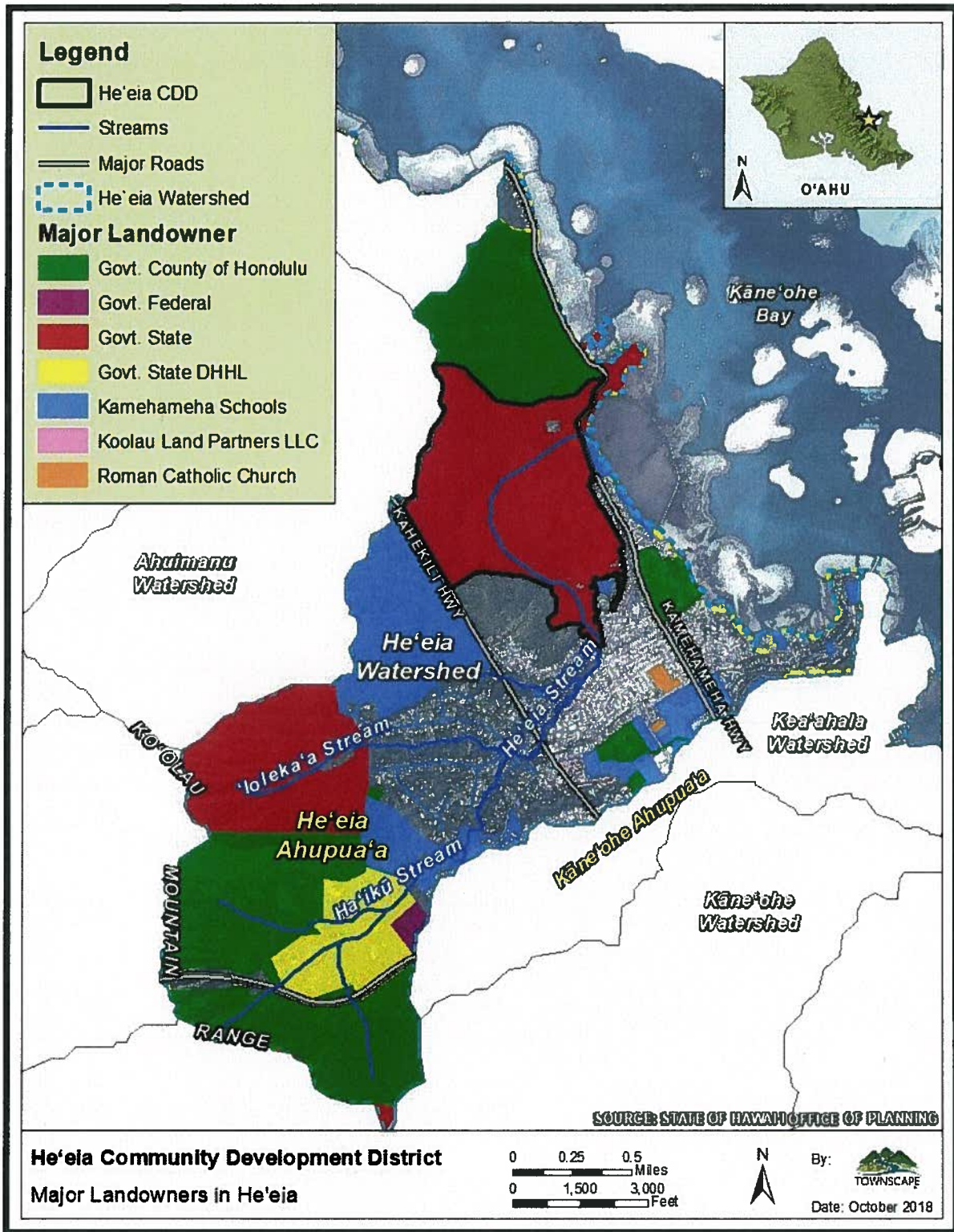


Figure 2. Major Landowners in He'eia

2.1.4 Major Landowners

In addition to the HCDA, several major landowners own significant amounts of land in the He'eia Watershed, as shown in Figure 2. Some major landowners include:

- The State of Hawai'i
- The State of Hawai'i's Department of Hawaiian Home Lands
- The City and County of Honolulu
- The Federal Government of the United States of America
- Kamehameha Schools
- Koolau Land Partners LLC
- Roman Catholic Church

2.1.5 State Land Use District

The majority of the He'eia CDD is within the State's Land Use District's Urban District and the remaining portion of the property is in the Conservation District, as shown in Figure 3. The portion of property in the Conservation District is classified as "General," the least restrictive of all sub-zones of the Conservation District. Therefore, these lands are subject to all applicable State Land Use District laws.

2.1.6 Zoning

HRS 206E-7 provides that the HCDA shall establish community development rules on health, safety, building, planning, zoning and land use within a community development district. Final adoption of a community development plan will supersede all other inconsistent ordinances and rules relating to use, zoning, planning, and development of land within the community development district. Therefore, the City and County of Honolulu zoning code will not apply to the District upon final adoption of He'eia CDD plan.

2.1.7 Special Management Area (SMA)

The majority of the He'eia CDD is within the boundaries of the Special Management Area, as shown in Figure 3. HRS Chapter 206E requires that SMA permit administration for the District shall continue to be under the authority of the City and County of Honolulu.

2.2 Consistency with Regional Policies and Plans

The He'eia CDD Plan is consistent with and supports various plans and projects that are concerned with improving conditions and quality of life in the He'eia District. These include the Ko'olau Poko Sustainable Communities Plan (KPSCP), the Ko'olau Poko Watershed Management Plan (KPWMP), and the He'eia National Estuarine Research Reserve (NERR), described in more detail in this section.

2.2.1 Ko'olau Poko Sustainable Communities Plan (KPSCP)

The Ko'olau Poko Sustainable Communities Plan (KPSCP) is a long-range plan to guide long-range public policy, investment, and decision-making in the district of Ko'olau Poko by 2035. The KPSCP is consistent with the City and County of Honolulu's General Plan and envisions that by the year 2035, "Ko'olau Poko's natural, cultural, historic, agricultural, and aqua-cultural/fishpond resources are protected and enhanced." Key elements of the KPSCP include:

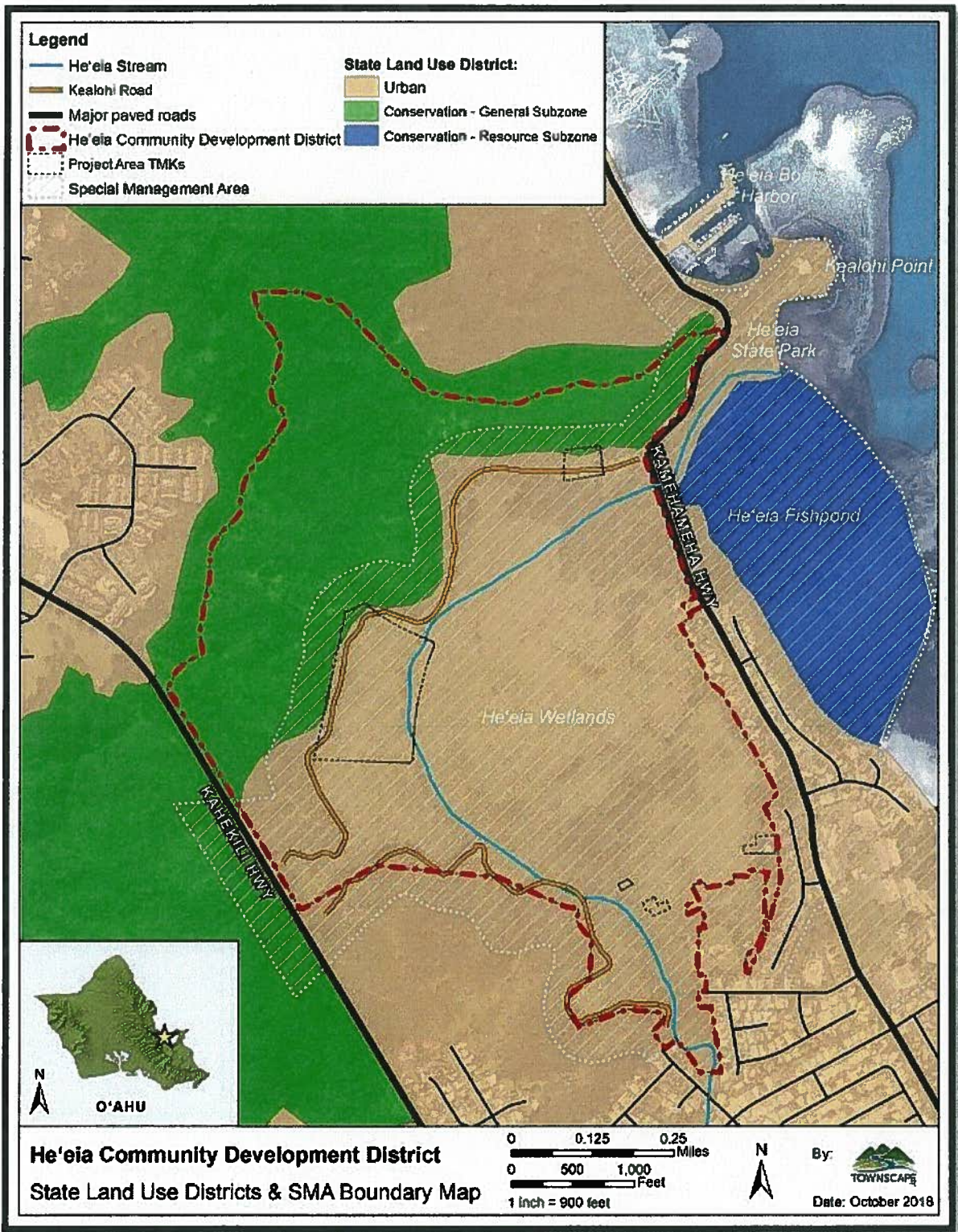


Figure 3. State Land Use District and Special Management Area Boundaries Map

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- Significant scenic views of ridges, upper valley slopes, shoreline areas from major public parks highways, coastal waters and hiking trails are protected;
 - Access to shoreline areas and mountainous regions are improved and provided for all to use and enjoy;
 - Cultural and historical resources are preserved through the protection of visual landmarks and significant views, protected access rights relating to traditional cultural practices, and the protection of significant historic, cultural, and archaeological features;
 - Ko'olau Poko contains productive and potentially productive agricultural lands that are preserved by adopted protective regulatory policies and implemented incentives and programs that promote active agricultural use of these lands.

The He'eia CDD Plan supports and is consistent with the overall vision of the KPSCP. The goals of the He'eia CDD Plan meets each of the key elements of the KPSCP vision stated above. More specifically, the He'eia CDD Plan and administrative rules will serve as protective regulatory policies to promote active agricultural use of He'eia lands, that will also preserve cultural and historical resources, and improve access to and scenic views of important resources of He'eia.

2.2.2 Ko'olau Poko Watershed Management Plan (KPWMP)

The Ko'olau Poko Watershed Management Plan, is a 20-year plan for the district of Ko'olau Poko that seeks to formulate an environmentally holistic, community-based, and economically viable water management plan that will provide a balance between (1) the protection, preservation and management of O'ahu's watersheds; and (2) sustainable ground water and surface water use and development to serve present users and future generations. To achieve this goal, the KPWMP proposes five objectives which include:

1. Promote sustainable watersheds;
2. Protect and enhance water quality and quantity;
3. Protect Native Hawaiian rights and traditional and customary practices;
4. Facilitate public participation, education, and project implementation; and
5. Meet future water demands at reasonable costs.

The KPWMP proposes more specific actions for He'eia which include: (1) a He'eia Stream Restoration Project, and (2) a projected, expanded supply of non-potable water demand for Ko'olau Poko from 11.434 million gallons per day (mgd) in 2000 to 14.271 mgd, in 2030. The increase in water use is expected to account for possible future kalo production in He'eia which could be met by an increase in the use of both stream water and ground water for agricultural irrigation.

The He'eia CDD Plan vision and goals stated in this report is consistent with the goals and objectives of the KPWMP, not only for the Ko'olau Poko District but also for He'eia. The He'eia CDD Plan prioritizes the development of agriculture and kalo production in He'eia which will increase water demand for non-potable water demand for agricultural purposes in Ko'olau Poko by 2030, as projected in the KPWMP. The He'eia CDD Plan also prioritizes the restoration of He'eia Stream, a critical resource for anticipated agricultural activities within the District.

2.2.3 He'eia National Estuarine Research Reserve

The He'eia Community Development District is part of the He'eia National Estuarine Research Reserve (NERR) which is multi-agency partnership between the National Oceanic and

Atmospheric Administration (NOAA), the State of Hawai'i, and the City and County of Honolulu that seeks to practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas. The He'eia NERR consists of approximately 1,385 acres and includes He'eia State Park, He'eia Fishpond, the He'eia CDD and its wetlands, Moku o Lo'e Island, and the large expanse of waters and reefs of Kāne'ohe Bay (Figure 4). As shown below, the goals and priorities of the He'eia NERR and the He'eia CDD Plan overlap in various areas, particularly in prioritizing education purposes and improving ecosystem conditions of the He'eia CDD.

The goals of the He'eia NERR include:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve System resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the system;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote federal, state, public, and private use of one or more reserves within the system when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

The He'eia NERR project prioritizes improving ecosystem conditions, as well as monitoring the effects of different management strategies on the ecosystem services provided by the areas within the He'eia NERR. The project is intended to inform adaptive management decisions that will support the health of the ecosystem. The NERR project has three foundational programs that include research, education, and stewardship. Some priority topics within these programs include: invasive species, loss of habitat, erosion and sedimentation, nonpoint source pollution, urbanization and human activities in the area, water quality issues, agricultural development, and climate change impacts on the area.

The priority goal for the research component of the NERR project is to promote contemporary research and traditional knowledge to improve the understanding of the effects of human activities and natural events and climate change to improve decision making for the He'eia estuary and coastal resources. The NERR consists of a System-Wide Monitoring Program (SWMP) to provide long-term data on water quality, weather, habitat, and land-use data. Traditional knowledge will be collected, integrated with scientific knowledge, and applied to strengthen the research conducted in the He'eia NERR. The NERR project will also serve as a facilitator, linking research products to end users.

A central mission for the education program of the He'eia NERR is to create pathways to marine science research and management careers for students in Hawai'i. The priority goal of the education program is to develop place-based education and training programs for the He'eia NERR that inspire and educate the community about estuaries, coastal ecosystems, and traditional Hawaiian practices. The He'eia NERR Education Program includes the hands-on, field-based workshop, Teachers on the Estuary (TOTE) program and the K-12 Estuary Education Program (KEEP). In addition, the Hawai'i Institute of Marine Biology (HIMB) has various formal and informal educational opportunities for participants of different age groups. Site partners, such

as Paepae o He'eia and Kāko'o 'Ōiwi, each have their own place-based knowledge and ecological-based education programs.

The He'eia NERR Stewardship Program seeks to support activities that involve the community's active engagement in management of the He'eia NERR site. The priority goal of the Stewardship Program, also referred to as Public Outreach and Resource Management, is to engage the various communities to create opportunities for greater stewardship that sustains cultural, biological, and natural resources. Encouraging the use of the He'eia NERR's monitoring data and research findings, educational products and informational outreach materials is an important step in linking the He'eia NERR to the land managers, the public, and local decision makers.

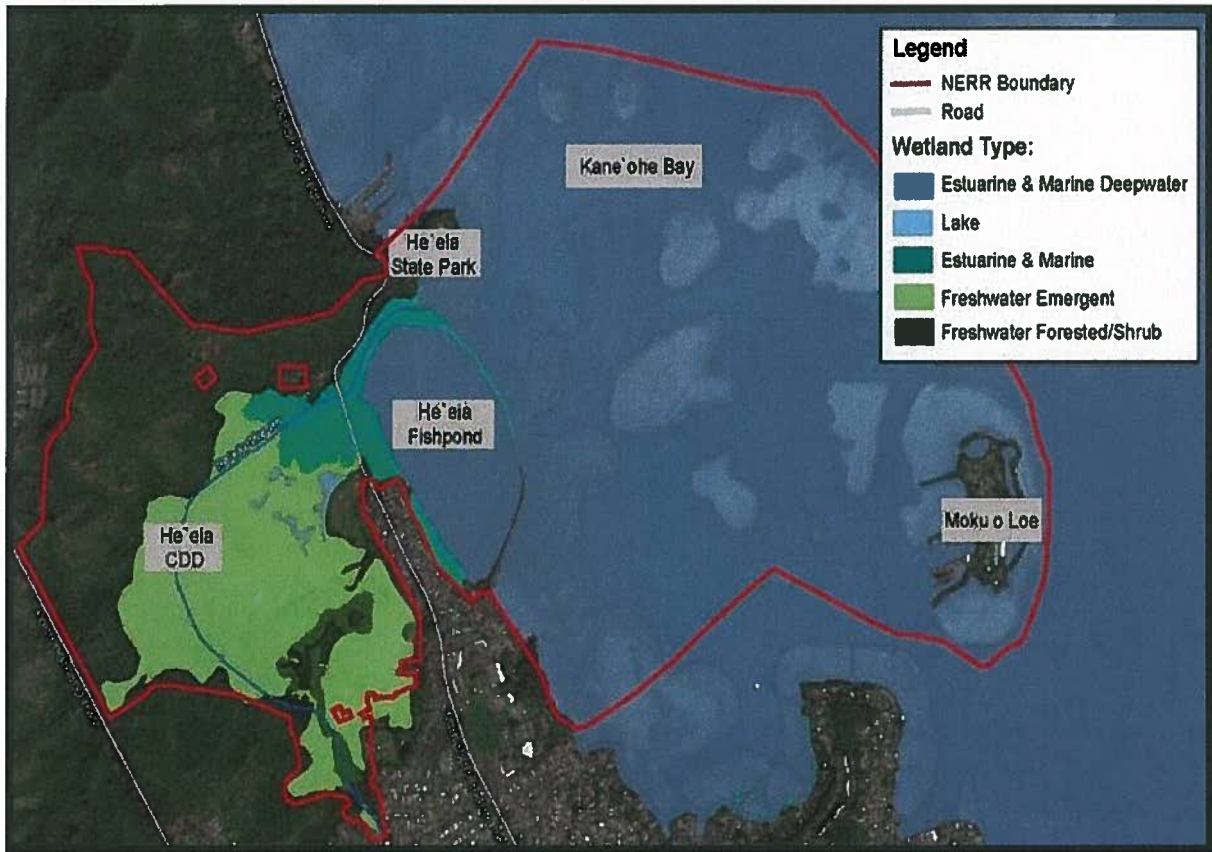


Figure 4. He'eia NERR Project Area. Source: (Hawai'i Office of Planning, 2016)

CHAPTER 3:

The Physical Environment of He'eia



3 PHYSICAL ENVIRONMENT

3.1 Overview

This section characterizes the physical environment of the He'eia CDD and the larger context of He'eia watershed and ahupua'a. The following topics are explored in more detail and include topography, geology, soil, vegetation, protected species and habitat, hydrology, sea level rise, and climate change.

