

**NORTH SHORE
WATERSHED MANAGEMENT PLAN:
Water Resources, Use &
Projected Future Water Demand**

November 15, 2012

Meeting #2

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- **Intro:**
Watershed Management Plan Overview
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North Shore Water Demand Projections

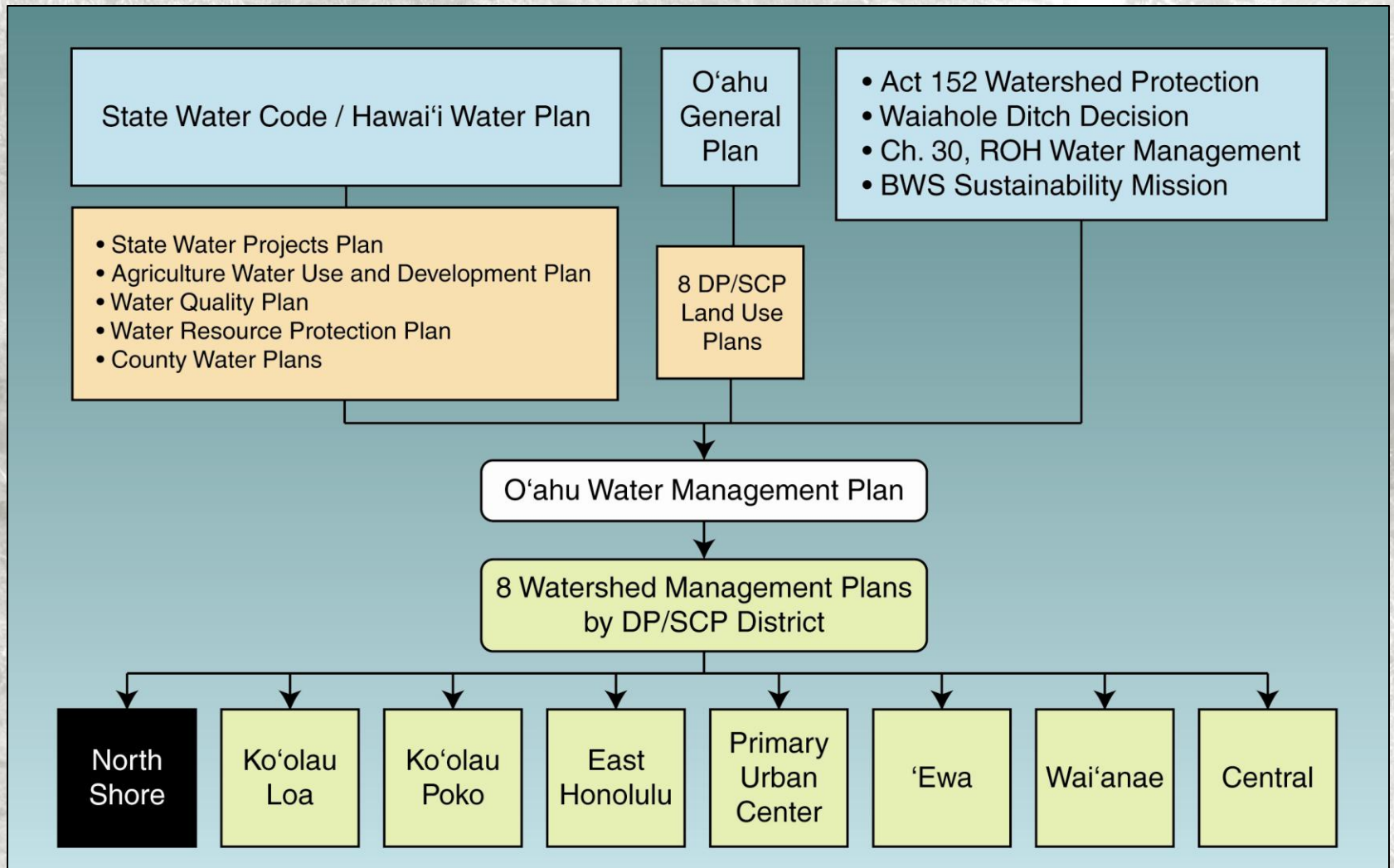


Intro: Background and Context

- County “**Water Use and Development Plans**” required by **State Water Code**
- **Revised Ordinances of Honolulu Chapter 30 - “O’ahu Water Management Plan”** by DPP
- Guidance includes the **Hawai’i Water Plan & City Development / Sustainable Communities Plans**
- BWS & DPP develop Watershed Management Plans & Development/Sustainable Communities Plans **by District** to provide community-specific strategies



Intro: O'ahu Water Management



Intro: Watershed Management Plan Goal

To formulate an **environmentally holistic, community based**, and **economically viable** watershed management plan that will provide a balance between:

- (1) the protection, preservation and management of O‘ahu’s watersheds
- (2) sustainable ground and surface water use and development to serve present users & future generations



Intro: Watershed Management Plan Objectives

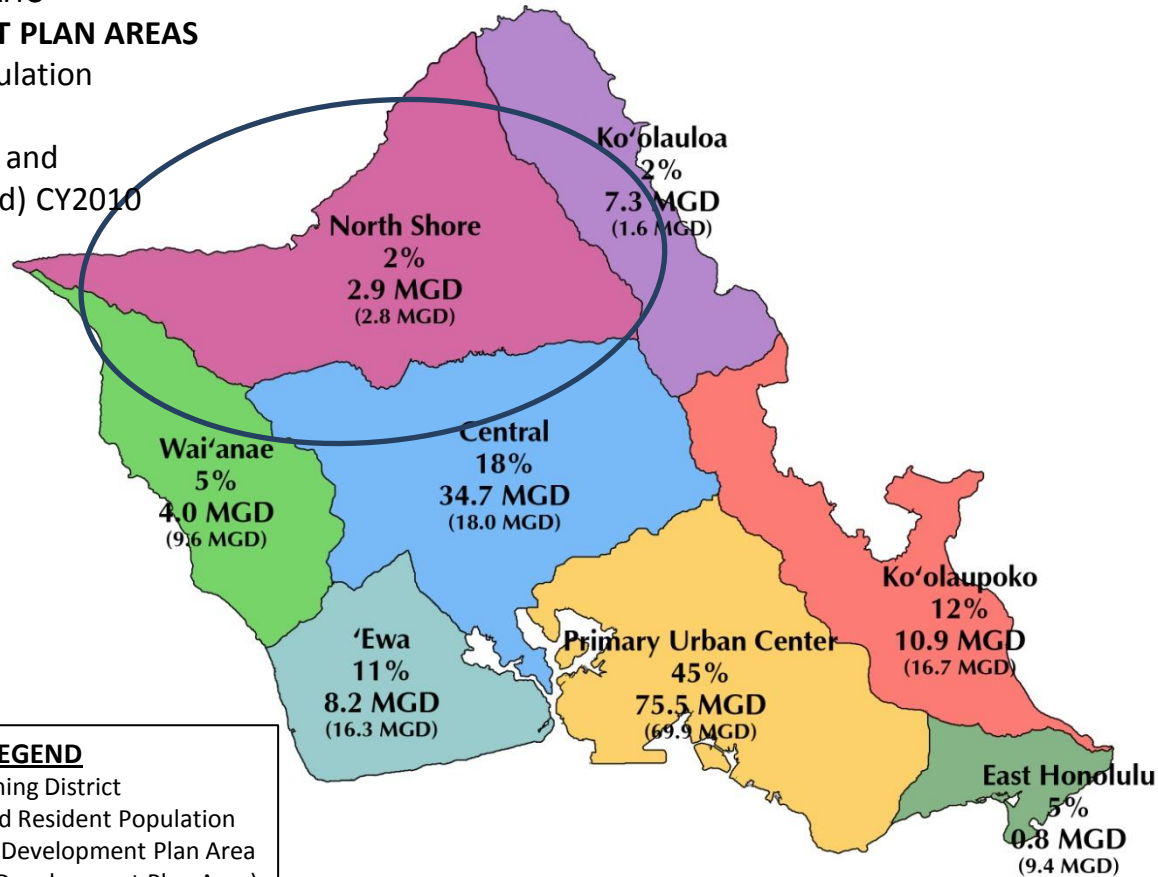
1. Promote Sustainable Watersheds
2. Protect and Enhance Water Quality & Quantity
3. Protect Native Hawaiian Rights and Traditional & Cultural Practices
4. Facilitate Public Participation, Education & Project Implementation
5. Meet Future Water Demands at Reasonable Costs



