

Hawaiian Stream & Riparian Systems Workshop

# Water quality degradation issues in Hawai'i



**Carl Evensen**



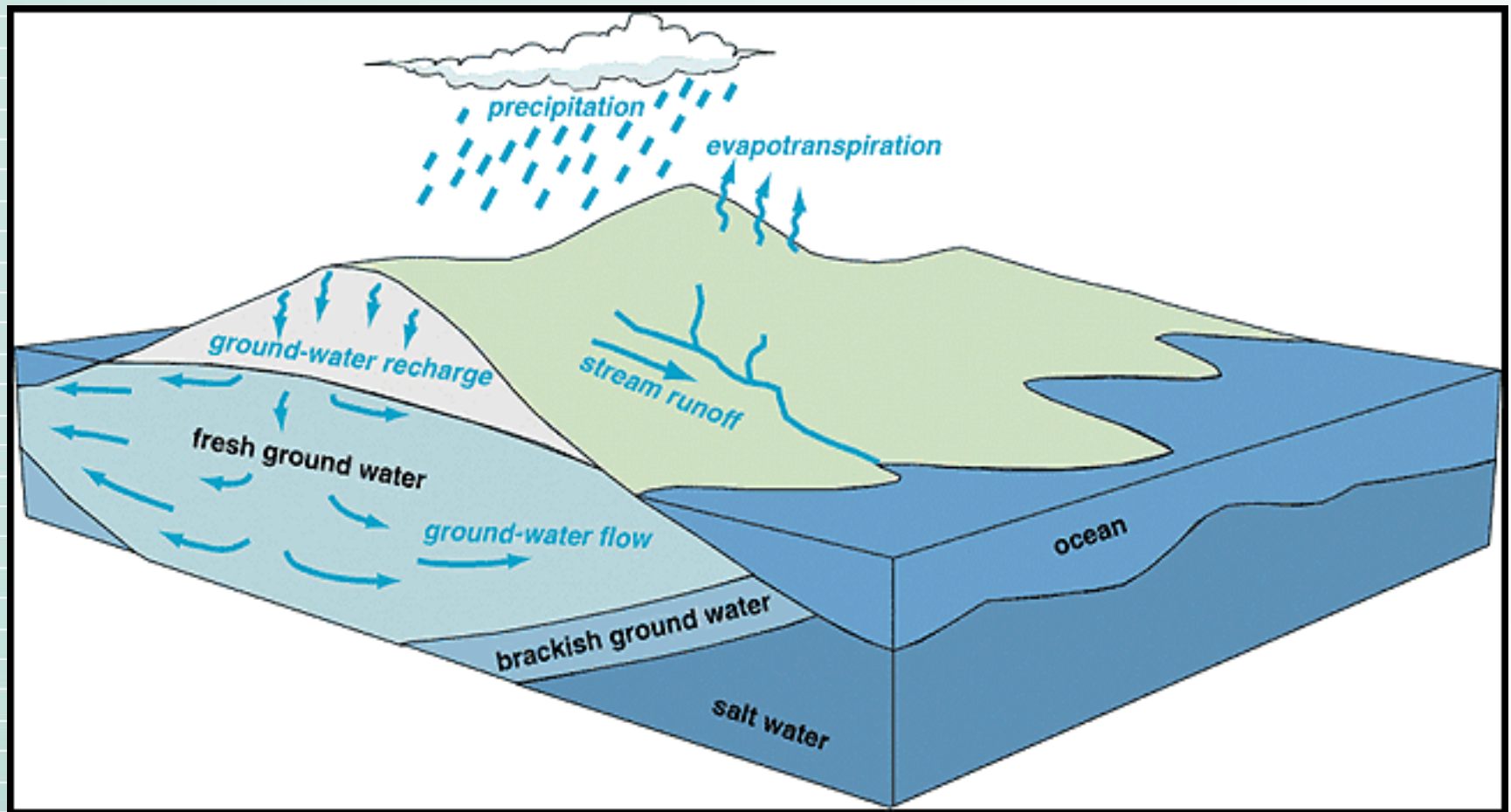
**College of Tropical Agriculture and Human Resources**  
University of Hawai'i at Mānoa

# OUTLINE

- **Island Water Resources**
- **History of Water Use & Degradation**
- **Water Quality Concerns**
  - **Human Health**
  - **Ecosystem Health**



# Hawaiian Water Resources



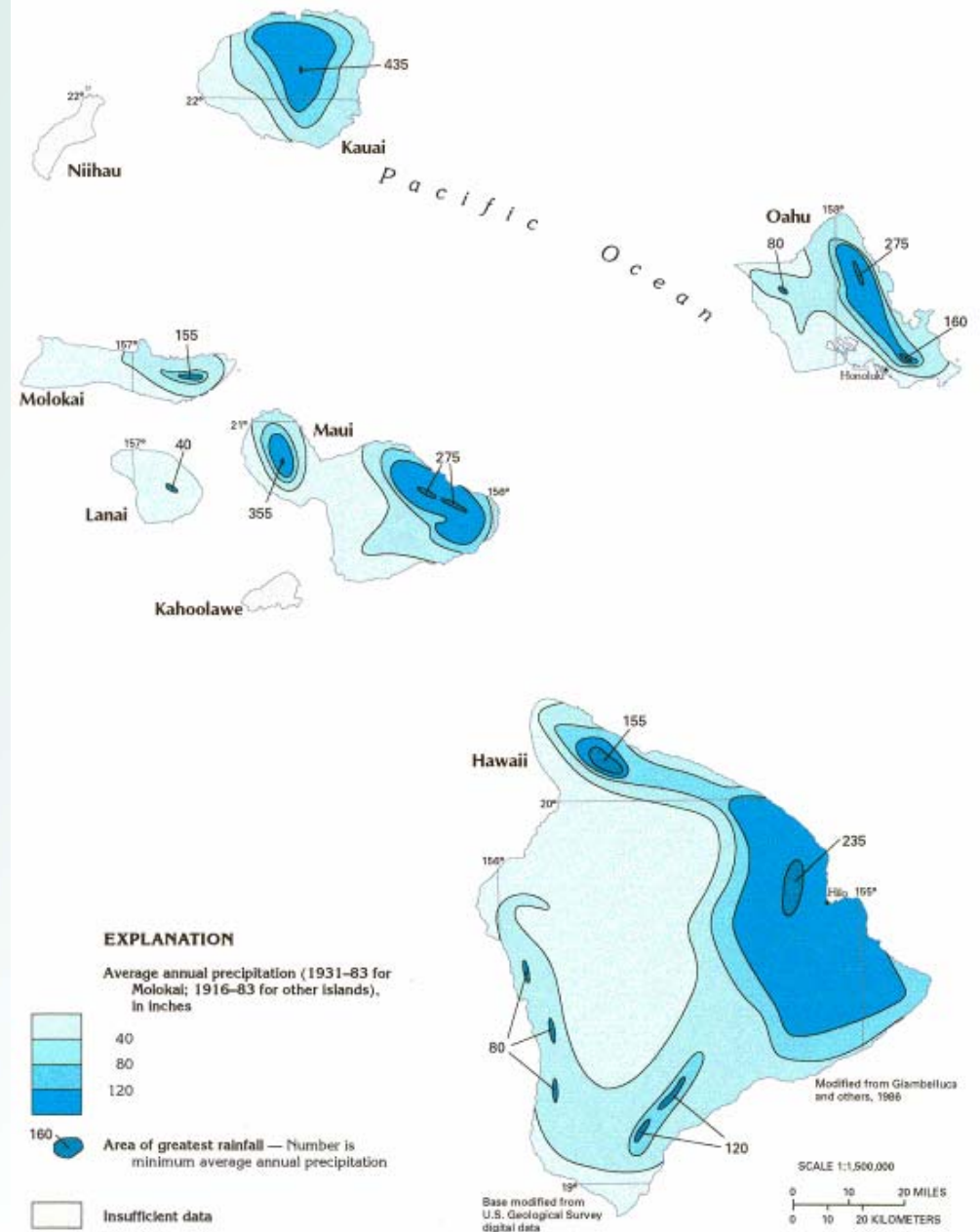
(Source: USGS)