3.2 Topography & Geology

The He'eia watershed extends from sea level to approximately 2,300 feet at the peaks of the Ko'olau Mountains. Located near the ocean, the majority of the He'eia CDD consists of low-lying wetlands with portions of higher regions that extend to about 440 feet. Geologically, the district of Ko'olau Poko is part of the Ko'olau volcano, one of two extinct volcanos that make up the Island of O'ahu. The geologic composition of the He'eia watershed consists of:

- Koolau Basalt (45.6%),
- Older Alluvium (37.4%),
- Alluvium (13.2%),
- Honolulu Volcanics (3.1%),
- Beach Deposit (0.5%) (Izuka et al., 1993; Stearns and Vaksick, 1935).

Koolau Basalt covers the majority of the mountain region of the watershed (Lau and Mink, 2006).

3.3 Soil

A number of soil types are found within the He'eia CDD and summarized in Table 2 and Figure 5. (Foot et al. 1972). Most of the wetland area consists of Hanalei silty clay (HnA), with portions of Lolekaa silty clay (LoB), and Marsh (MZ). The majority of the Kealahi road corridor lies above Alaeloa silty clay (AeE), and Marsh. A portion of the road corridor also lies directly alongside Waikane silty clay (WpE). The He'eia CDD had extensive fill deposited in the twentieth century and has partially been under taro cultivation but remains mostly in overgrown wetland.

Table 2. Soil types of the He'eia CDD

Soil Type	Characteristic
Alaeloa Series (ALF)	Well-drained soils in upland areas; rapid runoff and erosion hazard.
Alaeloa Silty Clay (AEE)	Occurs on smooth side slopes and toe slopes in the uplands
Marsh (MZ)	Occur in wet, flooded areas covered dominantly with grasses and bulrushes.
Waikane Series (WpE)	Well-drained soils on alluvial fans and terraces on O'ahu.
Hanalei Series (HnA)	Found on stream bottoms and flood plains with moderate permeability.
Loleka'a Series (LoB)	Well-drained soils on fans and terraces on the windward side of O'ahu.
Lolekaa Silty Clay (LoE)	Lolekaa Silty Clay, 25 to 40 percent slopes.
Lolekaa Silty Clay (LoF)	Lolekaa Silty Clay, 40 to 70 percent slopes.

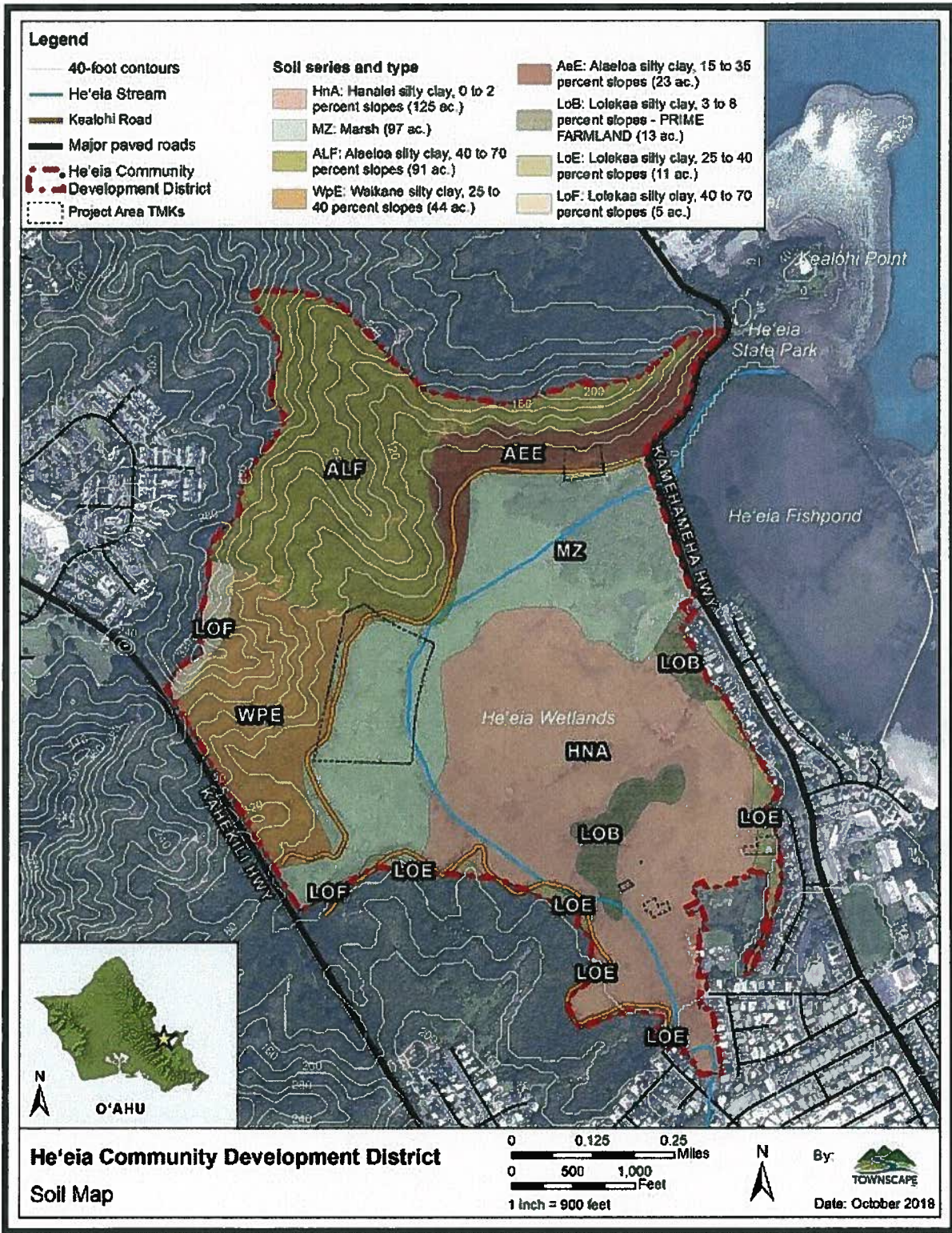


Figure 5. Soil Map of the He'eia Community Development District

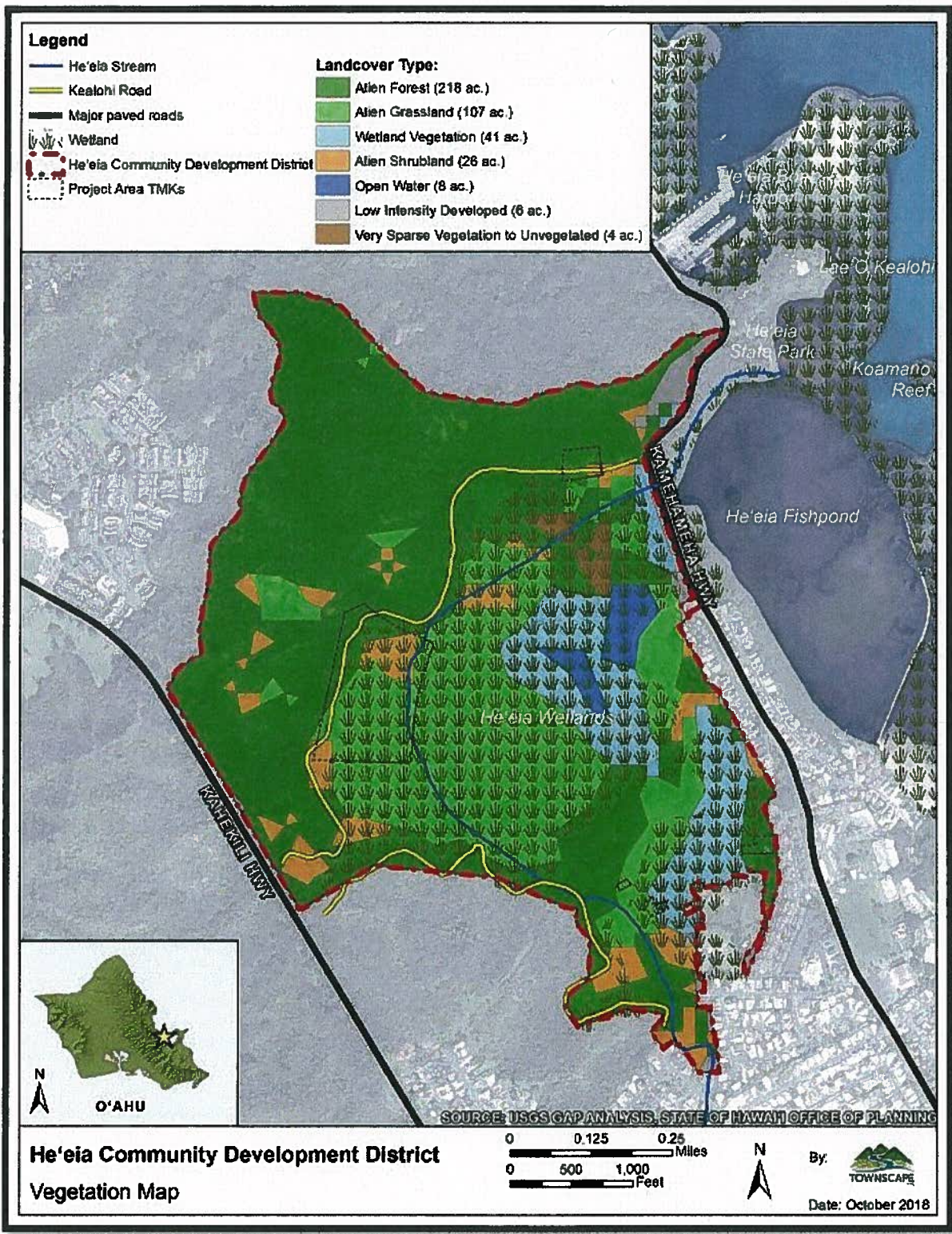


Figure 6. Vegetation Map of the He'eia Community Development District

3.4 Vegetation

Vegetation of the He'eia CDD predominantly consists of alien plant species with little to no native species (Figure 6). The majority (218 acres) of the District is in Alien Forest, consisting of trees like java plum (*Syzygium cumini*) and shrub species such as cat's claw (*Caesalpinia decapetala*), Cuba jute (*Sida rhombifolia*), koa haole (*Leucaena leucocephala*), and guava (*Psidium guajava*). Invasive mangroves have also established and choked out He'eia Stream near the coast (Figure 7). Approximately 107 acres of the property is covered with alien grasslands, including California grass (Figure 8). The dense growth of California grass and other alien grasses in the He'eia marsh is believed to have significant negative impact on native water-bird habitat (Calvin Kim and Associates 1990, Townscape 2011b).



Figure 7. Mangroves at He'eia



Figure 8. California grass, He'eia Stream

3.5 Protected Species and Habitat

The marsh habitat at He'eia is known to occasionally provide feeding and loafing habitat for four endemic and endangered water birds. These include:

- 'Alae Ula or Hawaiian gallinule
- Koloa or Hawaiian duck
- 'Alae Kea or Hawaiian coot
- Ae'o or Hawaiian stilt

The endangered Hawaiian hoary bat is also thought to roost in the mangroves at He'eia and migratory shorebirds, such as the Pacific golden plover, are also found in He'eia (Helber Hastert & Fee 2007). The *Pacific Islands Shorebird Conservation Plan* (Engilis and Naughton 2004) identifies Kāne'ohe Bay as an important tidal flat used by flocks of shorebirds that forage at low tide. Thus, native bird populations might re-establish at He'eia with the restoration of its wetlands. Therefore, removal of invasive vegetation and re-establishing native vegetation might attract native birds to the area.

3.5.1 'Alae 'Ulā or Hawaiian gallinule (Figure 9)

This endangered chicken-sized water bird is endemic to Hawai'i and once inhabited most of the main Hawaiian Islands. However, it is now a resident breeder only on Kaua'i and O'ahu. The 'alae 'ula is dependent on freshwater wetland habitats with dense emergent vegetation for nesting near open water. It inhabits mostly freshwater lowland wetlands. Population decline is due to habitat loss, hunting and predation by introduced animals. Traditionally, the 'alae 'ula was hunted for food and was known to be the keeper of fire in Hawaiian mo'olelo.



Figure 9. 'Alae 'Ula

3.5.2 Koloa or Hawaiian Duck (Figure 10)

The Koloa is a non-migratory bird, endemic to Hawai'i. Pure populations are believed to still remain on Kaua'i. Koloa was once on all the main Hawaiian Islands except for Lāna'i and Kaua'i. The koloa has been extirpated on all the main Hawaiian islands but have been re-established in O'ahu and Maui. The koloa is listed as an endangered species by the IUCN Red List of Threatened Species and its populations are in decline due to hybridization with the mallards, loss of lowland wetland habitats, and also to predators like cats, pigs, dogs, and mongoose because of the low location of nests on the ground.



Figure 10. Koloa

3.5.3 'Alae Kea or Hawaiian Coot (Figure 11)

This endemic bird is found in freshwater lakes, marshes, coastal saline lagoons, and water storage areas. The bird was listed on the Federal list of endangered species in 1970 and also in the State's list of endangered species. The bird was once abundant in coastal brackish and fresh water ponds, streams and marshes on O'ahu, Maui, Molokai, and Kaua'i. However, the first census of the birds in the 1950s to 1960s found fewer than 1,000 birds statewide. Population declines are due to habitat loss and the introduction of predators, such as the mongoose.



Figure 11. 'Alae Kea

3.5.4 Ae'o or Hawaiian Stilt (Figure 12)

This endemic bird has slender long-legs and thin beak. Generally found below elevations of 492 feet in wetlands and near the ocean, they may also occur in large groups on ponds, marshes, and mudflats. The Ae'o was a popular game bird until hunting water birds was banned in 1939. Population estimates for the Ae'o varied between 1,100 and 1,783 between 1997 and 2007. The Ae'o is endangered due to habitat loss; predators like rats, dogs, cats, and mongoose, bullfrogs; and disease. Native predators of the Ae'o include the pueo (Hawaiian owl) and black-crowned night heron.



Figure 12. Ae'o

3.6 Hydrology

Precipitation is the source of virtually all freshwater in the He'eia watershed but its distribution is highly variable. Rainfall on land is taken up by plants, some water infiltrates the soil and moves vertically downward to the water table to become ground water (re-charge), some of it evaporates back into the atmosphere (evapotranspiration) and the rest flows over land as runoff, enters streams and other water features, and ultimately discharges into the ocean. Ground water moves both vertically and laterally within the ground-water system and some water may seep through the surface into streams, springs, and wetlands. Therefore, surface and ground water are highly interdependent on the supply and quality of the other.

3.6.1 Surface Water

Surface water occurs as streams, lakes, wetlands, bays, oceans, as well as, snow and ice. Surface water in He'eia is found in He'eia Stream and its tributaries, ponds, stream diversions, and springs that feed the He'eia Wetland. Fresh water in He'eia comes entirely from precipitation along the Ko'olau Mountain Range averaging about 84 inches per year (Streamstats 2012). Rainfall varies spatially in He'eia with most rainfall in the mountain region and less near the coast (Giambelluca et al., 2013). As a result, the annual average rainfall in He'eia watershed varies from 47 inches to 119 inches and increases with elevation (Giambelluca et al. 2013). Between 2002 and 2014, rainfall was greatest during the wet season (November to April) and decreased during the dry season (May to October) (Figure 13). Almost half (45%) of annual rainfall at He'eia, was lost through evapotranspiration (Ghazal 2017).