Intro: O'ahu Water Management Plan - North Shore

ISLAND OF O'AHU DEVELOPMENT PLAN AREAS

Estimated Population
Distribution,
BWS Pumpage and
(Water Demand) CY2010

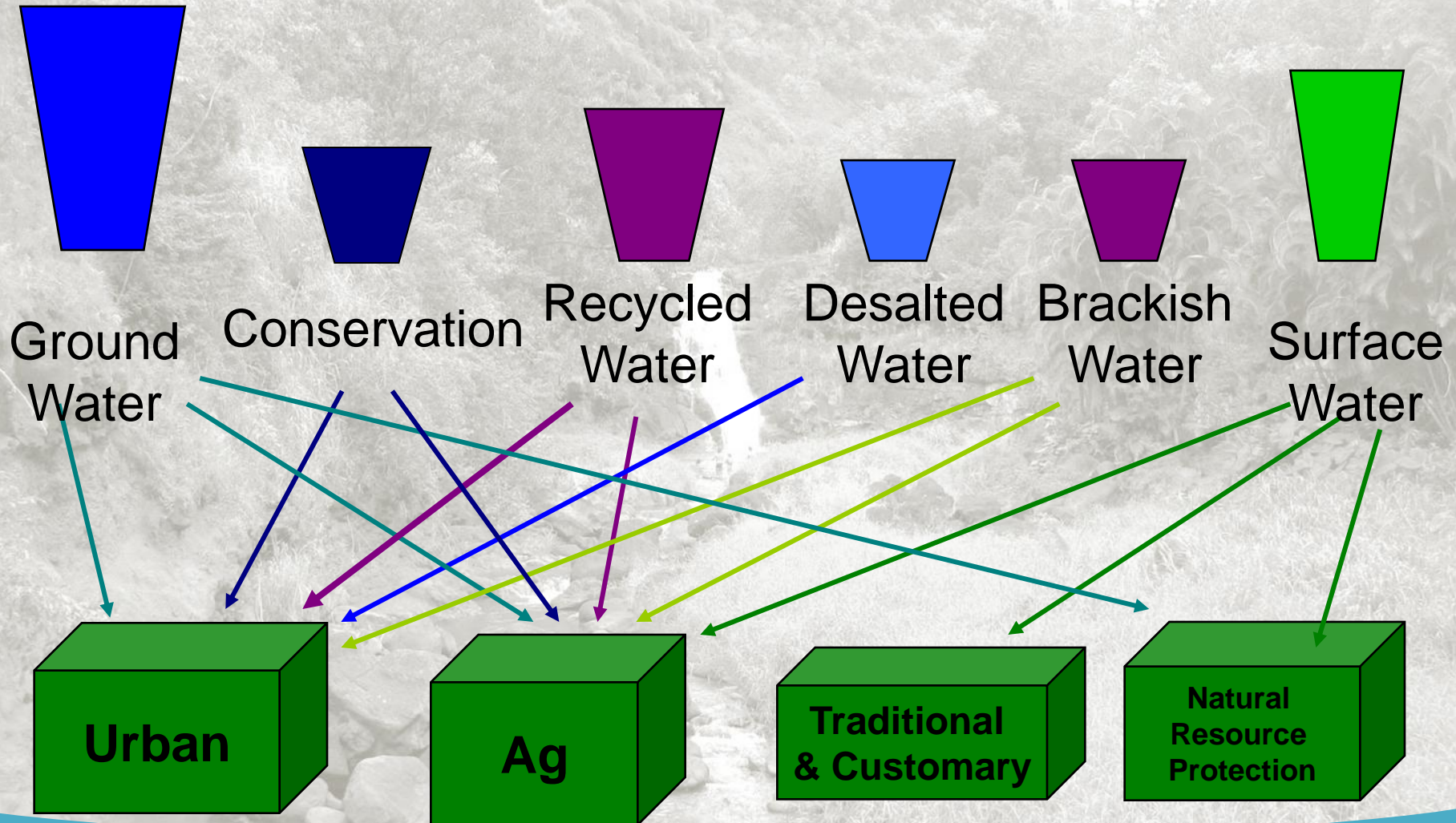


LEGEND

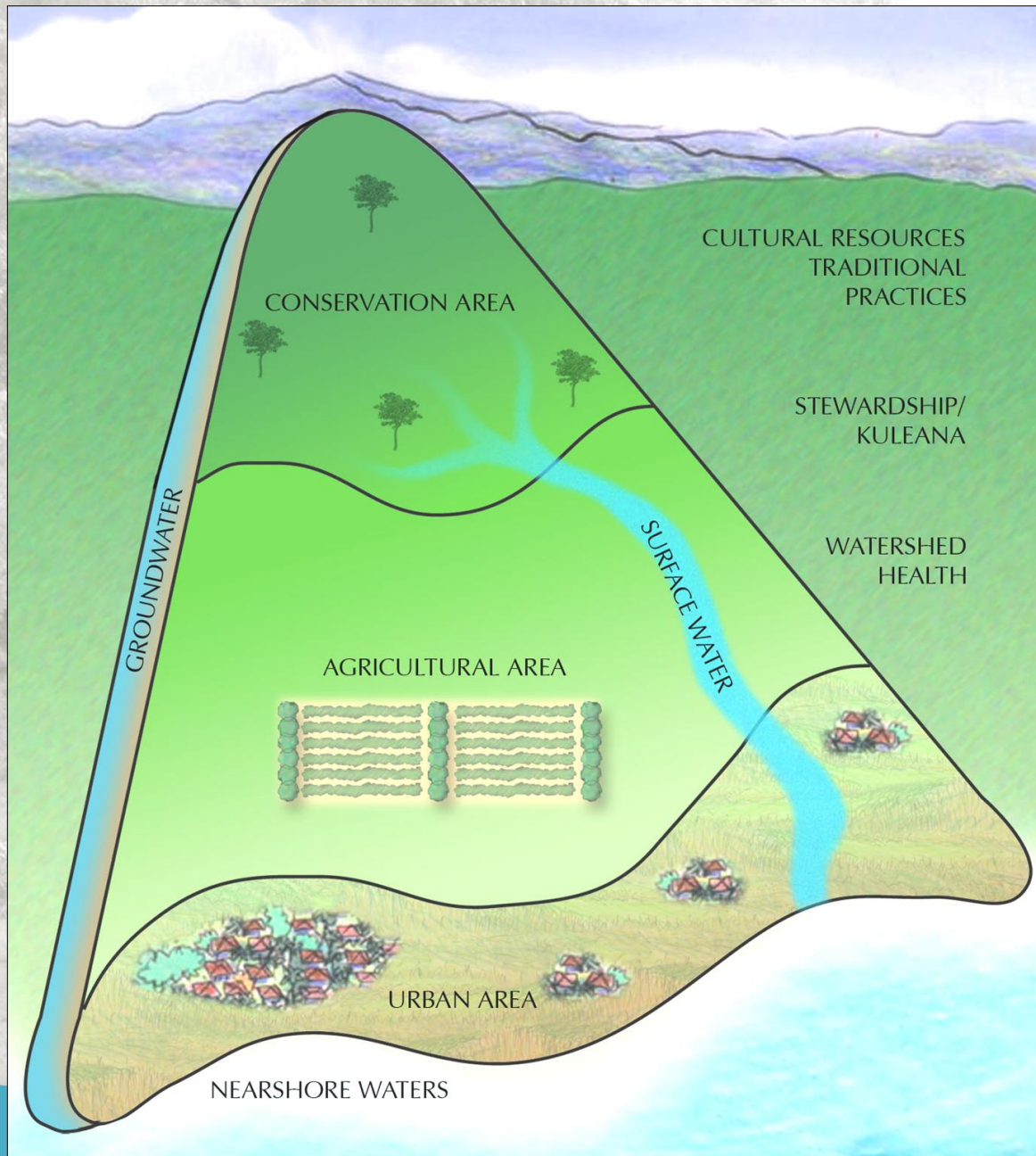
Planning District
Percent of Island Resident Population
BWS Pumpage in Development Plan Area
(Net demand for Development Plan Area)



Intro: Water Supply Matched with Appropriate Use



Intro: Watershed Management Projects, Programs & Strategies



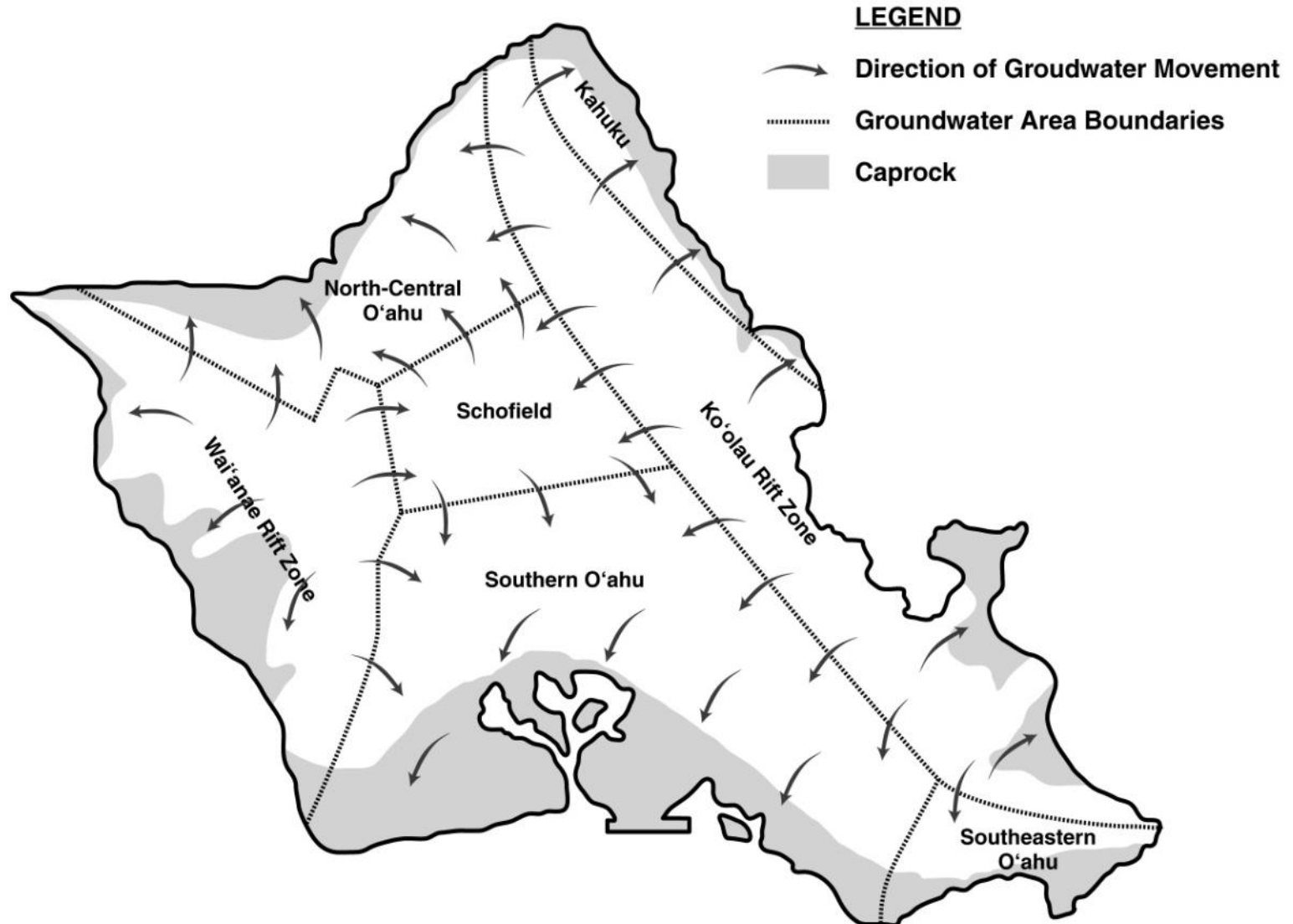
PART A

WATER RESOURCES, SYSTEMS & USES

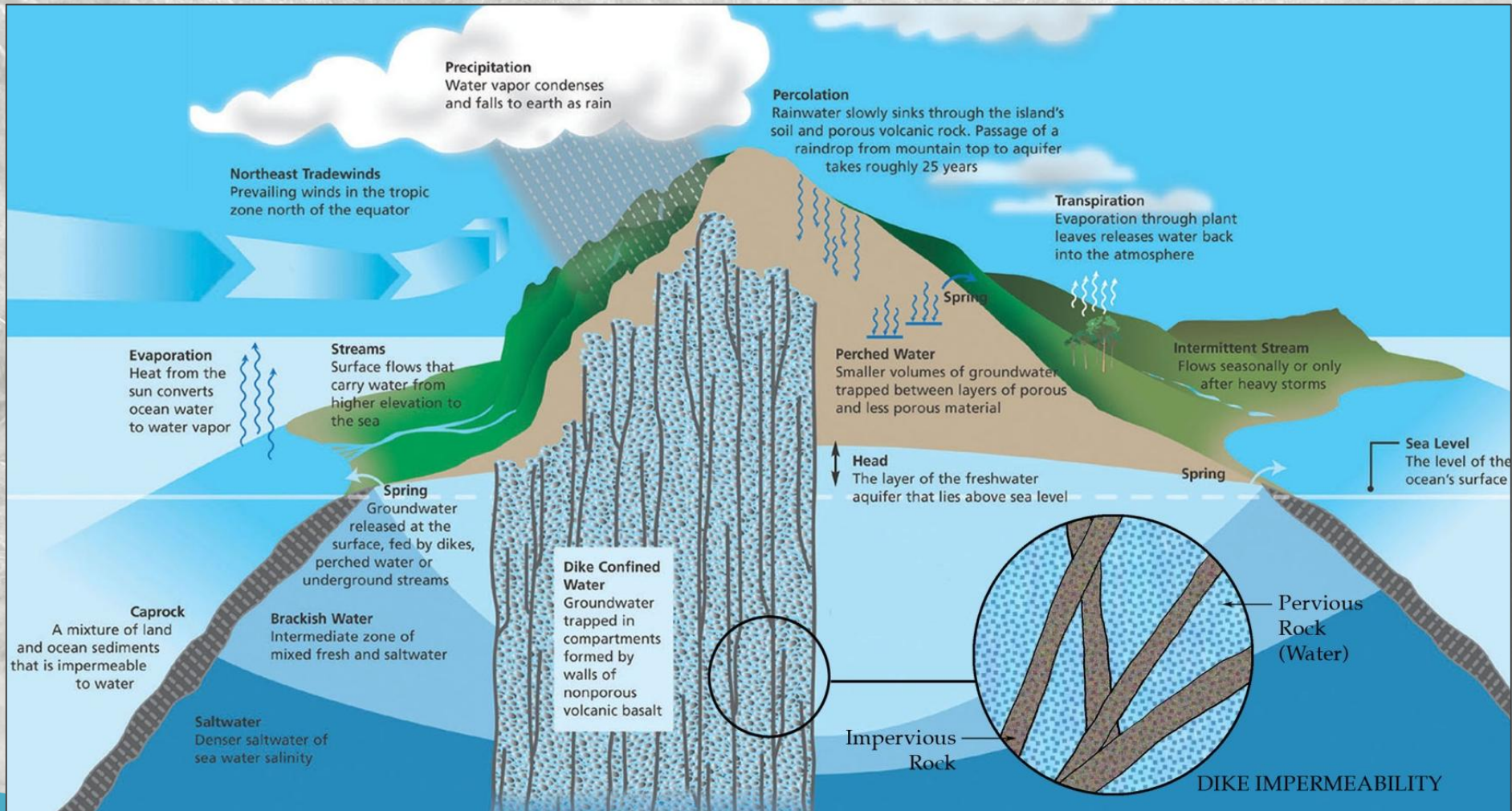
- Geology & Climate
- Groundwater
- Surface Water