# Rainfall Distribution in Hawaii

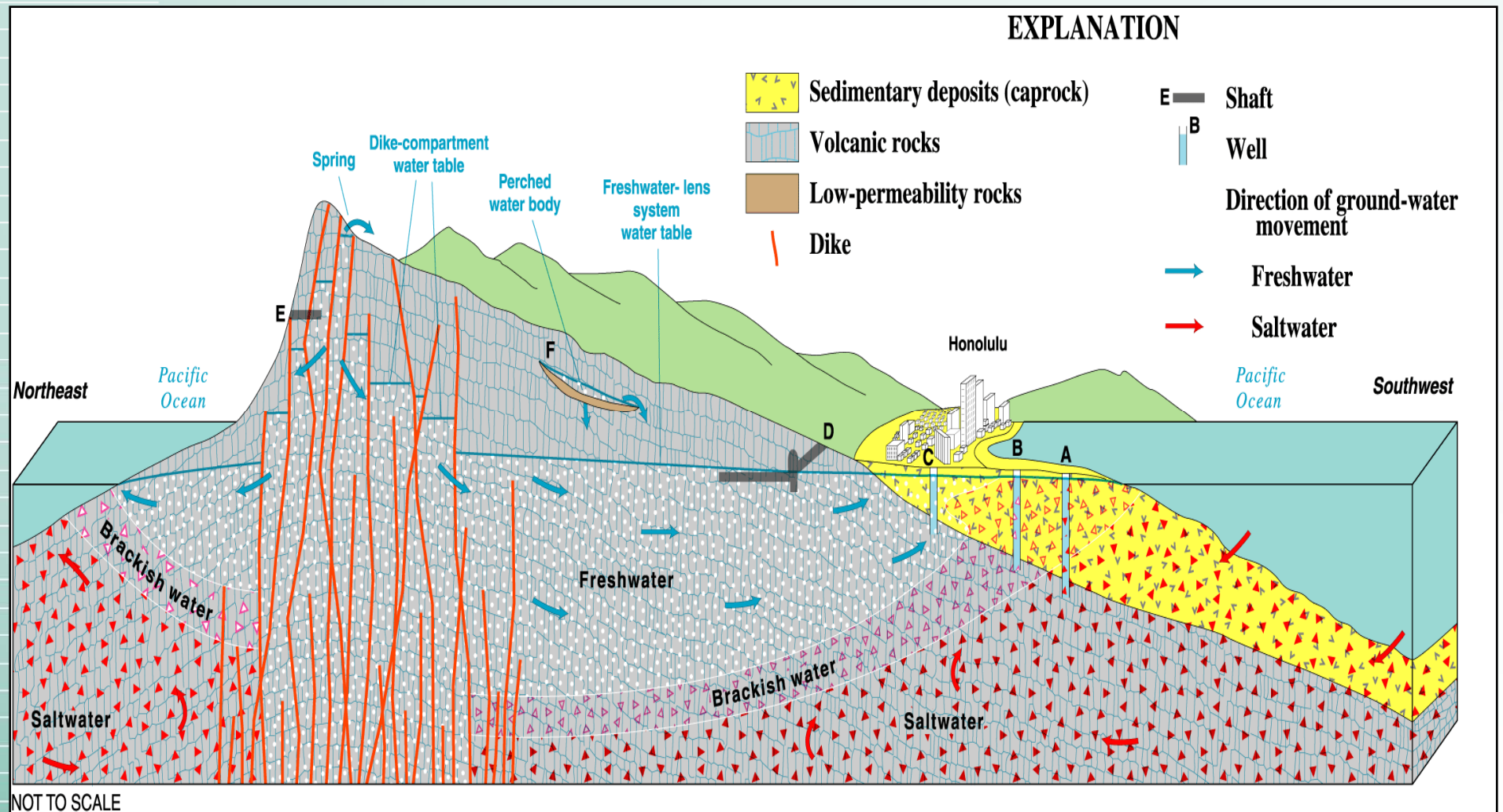
- Orographic rainfall
- Extreme variation over short distances

(Source: USGS)





# Groundwater in Hawaii





# **Island Streamflow Characteristics**

- **Streams are short with steep gradients and small drainage areas**
- **Few streams are perennial over their entire reaches**
- **Flow is highly variable**
  - **Low flows maintained by ground-water discharge**
  - **High flows in response to short-term rainfall events**