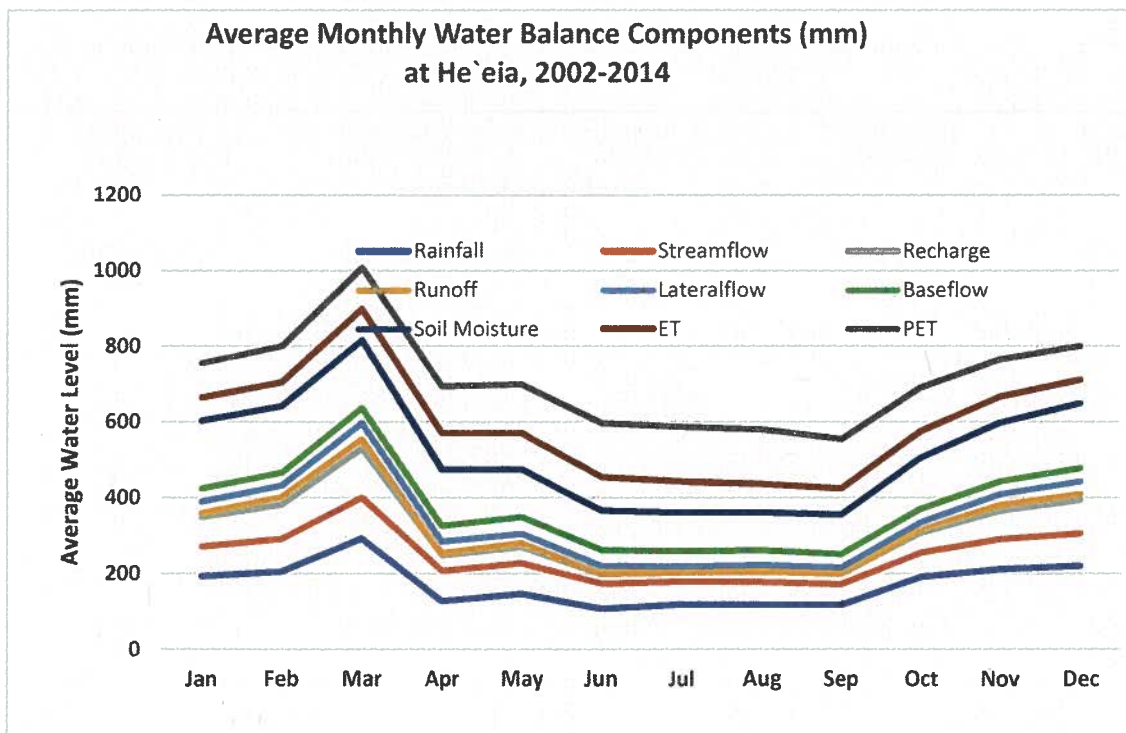


Figure 13. Average monthly Water Balance Components at He'eia (2002-2014); (Source: Ghazal 2017)

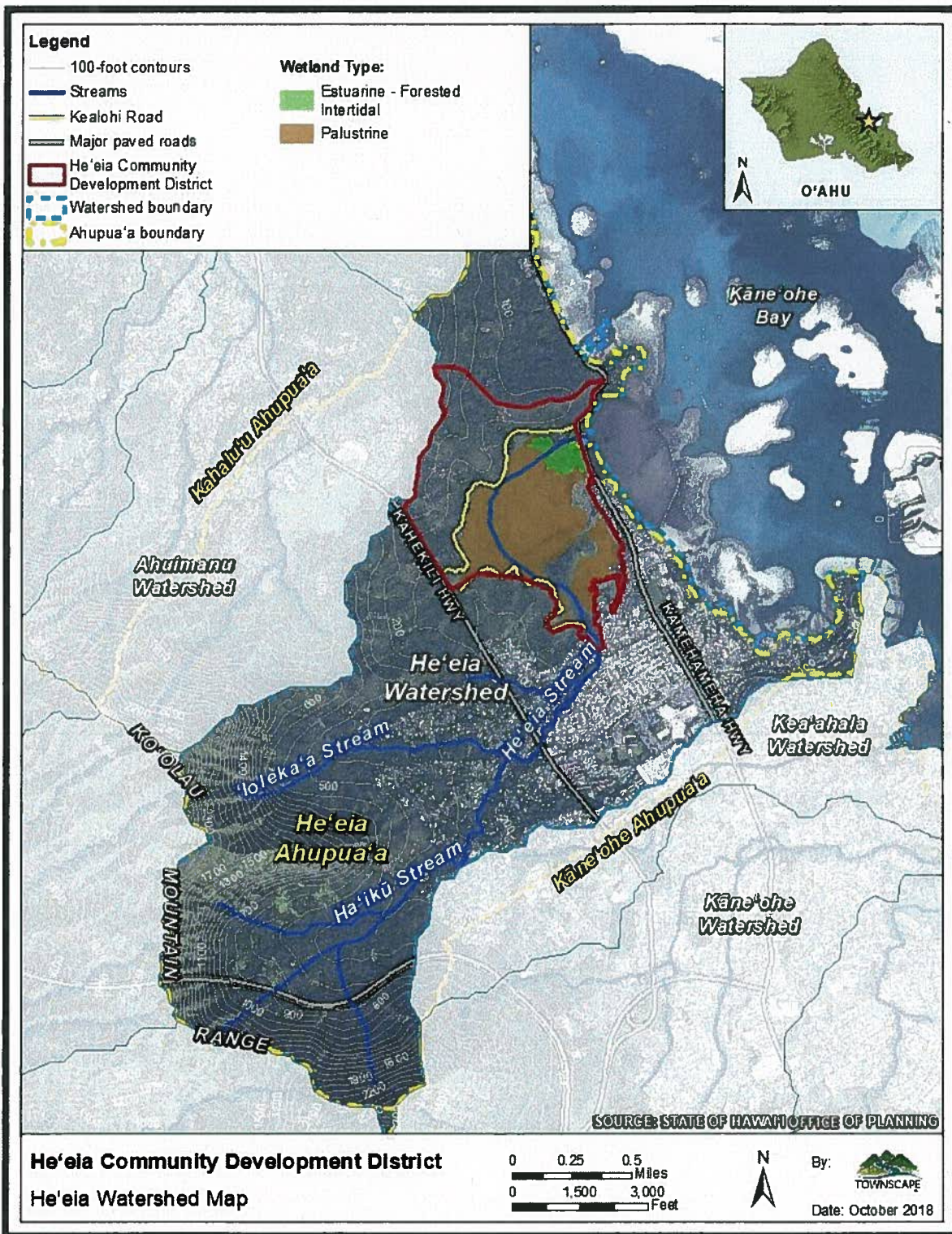


Figure 14. He'eia Watershed Map

3.6.1.1 He'eia Stream

He'eia Stream water comes from rainfall, runoff, and ground water seepage (Figure 14). Most (87%) of the average annual streamflow come from groundwater and the remainder from runoff (Ghazal 2017). Stream water extends 7.1 miles from the upper reaches of the Ko'olau Mountains to the end of the stream mouth at Kāne'ohe Bay (Parham et al. 2008). He'eia stream begins where the Ha'ikū Stream and 'Ioleka'a Stream merge. Several smaller tributaries and springs also contribute to the total flow of He'eia Stream which fan out to the wetland areas of the District and then to He'eia Fishpond. Approximately 1.3 miles of the stream is within the He'eia CDD. He'eia Stream and

its tributaries feed most of the water in the He'eia Wetland, draining an area of 4.44 square miles (Figure 15). The stream's average continuous main streamflow is 61,024 cubic inches per day with an average gradient of 11% (Wilson, 2004). Stream discharge at the He'eia CDD was found to be three times that in the uplands of Ha'ikū (Leta et. al 2016). The steep slopes of the watershed, high amounts of precipitation, and high precipitation intensity results in a high stream discharge per watershed unit area and a flash flood regime.



Figure 15. He'eia Stream

3.6.1.2 He'eia Wetlands

Wetlands are surface water areas that are regularly wet or flooded throughout most of the year. Wetlands provide habitat for fish, birds, and other wildlife and provide natural places with recreational opportunities. Wetlands also serve two major hydrological functions: (1) intercepting runoff and lessen the impact of flooding; and (2) absorbing sediment and pollutants in runoff. Therefore, wetlands play an important role in flood control and improving water quality and are important attributes of a watershed. As shown in Figure 14, the He'eia CDD consist of two types of wetlands: Estuarine Forested Intertidal (15 acres) and Palustrine (162 acres) (State of Hawaii Office of Planning 2016).



Figure 16. Ka Wai o Kāne, Ha'ikū

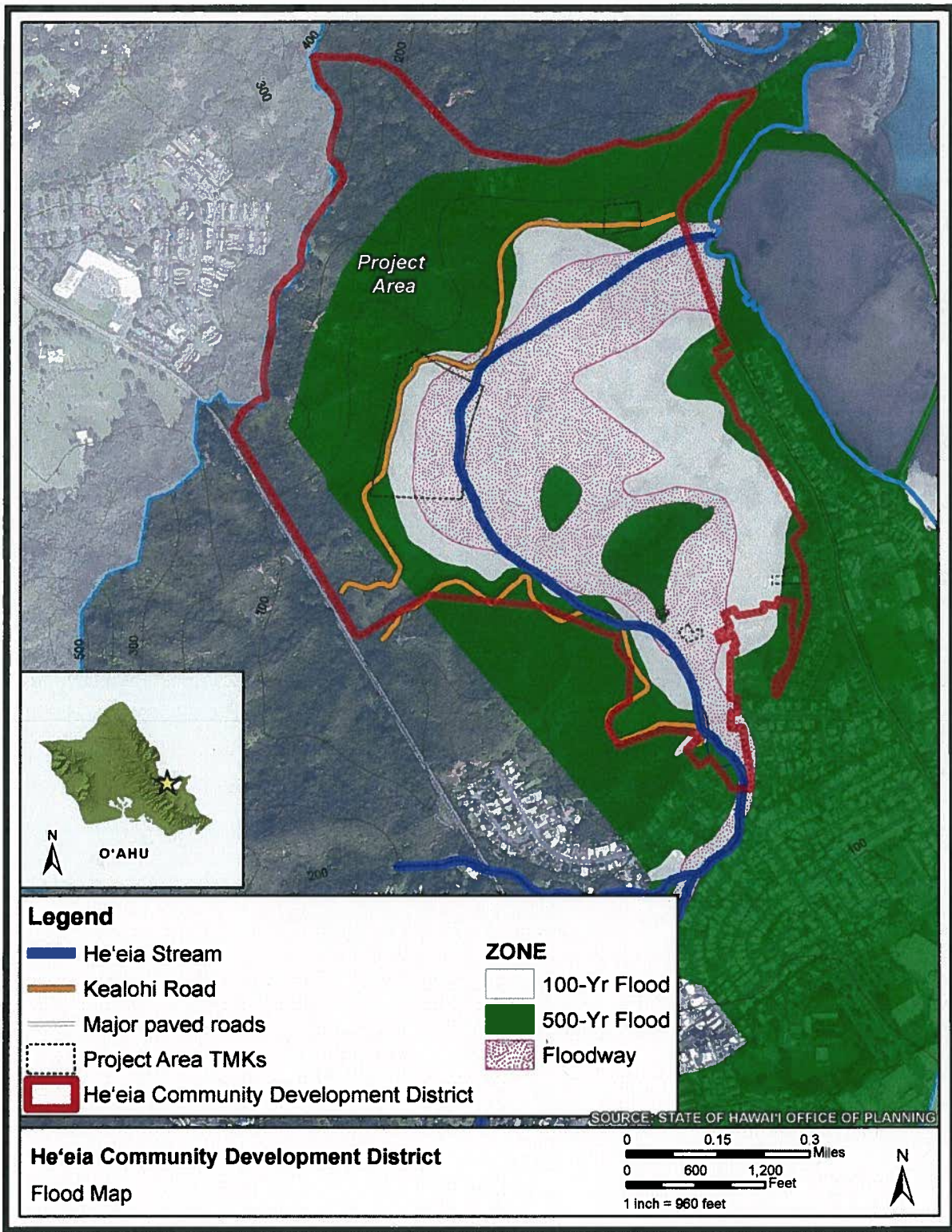


Figure 17. Flood Map of the He'eia Community Development District

3.6.1 Groundwater

In Hawai'i, rainfall fill dike compartments within its mountains' rock layers and as compartments fill up, water surfaces as springs or seepages. Ka Wai o Kāne is a spring in Ha'ikū that illustrates this phenomenon (Figure 16). Groundwater recharge is generally greatest in the upper regions of the Ko'olau Mountains with annual recharge rates exceeding 12.5 feet per day (Shade and Nichols, 1996). Ha'ikū Valley, which drains an area of about 1.0 square mile, receives recharge of approximately 3.3 feet per day. Ground water seepage into streams may take months or even decades from the original rainfall event. The He'eia CDD is within the Ko'olau Poko Aquifer System of the Windward Aquifer Sector.

3.6.2 Flooding

The majority of the He'eia CDD is within the Special Flood Hazard Area (SFHA), also known as 100-year flood zone (Figure 17). Thus, development in this area must be regulated. Moderate flood events in He'eia occur several times, annually (Koonce, 2012). Flood peaks can be achieved within hours following the onset of precipitation. Similarly, the return to base flow can occur within a matter of hours. Mitigating the potential impacts of flood events include clearing the stream channel to increase the surface area for water dispersal.

3.6.3 Water Quality

The water quality in the He'eia watershed is considered "impacted" (Honolulu Board of Water Supply, 2012). Water quality is generally better in the upper regions of the watershed compared to the bottom, as shown in Table 3. Similarly, the concentration of nutrients from fertilizers and wastewater sources, are higher in lower and coastal areas of the watershed (Table 4). Pollutants and nutrients are carried down to Kāne'ohe Bay and create phytoplankton blooms that threaten the health of the coral reefs (DeCarlo et al. 2007, Drupp et al. 2011, Guidry et al. 2013). Some nutrients like nitrites, are highly leachable and can impact the groundwater.

Table 3. Water quality in He'eia, 2014-2016

Site	Turbidity (NTU)	Total Suspended Solids (Mg/L)	Temperature (C)	Salinity	PH	Dissolved Oxygen (Mg/L)
Upper He'eia	1.42	3.56	21.20	0.08	7.88	8.24
Lower He'eia	3.60	5.36	22.85	0.10	8.08	7.79
He'eia Mouth	10.24	27.87	26.16	23.02	7.31	5.12

(Source: State of Hawai'i, Department of Health's Clean Water Branch, 2014-2016)

Table 4. Nutrient concentrations at He'eia, 2014-2016

Site	Filtered Ammonia N (Mg/L)	Nitrate/ Nitrite N (Mg/L)	Total Nitrogen N (Mg/L)	Total Phosphorous (P) (Mg/L)
Upper He'eia	0.01	0.09	0.14	0.03
Lower He'eia	0.01	0.23	0.36	0.03
He'eia Mouth	0.03	0.01	0.15	0.04

(Source: State of Hawai'i, Department of Health's Clean Water Branch, 2014-2016)

3.7 Climate Change

Changes in global climate is expected to impact Hawai'i in the future, including an overall reduction in rainfall, increasing temperatures, as well as an increase in storm frequency and intensity, leading to more flooding events. An overall reduction in annual rainfall would lead to a decline in the sustainability of groundwater sources (Burnett and Wada, 2014). Increasing temperatures will also drive evapotranspiration or water loss from plants and other surfaces. In addition, increasing water demands from urban development and population growth, will further impact water supply in Hawai'i in the future (Engott et al., 2015). At He'eia, these scenarios translate into a potential reduction in overall rainfall, surface water, groundwater, and stream flow.

Anticipated Impacts of Climate Change:

- Overall decrease in rainfall, surface water, groundwater, and stream flow
- Evapotranspiration may increase with increasing temperatures

3.8 Sea Level Rise (SLR)

Globally climate change is expected to result in sea level rise in the future that will impact the coastal areas of Hawai'i. Future impacts include (Bjerkie et al. (2012):

Anticipated Impacts of SLR:

- Rising groundwater levels
- Formation of new wetlands and expansion of existing wetlands
- Changes in surface drainage and soil saturation
- Increase in sporadic flooding events that will intensify seasonally when high tide events coincide with rainfall events
- Saltwater intrusion will impact root zone of plants
- Infrastructure damage in low-lying areas

Maps in Figure 18 show four sea level rise scenarios at He'eia: 0.5 feet, 1.1 feet, 2 feet, and 3.2 feet). These maps were based on the anticipated rate of increase in sea levels to 3.2 feet by 2100 which have recently been projected to be as high as 6 feet (IPCC 2014). Figure 18 suggests that marine inundation at He'eia at a rise in sea level of 0.5 feet and of 1 foot are similar with a rise in sea level near the south west region of the He'eia CDD. However, anticipated SLR of 1.1 feet and 3.2 feet will be observed along the northern portion of the property along Kamehameha Highway. An SLR of 2 feet around the year 2070, is expected to inundate the He'eia CDD along the mouth of He'eia Stream near Kamehameha Highway and cover the highway. By the Year 2100, an SLR of 3.2 feet is expected to also cover Kamehameha Highway and extend further into the He'eia CDD. These findings are significant for long-range infrastructure planning for the He'eia CDD that are typically constructed under roadways.

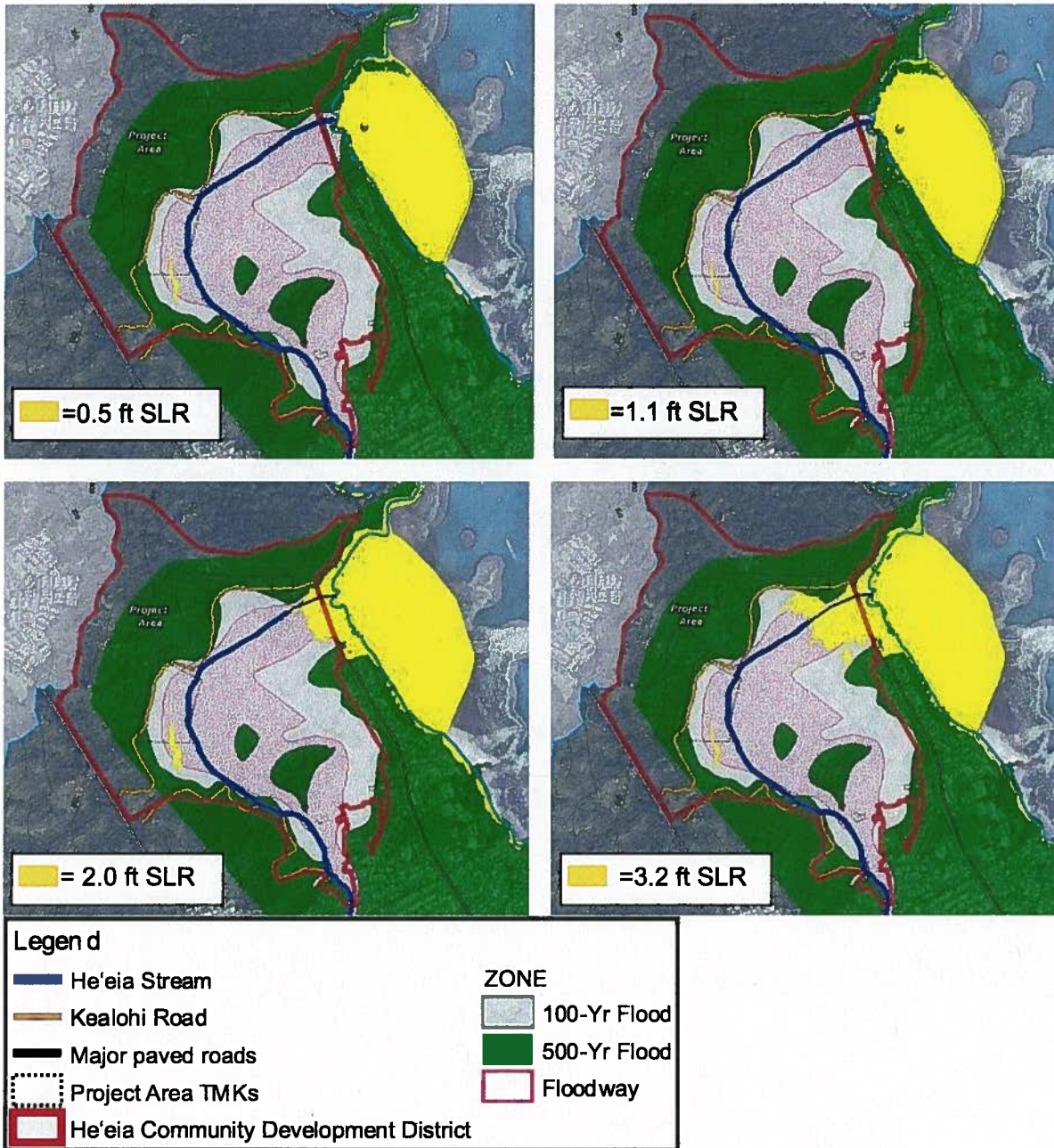


Figure 18. Projected marine inundation for four SLR scenarios at He'eia

3.9 Recommendations

To protect the integrity of the physical environment of He'eia, some mitigative actions are summarized here and include the following:

- To minimize the impacts of flooding, restore the stream channel as the first priority of flood mitigation actions. This action should take place before other restoration activities in the wetland.
- To minimize the impacts of climate change:
 - Remove invasive vegetation which consume and transpire more water than natives plants;
 - Prioritize the restoration of native plants.
- To improve water quality in the He'eia CDD:
 - Monitor nutrient and pollutant levels periodically over time at different points of the watershed to better understand the spatial distribution of pollutants in the watershed. This data will inform adaptive management strategies to improve water quality;
 - Traditional agricultural practices of lo'i kalo cultivation have been shown to reduce pollutants, therefore, the restoration of lo'i kalo cultivation practices at the He'eia CDD should be encouraged, practiced, and perpetuated.