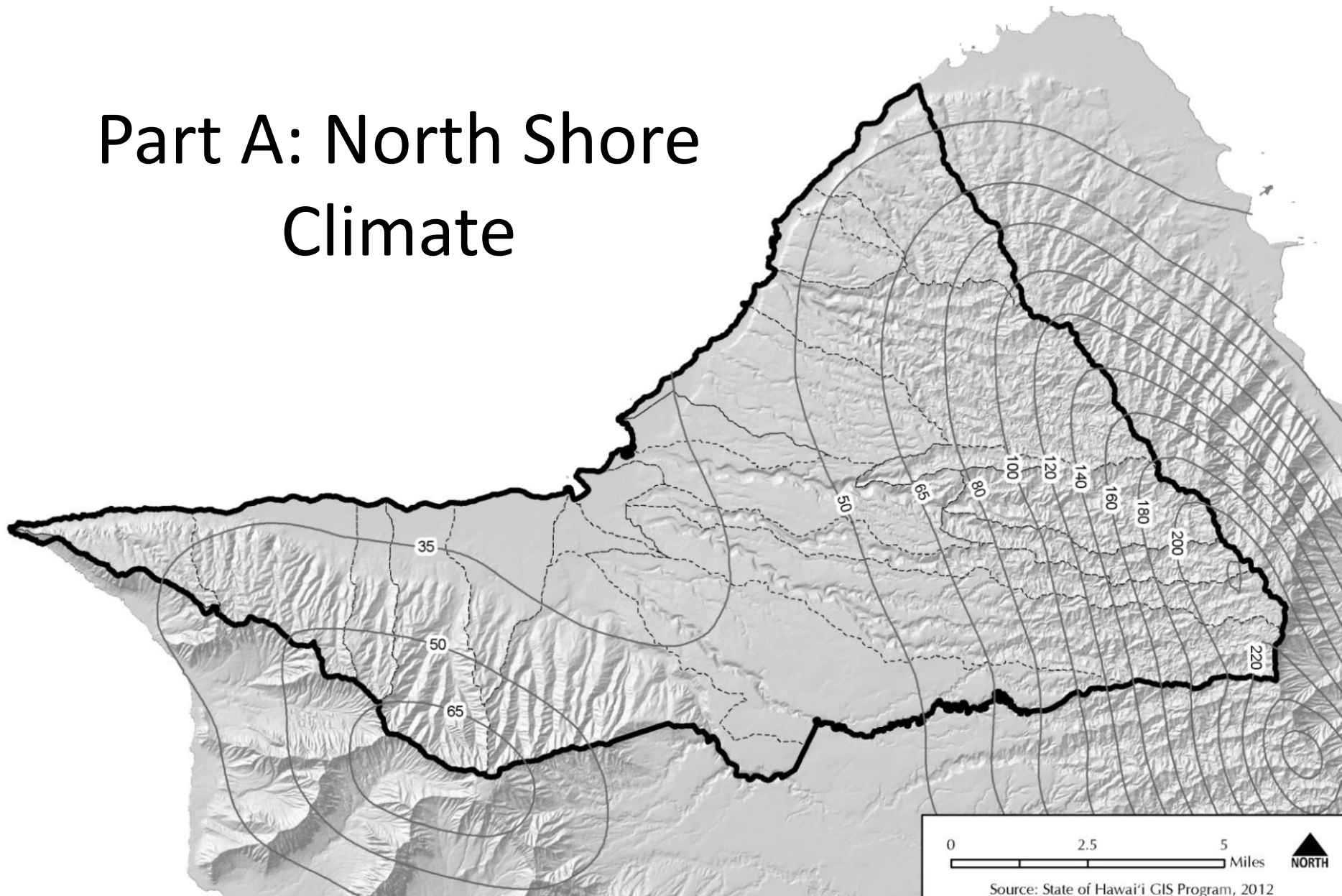
Part A: North Shore Geology



Part A: North Shore Climate



Part A: North Shore Climate



Source: State of Hawai'i GIS Program, 2012

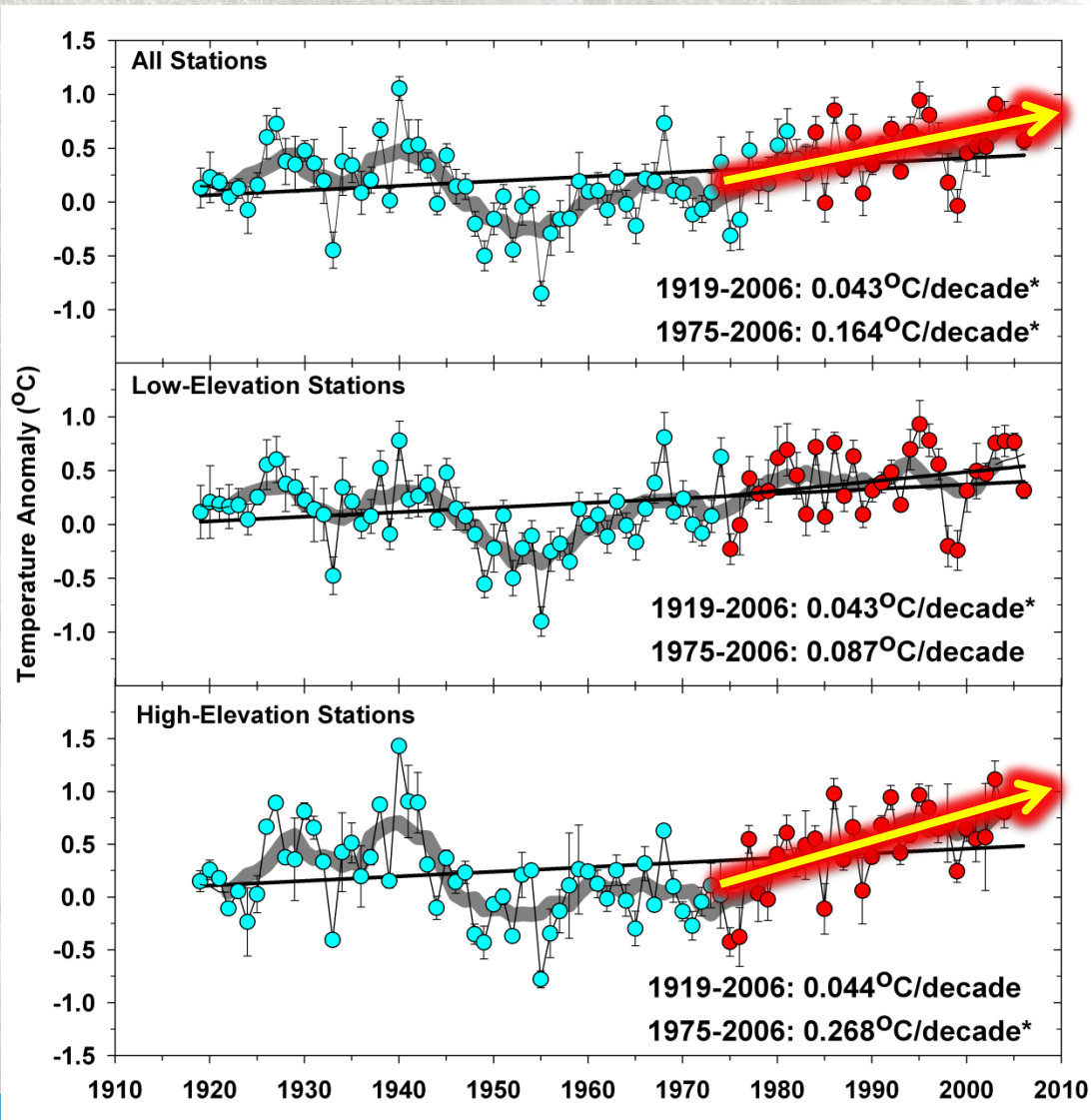
Part A: Climate - Drought Issues

Drought is a persistent and extended period of below normal precipitation having adverse effects on people, animals, and crops.

- Crop losses
- Increased risk of wildfires
- Affects water supply
- More often in El Nino years
- Can last multiple years



Hawai'i Temperature Index

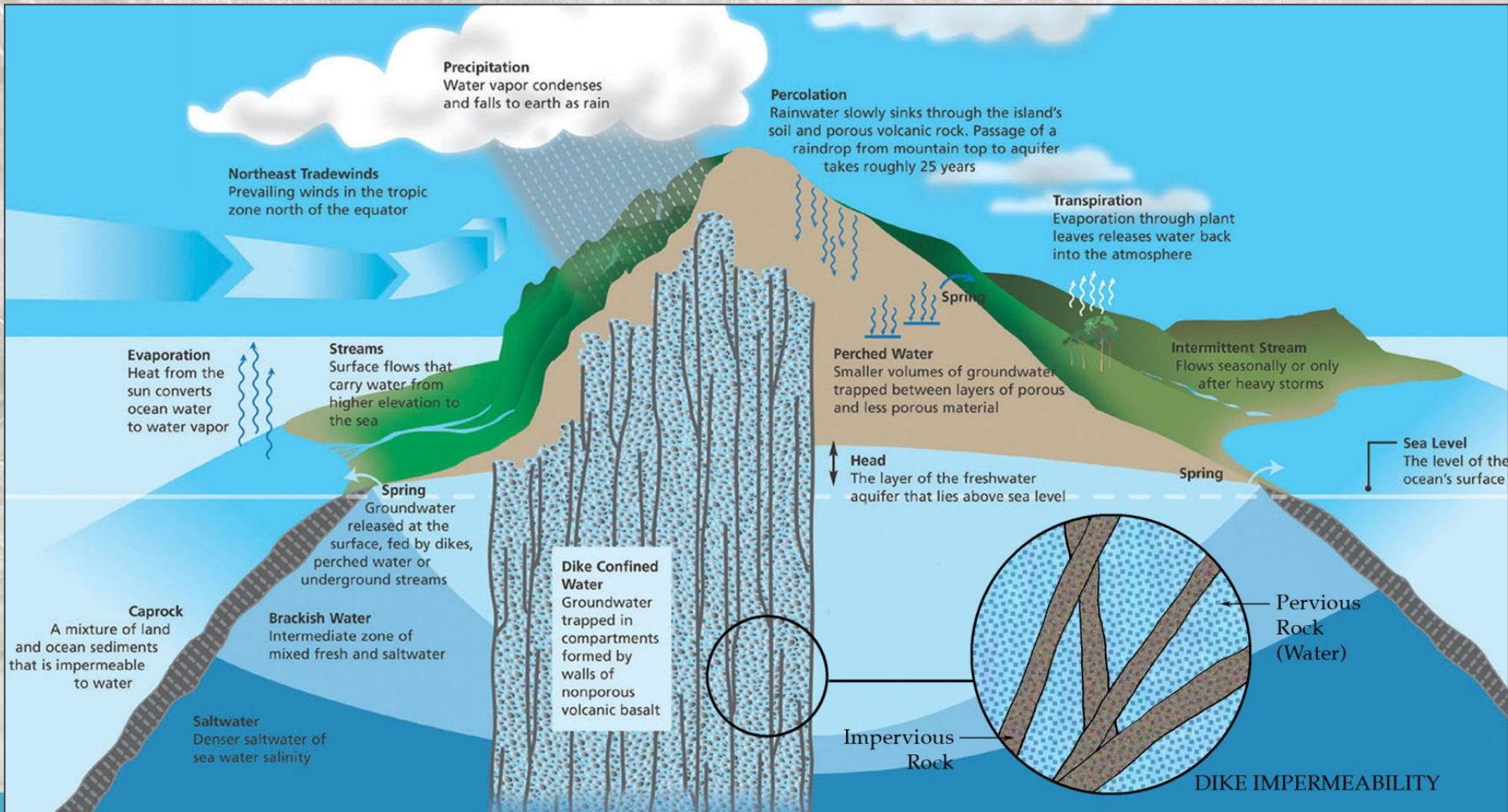


30-yr change = +0.9°F

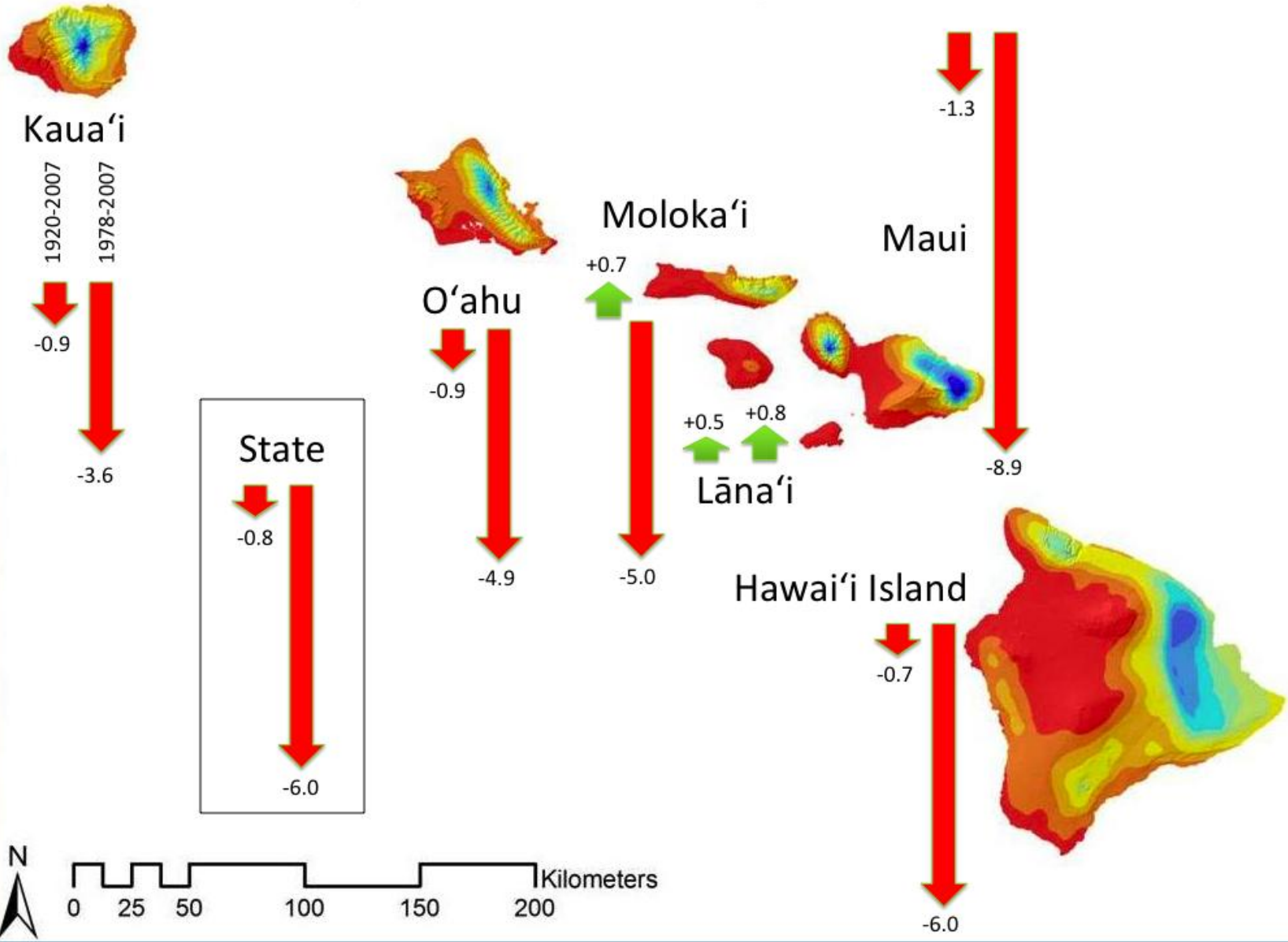
30-yr change = +1.4°F



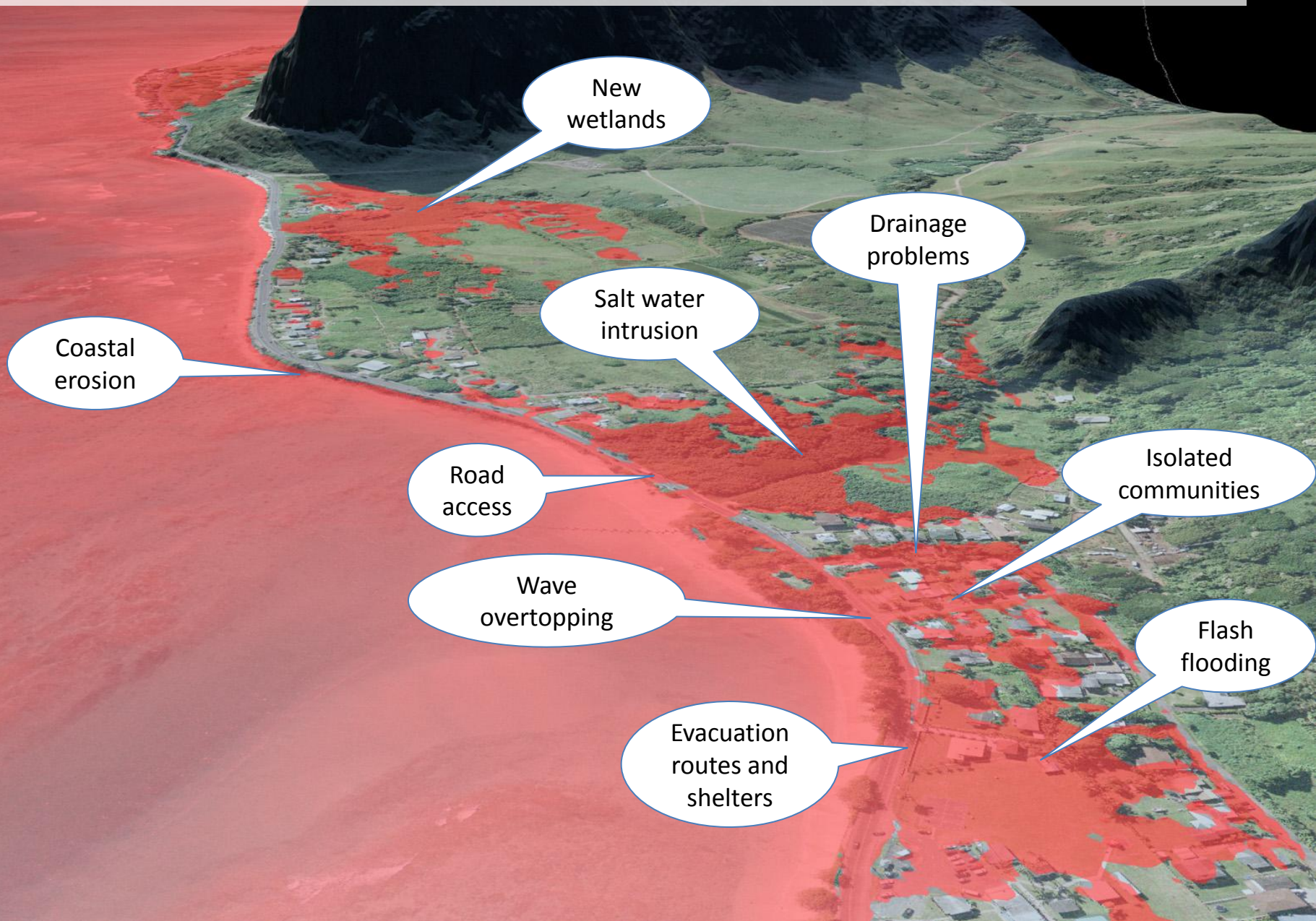
Part A: North Shore Climate Change



Precipitation Trends (% per decade)