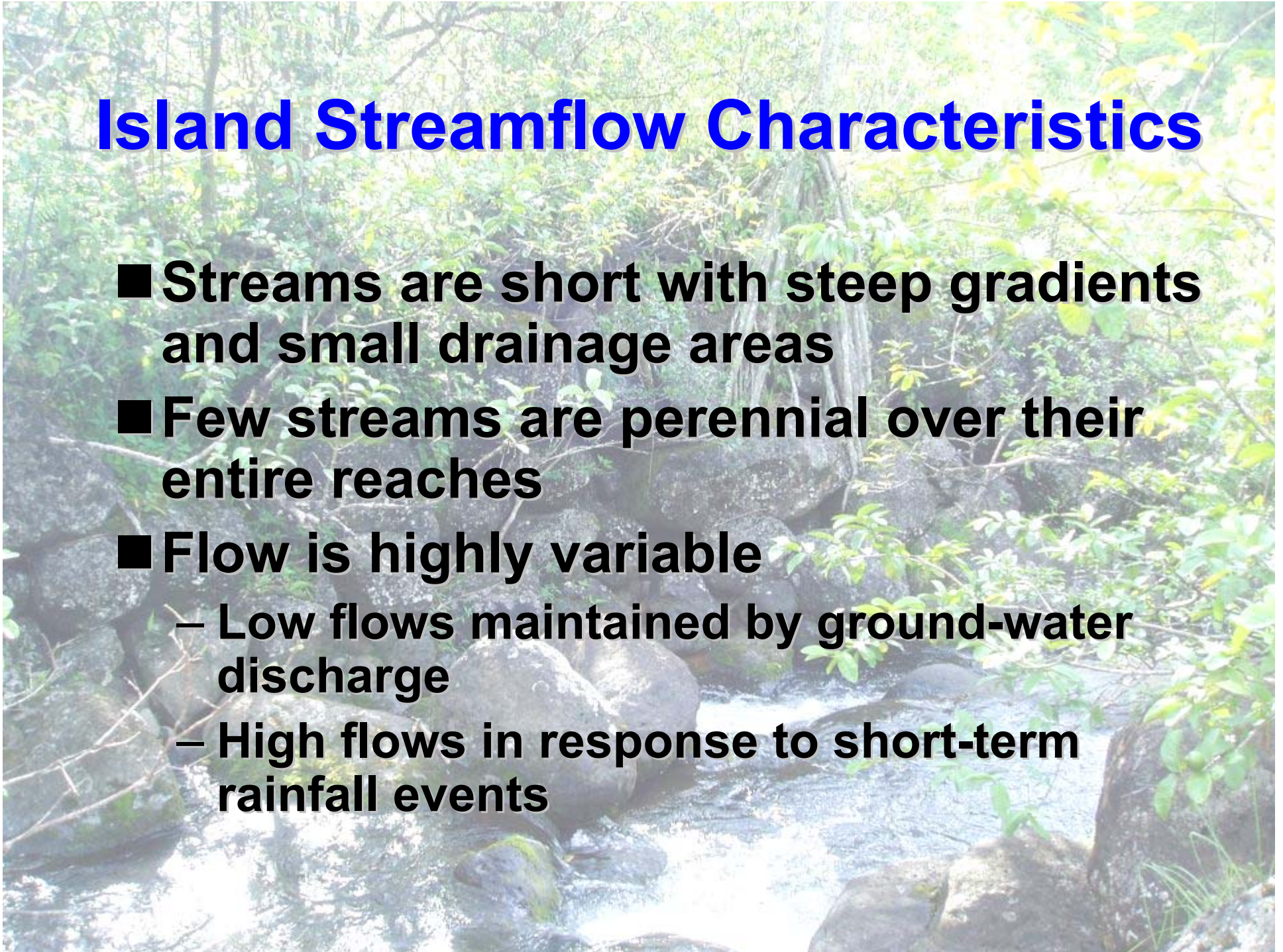




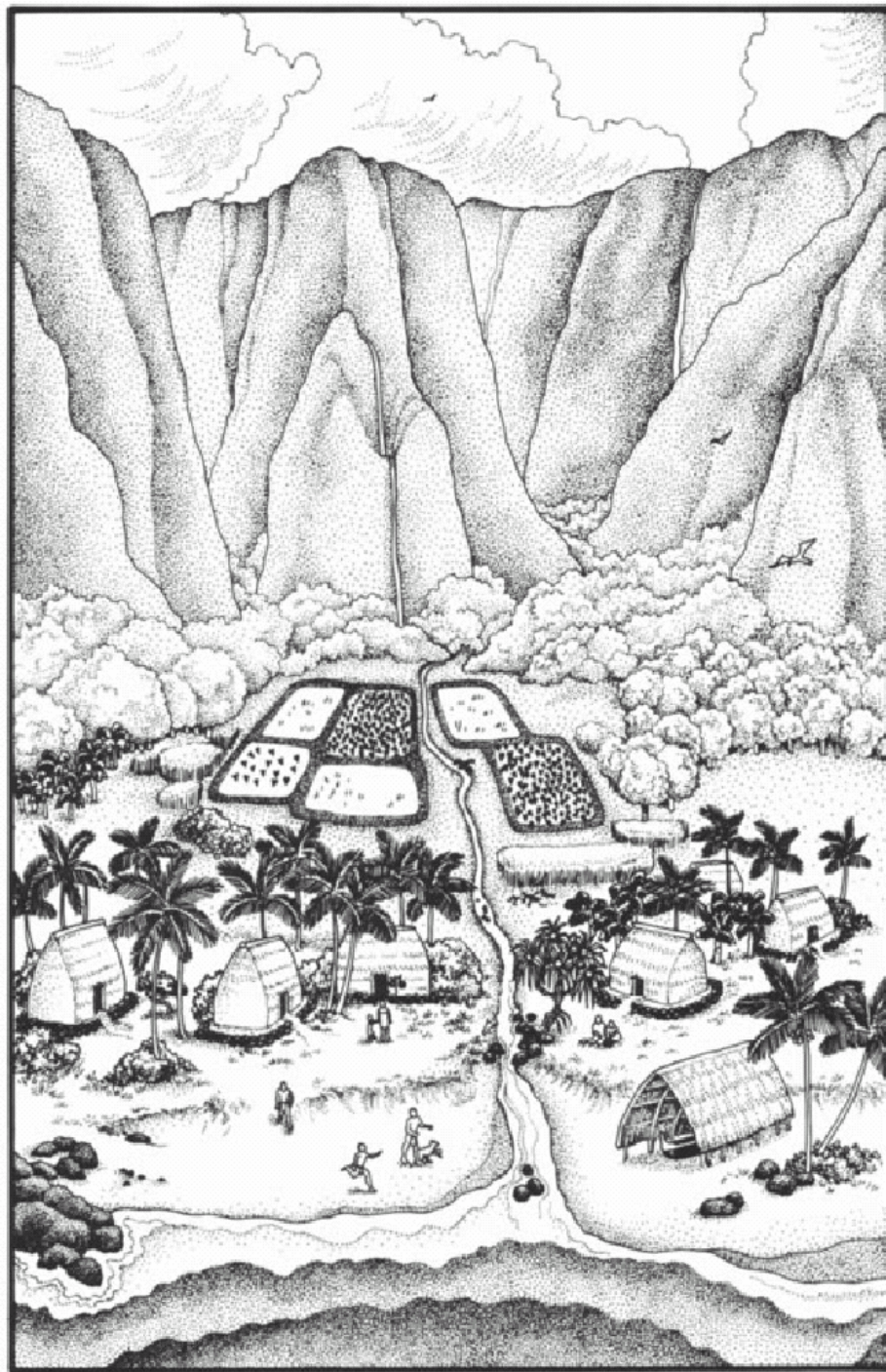


Illustration: ANTHONY A. B. DE BRUIN  
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**DAF**  
 DEPARTMENT OF AGRICULTURE  
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A. BRUNO