CHAPTER 4:

The Cultural Environment of He'eia



Nani (Beautiful) He'eia

*--Composed for Kamehameha Schools' 125th anniversary, and inspired by
Carol Hālualani Bright, Alice Pualeilani Hewett and Elizabeth Cypher Lau*

Nani He'eia 'eā 'eā, Mā'eli'eli 'eā ē
Noho kua'āina 'eā 'eā, 'ohi pāpa'i 'eā ē
'Ai limu kohu 'eā ē
Nu'a pala'ā 'eā 'eā, o 'Ioleka'a 'eā ē
A 'o Waipao 'eā 'eā, i ka uluwehi 'eā ē
O Ha'ikū 'eā ē
Hui: He'eiauli, He'eia Kea, he nani He'eia ē!
Lae Ke'alohi 'eā 'eā, 'au i ke kai 'eā ē
Ko'a mokumoku 'eā 'eā, o He'eia 'eā ē
Ahu-a-Laka 'eā ē
Wehi pua hau 'e 'eā, no Meheanu 'eā ē
Kia'i loko 'eā 'e, pāewa kapalili 'eā ē
O ka 'ama'ama 'eā ē
Pali hāuliuli 'eā 'eā, Ko'olaupoko 'eā ē
Home ho'okipa 'eā 'e, o nā kūpuna 'eā ē
Poina 'ole 'eā ē
Hali 'ia mai 'eā 'eā, e ka Ulumano 'eā ē
Ke aloha nui 'eā 'eā, o ka haku 'āina 'eā ē
Ka'ehu Pākī 'eā ē, makua hi'ilei 'eā ē
Ke Ali'i Pauahi 'eā ē

Beautiful He'eia, Mā'eli'eli hill
Country lifestyle, gathering crabs
Enjoying limu kohu
Abundant pala'ā fern at 'Ioleka'a
And Waipao in the lush splendor
Near Ha'ikū
Chorus: Dark He'eia, white He'eia, beautiful!
Ke'alohi point reaches out to sea
Shattered corals of He'eia are seen
And Ahu-a-Laka ("sandbar")
Hau blossom adornment for Meheanu
Keeper of the pond teeming with fish
Plenty mullet
Dark green cliffs of Ko'olaupoko
Welcoming homes of the elders
Unforgettable
Carried forth by the Ulumano wind
The great love of the land steward
Ka'ehu Pākī, affectionate father
Of our beloved ali'i, Pauahi

4 CULTURAL ENVIRONMENT

“Southward along the windward coast, beginning with Waikane and continuing through Waiahole, Ka’alaea, Kahalu’u, He’eia, and Kane’ohe, were broad valley bottoms and flatlands between the mountains and the sea which, taken all together, represent the most extensive wet-taro area on O’ahu. These taro lands were irrigated from both streams and springs. Along the shores thereabouts were also some very large salt-water fishponds. This whole region must have supported a dense population, but so far as is known it was not noted traditionally or historically as a seat of political power...

The extensive salt marshes of He’eia inland from fishponds (*loko*) were not suitable for cultivation, but fringing them to the southward, flanking both sides of He’eia Stream from which they are irrigated, lie the vast terraced lowlands of this ahupua’a, which were in 1935 still largely planted in commercial. The southern portions of these lo’i were irrigated from Kalimukele Stream which turns southward and flows into Kane’ohe; where the small stream named Pu’olena supplements He’eia on the north. These terraces extend up the main stream to the junction of Ha’iku Stream and ‘Ioleka’a, flowing from the west and the southwest, respectively... Up all these valleys are old lo’i, now abandoned.”

Handy and Handy 1972: 272 & 454-455

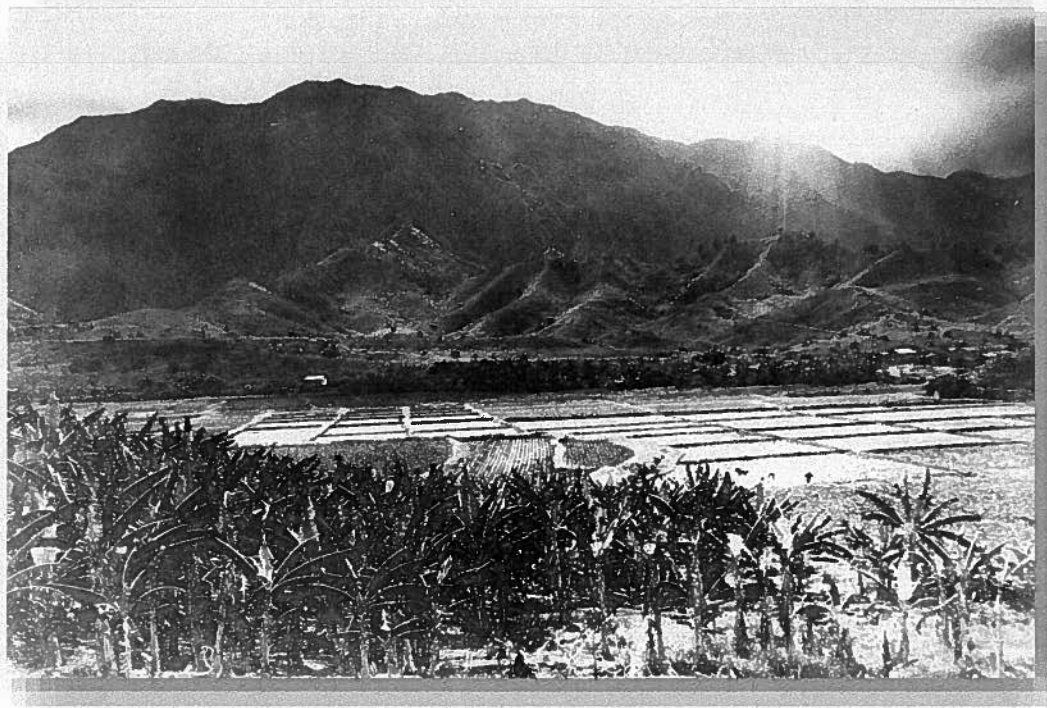


Figure 19. Expansive lo’i terraces of He’eia circa 1928

4.1 Kūpuna Reflections of He'eia

Though the expansive lo'i terraces that once characterized the landscape of He'eia, shown in Figure 19, are no longer visible today, old timers and lineal descendants of He'eia remember how it was before. A matriarch and kupuna of He'eia whose ancestors were in He'eia for more than two centuries and who grew up in He'eia in the 1930s and 1940s, described the landscape of He'eia of her childhood as a rural place where people worked the land and common practices consisted of taro cultivation, cattle ranching, and raising livestock.

"There was nothing there before," she said, noting the many residential areas that have since developed around the He'eia CDD (Figure 20). People also accessed the ocean frequently to supplement their diet with fish. She explained:

Everything was lo'i, pastures, and farms. There used to be all taro right up to the highway (Kamehameha) and up to the backside of Sears. All the way up was all taro. I don't remember all the twenty different types but I remember the purple taro... This place was full of lo'i.

There was also a cattle pasture with a dairy across the street from her house near the He'eia CDD. Below the pasture, a Japanese man grew taro all the way up to Kahekili Highway.



Figure 20. Rural He'eia with many fishponds circa 1930. Closest fishpond is Oohope Fishpond

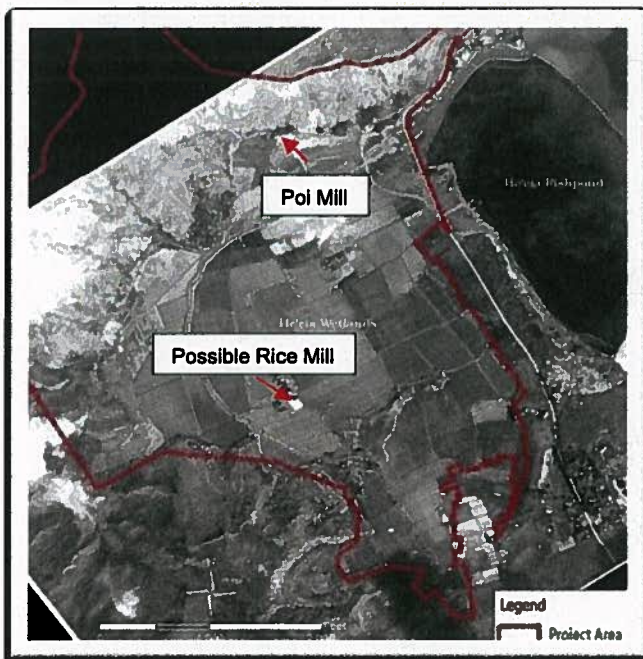


Figure 21. Aerial view of He'eia CDD circa 1928 showing poi mill and lo'i

"Taro was abundant," she said. The abundance of taro in He'eia, reflected its importance. Taro was central to life in He'eia and poi, along with rice, was the main food staple. Breakfast often consisted of taro with cream and sugar. "We never had pa'i'ai," she said. When we didn't have enough poi, we'd mix it with flour." There were four poi mills in the area in addition to her family's poi mill near King Intermediate School. The mills were situated at: Ha'ikū Road, Kāne'ohe, Wai'ahole, and in the He'eia CDD which likely is the poi mill depicted in Figure 21. Her cousin opened a poi shop and though the building was not large, it produced "barrels and barrels" of poi that sold at \$2 for 5 lbs. Despite the abundance and importance of poi, the kupuna described making poi as hard work.

"Poi is a lot of work. When the taro is in the ground, it's fine. It's growing for months. But making poi is a lot of work. To make poi, we had to clean the taro before school and the boys would steam them at 1 AM. We also delivered poi but sometimes it was hard because people wouldn't pay us." -Kupuna from He'eia

Wai (water) was also central to life in He'eia, not only for taro cultivation but it was an important habitat for many organisms including fish and crustaceans that supplemented the diet of local residents. So prominent was He'eia Stream that it was referred to simply as, "He'eia." The stream began where the Ha'ikū Stream meets 'Ioleka'a Stream. The kupuna shared fond memories of the streams of He'eia:

There were streams everywhere. In Ha'ikū, almost every house had a lo'i, a pig farm, and the stream would help. There were so many streams but building the roads took up many of the streams. We used to drink the water up at Ha'ikū Valley. Now, cannot. We used to walk all along the side [of the He'eia Stream] and catch crayfish with the midrib of the coconut leaves. There were no 'ōpae there because the 'ōpae only live by the ocean. There were also 'o'opu in the streams.

According to the kupuna, Meheanu takes care of He'eia Stream whom she also described as the guardian of Paepae o He'eia at Kāne'ohe Bay. "There's a time when she comes and she comes in different forms," she said, stressing the importance of keeping the stream open and flowing into the ocean.

Her cousin, another leader and well respected kupuna in the He'eia community, explained that the overgrowth of invasive mangroves that have choked He'eia Stream along Kamehameha Highway were introduced by her ancestors initially as a strategy for flood mitigation (Figure 22). Her grandfather was the last konohiki of He'eia Ahupua'a, responsible for the management of land awarded to Komomua during



Figure 22. Mangroves plants for flood mitigation circa 1926

the Great Māhele of 1848 and who also served as the first attorney general of the Kingdom of Hawai'i. She was proud of his legacy of stewardship and how he managed the water in He'eia. "I think that was how they decided on the mangroves being planted there at He'eia," she said noting that though the mangroves were meant to control floods, they eventually grew out of hand. The publication, "Distinguished Kama'āina of Kāne'ohe Bay," writes the following excerpt of her grandfather:

In his horse and buggy with one of his sons at the reins, Jones would ride through the ahupua'a making house visits and lending advice when needed, while keeping an eye on the water system and making sure the community kept the 'auwai clean and clear of debris. Fluent in Spanish, Hawaiian, and Japanese, he taught his 'ohana that everyone is important and needed in the community to keep it managed well. [He] also served as road overseer for the Ko'olaupoko district from Makapu'u to Kahuku, helping to guide Hawaiian Electric in the installation of power lines, and was instrumental in the construction of the He'eia long bridge and district planning in He'eia and Ha'ikū.

The bridge, shown in Figures 23, is also mentioned by kupuna in their memories of He'eia. The bridge was built adjacent to Paepae o He'eia (Figure 24), an important place that children of He'eia visited frequently. "Before the bridge, there was a road that went down to the fishpond and the fishpond belonged to Bishop Estate," a kupuna remembered. "We used to go there every day to catch crab. The whitest crabs. That place had a beautiful white sand beach," she said.

For these kūpuna, He'eia was also made up of close-knit families where people grew up like brothers and sisters. "It was beautiful. It was open. Free," a kupuna shared. However, this quality of life that retained characteristics of Old Hawai'i in He'eia, was threatened in the 1960s by a growing culture of development to support a burgeoning tourism industry, resulting in many land struggles. Land



Figure 23. He'eia Bridge



Figure 24. Paepae o He'eia, circa 1930

evictions of residents and long-time lineal descendants occurred in He'eia to make room for development plans. Among these plans was a proposal to develop the He'eia Wetlands, formally known as the Middle Lands, into a marina that would mimic the Hawai'i Kai Marina in South O'ahu. Communities from Waiahole, Waikane, and He'eia joined forces and created the He'eia Community and Middle Lands Association to fight against urban development in the area. Their efforts stopped the proposed development of the wetlands. Deep aloha for the land is shared by a community, committed to creating a legacy of stewardship of the lands of He'eia for future generations. Many expressed that they would like to see lo'i terraces characterize the He'eia landscape once again and become a center for kalo production and agriculture, bringing food abundance and security back to the region.

4.2 Wahi Pana (Place Names) and Mo'olelo (Stories)

He'eia was named for the grandson of the demigod 'Olopana, an uncle of Kamapua'a (Pukui et al. 1974). The child was adopted by the goddess Haumea, also the mother of Pele, who named him He'e-ia after a tidal event that, "washed (he'e'ia) the[m] out to sea and back, after which they were victorious...[d]uring a battle with people from Leeward O'ahu" (Pukui et al. 1974:44). He'eia grew into a handsome man who fell in love with Ka'ohelo, a younger sister of Pele and Hi'iaka [Kahele 1918 - 1919, 5:576-582] (cited in Kelly 1975:2).

Paepae o He'eia, one of the remaining ancient fishponds in O'ahu, is located adjacent to the He'eia CDD. Traditionally, walled fishponds were guarded by water spirits, or akua mo'o, whom people depended upon to assure an abundance of fish (Kelly 1975:2). Mo'olelo convey that Paepae o He'eia was guarded by Meheanu, a water spirit who could transform herself into the form of a lizard (mo'o), eel, or frog (Figure 25). Meheanu is said to have dwelled at Luamo'o, a place described as "a small land adjacent to the pond" and shown in Figure 26 (Kelly 1975:2).

Luamo'o is located where freshwater intercept seawater at the He'eia CDD (Figure 25). The location of Luamo'o suggests that Paepae o He'eia and the He'eia CDD were once interconnected and likely functioned as one system. The ability of Meheanu to transform between fresh water forms as a frog and a lizard, as well as an eel that could inhabit saltwater, is suggestive of estuarine environments at Luamo'o. The mo'olelo of Meheanu also tells of the historic land use of the area which was once overgrown with hau but now replaced with invasive mangrove.

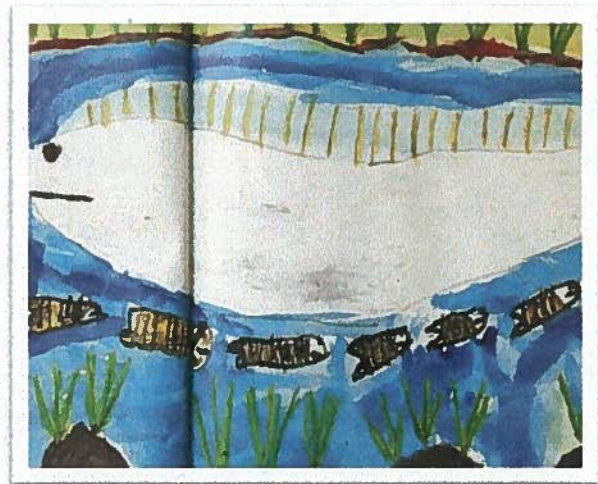


Figure 25. Meheanu, the kia'i of He'eia Fishpond (Source: Ke Kula o Samuel M Kamakau, 2008)

Mo'olelo of Luamo'o

"About Luamoo, there were formerly many sheltering *hau* trees beneath which this *moo* lived. When the *hau* was yellow, then the natives were certain of the presence of Meheanu, but when the *hau* was green, then she was more likely to be somewhere else in the form of an eel." (McAllister 1933:173)

Mo'olelo of Kealohi Point

Kealohi Point separated He'eia-'Uli (dark He'eia) from He'eia-Kea (white He'eia), the ocean regions north and south of the point. Souls of the dead were judged as either black or white and those who were white were buried and their souls leaped off of He'eia-Kea while those judged black were cast into the ocean and their souls leaped off of He'eia-'Uli (Sterling and Summers 1978:197).