Part A: Potential Effects of +3 ft Sea level



Part A: Climate Change

Planning Implications

- Higher temperatures & decreased rainfall
- Less rainfall = less surface & groundwater recharge
- Increased demand with higher temperatures
- Increased severity and frequency droughts & flooding
- Wildfire risk increases
- Rising sea levels may affect caprock protection of groundwater and coastal hazards

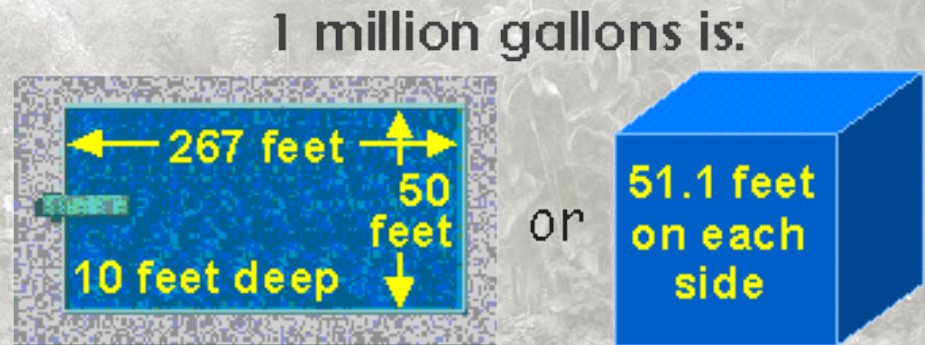


Part A: Ground and Surface Water Measurement

Million Gallons per Day (mgd)

1 mgd = a swimming pool

- 267 feet (nearly as long as a football field without end zones)
- 50 feet wide
- 10 feet deep



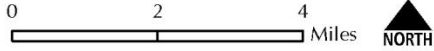
Sustainable Yield (SY)

is the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by CWRM.



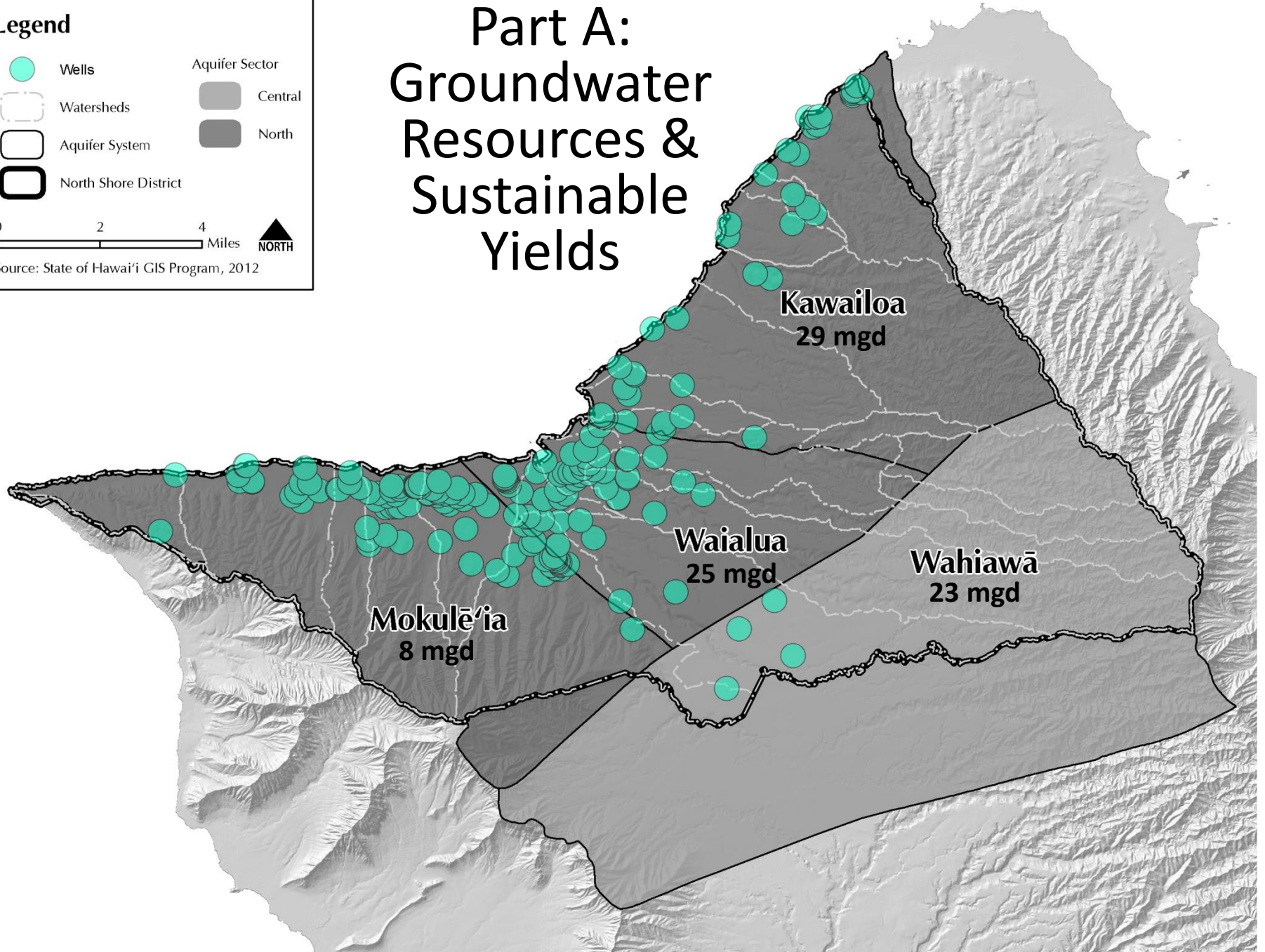
Legend

- Wells
 - Watersheds
 - Aquifer System
 - North Shore District
- Aquifer Sector
- Central
 - North



Source: State of Hawai'i GIS Program, 2012

Part A: Groundwater Resources & Sustainable Yields



Part A: Groundwater Users

- Potable Water
 - Honolulu BWS
 - North Shore Water Company
 - State Department of Transportation – Dillingham Airfield
 - Federal (Helemano Military Reservation) – from Wahiawā
- Non-Potable Uses – Agriculture
 - Kamehameha Schools
 - Dole Food Company
 - Other farmers

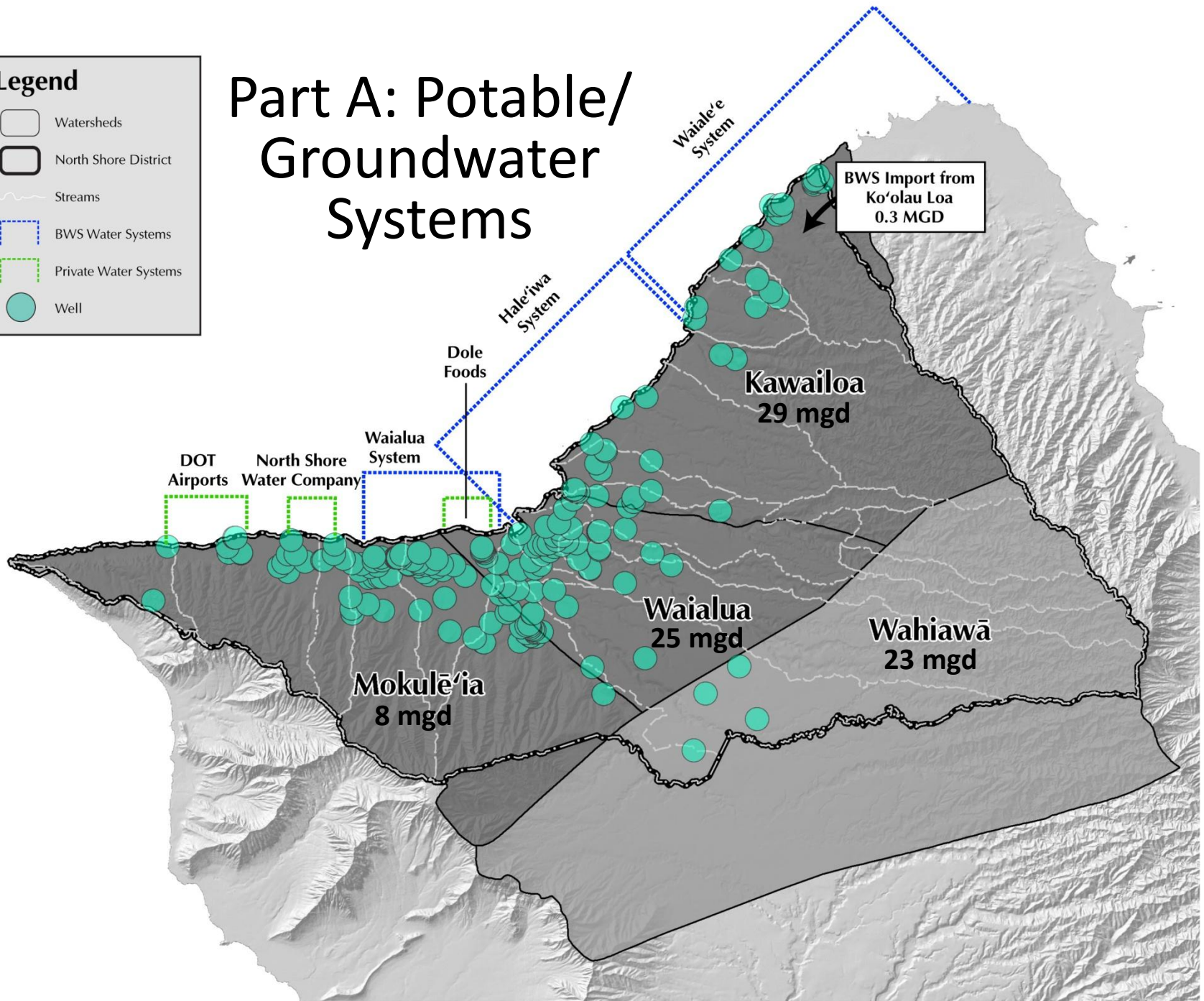
Note: Groundwater is used for agriculture where there is no surface water irrigation system, as back-up system to surface water system during periods of drought, and for agricultural process where required for food safety



Legend

- Watersheds
- North Shore District
- Streams
- BWS Water Systems
- Private Water Systems
- Well

Part A: Potable/ Groundwater Systems



Part A: Groundwater Permitted Uses

Aquifer System Area	Sustainable Yield (mgd)	Permitted Use (mgd)	Difference (mgd)	Average Reported Total Pumpage for 2010 (mgd) ¹
Mokulē'ia	8	8.025	-0.025	0.233
Waialua	25	16.937 ²	8.063	5.76 ³
Kawailoa	29	1.614	27.386	0.534
TOTAL	62	26.576	34.424	6.627
<i>Wahiawā</i>	23	22.663	0.337	
Wahiawā in NS DP area		7.742		0.662

¹These numbers reflect many water use permit holders that are not reporting pumpage for their wells

² Reflects the October 10, 2012 water revocation and allocation of water use permits

³4-year use, the reported maximum 12-month moving average in the past four years



Part A: Groundwater Systems

- Potable Water Systems (2010 pumpage)
 - Honolulu BWS – 3.331 mgd
 - North Shore Water Company – 0.151 mgd
 - Department of Transportation – 0.081 mgd
 - Federal (Helemano Military Reservation)
- Ag well users (2010 pumpage)
 - Dole Foods – 1.7 mgd
 - Kamehameha Schools – 1.2 mgd
 - UH Animal Science – 0.112 mgd; Kalena Farms 0.660 mgd; Poamoho 0.092 mgd; Theo Lopez Trust – 0.007 mgd
 - *Non-reporting – Paniolo Ranch, Mark Hamamoto, Ka'ala Farm, Stanhope Farm, Richard Serman, Jewett & Ward, Mary Lou Gora, Paradise Shrimp*