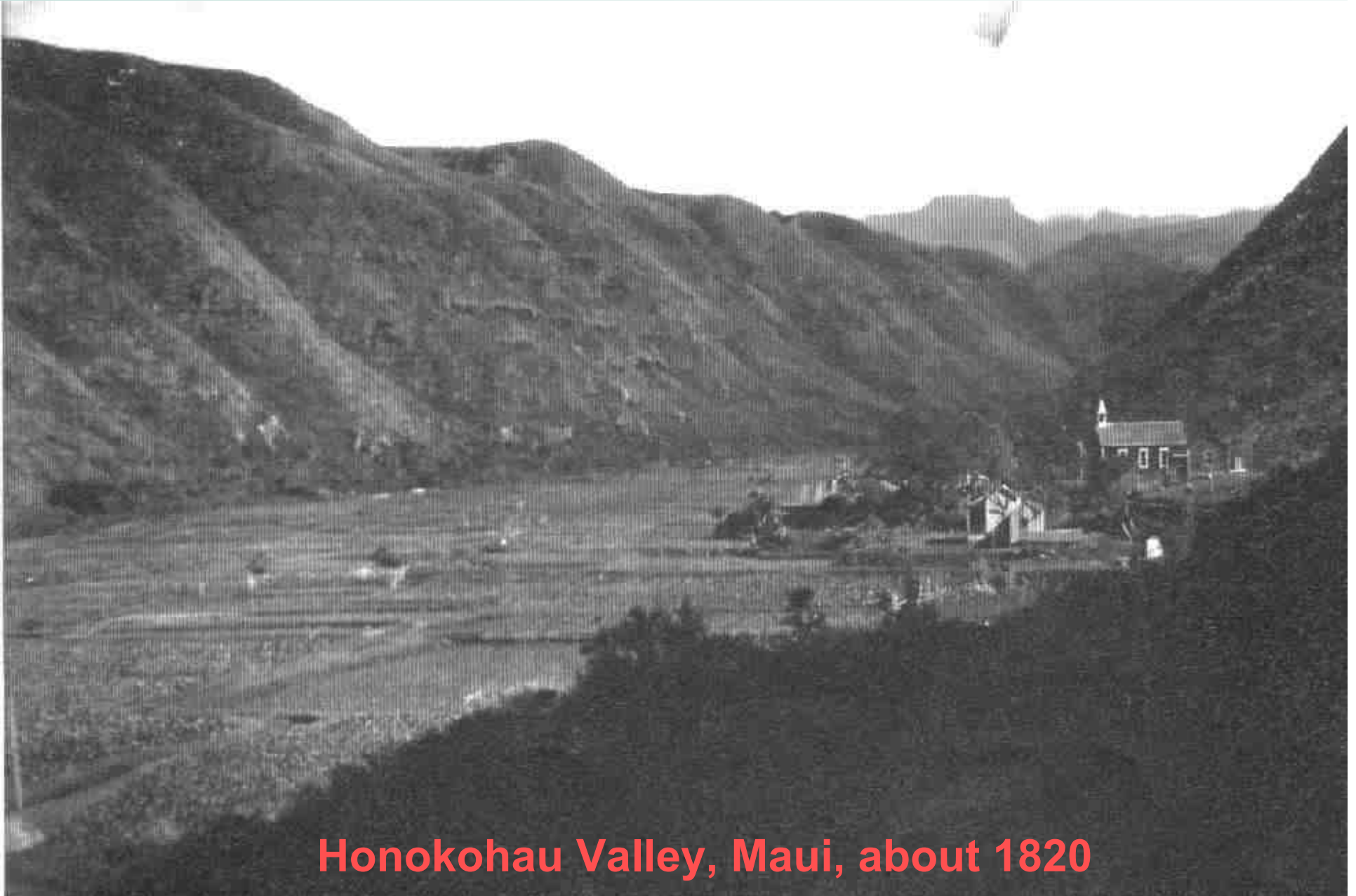
**Sugarcane**  
**(~ 1830 → )**

**Pineapple**  
**(~ 1900 → )**



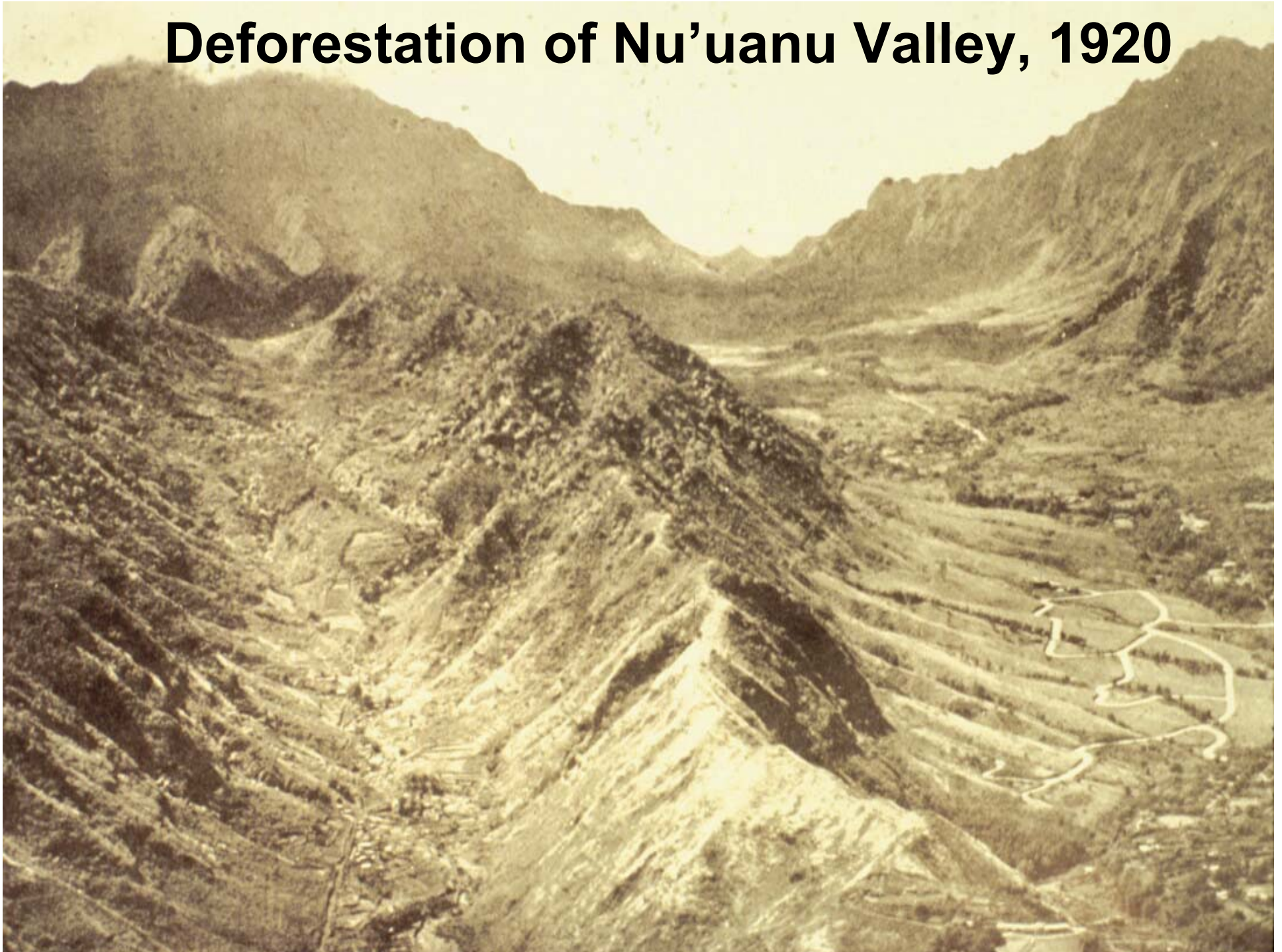


# Water diversions



**Honokohau Valley, Maui, about 1820**

# Deforestation of Nu'uaniu Valley, 1920







**Manoa Valley  
deforestation, 1919**



**Same view,  
1926 (Lyon  
Arboretum)**



# Land Use Change in Hawaii

## Plantation Agriculture

**Diversified  
Agriculture**



**Suburban  
Development**



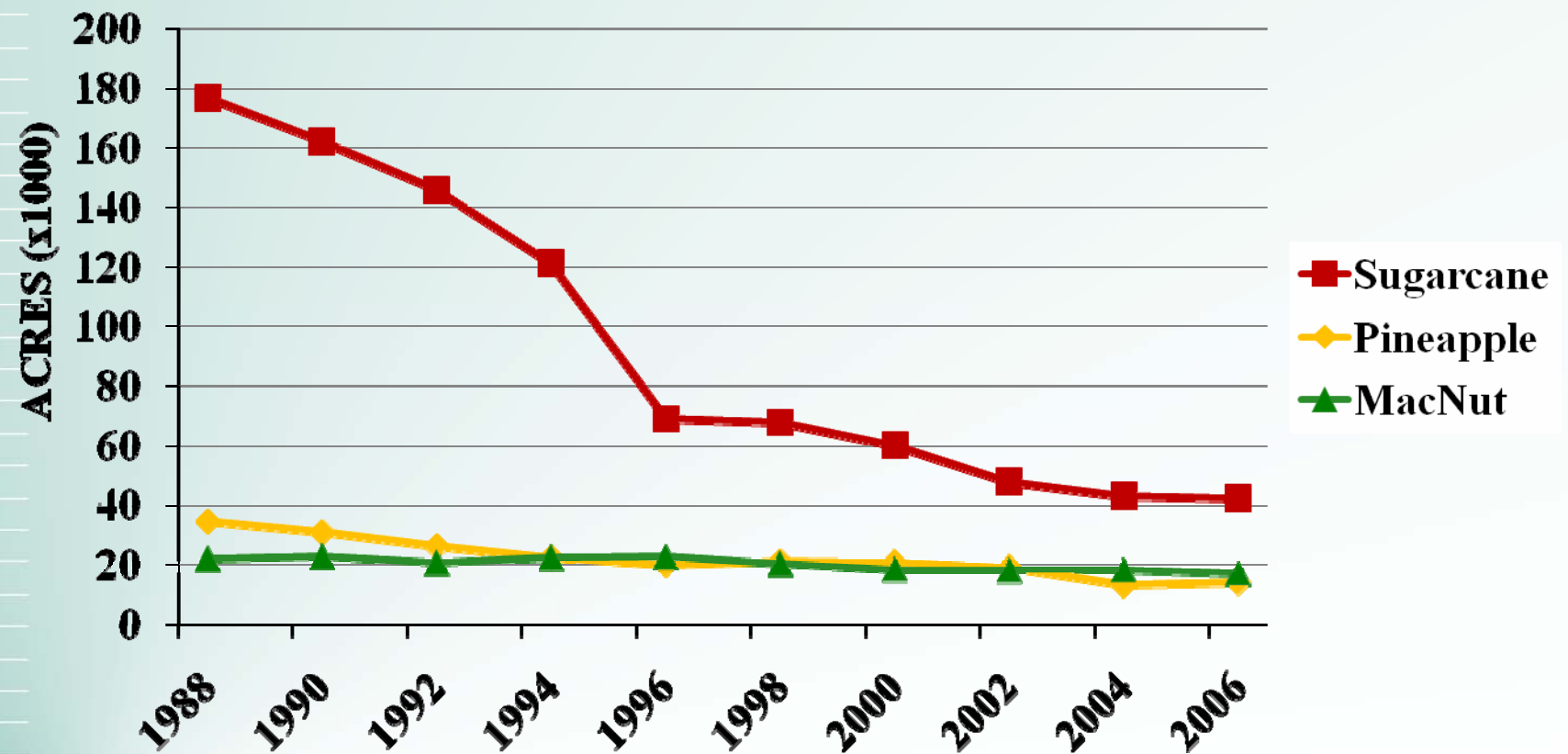
**(Source: USGS)**





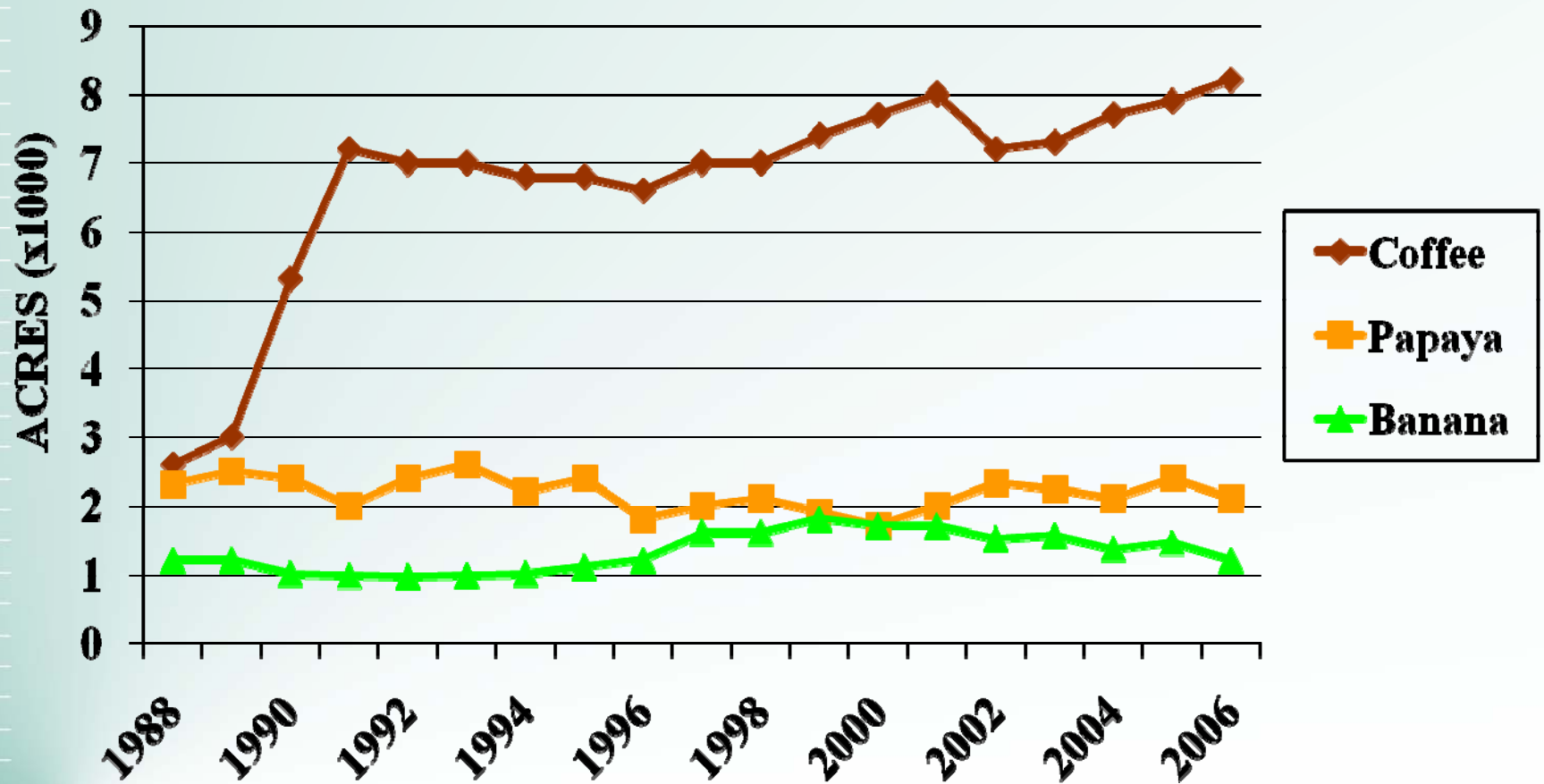
# Changes in Hawaii's Agriculture

## PLANTATION CROPS



# Changes in Hawaii's Agriculture

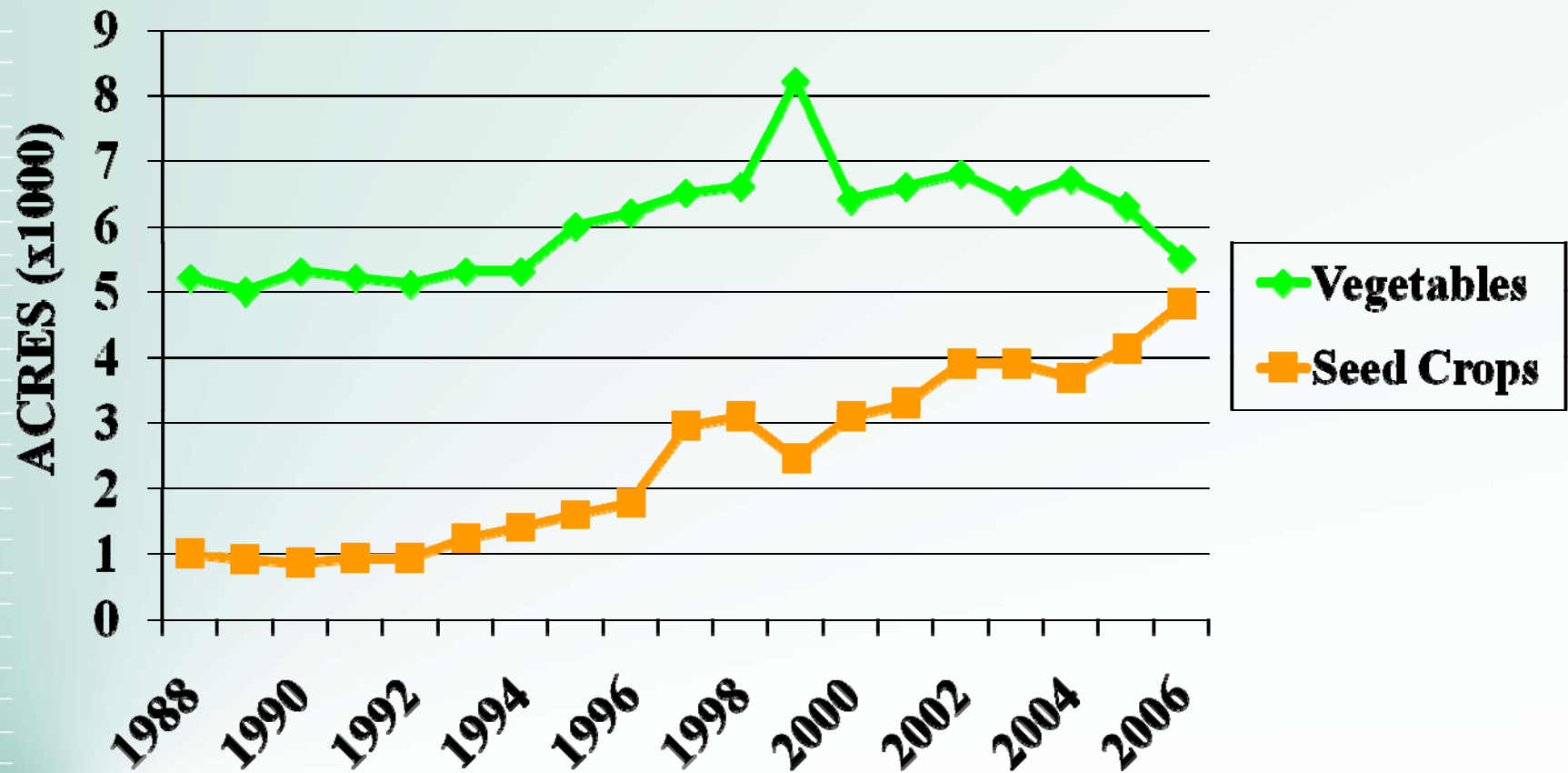
## TREE CROPS





# Changes in Hawaii's Agriculture

## DIVERSIFIED CROPS



# Summary of Changes in Land Use

- **Plantation crops have been replaced to a small extent by diversified crops, forestry and grazing.**
- **Agricultural chemical use is lower in total quantity but much more diverse.**