Table 5. Place names of He'eia

Number	Place Name	Meaning
1	Ha'ikū	Valley, Kāne'ohe qd., O'ahu. Translates literally as to speak abruptly or sharp break.
2	He'eia	A land division and bay noted for surfing (Pukui et al, 1974:43).” Translates literally as he'e: “to slide, surf, slip,... [or] flee while “ia” is the pronoun for he, she, and it (Pukui et al. 1983).
3	He'eia 'Uli	Dark He'eia. Refers to an area of Kāne'ohe Bay south of Kealohi Point.
4	He'eia Kea	White He'eia. Refers to the area of Kāne'ohe Bay north of Kealohi Point.
5	'Ioleka'a	A valley and stream in He'eia which translates literally as “rolling rat.”
6	Kealohi Point	The point of land immediately north of Paepae o He'eia. Also known as Ke'alohi, the name translates literally as “the shining.” This point was a leiana 'uhane where the souls of the dead leap into the sea. This point separated the region called He'eia-'Uli (dark He'eia) from He'eia-Kea (white He'eia).
7	Ko'amano Reef	A reef near He'eia Fishpond. Ko'amano translates as “many shrines,” possibly referring to the many caves of the reef. Ko'amano may also translate to “shark shrine.”
8	Luamo'o	A small area of land adjacent to He'eia Fishpond in the He'eia CDD. Translates literally as, “mo'o pit.” Mo'o may be defined as: “lizard, reptile of any kind, dragon, serpent, water spirit, or enchanter” (Pukui et al. 1974).
10	Mā'eli'eli	Named for the dragon woman of He'eia, who, at one time, lived in the district of He'eia (Westervelt, 1915:41 as cited in Handy and Handy, 1972)
11	Mōkapu	Mōkapu translates as, “taboo district,” on Moku o Loe. Mōkapu was known as the sacred land of Kamehameha I because he would meet there with his chiefs (Pukui et al. 1974).
12	Moku o Loe	An island in Kāne'ohe Bay commonly known today as Coconut Island.
13	Paepae o He'eia	Located adjacent to the He'eia CDD, He'eia Fishpond is likely a very old pond because of its affiliation with ancient and traditional akua mo'o as part of its lore (Kelly 1975:47).

4.3 Cultural Sites of He'eia

Various archaeological studies have documented many cultural sites in He'eia. Gilbert McAllister (1933) conducted the earliest archaeological research in He'eia Ahupua'a in the 1930s. He reported some 17 major sites within the ahupua'a, five of which were heiau and Site 326, Luamo'o, is within the He'eia CDD. Figure 26 shows the locations of some of these sites and highlights burials, heiau, fishponds, and water sources in He'eia. The ahupua'a is thought to have had six heiau of which one, Kalaeulaula Heiau, used to be located adjacent to the He'eia CDD. Kapuna Springs in He'eia mauka is described by McAllister as the site where Kāne and Kanaloa, the gods associated with water, obtained their drinking water, suggesting a historical richness of water in the ahupua'a. More detailed information about sites on Figure 27 can be found in an archaeological inventory survey (AIS) conducted by Cultural Surveys Hawai'i (2017).

In 2017, 17 historic properties were discovered within the He'eia CDD (CSH 2017). Sites included remnants of historic ranching, plantation-era, and World War II (WWII) -era properties, as well as traditional Hawaiian historic properties. Numerous sites occurred along Kealohi Road which likely was the access road for the site. Kealohi Road also appears to have been connected to Kealohi Point. The historic properties in the He'eia CDD are depicted visually in Figure 27 and each site is described in Table 6.

4.4 Historical Time Line at He'eia since 1780

He'eia's productive agricultural lands, derived from large fishponds and lo'i terraces, likely supported the armies of prominent rulers like Kahekili and Kamehameha. He'eia was retained by Kamehameha I and awarded to Abner Pākī during the Māhele who served as the konohiki of the ahupua'a. The lands were passed onto Bernice Pauahi Bishop who allowed leases at He'eia for Chinese workers to cultivate rice. During the pre-Contract era, agricultural production at He'eia was characterized by expansive taro lo'i terraces which transitioned into rice cultivation by the 1870s.

During this period, a decrease in the Native Hawaiian population occurred at He'eia with an influx of Chinese immigrants who obtained leases to cultivate rice and then sugar into the 20th century. In 1878, the He'eia Sugar Plantation built the He'eia Sugar Mill and by 1880, the He'eia Rice Plantation employed 250 workers. By the 1890s, the cultivation of pineapple began in He'eia which replaced sugar and became the main industry in the area between 1910 to 1925. Up to 2,500 acres of pineapple were cultivated in Windward O'ahu at the peak of the pineapple industry. Sugar production diminished in He'eia in the early 1900s and the He'eia Sugar Plantation ceased to operate in 1903.

Taro made a come-back and re-appeared in He'eia between 1920 and the 1940s which also coincided with declines in rice production. During this time, old taro terraces were returned to taro production. Between the 1930s and 1940s, World War II brought U.S. military presence to He'eia and a Naval Reservation and He'eia Radio station were established along the coast between 1933 and 1941. After the war ended, the U.S. military had filled in six fishponds in Kāne'ohē Bay.

In 1991, the HCDA acquired 406 acres in He'eia through a land exchange with Bishop Estate and Act 210 established the HCDA as the re-development authority for the property. In 2011, the Hawai'i State Legislature established the He'eia CDD.

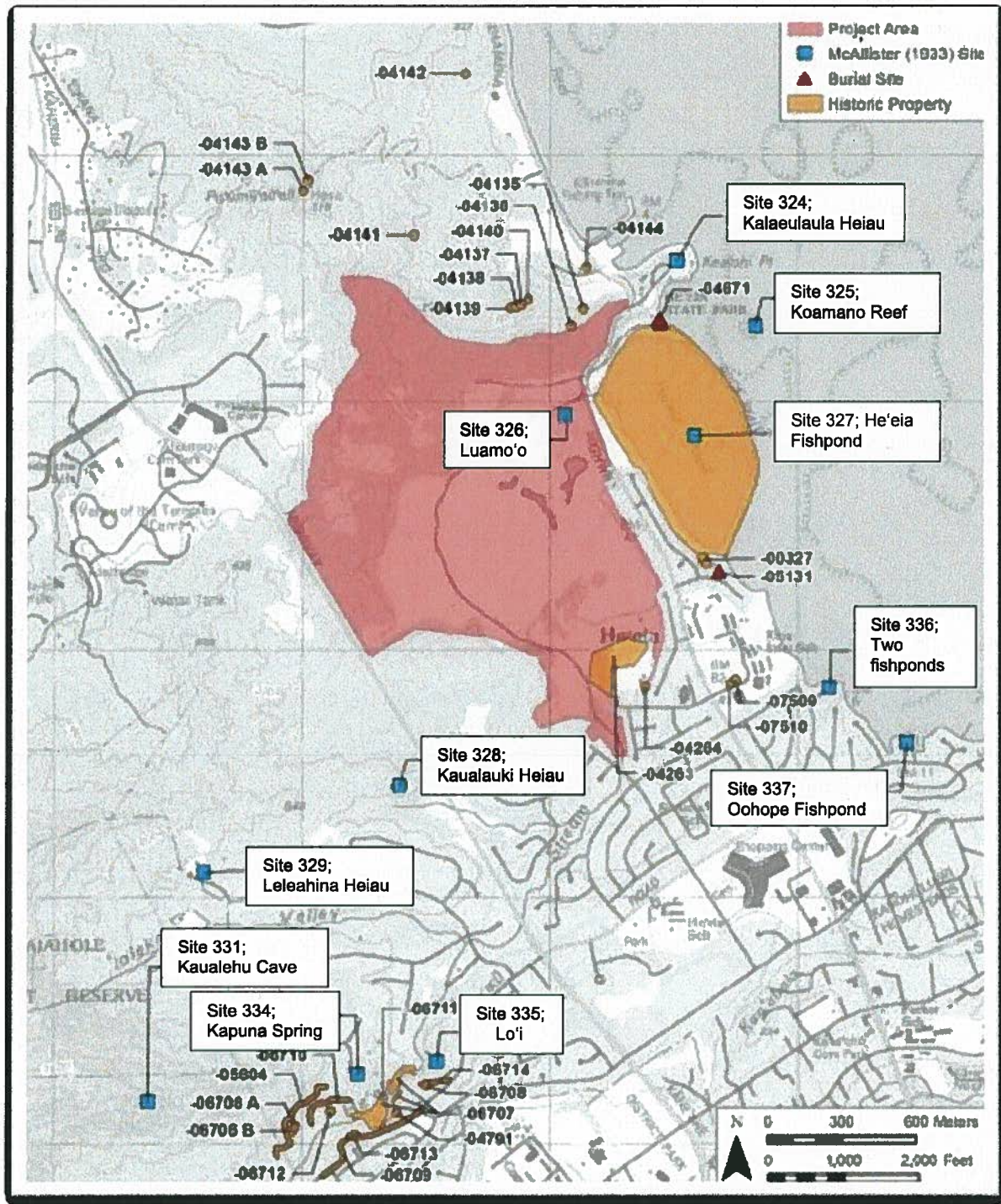


Figure 26. Important historic sites in He'eia (Source: Cultural Surveys Hawaii, 2017)

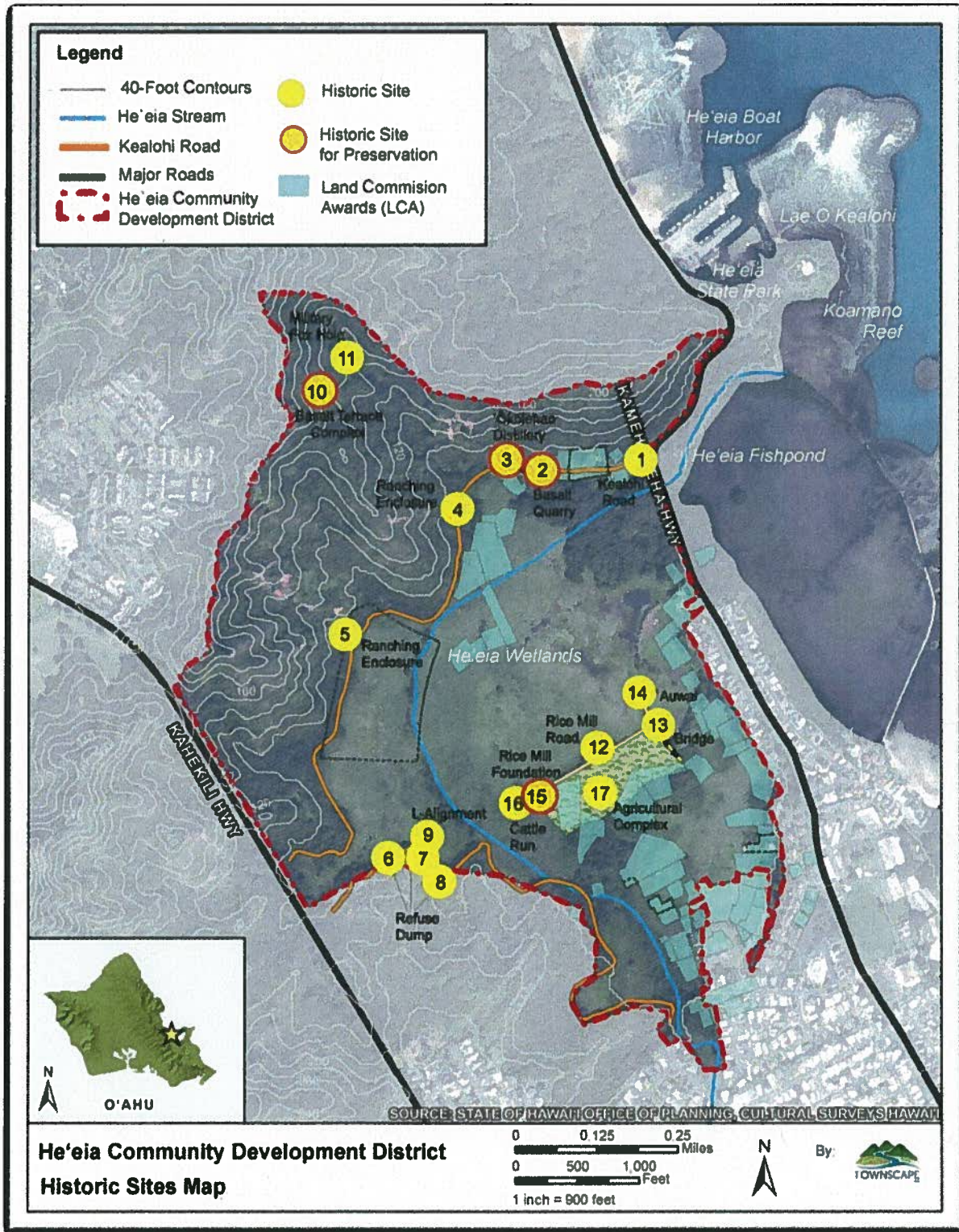


Figure 27. Historic properties in the He'eia Community Development District

Table 6. Historic Properties at the He'eia Community Development District

Site #	Historic Site	Description
1	SIHP # 50-80-10-7521 Kealohi Road Corridor	Likely a plantation-era road to access wetlands/ agricultural land border, and a traditional trail to Kealohi Point.
2	SIHP # 50-80-10-7522 Basalt Quarry	Likely for road grading and historic development in the area. •Recommendation: Preserve through avoidance.
3	SIHP # 50-80-10-7523 Possible 'Okolehao distillery	Possibly an 'okolehao (ti root liquor) distillery •Recommendation: Preserve passively into planned improvements.
4	SIHP # 50-80-10-7524 Ranching enclosure	Possibly a former bullpen that utilized the marsh as a free-range grazing area for enclosed animals.
5	SIHP # 50-80-10-7525 Ranching enclosure	The enclosure's function is indeterminate other than cattle or bull husbandry purposes.
6	SIHP # 50-80-10-7526 Refuse Dump	Likely a refuse dump during the historic period.
7	SIHP # 50-80-10-7527 Refuse Dump	Likely a refuse dump during the historic period.
8	SIHP # 50-80-10-7528 Refuse Dump	A likely refuse dump during the historic period and possibly plantation era.
9	SIHP # 50-80-10-7529 L Alignment	An indeterminate date "L" alignment of waterworn cobbles and boulders bonded together with mortar.
10	SIHP # 50-80-10-7530 Basalt terrace complex	A traditional terrace complex likely for agriculture. •Recommendation: Preserve through avoidance and incorporate into a preservation plan.
11	SIHP # 50-80-10-7531 Military Foxhole	Likely a weapons training ground in WWII where unexploded ordnance were found .
12	SIHP # 50-80-10-7532 Rice Mill Road	A post-Contact plantation-era road that terminates near an old rice mill site.
13	SIHP # 50-80-10-7533 Bridge	A plantation-era bridge above an 'auwai (SIHP # -7534) and likely associated with the rice mill for crossing the 'auwai.
14	SIHP #50-80-10-7534 'Auwai	An 'auwai that was likely was used to irrigate the crops.
15	SIHP # 50-80-10-7535 Concrete platforms	This site consists of two concrete platforms believed to be a portion of the former rice mill foundation.
16	SIHP #50-80-10-7536 Cattle run	A historic, ranching cattle run.
17	SIHP # 50-80-10-7537 Agricultural complex	Subsurface lo'i and rice berms. •Recommendation: Preserve actively by incorporating into planned improvements as revitalized lo'i in a preservation plan.

4.4.1 Kuleana Parcels

Approximately 93 Land Commission Awards (LCAs) were granted in He'eia which totaled 203 acres and averaged 2.18 acres per award. The large number of kuleana parcels in He'eia suggests the lands of He'eia were likely highly sought after for agriculture. LCA claims indicated that land within the He'eia CDD at the time of the Māhele was used primarily for lo'i cultivation and house lots. Today, three kuleana parcels remain within the He'eia CDD and account for approximately 2.8 acres or 0.01 % of the total area of the He'eia CDD. Though these parcels are owned privately, they are part of the He'eia CDD and will be subject to the provisions of the He'eia Community Development District Plan and Rules.

Table 7. Land Commission Awards (LCAs) remaining in the He'eia CDD

LCA Number	TMK #	Awardee	Royal Patent Number	Size at Māhele (Acres)	Notes
4407	TMK 4-6-16:004	Kahalau	1574	1.75	By 1978, the parcel was 1.72 acres and 76,230 sq feet in 2010. Owner in 2010: McCabe family
3573:1	TMK 4-6-16:012	Kailaa	0996	0.4	This parcel was 18,140 sq. ft after 1931. Owner in 2010: Hernando Enriquez
4467:1	TMK 4-6-16:017	Keawe	1015	0.6	By 1934, this parcel was 0.68 acres. Owner in 2010: Pio Sanchez and wife Vaimoe

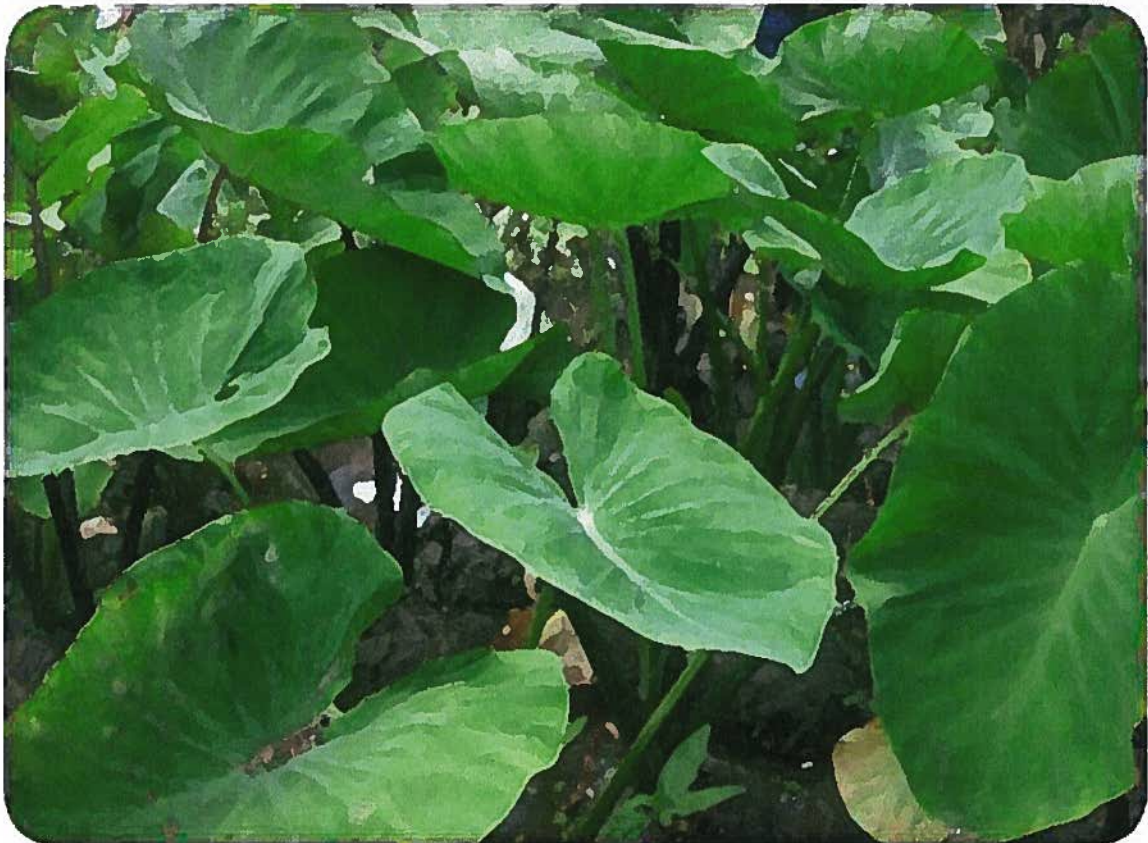
4.5 Recommendations

The following are recommendations to protect and preserve historic properties in the He'eia CDD:

- A preservation plan is recommended for four historic properties and include sites SIHP #:
 - -7522 (a basalt quarry)
 - -7523 ('ōkolehao still structural foundation)
 - -7530 (pre-Contact terrace complex)
 - -7535 (a rice mill foundation remnant)
- Two sites are recommended to be incorporated into restoration efforts of the agricultural lo'i system in the District:
 - -7534 (an 'auwai);
 - -7537 (field berms).
- The remaining 11 historic properties are recommended to be preserved through avoidance.