Part A: BWS Waialua – Kawela Water System

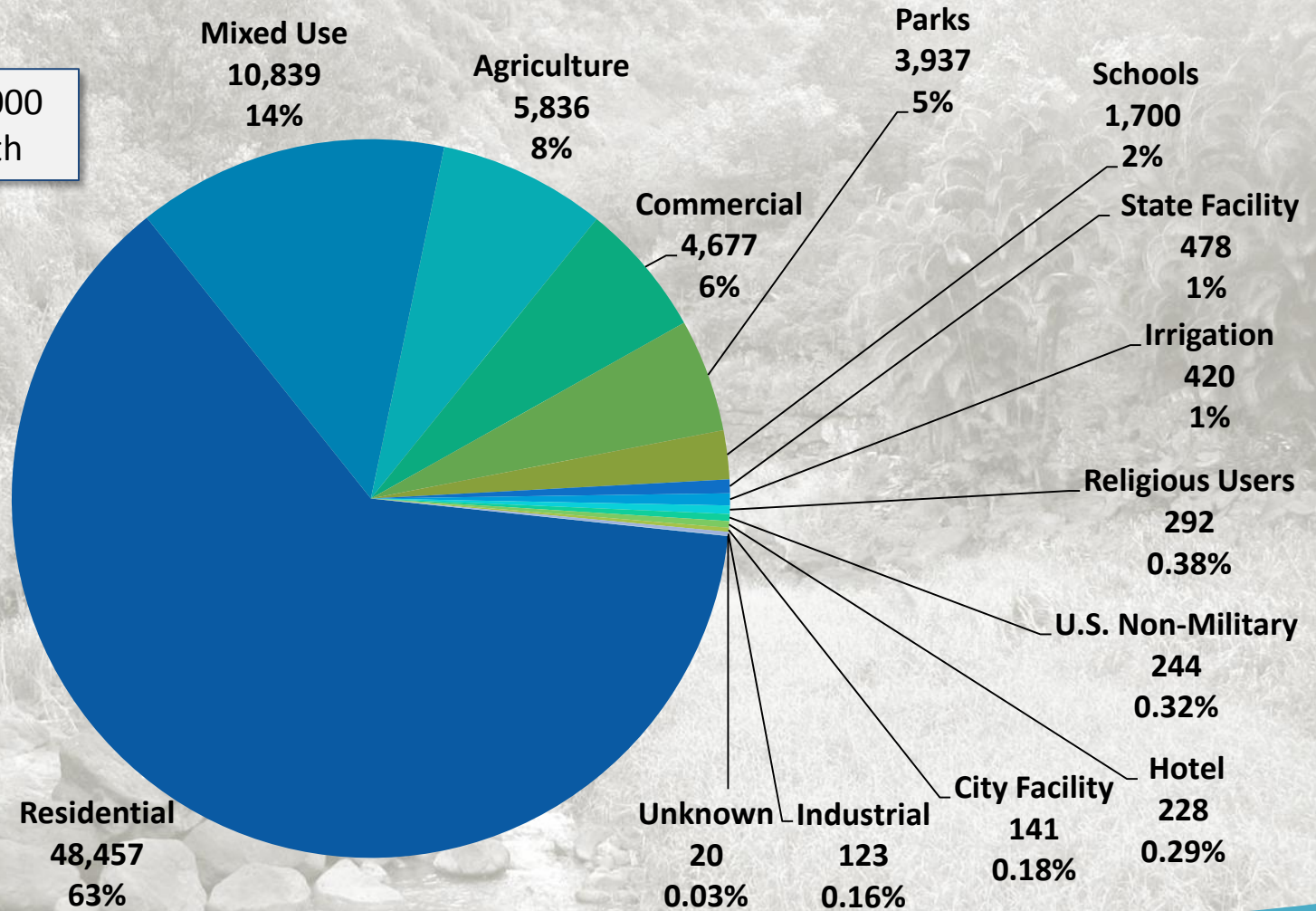
- 4 well stations - Waialua, Hale'iwa, Waile'e, 'Ōpana
- Permitted use - 3.75 mgd; pumpage (5yr avg) - 3.229 mgd
- Remaining capacity is about 0.5 mgd
- Pesticide contamination; source water protection needed
- DOH revisiting pesticide water quality standards
- North Shore Water Company would like BWS connection



Part A: BWS Metered Consumption

(2010)

Amounts = 1,000
gallons / month



Part A: BWS Largest Users (2010)

User	Daily Avg Use (mgd)	Monthly Avg Use (gallons)
Dole Food Co.	0.3589	10,916,833
C & C Hale'iwa Ali'i Beach Park	0.0452	1,374,750
Waimea Valley	0.0355	1,080,083
DOE Waialua High/Intermediate Schools	0.0284	862,333



Part A: Groundwater Planning Implications

- Nearly half of groundwater is not allocated
- 27 mgd of permits; 6.6 mgd is used (24%)
- Limited ag use of groundwater due to expense (electrical/pumpage costs)
- Groundwater used for ag
 - Where there is no surface water option
 - When surface water quality limits crop types
 - During periods of drought as back-up



Legend

Streams

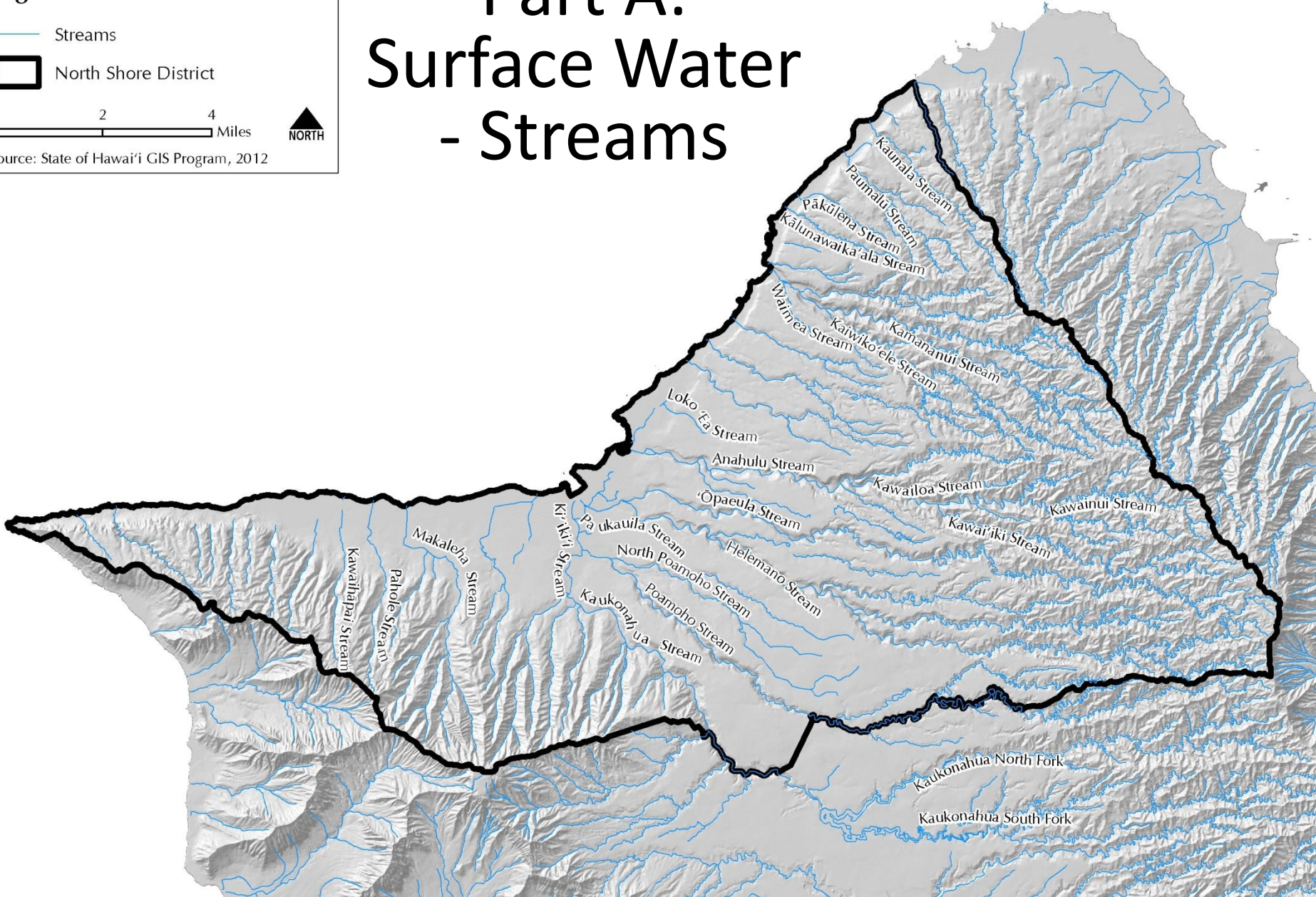
North Shore District

0 2 4 Miles



Source: State of Hawai'i GIS Program, 2012

Part A: Surface Water - Streams



Part A: Surface Water - Streams

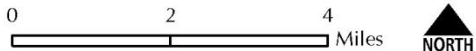
Stream Name	2010 Annual Median (mgd)	Median Flow (mgd) from Hawaii Stream Assessment 1990	Data Years (Hawaii Stream Assessment 1990)
N. Kaukonahua	4.1	5.0	1913-1990
S. Kaukonahua	2.8	5.7	1957-1990
‘Ōpae‘ula	1.9	2.8	1959-1990
Kamananui	0.8	2.4	1960-1990
Ki‘iki‘i System	Not available	9.6	calculated based on multiple stream gages
Paukauila	Not available	2.9	calculated based on multiple stream gages
Waimea River	Not available	2.3	calculated based on multiple stream gages
Helemano	Not available	0.1	1967-1982



Part A: Stream Diversions & Reservoirs

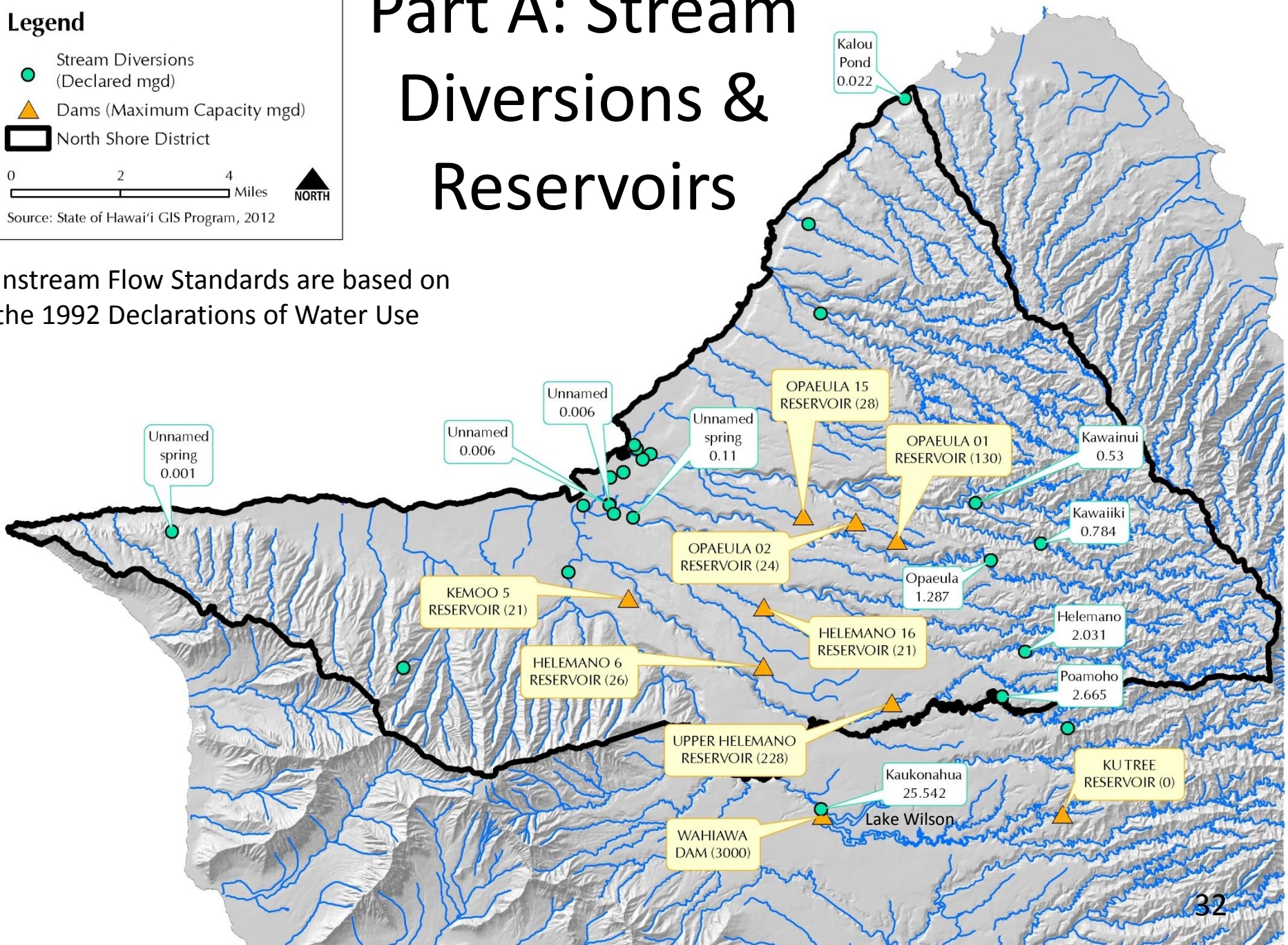
Legend

- Stream Diversions (Declared mgd)
- ▲ Dams (Maximum Capacity mgd)
- North Shore District



Source: State of Hawai'i GIS Program, 2012

Instream Flow Standards are based on the 1992 Declarations of Water Use



Diversions & Reservoirs

Stream Diversions (mgd) ¹	
Kaukonahua	25.542
Poamoho	2.665
Helemano	2.031
‘Ōpae‘ula	1.287
Kawai‘iki	0.784
Kawainui	0.530
Unnamed Spring	0.110
Kalou Pond	0.022
Unnamed	0.006
Unnamed	0.006
Unnamed Spring	0.001
TOTAL	33

Reservoirs (gallons, millions)	
Wahiawā Dam	3,000
Upper Helemano Reservoir	228
‘Ōpae‘ula 01 Reservoir	130
‘Ōpae‘ula 15 Reservoir	28
Helemano 06 Reservoir	26
‘Ōpae‘ula 02 Reservoir	24
Helemano 16 Reservoir	21
Kemo‘o 5 Reservoir	21
Ku Tree Reservoir	0
TOTAL	3,478