- **Large areas of land are now idle, presenting problems of exotic weed growth, erosion and fire.**
- **Urban growth and pressure on agricultural land continue to increase.**







# Urban Watersheds



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Streets in urban areas should be considered as “tributaries” to streams.









**Channelized urban stream in Manoa**



# **Hawaii's Water Pollution Problems**

**Water Contaminants from both agricultural and urban lands...**

- **Sediment**
- **Nutrients**
- **Pesticides/Toxins**
- **Pathogens**



# Public Attitudes about Water Issues (2004 Survey, Univ. Hawaii)

RANK	ISSUE	PRIORITY, %
1	Drinking water	98
2	Groundwater	97
3	Household water	95
4	Clean rivers, streams, lakes	93
5	Water for agriculture	83
6	Aquatic organism protection	83





# Public Attitudes Survey

RANK	ISSUE	PRIORITY, %
7	Watershed restoration	81
8	Wetlands	78
9	Water for industry	66
10	Power generation	58
11	Water for recreation	56

(Values differing by > 5% are significantly different)



# Awareness of Conditions Affecting Water Quality

POLLUTANT	KNOW	SUSPECT	DON'T KNOW	NOT A PROBLEM
	%			
High bacteria	9	21	<b>48</b>	22
Fertilizers/Nitrates	14	31	<b>40</b>	15
Heavy metals	11	17	<b>51</b>	21
Minerals	10	25	<b>46</b>	19
Pesticides	15	34	<b>36</b>	15





# Human Health Issues

- Drinking water contamination
- Recreational water concerns
- Water-borne pathogens
  - Enterococcus indicator tests
  - Leptospirosis

# Ecosystem Health Issues

- Streams / Riparian ecosystems
- Coastal areas



# **Oahu Groundwater Pesticide Contaminants**

(Hawaii DOH, 2004)

<b><u>Chemical</u></b>	<b><u>% of wells</u></b>	<b><u>Use</u></b>	<b><u>Status</u></b>
<b>Atrazine</b>	<b>31</b>	<b>herbicide</b>	<b>still in use</b>
<b>Ametryn</b>	<b>4</b>	<b>herbicide</b>	<b>still in use</b>
<b>Chlordane</b>	<b>9</b>	<b>termaticide</b>	<b>discontinued</b>
<b>Dieldrin</b>	<b>19</b>	<b>insecticide</b>	<b>discontinued</b>
<b>DBCP</b>	<b>22</b>	<b>fumigant</b>	<b>discontinued</b>
<b>EDB</b>	<b>9</b>	<b>fumigant</b>	<b>discontinued</b>
<b>TCE</b>	<b>17</b>	<b>solvent</b>	<b>still in use</b>