CHAPTER 5:

Principles of Land Use for He'eia



E ola hou ke kalo; ho'i hou ka 'āina lē'ia
The taro lives; abundance returns to the land

5 PRINCIPLES OF LAND USE FOR HE'EIA

E ola hou ke kalo; ho'i hou ka 'āina lē'ia
The taro lives; abundance returns to the land

5.1 Overview

The overarching principle for the He'eia CDD is represented by the phrase: E ola hou ke kalo; Ho'i hou ka 'āina lē'ia. This phrase translates literally as, "taro lives, abundance returns to the land". This section explores this principle in more detail to guide how the lands of the He'eia CDD might best be utilized to restore food abundance and achieve the District's vision and goals. The principles summarized in this section are intended to serve as a guide for appropriate land uses and activities for the He'eia CDD in ways that maintain the natural, economic, and social integrity of the District.

5.2 Natural Systems Restoration

5.2.1 Ahupua'a: Traditional Management System

The traditional land management system of the ancient Hawaiians was based on geographic units, or ahupua'a, that usually extended from the mountain ridges to the outer edges of the reef. The ahupua'a often consisted of upland forested areas, entire valleys with areas for agriculture and human activities, and coastal areas that were utilized for aquaculture and fishing. Water flowed through these lands from the mountains to the sea, and it was diverted to grow taro in expansive lo'i terraces. Therefore, water sources, such as streams, were among the most important resources to be managed. The value of water is reflected in the meaning of the term, wai (water) which is also the word for wealth (waiwai), abundance, and prosperity.

Land use in the ahupua'a was managed by a konohiki, or an overseer who enforced strict rules that governed how resources were used. Often, restrictions were placed on certain practices, such as fishing certain species during specific seasons, the gathering of certain plants, and on social interactions and behaviors, to maintain order and the sustainability of resources. Taking only what one needed was a core value of this system. Those who did not abide by these rules were severely punished.



Figure 28. He'eia Ahupua'a

There are eight basic principles of the ahupua'a approach (Blane and Chung 2000):

- **Kai Moana:** Preserve all life in the ocean extending from the shoreline to the horizon
- **Makai:** Respect the land and resources extending from the shoreline to the sand's reach
- **Mauka:** Respect all land and resources from the sand's edge to the highest mountain peak
- **Kamolewai:** Respect all water resources, including rivers, streams, and springs and life

- **Kanakahonua:** Preserve and respect the laws of the land and each other to ensure the community's health, safety, and welfare
- **Kalewalani:** Respect the elements that float in the sky, including the sun, moon, clouds, stars, wind, and rain, which guide the planting and fishing seasons, provide water, and create the tides and directions for ocean navigation
- **Kapahelolona:** Preserve the knowledge of practitioners

5.2.2 Models for Ahupua'a-based Management

He'eia is a relatively small ahupua'a that illustrates the traditional Hawaiian ahupua'a land unit (Figure 28). Though the traditional land management system is no longer practiced widely, efforts are currently underway to revive and perpetuate this management approach. The program, "Huli ā Mahi" is an example of such efforts at He'eia. This program is a collaboration between three non-profit organizations committed to stewarding the resources of He'eia Ahupua'a at the three different zones. Papahana Kuaola (Figure 29), is located along Ha'ikū Stream at the top of the ahupua'a, Kāko'o 'Ōiwi is situated on the He'eia CDD lands in the kula lands of the ahupua'a, and He'eia Fishpond at Kāne'ohe Bay (Figure 30). Water flows through the sites of all three organizations from the mountains to the ocean, offering students hands-on opportunities to understand the connectivity of resources and the value of a mauka-makai approach to resource management. Students are exposed to and become involved in the stewardship practices of each organization to gain insight into the importance of the holistic systems approach that the ahupua'a system offers.

Thus, the restoration of the He'eia Wetlands offers numerous opportunities to apply, practice, and revive this traditional management approach. The He'eia CDD can become a model for other organizations and communities throughout Hawai'i to learn more about how the ahupua'a management system can be applied in their respective places. The programs at the He'eia CDD can also offer valuable knowledge to inform how traditional knowledge can be integrated with scientific knowledge to address global issues like climate change and sea level rise.



Figure 30. Papahana Kuaola in Ha'ikū



Figure 29. He'eia Fishpond at Kāne'ohe Bay

5.2.3 Vegetation Restoration

As summarized in Chapter 3, invasive vegetation poses numerous threats to the integrity of the terrestrial and aquatic ecosystems at the He'eia CDD. In particular, alien forest and alien grassland species account for approximately 80% of the total area of the District. Thus, extensive vegetation restoration in the District is needed which may consist of two main types of activities:

- 1) Invasive vegetation removal, and
- 2) Native vegetation restoration.

Vegetation restoration offers opportunities for hands-on education and community engagement through service learning, volunteer programs at the District.

5.2.3.1 Invasive Vegetation Removal

Effectively removing invasive vegetation can be challenging as certain plants have adapted well to survival. Therefore, methods for vegetation removal are important as they may vary depending on target species, cost, as well as the land use designation of the vegetated area that may limit the types of vegetation removal activity. For example, mangroves have deep roots and occur in the SMA region of the District, therefore, mangrove removal might best be achieved by cutting tree trunks above the water, then burning the remaining debris, rather than uprooting trees and disturbing the wetland. Similarly, an effective method for removing invasive California grasses and Job's tears (Figure 31) that often



dominate large areas, might consist of a slash and burn scenario rather than manually cutting them down with weedwhackers and mowers as the latter require many consistent hours of labor. Therefore, activities for invasive vegetation removal should be carefully considered to be consistent with the vision and goals of the District and conform to all applicable land use requirements.

5.2.3.2 Native Vegetation Restoration

Enhancing the presence of native plants in the District through the planting of native species, will provide additional ecosystem services such as native wildlife habitat, shoreline stabilization, and soil and nutrient retention. However, to provide an adequate and consistent supply of native plants to replenish areas where the invasive vegetation has been removed, a nursery for propagating new plants on-site would be necessary. Once invasive species have been removed and replaced by native species, endangered wetland birds might re-establish at He'eia.

5.2.4 Restore Stream 'Auwai in the District

As a historic lo'i site, the District once had many streams that were irrigated and diverted for lo'i cultivation. To restore the lo'i terraces of the site, understanding the system of 'auwai that fed the lo'i, is critical to understanding the flow of water within the District. Currently, the 'auwai are

overgrown with invasive vegetation. Therefore, clearing invasive vegetation would aid in identifying pre-existing 'auwai.

5.3 Climate Change & Sea Level Rise

Climate change and sea level rise will impact the District in the future, including an overall decrease in rainfall and water resources, increases in storm frequencies and intensities, flooding events, and salt water intrusion. These events will affect the long-term planning and management of the District. Planning and preparing for climate change and sea level rise should consider these principles:

- Plan for 100-years rather than 10 years;
- Inform long-term planning with technologies developed to predict future scenarios;
- Integrate scientific knowledge and traditional knowledge to mitigate potential hazards;
- Invest in invasive plant removal to mitigate water loss and flooding;
- Prioritize the restoration of resilient native wetland vegetation to reduce water loss and salinity, and improve filtration;
- Restore traditional agricultural practices, like lo'i kalo, that improve water quality.

5.4 Economic Programs

The cultural and historical significance of taro has made it a symbol of food security and self-sufficiency, therefore, the economic revitalization of the taro industry is important at all levels of taro farming. The value of the lands of the He'eia Community Development towards contributing to Hawai'i's food security and self-sufficiency, is potentially significant. The kalo (taro) industry is unique to Hawai'i because kalo is an important foundation of Hawaiian culture and also because it is Hawai'i's oldest and first agriculture industry. Historically, expansive kalo lo'i covered the landscapes of all the islands of Hawai'i, supporting a population similar in size to that of modern day Hawai'i. By the early 1900s, the estimated number of kalo farmers were in the thousands. However, by 2008, only 105 commercial kalo farmers were documented with about 500 acres of land in taro cultivation, statewide (Taro Security and Purity Task Force, 2010). By 2015, the area of wetland kalo across the state increased marginally to 610 acres, with most of these lands in Kaua'i (73%) and only 8.4 percent (51 acres) in O'ahu Island. Also, Hawai'i imports millions of pounds of taro annually, suggesting a significant shortage in Hawai'i's local supply of kalo (Taro Security and Purity Task Force, 2010). This shortage reflects a statewide dilemma of food insecurity where 85% to 90% of the state's food is imported (DBEDT, 2012).

To address this issue, the state's Department of Business, Economic Development and Tourism (DBEDT), proposed an "Increased Food Security and Food Self-Sufficiency Strategy" to increase the amount of locally grown food consumed by Hawai'i residents (DBEDT, 2012). The strategy consists of three objectives: 1) Increase demand for and access to locally grown foods; 2) increase production of locally grown foods; and 3) provide policy and organizational support to meet food self-sufficiency needs. In 2017, the total value of the taro industry to Hawai'i's economy was 2.58 million (Taro Security and Purity Task Force, 2010). The strategy estimates that replacing just 10% of imported food would generate approximately \$313 million of revenues for the State. Therefore, investment in programs and projects that support greater food self-sufficiency will create significant benefits for Hawai'i not only economically, but also socially, culturally, and environmentally. State initiatives and leadership to implement the above strategies are paramount to pave the way towards addressing Hawai'i's food insecurity problem.

To increase the commercial supply of taro, farmers must be able to make a living. Unfortunately, the profit margins for taro farmers, if they exist at all, are small and labor is intensive. Thus, most taro farmers have another job or depend on supplemental income to meet family needs and health insurance coverage. Expanding the taro industry means:

- reducing the costs of inputs,
- creating a committed labor force, and;
- increasing returns for products.

It also means that the farming experience must start at a young age and continue all the way through life to perpetuate the ability to pass on the practice from generation to generation. Therefore, incentives must be available to entice young farmers to develop a long-term interest and commitment to the hard work of taro farming. Incentives might include ancillary facilities and infrastructure to reduce the cost of inputs for farmers. Alternative models to increase economic viability for taro farmers, should be explored and encouraged. These include programs targeted towards small-scale family farms. Alternative models may include developing value-added products of taro, agroforestry, and agri-tourism.

5.4.1 Value-Added Products

Technology add value to taro. Family- run and cooperative poi mills, is a potential business model that adds value to taro through processing. This model also increases food security on a wider scale by encouraging the spread and distribution of taro products throughout the islands, rather than concentrating production in one area. Small poi mills also increase economic diversity for rural communities (Figure 32). Certified community kitchens also provide opportunities for taro farmers and members of communities near-by to also benefit and create value-added products from the crop. Therefore, the establishment of these technologies to



Figure 32. Milling poi

support such entrepreneurial ventures, is crucial. In addition, programs targeted towards building the skills of farmers to be successful in these ventures are important and needed.

The use of local and organic fertilizers should also be encouraged as alternatives to fossil-fuel based fertilizers. The use of cover crops and other sustainable methods of farming and production also creates added value to taro production. There is a growing niche market for local, organic, and gluten free products and the demand will continue to increase in the future.

5.4.2 Agroforestry

Though the primary crop for the He'eia Community Development District is taro, there is also potential to explore the value-added products derived from other crops and products grown

concurrently with taro. Agroforestry is a traditional Polynesian method of land management that involves the simultaneous cultivation of farm crops and trees that ensures a continuous food supply. This strategy not only diversifies agricultural products but also helps restore soil health and integrity which can be a significant cost saving.

5.4.3 Agritourism

Agritourism is a potential economic model that leverages Hawai'i's robust tourism industry while supporting local agriculture and food sustainability. Though this business model is relatively undeveloped in Hawai'i, it offers great potential in the future as the visitor industry evolves. Whereas Hawai'i has conventionally been a tourist destination of leisure and entertainment, there is a growing interest in "real" and experiential tourism where visitors want more meaningful experiences with the local culture and people. These types of visitors include millennials, who make up an important segment of the visitor industry. Also, more than two thirds of visitors to Hawai'i are returning visitors who are likely to be more interested in more meaningful experiences that connect them to Hawai'i. Agritourism has the potential to fill this niche.

However, agritourism activities should be consistent with the values and vision of the He'eia CDD and remain secondary to the goal of achieving food security. This is an important consideration because despite being the state's economic base, conventional mass tourism has significantly impacted Hawai'i's natural and cultural resources. There is opportunity for agritourism to become an alternative, more sustainable model of tourism that fits with small islands and gives back to the state's long-term self-sufficiency. Such models for agritourism might focus on creating mutually beneficial experiences for both local communities and visitors and provide additional benefits that include:

- perpetuating cultural knowledge;
- teaching leadership and life skills;
- preserving special places;
- building relationships;
- encouraging local food security;
- and building community capacity.

This approach to agritourism is based upon the concept of, "small is good" and prioritizes quality over quantity. To achieve this, investments in tour development, delivery, and adequate staff training are crucial to create an appropriate agritourism culture.

5.5 Social Programs

5.5.1 Culture

In Hawai'i, the taro plant is closely tied to the identity of the Hawaiian people who trace their origin to Hāloanakalaukapalili, the first taro plant, and his brother, Hāloa, the first man. Therefore, taro has great significance to Hawai'i. In modern times, taro has become a symbol of the family

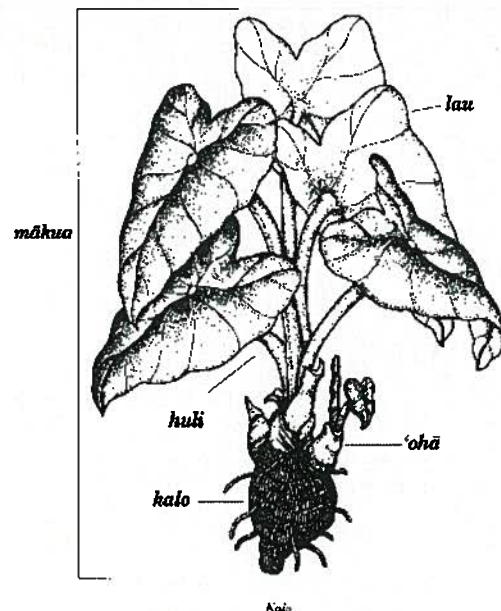


Figure 33. Kalo represents family
(Source: Get Drawings)

with the corm representing the parents (mākua) who are surrounded by the 'ohā, or the children (Figure 33).

As a center for kalo agriculture and production, the He'eia CDD becomes a place that honors and nurtures the foundation and origins of the Hawaiian people. As such, the District becomes a host site, committed to the growth, perpetuation, and resilience of the Hawaiian culture and its people. Therefore, the District serves the important role of connecting the Hawaiian people to the land. The establishment of facilities and infrastructure to support programs

for the practice and perpetuation of traditional Hawaiian knowledge, values, and traditions, are critical components of this process. The development of ancillary facilities and services, such as gathering places like community centers, should reflect the values and worldviews of the culture that it serves. Therefore, the built environment should be designed to maintain the sense of place of He'eia.

Kalo & Native Hawaiian Identity

The genealogy of the Hawaiian people begins with Hāloanakalaukapalili (the kalo plant) and Hāloa, (the man); inseparable in their relationship. In the twelfth era of the Kumulipo, Hāloanakalaukapalili, the stillborn child of the gods, Wākea and Ho'ohōkūkalani, was born. When the child was buried, he became Hawai'i's most important plant food, the kalo plant. Hāloa was born next who was the first man.

5.5.2 Education and Research

The He'eia CDD offers an opportune venue for education and research surrounding the practices and resources of the place. The District can serve as a kīpuka (oasis) and place for learning to perpetuate native Hawaiian history, values, and practices.

5.5.2.1 Place-based Education

The rural character and the scenic views of the He'eia CDD is important for 'āina-based education. The ability to experience majestic mauka (mountain) to makai (seaward) views from the site provides a visual context for the traditional ahupua'a system. Also, the focus on taro cultivation, provides opportunities to connect people to the land through hands-on experiences, such as huaka'i (tours), workshops, and volunteer, service learning projects (Figure 34). The He'eia CDD becomes a valuable site for educating different target groups, particularly students, Native Hawaiian cultural groups, farmers, and the He'eia community. Also, the He'eia CDD can potentially become a site that complements learning in:

- Taro cultivation and traditional agricultural practices;
- History and culture;



Figure 34. Connecting people to the land (Source: Kāko'o 'Ōiwi)

-
- Ahupua‘a-based management;
 - Watershed and water resources management;
 - Native species restoration

5.5.2.2 Research

The cultural and ecological importance of the He‘eia CDD lends itself as an important site for research in these areas (Figure 35):

- Taro cultivation, genetics, and pest control;
- Watershed and water resources management;
- Hawaiian archaeology;
- Climate change and sea level rise.