¹Stream diversion data from the 1980's and declared in 1990



Part A: Surface Water Systems

No municipal uses – only agricultural uses

- Wahiawā Irrigation System irrigates 5,355 acres (2007 report):
 - Dole – 1,000 acres pineapple, 140 acres coffee
 - Pioneer HiBred – 1,400 acres
 - Kamehameha Schools – 2,300 acres
 - Mokulē‘ia Farms – 200 acres seed corn, papaya, banana, mango
 - Various other entities – 375 acres fruit/nut/noni trees & grass

Note: Additional irrigated acreage has been added since 2007

- Wahiawā Irrigation System provides 20 mgd (2010 estimate)

Note: System losses unknown

- Kamehameha Schools (2010)
 - 2 mgd from Wahiawā Irrigation System
 - 3.5 mgd from ‘Ōpae‘ula /Kawai‘iki Diversion – piped irrigation system
- Pioneer Hi-Bred (2010)
 - 1.1 mgd from Wahiawā Irrigation System



Part A: Surface Water Irrigation System & Existing Ag

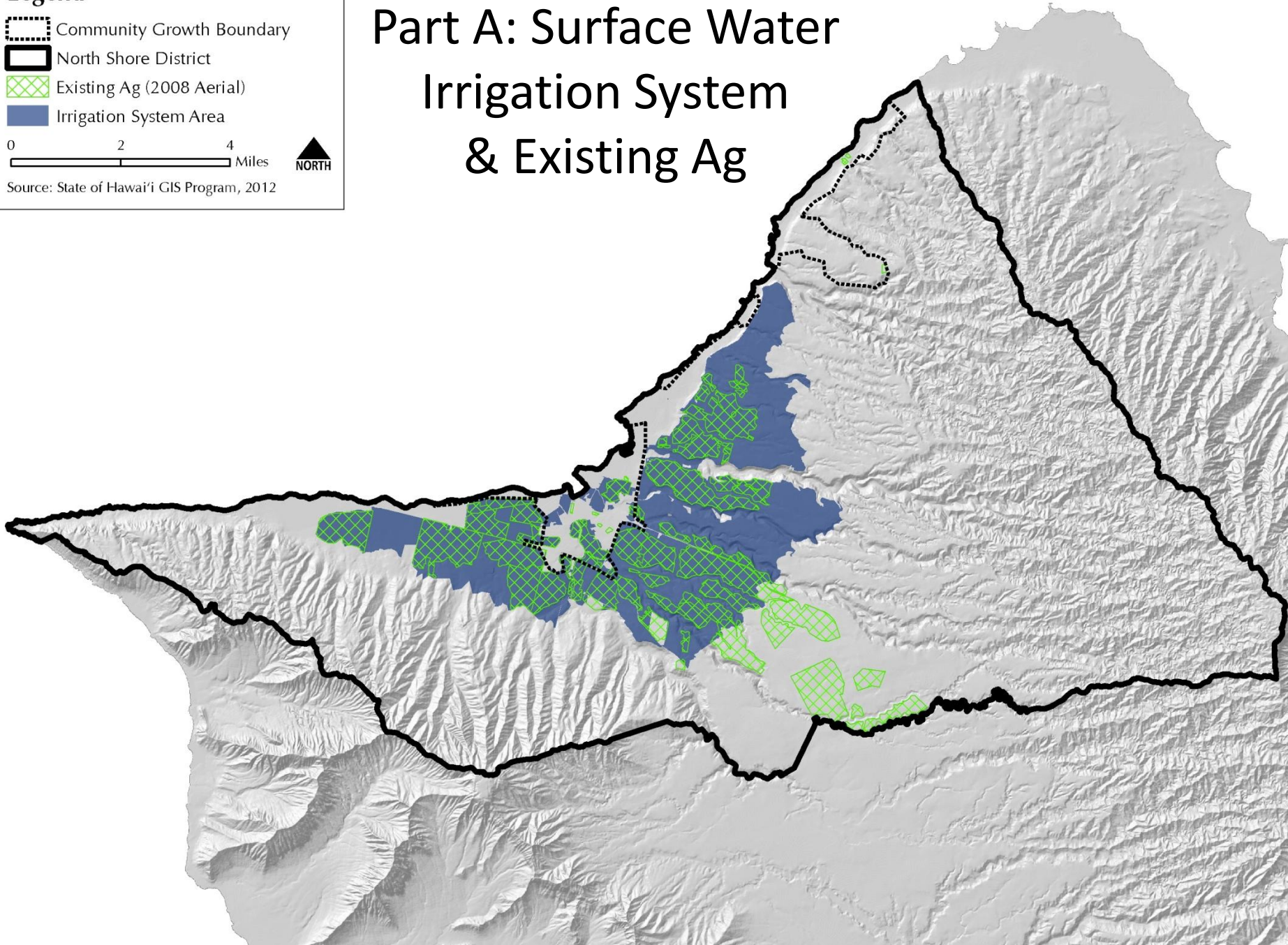
Legend

- Community Growth Boundary
- North Shore District
- Existing Ag (2008 Aerial)
- Irrigation System Area

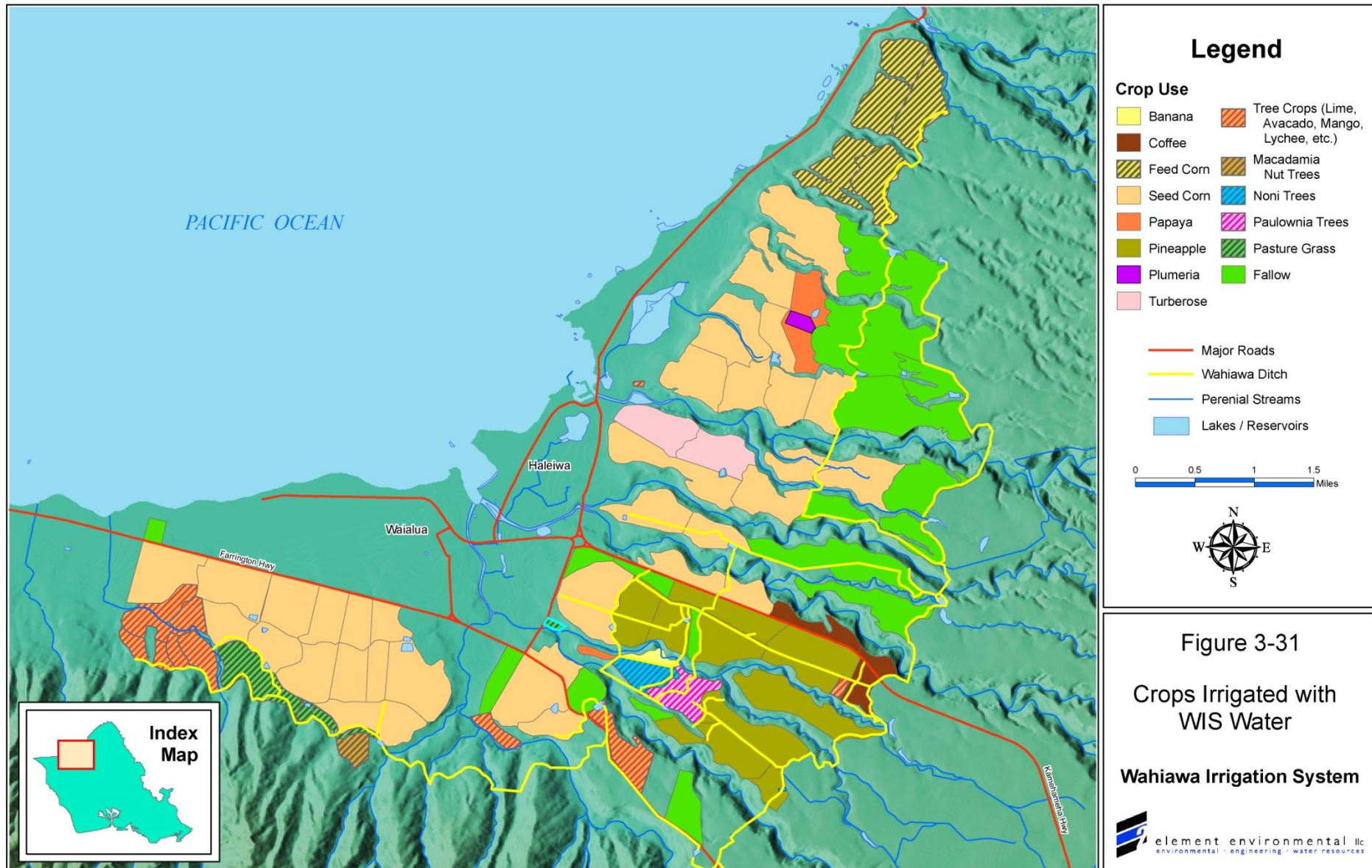
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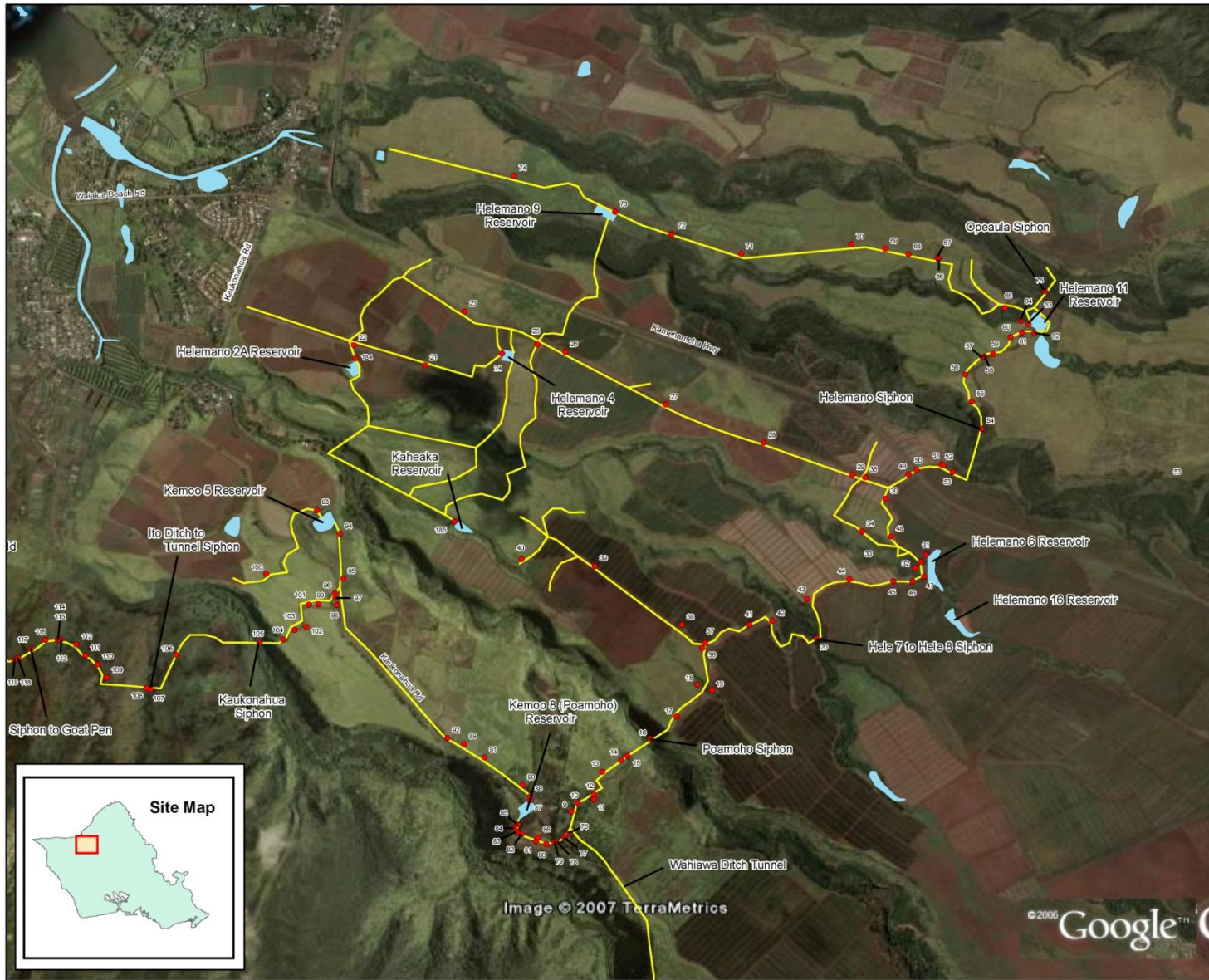
NORTH

Source: State of Hawai'i GIS Program, 2012



Wahiawa Irrigation System Crops (2007)