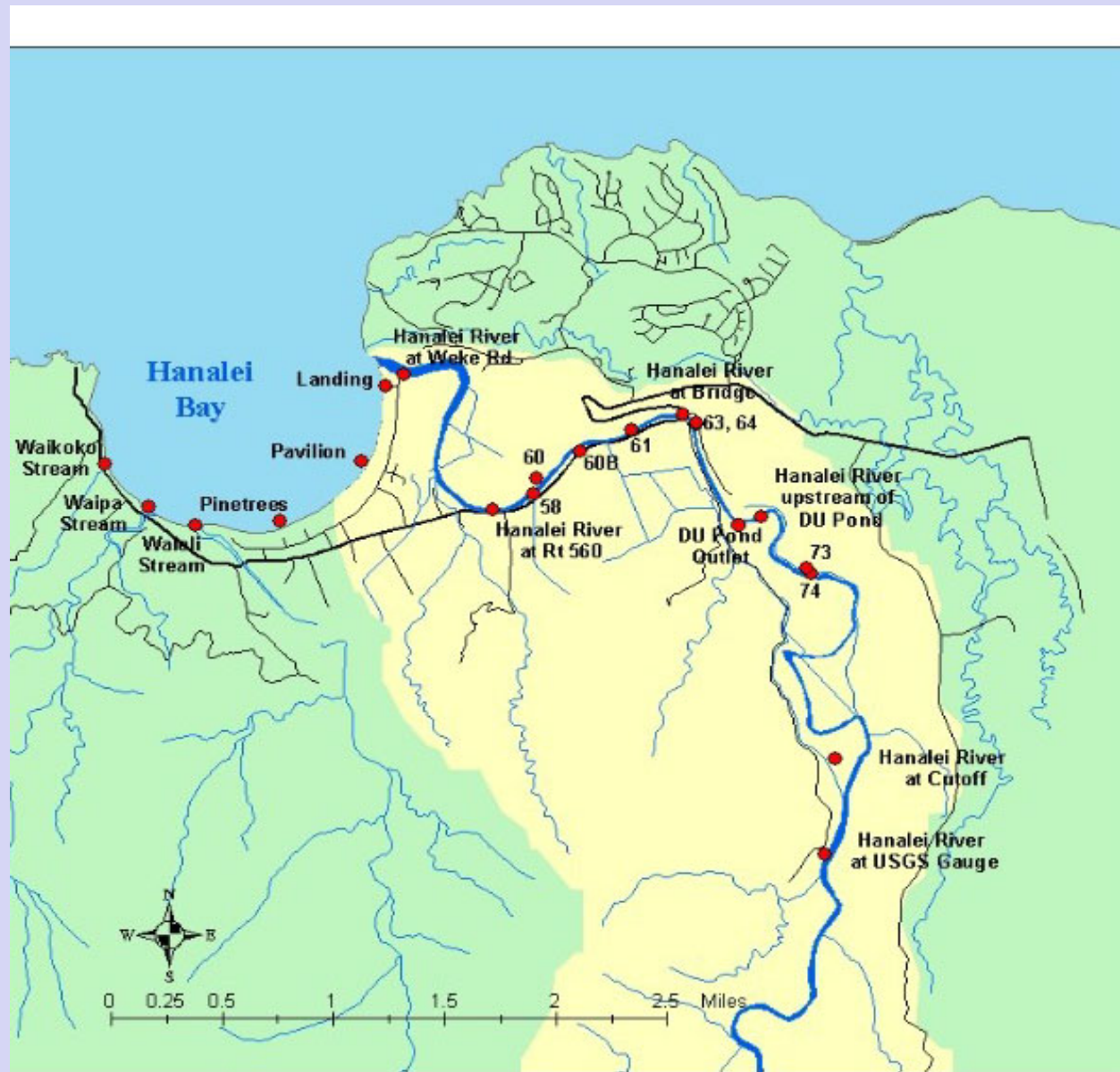




# Recreational Water Use



# Water Quality Sampling Locations in Hanalei



Hanalei Watershed Hui  
Version 1.3 10-21-03



## Safe to Swim?

**Red:** Bacteria level exceeds state standards of clean water for **both** current value & average of the last 5 values

**Yellow:** Bacteria level exceeds state standards of clean water for **either** current value or average of the last 5 values

**Green:** Bacteria level below state standards of clean water for **both** current value & average of the last 5 values

Date: January 31, 2005	Hanalei River	Black Pot Beach Park	Pavilion Beach Park	Pinetrees Beach Park	Waioli Stream	Waipa Stream	Waikoko Stream
Enterococcus Levels at date above:	148	86	<10	<10	1081	771	1046
Geometric mean of latest 5 bacteria levels	206	335	49	16	519	592	1007

Bacteria levels are for fecal indicating Enterococcus bacteria

Colors based on Hawaii State Standards of geometric mean <7 and single sample value <100

U.S. EPA standards are geometric mean of <35 and single sample value <104

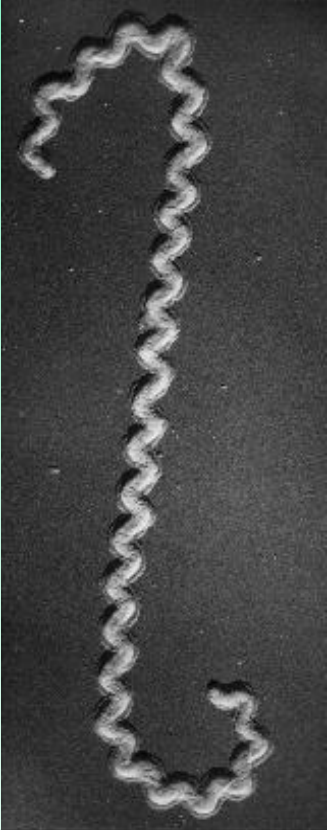


**Ahupua'a ~ A traditional Hawaiian approach to sustainable watershed management  
also called Ridges to Reefs, White Water to Blue Water, and Summit to Sea**