Figure 35. Water quality monitoring station at He‘eia

5.5.3 Community Engagement

Community is at the heart of this project. The He‘eia CDD was created to develop long-range planning and implementation processes to improve community development for certain areas in the State of Hawai‘i that are substantially undeveloped, blighted, or economically depressed and where community development needs are unmet, such as the He‘eia CDD. Therefore, the He‘eia CDD targets communities of He‘eia to improve their needs. Thus, opportunities to involve and engage community participation in activities in the District are important. These activities might target certain groups that may particularly benefit from the exchange which include but may not be limited to:

- Kūpuna
- Youth from local schools
- Non-profit organizations
- Cultural Practitioners
- Lineal and cultural descendants

Various activities and strategies to encourage and engage community participation should be consistent with the vision and goals of the District. Some examples of activities for community engagement are described here:

5.5.3.1 Huaka‘i or Site Visits

Considering the District’s rich cultural history, majestic views of the Ko‘olau mountains and surrounding bodies of water, coupled by its remote location and focus on agriculture, the He‘eia CDD serves as an ideal site for groups that are interested in learning more about history, water resources management, and lo‘i kalo agriculture in O‘ahu. These visits can vary in length from a few hours to a day trip depending on the needs of the group. The intent of such visits is to expose visitors to a “real life context” that could also allow for hands-on experiences that facilitate learning

in an outdoor classroom situation. These types of visits are ideal for groups on O'ahu, particularly school groups, who are able to provide their own transportation, staff, and food for their experience. However, such visits should be consistent with and support the vision and goals of the District.

5.5.3.2 Workshops

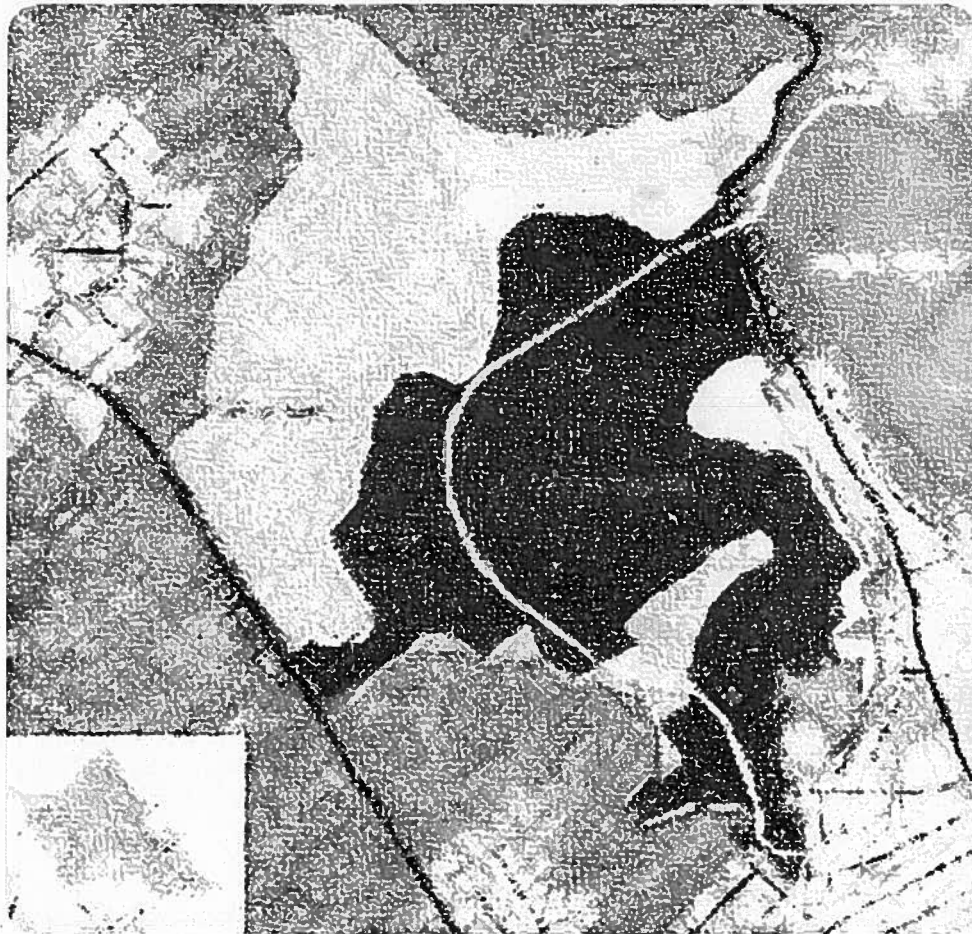
Workshops are educational opportunities to engage community groups. Through education, knowledge can be practiced, passed on, and perpetuated. There are opportunities to explore cultural educational workshops on various aspects of Hawaiian culture to occur either as part of a huaka'i or short tour or as extended workshops that focus exclusively on a particular topic. The duration of these workshops may vary depending on the tasks that need to be accomplished. For example, short workshops could be tailored to complement a short tour, whereas extended workshops might involve a more in-depth experience where participants could also return for multiple class experiences. However, to support these workshops, adequate facilities and amenities are key.

5.5.3.3 Service Learning Volunteer Workdays

Volunteer experiences offer opportunities for service learning where visitors might be able to participate in on-going projects in the District and to connect with nature. This experience provides opportunities for participants to also give back to the District by donating time and labor. Examples of such volunteer programs may include vegetation removal, planting native and canoe plants, and weeding and clearing activities to maintain the property, and the restoration of lo'i kalo, fishponds, and 'auwai. These activities also provide opportunities for visitors to spend time working side by side with farmers and practitioners who are practicing their culture and also get a feel for the place through hands-on experience. Volunteer experiences foster building relationships, promote locally grown food and healthy lifestyles, and reinforce core Native Hawaiian values such as aloha (love), mālama 'āina (taking care of the land), kuleana (responsibility), and reciprocity. Volunteers should expect to come prepared to work, be flexible and flow with the experience.

CHAPTER 6:

Land Use Plan & Development Guidelines



6 LAND USE PLAN AND DEVELOPMENT GUIDELINES

6.1 Overview

This section describes a land use plan and development guidelines for the lands of He'eia, to provide a roadmap that supports the vision for the land while maintaining the long-term integrity of the place and its people. The land use plan consists of a re-classification of the 409-acre District lands into land divisions and identifying appropriate uses for each land division. The process of demarcating land divisions considered the physical characteristics of the land, the State Land Use (SLU) District boundaries, as well as maximizing the ability to support priority activities for the District, such as agriculture, cultural practices, education, and resource management activities. The process was based on a thorough understanding of the existing ecological, cultural, and socio-political conditions of the District to inform how the land could best be utilized to achieve the vision for the He'eia CDD.

6.2 Land Use Plan

This plan proposes re-classifying the lands of the He'eia CDD into three land divisions or zones with appropriate land use activities for each zone. These zones consist of: Kula Uka (34%), Kula Kai (23%), and Loko I'a Kalo (43%) (Table 9). These land divisions would replace City & County of Honolulu zoning that previously governed the land. The land use divisions (Figure 36), as well as potential land uses for each land division, are described in more detail in this section.

Table 8. Land division composition of the He'eia CDD

LAND DIVISIONS			
HAWAIIAN NAME	COMMON NAME	SIZE (Acres)	PROPORTION OF HE'EIA CDD
Kula Uka	Uplands	136.9	34 %
Kula Kai	Lowlands	93.6	23 %
Loko I'a Kalo	Wetlands	175.6	43 %

Land Division Names:

[to be filled out after consulting with kūpuna and working group]

Table 9. Descriptions of land divisions and uses in the He'eia CDD

LAND USE DIVISIONS & USES THE HE'EIA COMMUNITY DEVELOPMENT DISTRICT		
LAND DIVISIONS	LAND CHARACTERISTICS	PROPOSED LAND USE
1. KULA UKA (Uplands)	<ul style="list-style-type: none"> • Lands with the highest elevation in the He'eia CDD. • Located in Zone X, moderate flood hazard area, on the Flood Insurance Rate Map. • Predominantly alien forest vegetation, including java plum (<i>Syzygium cumini</i>) and shrub species such as cat's claw (<i>Caesalpinia decapetala</i>), Cuba jute (<i>Sida rhombifolia</i>), koa haole (<i>Leucaena leucocephala</i>), and guava (<i>Psidium guajava</i>). • Lands located in the State Land Use Conservation District. • May contain unexploded ordnances. 	<ul style="list-style-type: none"> • Upland agriculture, including planting of fruit trees, medicinal & ornamental plants, and plants used for cultural practices. • Forest restoration with native plants. • Educational and cultural practices. • Ecological and environmental research. • Limited community, educational and agricultural support facilities, where can be accommodated
2. KULA KAI (Lowlands)	<ul style="list-style-type: none"> • Lands generally lower in elevation than Kula Kai lands. • Generally located within the AE Zone, and is considered to have a 'high risk of flooding' (100-year floodplain). • Predominantly alien forest and alien shrubland vegetation, including (list plants). • East boundary at the mouth of the He'eia Stream will see significant marine inundation due to sea level rise by year 2100. • Land predominantly located in the State Land Use Urban District. 	<ul style="list-style-type: none"> • Community, educational, cultural and administrative support facilities, including community center, hale for Hawaiian art and cultural practitioners, administrative offices and support, health and wellness center and activities. Facilities will primarily be located along Kealohi Road and along the east boundary of the District. • Dryland agriculture and aquaculture-type activities, including fruit trees and crops for sale. • Agricultural and aquaculture-type support facilities, including poi mill and commercial kitchen, farmer's market, educational centers and offices, base yard and composting facilities, and housing for agricultural workers. • Commercial activities to support agricultural and aquaculture-type uses. • Agritourism uses to support local agriculture, sustainability, cultural and educational opportunities. • Educational facilities including observations, observatories, experimental and research stations.

<p>3. LOKO I'A KALO (Wetlands)</p>	<ul style="list-style-type: none"> • Lands with the lowest elevation in the He'eia CDD. • Generally located within the AEF Zone, and is considered the 'flood way' area in Zone AE. The flood way is the channel of a stream plus any adjacent floodplain area. • Predominantly alien grassland and wetland vegetation, including California grass and Job's tears. • Land located in the State Land Use Urban District. 	<ul style="list-style-type: none"> • Natural system restoration • Wetland and dryland agriculture and aquaculture, including kalo, food & ornamental crops, and fishponds. • Allow livestock to support agricultural use (commodities) and maintenance of the He'eia CDD. • Educational and research activities. • Cultural practices. • Restoration activities. • Ancillary support facilities for agriculture and aquaculture, including poi mill, base yards, staff support areas, comfort stations, and offices. • Agritourism uses to support local agriculture, sustainability, cultural and educational opportunities.
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6.2.1 Description of Land Use Division Zones and Uses

6.2.2 KULA UKA (Uplands)

The Kula Uka zone, shown in green in Figure 37, consists of approximately 136.9 acres and accounts for 34 % of the District. Located entirely within the Conservation District, the Kula Uka lands extend from Kamehameha Highway on the northeastern boundary of the He'eia CDD, to Kahekili Highway on the southwestern boundary. This zone is generally outside the 100-year flood zone, however, the flood zone may spread more into this region in the future with climate change. These lands are characteristically higher in elevation than other regions of the He'eia CDD, with peak elevations of up to 440 feet. The topography is steep in some areas with swales that could potentially flood during heavy rain events. Possible unexploded ordnances have also been identified in this region posing challenges for potential activities in this area (CSH 2017). Nevertheless, this zone is suitable for dryland agriculture, such as the cultivation of crops like breadfruit ('ulu) and kukui. The vegetation of this region predominantly consists of invasive alien forest species.

The Kula Uka region is categorized as "General" Conservation District lands, the least restrictive of the four sub-zones of the Conservation District. Conservation lands are comprised primarily of forest and water reserve zones, lands subject to flooding and soil erosion, and areas necessary for protecting watersheds and water sources, scenic and historic areas, parks, wilderness, open space, recreational areas, habitats of endemic plants, fish and wildlife, and all submerged lands seaward of the shoreline. Uses within the Conservation District are limited however, some uses may be permitted upon fulfilling specific requirements. The Conservation District is administrated by the State Board of Land and Natural Resources (BLNR) and uses are governed by rules promulgated by the State Department of Land and Natural Resources (DLNR). Permitted uses and requirements in the Kula Uka region, are listed in Appendix 1.

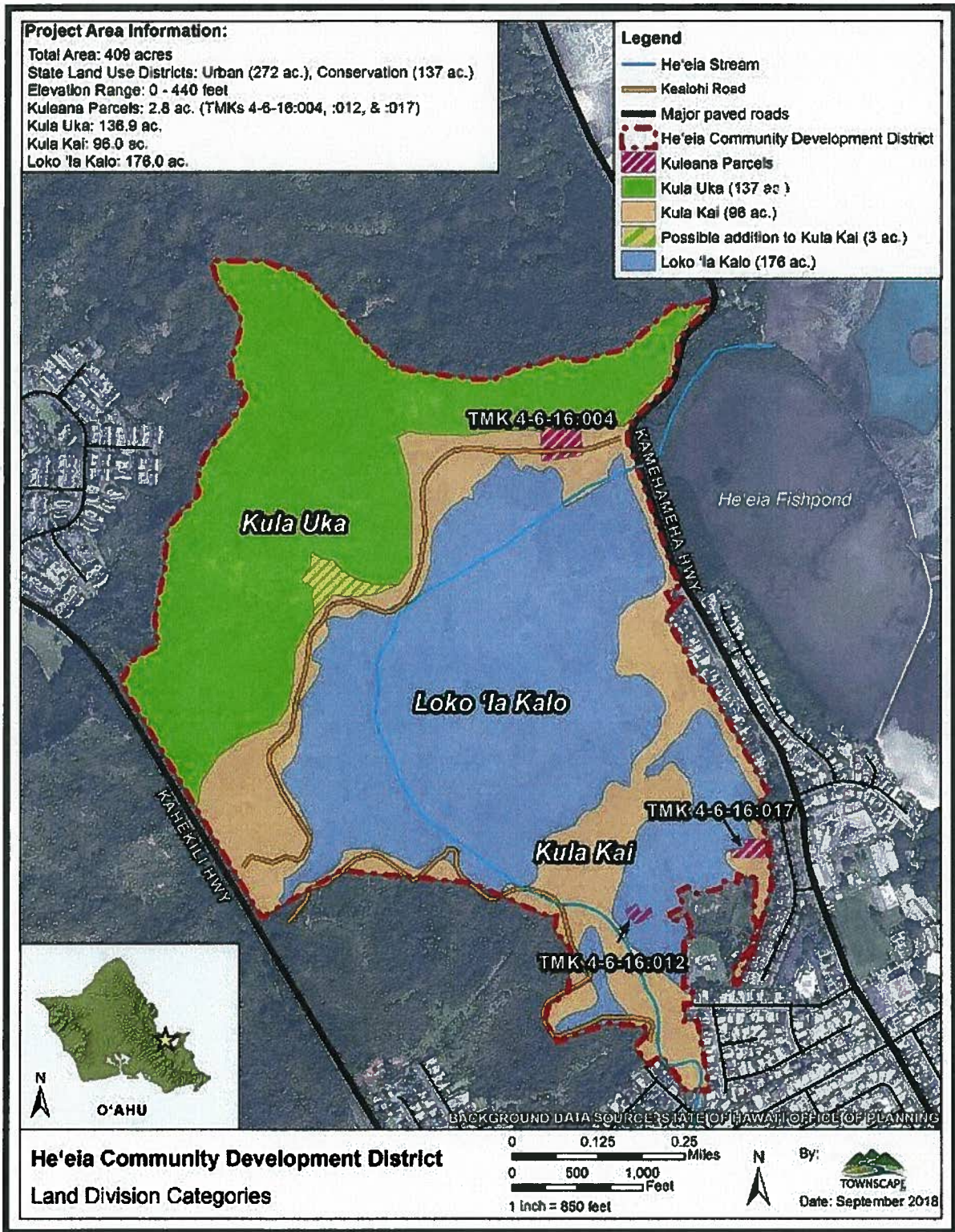


Figure 36. Land Division Categories

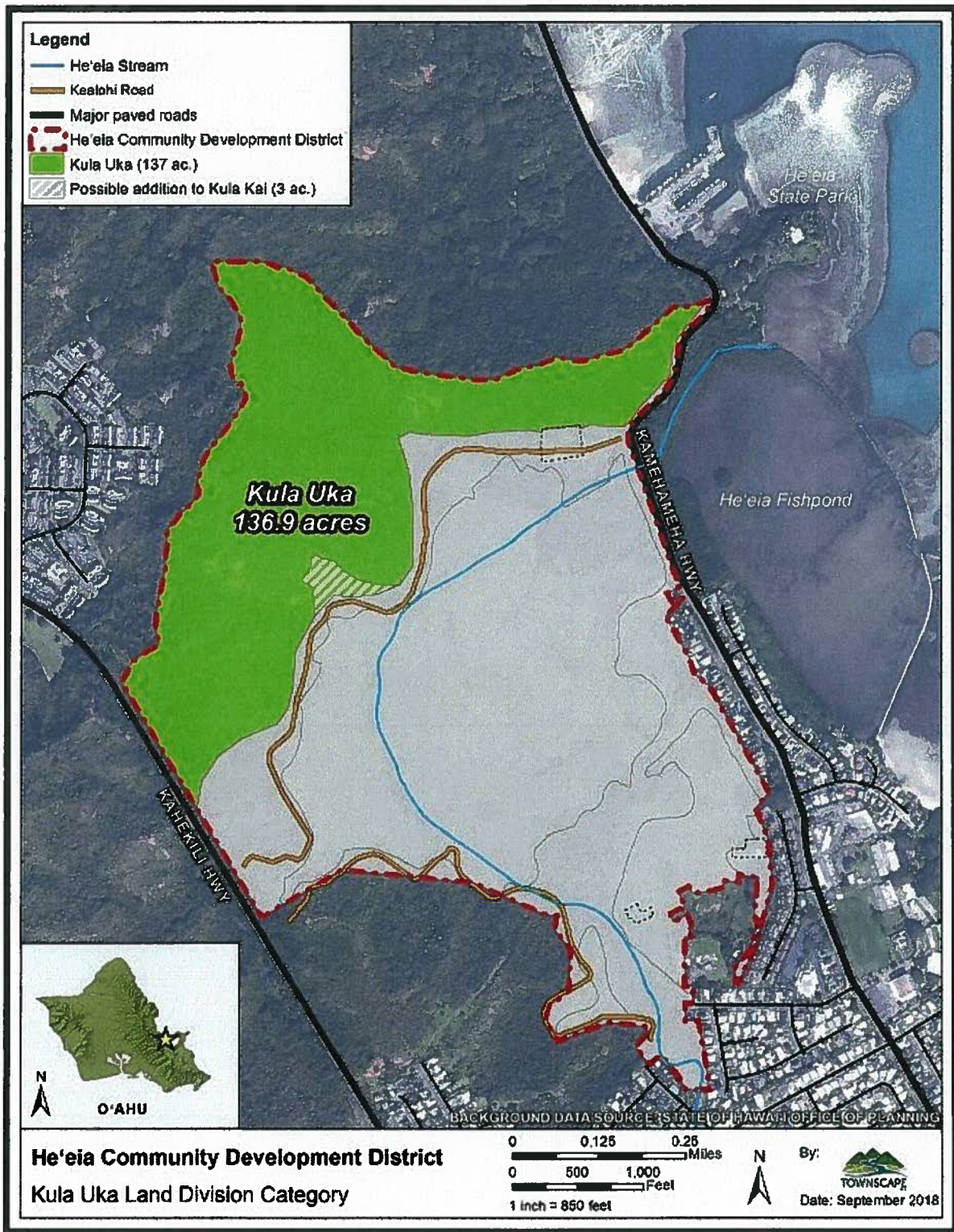


Figure 37. Kula Uka region

6.2.3 KULA KAI (Lowlands)

The Kula Kai zone, shown in brown in Figure 38, consists of approximately 93.6 acres of low lying lands that account for 23 percent of the He'eia CDD. This zone is generally lower in elevation than Kula Uka lands but higher than the wetlands with portions of the land within the 100-year-flood zone. Therefore, this zone may more likely to be inundated by water during high rainfall events. The Kula Kai region is distributed throughout the He'eia CDD along Kealohi Road and surrounding the wetlands.