Legend

- Component Photo Location
- Wahiawa Ditch
- Lakes / Reservoirs

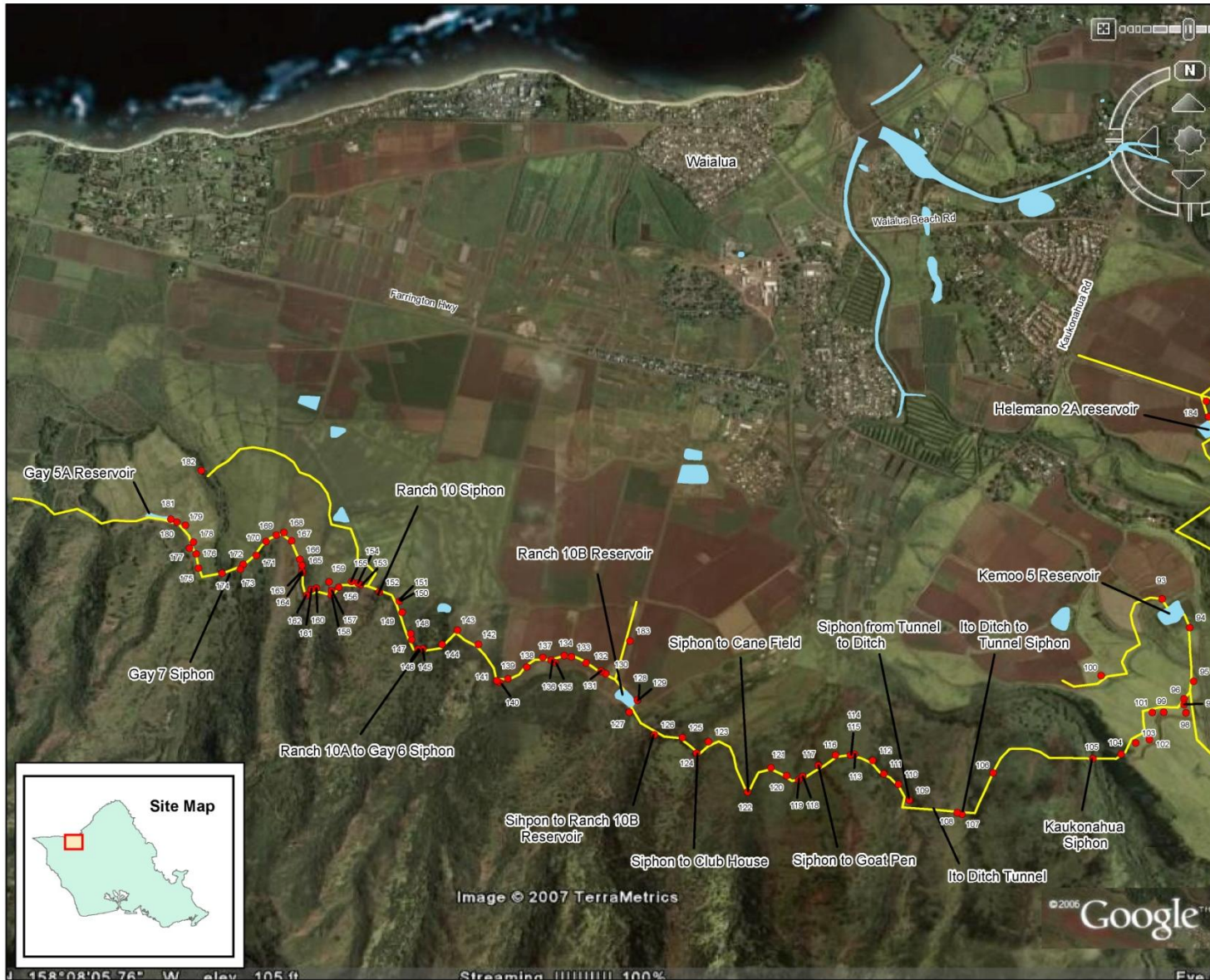


Figure 3-10

System Components -
Irrigation Ditch

Wahiawa Irrigation System





Legend

- Component Photo Location
- Wahiawa Ditch
- Lakes / Reservoirs

0 0.25 0.5 0.75 Miles

Figure 3-11
System Components -
Irrigation Ditch

Wahiawa Irrigation System

Part A: Surface Water Planning Implications

- Data is not reliable – for diversion, usage, losses
- Kawaihoa system is efficient with piping improvements; diversion takes only what is needed
- Wahiawā Irrigation System may have opportunities to increase supply through increased efficiencies
- Improvements to water quality may increase demand (less restricted uses)
- Surface water not as reliable and may need groundwater backup



North Shore Greenprint Kahuku to Ka'ena, Mauka Makai

Protect Water Quality and Quantity

Hawaiian Islands Humpback
Whale National
Marine Sanctuary



Protect Water Quality and Quantity

- High Priority
- Moderate-High Priority
- Moderate Priority

Contextual Information

- City Parks
- Protected Areas *
- Military Reservations and Training Areas
- Kamehameha Schools Lands
- Ahupua'a Boundary
- NSCLT Mission Area
- Army Compatible Use Buffer Project
- Military Leased Training Areas

Transportation

- State Freeway
- State Route
- County Route
- Local Roads
- Trails

Water Features

- Rivers and Streams

This map displays the results of the Protect Water Quality and Quantity goal for the North Shore Greenprint. The degree of priority for each area is shown with a color scale with bright red representing high priority and orange representing moderate priority.

These priorities are the result of a weighted analysis on the following criteria:

Stream and waterbody buffers	18%
High recharge areas for aquifers	17%
Wetlands	15%
Highly erodible areas	13%
Upland forested areas	11%
Areas of high rainfall concentrations	10%
Natural freshwater springs	8%
Bluffs above stream gulches	6%

* Protected Land Includes Reserves, Game Management Areas, Forest Preserves, State Parks, and National Wildlife Refuge Areas.



PART B

WATER DEMAND PROJECTIONS

- Overview / Methodology
- Potable Water Demand Projections
- Agricultural Water Projections
- Summary



Part B: Water Demand Overview

- Guide responsible land & water use decisions
- Plan for infrastructure to meet increased demands
- Provide possible timing



Part B: Projection Methodology

- **Per Capita** (population-based) Methodology
- **End Use Inventory** (land-based) Methodology
- ***Hybrid*** of the methodologies used for WMP



Part B: DPP Population Projections

2010 Census Data / DPP Population Projections

Year	2010	2015	2020	2025	2030	2035
Population	17,720	18,325	18,770	19,126	19,375	19,517
Total Additional Population	na	605	1,050	1,406	1,655	1,797

Note – 2010 is Census data; 2015 to 2035 projections are from 2009 and will be updated when 2010 data are available

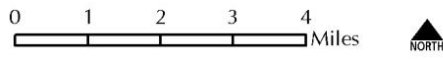
LOCATION	% SHARE OF 2025 ISLANDWIDE POPULATION
Primary Urban Center	46.0%
‘Ewa	13.0%
Central O‘ahu	17.0%
East Honolulu	5.3%
Ko‘olaupoko	11.6%
Ko‘olauloa	1.4%
North Shore	1.7%
Wai‘anae	4.0%

General Plan
Distribution of Residential Population



Legend

- North Shore District
- Community Growth Boundary



Source: State of Hawai'i GIS Program, 2012

North Shore Community Growth Boundary



Source: North Shore Sustainable Communities Plan

Part B: Potable Water Demand Scenarios

Scenario	Basis	Population Increase by 2035
LOW	Less than DPP Policy Projections	+ 900 persons
MID	DPP Policy Projections	+ 1,800 persons
HIGH	Historic Population Trend (1990-2010)	+ 3,000 persons
<i>ULTIMATE</i>	<i>Lands within the Community Growth Boundary are residential developments</i>	<i>An additional 800 acres of residential development by an unspecified time period</i>



Part B: Potable Water Demand Scenarios

Data Sources

- City and County of Honolulu Department of Planning and Permitting 2035 Socioeconomic Projections, September 2009
- Honolulu Board of Water Supply North Shore Pumpage 2010
- 2010 Census Population
- Sustainable Community Plan Community Growth Boundary
- 2008 Aerial Maps for the North Shore
- 2,500 gallons per acre for residential development (BWS Water Systems Standards)



Part B: Potable Water Demand Projections

Scenario	2010 Population	2010 Consumption (mgd)	2035 Population Projection	Per Capita Consumption ² (Gallons/person)	2035 Projection (mgd)
LOW	17,720	3.46	18,624	195	3.6
MID	17,720	3.46	19,517 ¹	195	3.8
HIGH	17,720	3.46	20,707	195	4.0
<i>ULTIMATE³</i>	17,720	3.46	<i>Based on 2,500 g/acre for the 800 acres of undeveloped lands within the Community Growth Boundary</i>	<i>An additional 2 mgd</i>	<i>5.5 (no timeframe)</i>

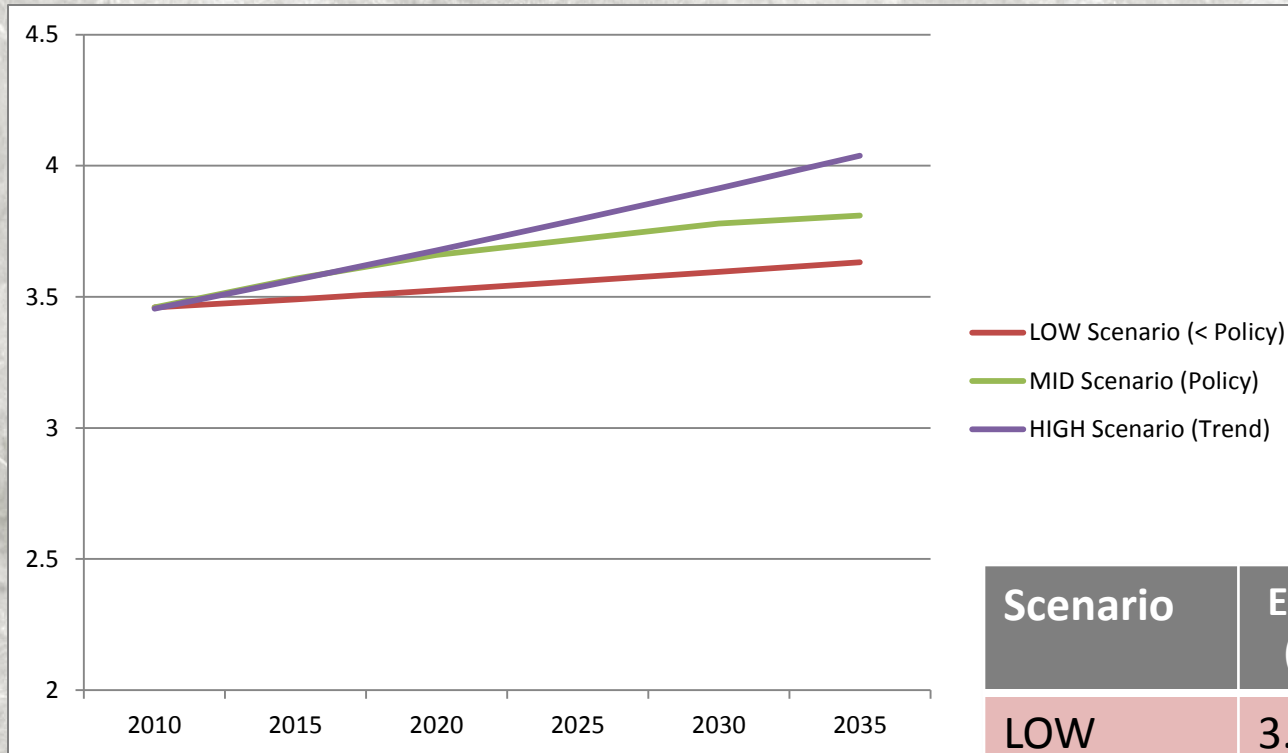
¹Placeholder number; awaiting DPP projections based on 2010 Census

²195 gallons / capita - based on BWS 2000 pumpage / BWS 2000 served population

³Ultimate Scenario for comparative, not planning purposes



Part B: Potable Water Demand Scenarios



Scenario	Existing (mgd)	2035 Projection (mgd)
LOW	3.5	3.6
MID	3.5	3.8
HIGH	3.5	4.0
<i>ULTIMATE</i>	3.5	5.5 (no timeframe)



Part B: Agriculture Water Demand

Data Sources

- Oahu Agriculture Report (2011)
- Agricultural Lands of Importance to the State of Hawai'i (ALISH) (1977)
- Sustainable Community Plan Community Growth Boundary (2011)
- Agricultural Water Use and Development Plan (2004)
- Ag Landowners

Note: DPP has convened a committee to determine a criteria to be used for Important Agricultural Lands (IAL) designation



Part B: Potential & Existing Agriculture

Legend


 Community Growth Boundary

 North Shore District

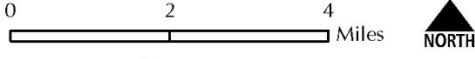
 Existing Ag (2008 Aerial)

ALISH Category

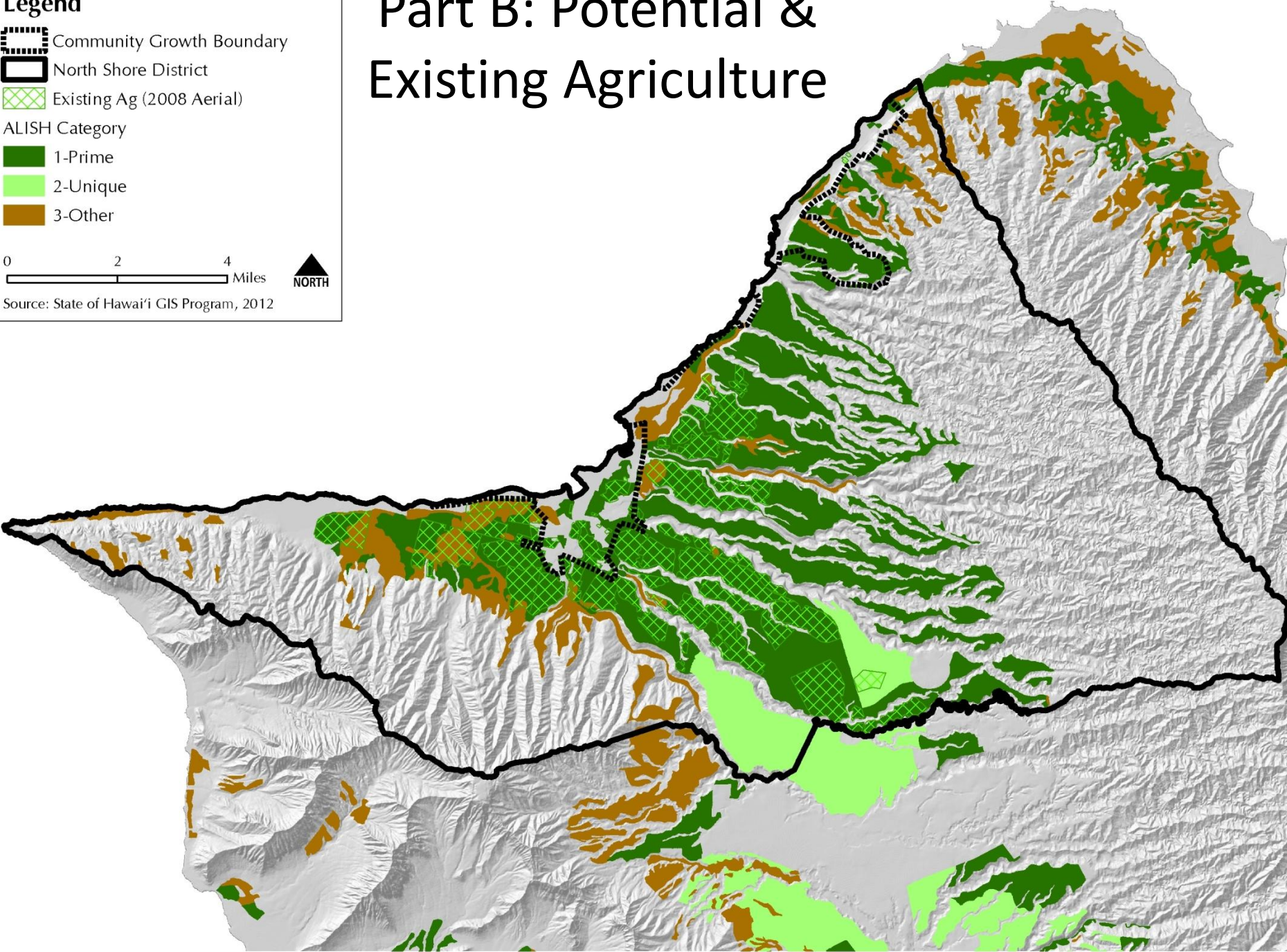
 1-Prime

 2-Unique

 3-Other



Source: State of Hawai'i GIS Program, 2012



North Shore Greenprint Kahuku to Ka'ena, Mauka Makai

Protect Agricultural Lands

Hawaiian Islands Humpback
Whale National
Marine Sanctuary



Protect Agricultural Lands

- High Priority
- Moderate-High Priority
- Moderate Priority

Contextual Information

- City Parks
- Protected Areas *
- Kamehameha Schools Lands
- Ahupua'a Boundary
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- Military Leased Training Areas