Infrastructure and Facilities Corridor: The location of the Kula Kai zone in the Urban District provides ideal conditions in this region for the development of infrastructure and facilities to support the activities of the District. Facilities may be situated along Kealohi Road and along the east boundary of the District. Facilities may include structures for community, educational, cultural and administrative support. Examples of such facilities include:

- community center,
- hale for Hawaiian art and cultural practitioners,
- administrative offices and support,
- health and wellness center,
- poi mill and commercial kitchen,
- farmer's market,
- educational centers and offices,
- baseyard,
- composting facilities,
- housing for agricultural workers,
- observatories,
- experimental and research stations.

Other proposed uses for the Kula Kai region include dryland agriculture and aquaculture-related activities, commercial activities to support agricultural and aquaculture-type uses, as well as agritourism uses to support local agriculture, sustainability, cultural, and educational opportunities.

To maximize the potential area for the proposed activities in this region, additional lands are proposed to be added to the Kula Kai region. This site is situated along Kealohi Road, as indicated in Figure 38. At this time, the area of land to be added to the Kula Kai region is undetermined. However, it should be noted that these lands are within the State's Conservation District. Therefore, any development within these lands might be restricted or subject to a district boundary amendment.

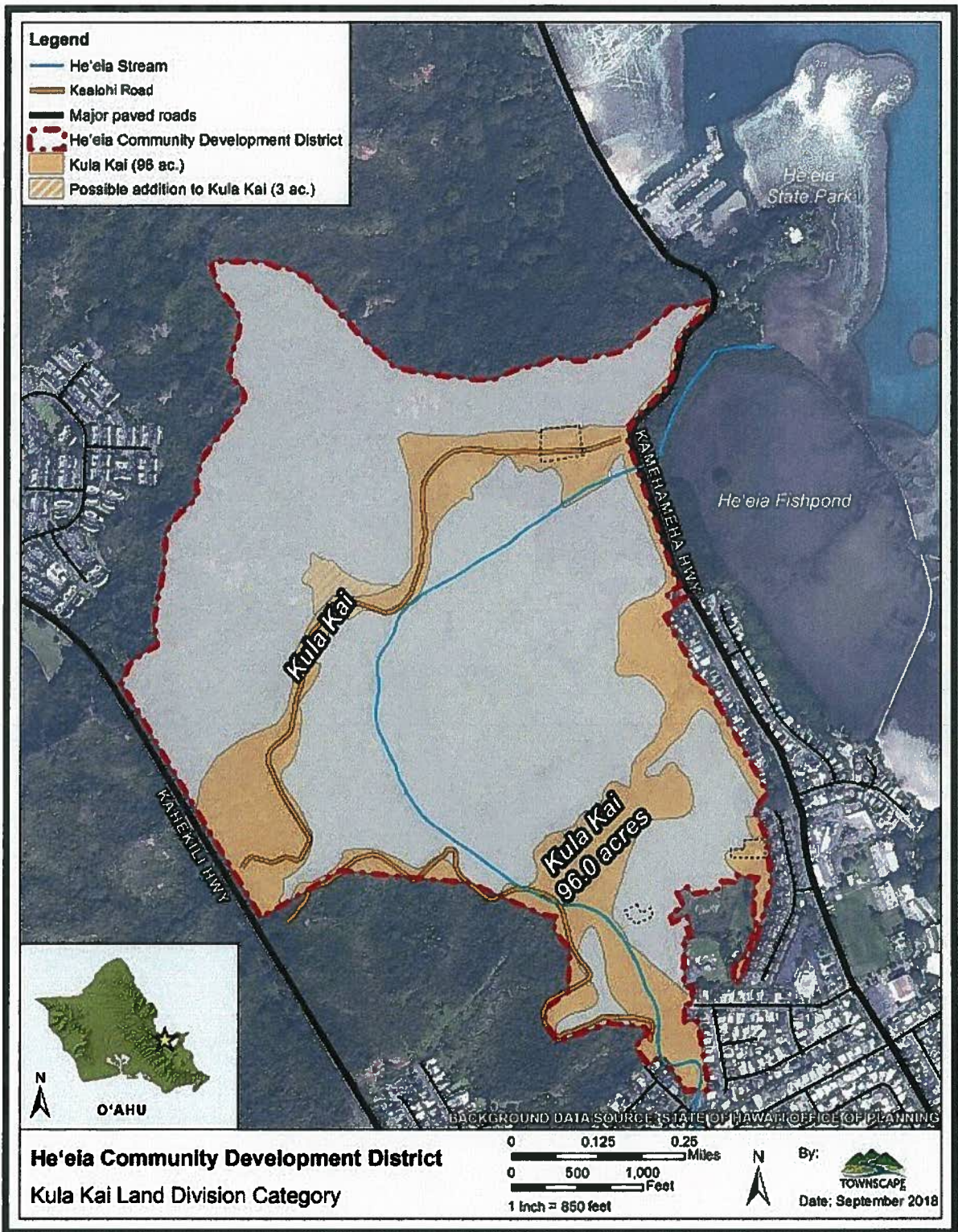


Figure 38. Kula Kai region

6.2.4 LOKO I'A KALO (Wetlands)

The Loko I'a Kalo zone, shown in blue in Figure 39, is the largest land division of the He'eia CDD. This zone consists of 175.6 acres and accounts for almost half or 43 percent of the District's property. This zone is situated entirely within the Urban District and mostly in the 100-year-flood zone. The Loko I'a Kalo region is a wetland, inundated by fresh water from He'eia Stream, springs, man-made 'auwai, and salt water from Kāne'ohē Bay. The majority of the wetland is characterized as estuarine wetlands with a portion of palustrine wetlands. The vegetation of this zone is dominated by alien grasslands, such as California grass and Job's tears.

The wetland zone, like other wetlands in Hawai'i, is regulated and protected by county, state, and federal laws and programs. Various agencies with jurisdiction over wetlands include:

- City and County of Honolulu - Coastal Zone Management Act;
- DLNR's Commission on Water Resources Management (CWRM) - administers the Stream Channel Alteration Permit (SCAP);
- DOH – administers the Water Quality Certification Process (Clean Water Act, Section 401);
- U.S. Army Corps' of Engineers (USACOE) – regulates dredge and fill permits (Clean Water Act, Section 404); and construction of structures, deposition of material or alteration to any navigable waters of the United States (Rivers and Harbors Act, Section 10).

Therefore, uses within this zone are limited and must comply with all applicable policies and regulations. Details on these permits are described in Section 8.1.

6.3 Development Guidelines

6.3.1 Lo'i and Loko I'a Design Framework

Objective	Guidelines
Prevent adverse effects to historic sites	<ul style="list-style-type: none">○ Precautionary measures, approved by DLNR State Historic Preservation Division (SHPD), shall be taken for all shore side reconstruction activities (e.g., transport of construction materials).○ Should offsite reconstruction materials be utilized, they will not be from any historic sites. Excess construction materials shall not be disposed in historic sites.○ Maintain close coordination with the DLNR-SHPD before, during, and after reconstruction.
Compliance with applicable government policies and regulations	<ul style="list-style-type: none">○ Activities must comply with all applicable statutes, ordinances, rules, and regulations of the federal, state and county government and applicable parts of Chapter 13-5, Hawai'i Administrative Rules.○ All activities must comply with all applicable Department of Health rules.○ The State of Hawai'i will be held harmless from and against any loss, liability, claim, or demand for property damage, personal injury, and death arising out of any act or omission of the applicant, its successors, assigns, officers, employees, contractors, and agents under this permit or relating to or connected with the granting of this permit.

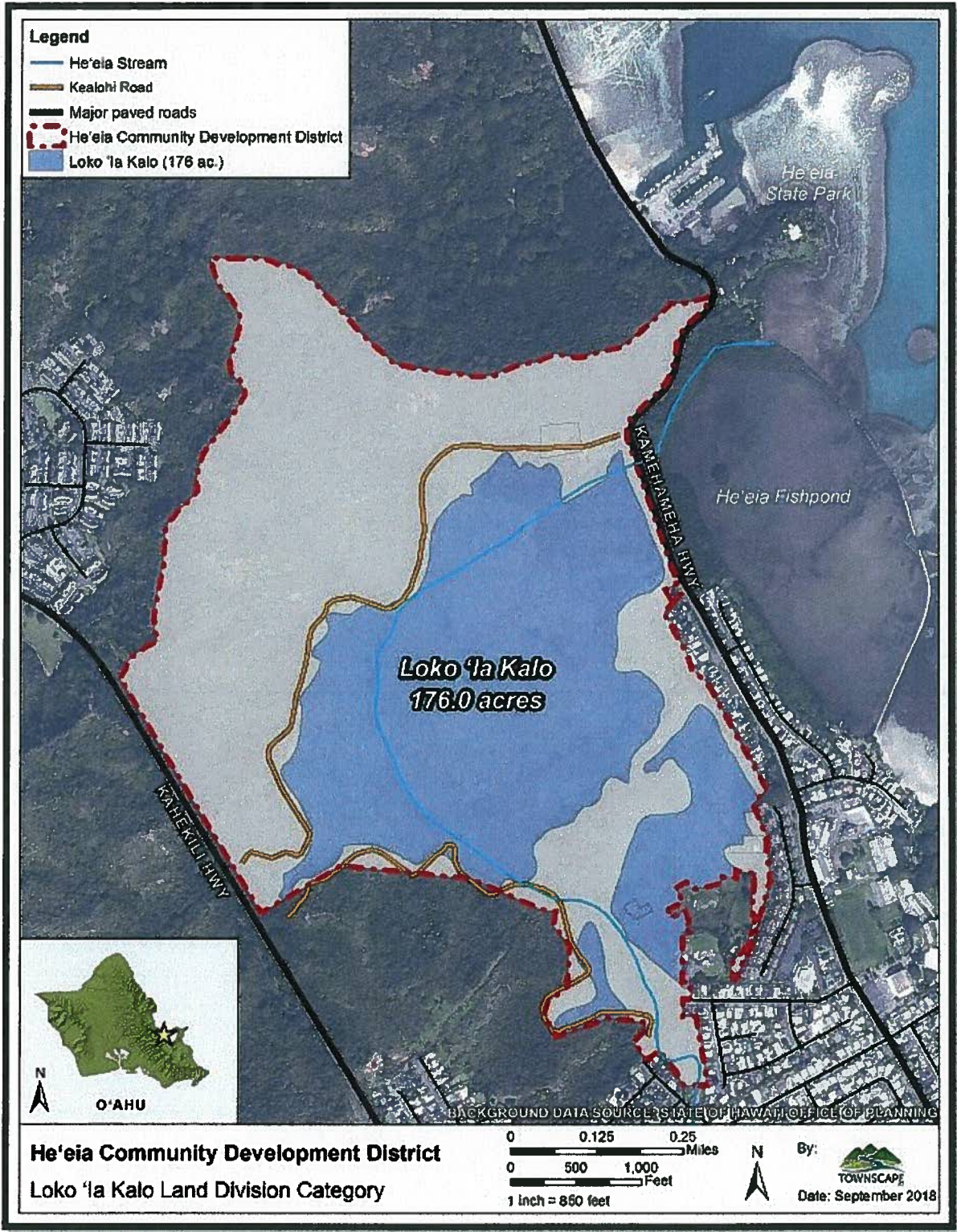


Figure 39. Loko I'a Kalo

6.3.2 Roadways Guidelines

Objective	Guidelines
Maximize District connectedness	<ul style="list-style-type: none"> ○ Connect new roads, paths, and trails to the existing major roadway system.
Beautify roads, trails, and paths with trees and green infrastructure practices	<ul style="list-style-type: none"> ○ Encourage the use of green infrastructure practices as standard practice for roads, trails, and paths. For example, plant trees on both sides of roads. ○ Use appropriate tree species such as native or canoe trees and ensure the trees have the correct soils and root and growth space to thrive.
Reduce traffic and create desirable pedestrian friendly, safe roads	<ul style="list-style-type: none"> ○ Design safe, pedestrian-friendly roads by including elements such as benches, trees, another landscaping along main roads. ○ Design narrower roads (_feet) to reduce speeds and impervious surfaces.
Minimize the negative impact of car parking	<ul style="list-style-type: none"> ○ Design car parking areas so that they do not impact the rural character of the District.

6.3.3 Sustainable Site Development Guidelines

Objective	Guidelines
Use materials and products that are environmentally preferable and safer for health	<p>To the greatest extent possible, use materials that have minimized environmental and health impacts over their lifecycle:</p> <ul style="list-style-type: none"> ○ Use recycled or recyclable building and finish materials. ○ Use locally available, indigenous materials and/or products that have been certified under a trusted green program. ○ Use healthier and durable materials.
Reduce maintenance requirements and costs, water consumption, and negative environmental impacts	<ul style="list-style-type: none"> ○ Limit the use of turf grass and plant native, drought-tolerant ground cover. ○ Design landscapes to be low maintenance and require little to no fertilizers, pesticides, or watering except for when they are first established. ○ Select and establish plants that are appropriate to the site's soils and micro-climate and require little or minimal irrigation, fertilization, and chemical management (pesticides). ○ Reduce areas maintained by greenhouse gas-emitting maintenance equipment.

Objective	Guidelines
<p>Incorporate stormwater management practices as part of District design features and amenities</p>	<ul style="list-style-type: none"> ○ Use green infrastructure and low-impact development techniques to manage runoff on-site, such as bioswales, tree plantings, biofiltration, and cisterns and/or water tanks. ○ To the extent practicable, minimize impervious surfaces by using gravel, permeable pavers and similar pervious surfaces for driveways, parking lots, and other areas that would usually be paved. ○ Encourage green infrastructure practices in landscaping features, such as community gardens, rain gardens and large canopy trees.
<p>Mitigate heat island impacts</p>	<ul style="list-style-type: none"> ○ Use ENERGY STAR qualified or other highly reflective roofing products. ○ Select and install trees along roadside, and or preserve existing trees.
<p>Control soil erosion and sedimentation</p>	<ul style="list-style-type: none"> ○ Implement local or state erosion and sedimentation controls during construction using EPA's Stormwater Best Management Practices.
<p>Reduce excess construction waste and make recycling easy</p>	<ul style="list-style-type: none"> ○ Whenever possible, use building technologies, materials and finishes that minimize finishing on-site. ○ Place recycling bins on construction site for recyclable/reusable waste materials that can be diverted from landfills.
<p>Encourage on-site production and use of renewable energy sources</p>	<ul style="list-style-type: none"> ○ Install non-polluting, renewable energy generation technologies such as solar and wind. ○ Alternatively, consider designing and wiring the development to accommodate renewable energy sources, such as photovoltaic cells, in the future.
<p>Enhance on-site energy production with off-site renewable energy sources</p>	<ul style="list-style-type: none"> ○ Purchase energy for on-site use from renewable resources that may be available from the local utility/energy provider.
<p>Create high performance site development projects to reduce water consumption, water utility costs, and protect natural water supply</p>	<ul style="list-style-type: none"> ○ Use durable, water-efficient fixtures, such as EPA WaterSense labeled products: <ul style="list-style-type: none"> ○ Showerheads with a flow of less than 2 gallons per minute (gpm) ○ Sink faucets with a flow of less than 2 gpm. ○ Toilets that use less than 1.6 gallons per flush (gpf). ○ Urinals that are waterless or use less than 1 gpf.
<p>Create high performance site</p>	<ul style="list-style-type: none"> ○ Identify ENERGY STAR partners to design and build facilities.

Objective	Guidelines
development projects to reduce energy consumption, and energy utility costs	
Design and construct sound building envelope	<ul style="list-style-type: none"> ○ Complete Thermal Bypass Inspection Checklist. ○ Complete Quality Farming Checklist. ○ Install ENERGY STAR qualified or better windows and doors.
Design water efficient plumbing system	<ul style="list-style-type: none"> ○ Use demand pumping or manifold distribution system.
Specify construction methods that ensure healthy indoor air quality	<ul style="list-style-type: none"> ○ Use EPA's Indoor airPLUS. ○ Complete Indoor Air Quality Checklist. ○ Complete Water-Managed Construction Checklist.

7 INFRASTRUCTURE [To be fill in once Infrastructure plan is done]

7.1 Roadways

7.2 Drainage

7.3 Potable Water Supply

7.4 Sewer System

7.5 Electrical System

7.6 Telecommunications

8 RECOMMENDATIONS AND IMPLEMENTATION

8.1 Regulatory Coordination and Approvals

8.2 Project Phasing

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