Transportation

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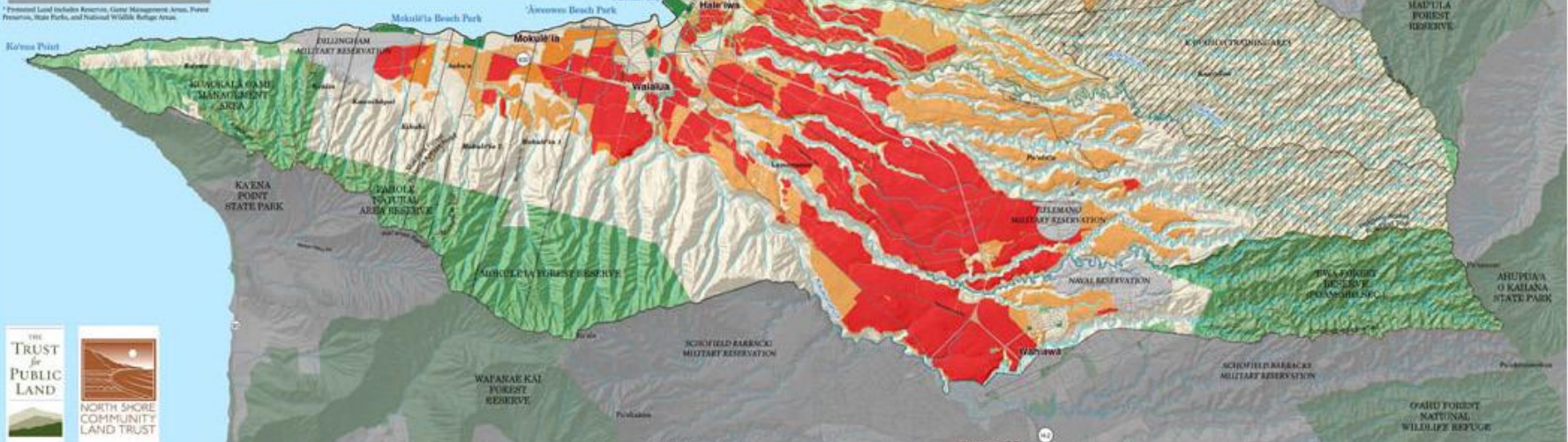
Water Features

- Rivers and Streams

This map displays the results of the Protect Agricultural Lands goal for the North Shore Greenprint. The degree of priority for each area is shown with a color scale with bright red representing high priority and orange representing moderate priority.

These priorities are the result of a weighted analysis on the following criteria:

Opportunities to protect cultivated agricultural land	34%
Uncultivated agricultural lands	21%
Places for community gardens	13%
Proximity to people	11%
Agricultural land adjacent to schools	8%



Special thanks to the following data providers: The State of Hawaii, HDCL, Civil Engineer and Thomas Gumbert of the University of Hawaii and ESRI. Map created by The Trust for Public Land on July 21, 2011. Created in ArcGIS 10.0. Map Projection: NAD 83 UTM Zone 18N. Scale: 1:50,000. The Trust for Public Land and the Trust for Public Land logo are trademarks of The Trust for Public Land. Copyright © 2011 The Trust for Public Land. All rights reserved. Information on this map is provided for purposes of discussion and visualization only.

Part B: Existing Agriculture

- Visual analysis for 2008 – 7,200 acres
 - 5,600 acres within surface irrigation system area
 - 1,600 acres outside surface irrigation system area
 - Outside of irrigation system, smaller farmers using their own wells
- 2011 Oahu Agriculture Report – 8,500 acres
 - 6,000 acres diversified agriculture
 - 2,500 acres pineapple
- Kalo (taro) cultivation
 - HPC - 30 acres
 - Others



Part B: Agricultural Water Demand Scenarios

Scenario	Basis	Description	Acres by 2035
LOW	DPP Projections (2009) show no increase in agricultural jobs	Status Quo	9,000
MID	2011 O‘ahu Agriculture Report; displaced agriculture from ‘Ewa	+ 1,100 acres by 2035	10,600
HIGH	North Shore Sustainable Communities Plan support for agriculture expansion	60% of ALISH lands outside of Community Growth Boundary are irrigated by 2035	13,300
<i>ULTIMATE</i>	<i>Full development of ag lands in the future; climate change impacts</i>	<i>All ALISH Lands outside of the Community Growth Boundary are irrigated</i>	26,400



Part B: Agricultural Water Demand Projections

Scenario	Irrigated Agriculture (Acres)	Irrigation Rate (Gallons/Acre/Day)	Projected Water Demand 2035 (mgd)
LOW	9,000		24.4
Diversified Ag	6,000	3,400	20
Pineapple	2,500	1,600	4
Pasture	500	840	0.4
MID	10,600		30.8
Diversified Ag	7,100	3,400	26
Pineapple	2,500	1,600	4
Pasture	1,000	840	0.8
HIGH	13,300		42.4
Diversified Ag	10,500	3,400	36
Pineapple	2,500	1,600	4
Pasture	2,800	840	2.4



Legend

— 50" Rainfall Line

⋯ Community Growth Boundary

▭ North Shore District

ALISH Below 50" Rainfall


■ Prime & Unique

■ Other

ALISH Above 50" Rainfall

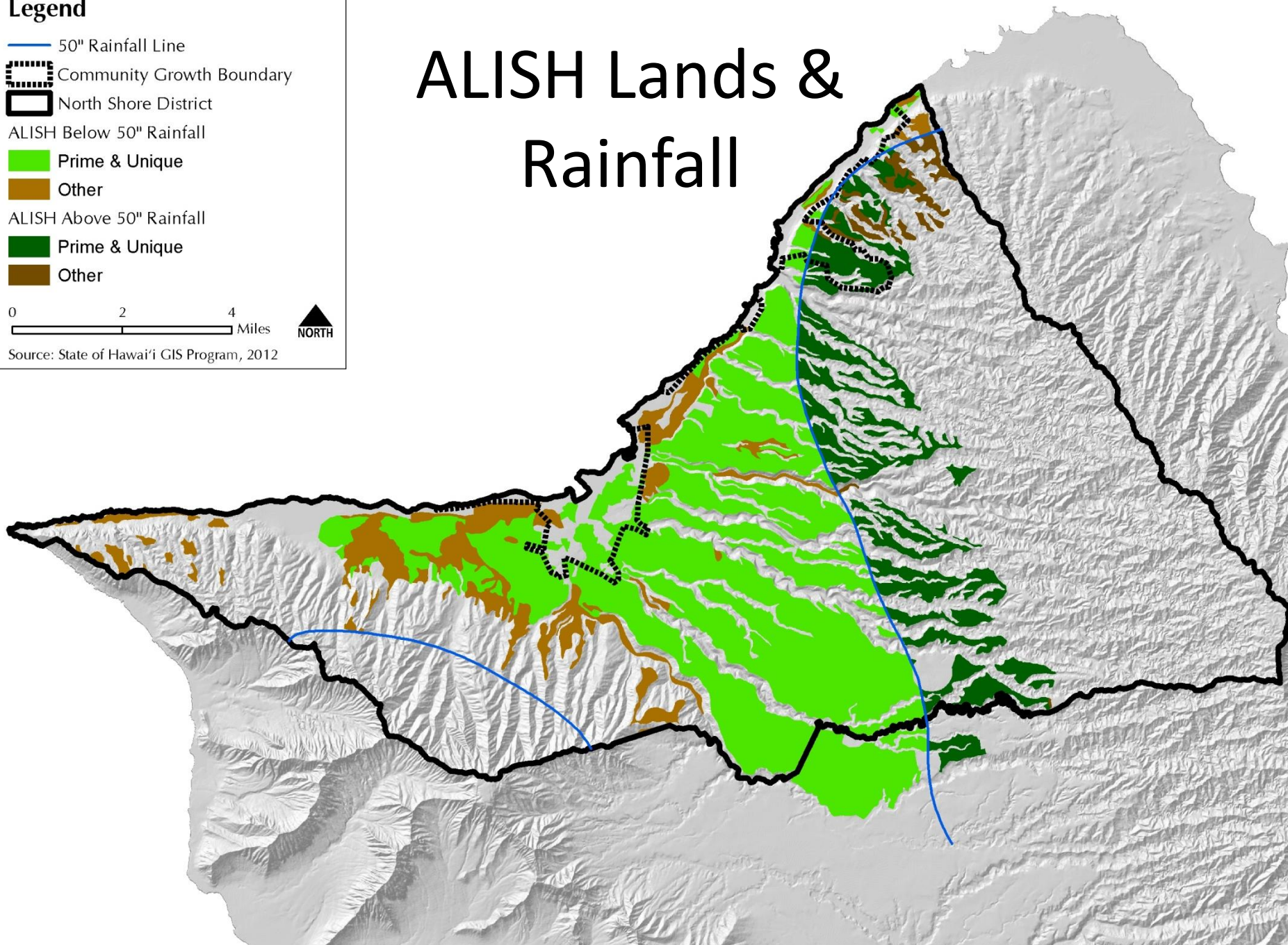
■ Prime & Unique

■ Other

0 2 4 Miles 

Source: State of Hawai'i GIS Program, 2012

ALISH Lands & Rainfall



Part B: Agricultural Water Demand Projections

Scenario	Irrigated Agriculture (acres)	Irrigation Rate (gallons/acre/day)	Projected Water Demand (mgd)
ULTIMATE	26,400		73
ALISH lands with less than 50" of rainfall	15,700	3,400	54
ALISH lands with more than 50" of rainfall	6,100	2,500	15
Pasture (ALISH Other)	4,600	840	4

Scenario	Irrigated Agriculture (acres)	Irrigation Rate (gallons/acre/day)	Projected Water Demand (mgd)
ULTIMATE with Climate Change	26,400		76
ALISH lands with less than 57.5" of rainfall	19,400	3,400	66
ALISH lands with more than 57.5" of rainfall	2,400	2,500	6
Pasture (ALISH Other)	4,600	840	4



Part B: Agricultural Water Demand Projections

Scenario	Irrigated Agriculture (acres)	Projected Water Demand (mgd)
LOW	9,000	24.4
MID	10,600	30.8
HIGH	13,300	42.4
ULTIMATE with Climate Change	26,400	76.0



Water Supply Summary

Groundwater: Aquifer System Area	Sustainable Yield (mgd)
Mokulē'ia	8
Waialua	25
Kawailoa	29
TOTAL	62
<i>Wahiawā</i>	23
<i>Wahiawā WUP in NS DP area</i>	7.7

Surface Water	Total Quantity (mgd)
Declared Stream Diversions	33

**Total Ground & Surface Water
= 95 mgd**

Note: These supply numbers do not account for system losses



Water Demand Summary

Potable Water Demand		
Scenario	Existing (mgd)	2035 Projection (mgd)
LOW	3.5	3.6
MID	3.5	3.8
HIGH	3.5	4.0
<i>ULTIMATE</i>	3.5	<i>5.5 (no timeframe)</i>

Agricultural Water Demand		
Scenario	Irrigated Agriculture (Acres)	Projected Water Demand (mgd)
LOW	9,000	24.4
MID	10,500	30.8
HIGH	13,300	42.4
ULTIMATE w/ Climate Change	26,400	76.0

Agricultural demands are more than 10 times those of potable demands

Total High Demand (Potable & Ag) = 46.4 mgd



Supply & Demand Summary

Current/Near Term

- **Supply** (ground and surface) = **95 mgd**
- **Demand for High Scenarios** = **46.4 mgd**

Long Term/Climate Change

- **Supply** (ground) = **86.7 mgd**
Climate Change = less 15% rainfall/groundwater
- **Demand** (potable and agriculture) = **76 mgd**
Decreasing rainfall level = increased demands



Potential Water Resource / System Projects

- Identification of Wahiaiwā Irrigation System losses (BWS & Dole)
- Back up/emergency wells for major ditch systems
- Storage for water
- Additional infrastructure to expand ag lands
- Advanced conservation – piping ditches
- BWS source water protection (wells near ag uses)
- Mokulē‘ia water system improvements



Next steps

- Meeting #3 – *Thursday, December 6th?*
 - Incorporate issues into subobjectives which reflect community issues & concerns
 - Solve issues with watershed and water supply projects & strategies
- Develop project & strategy descriptions
- Draft report



MAHALO!