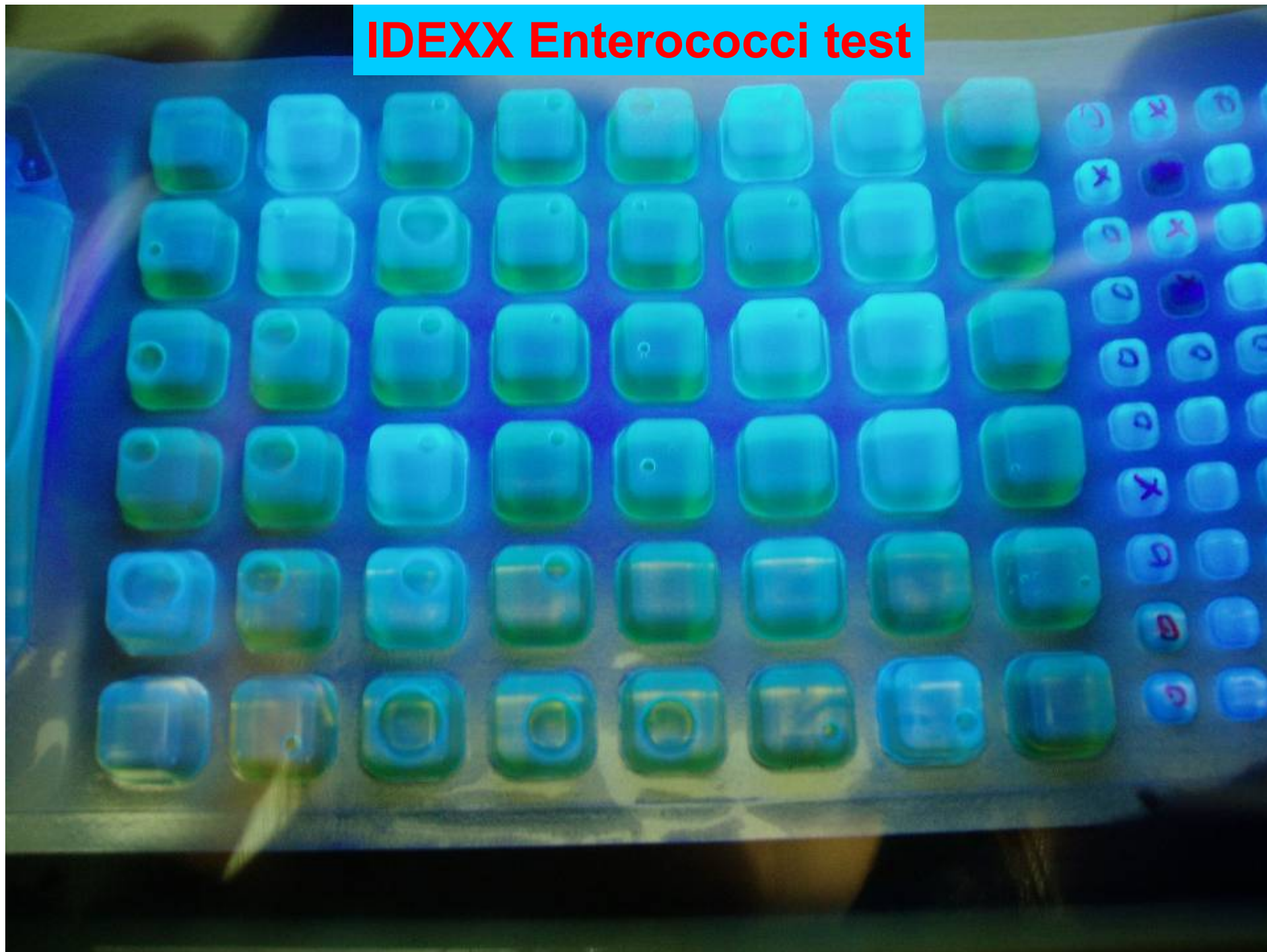


# Leptospirosis

- Disease of worldwide importance
- Caused by spirochete *Leptospira*
- Symptoms range from no reaction to extreme illness, sometimes fatal
- Serological tests are available, but no environmental tests

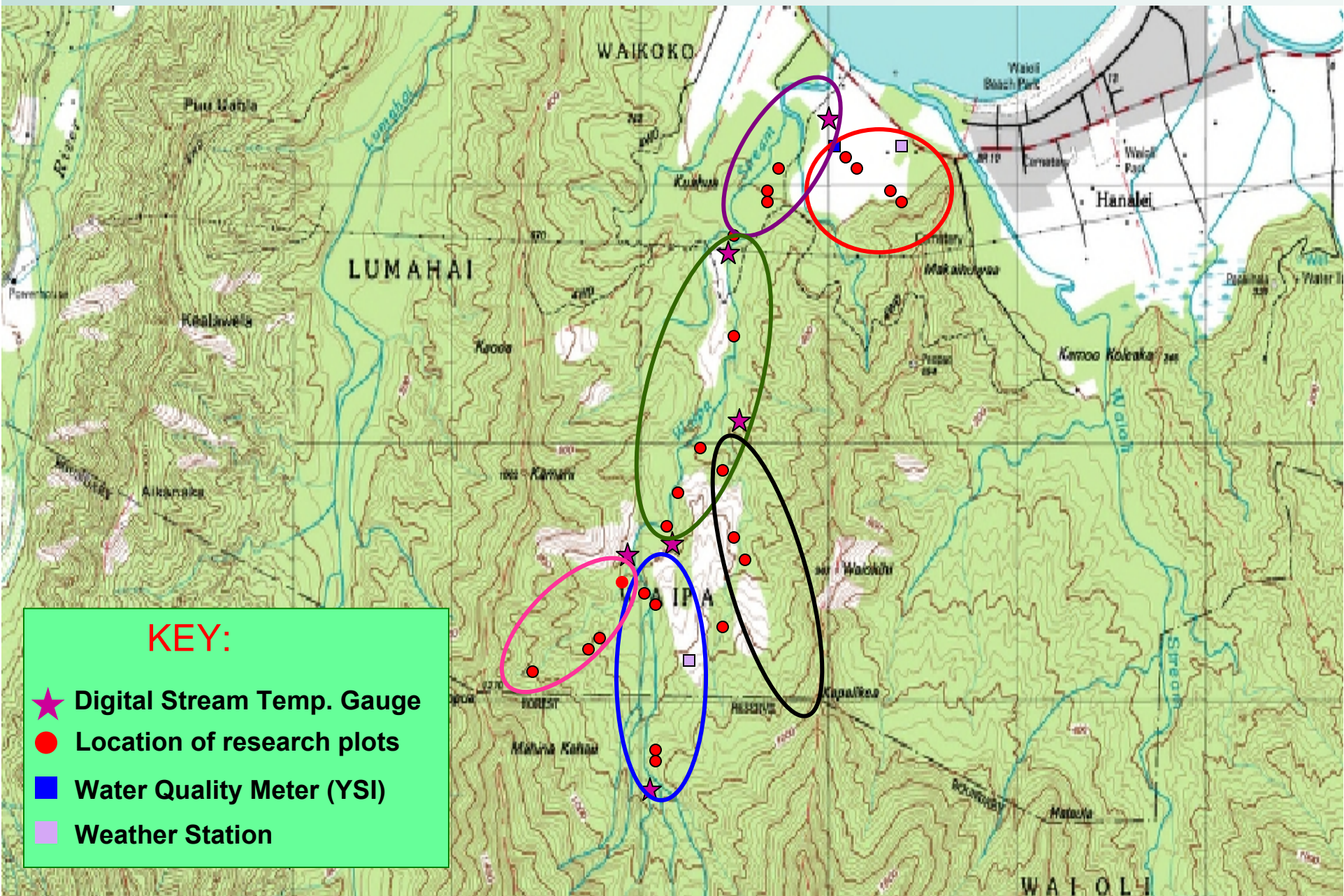


## IDEXX Enterococci test

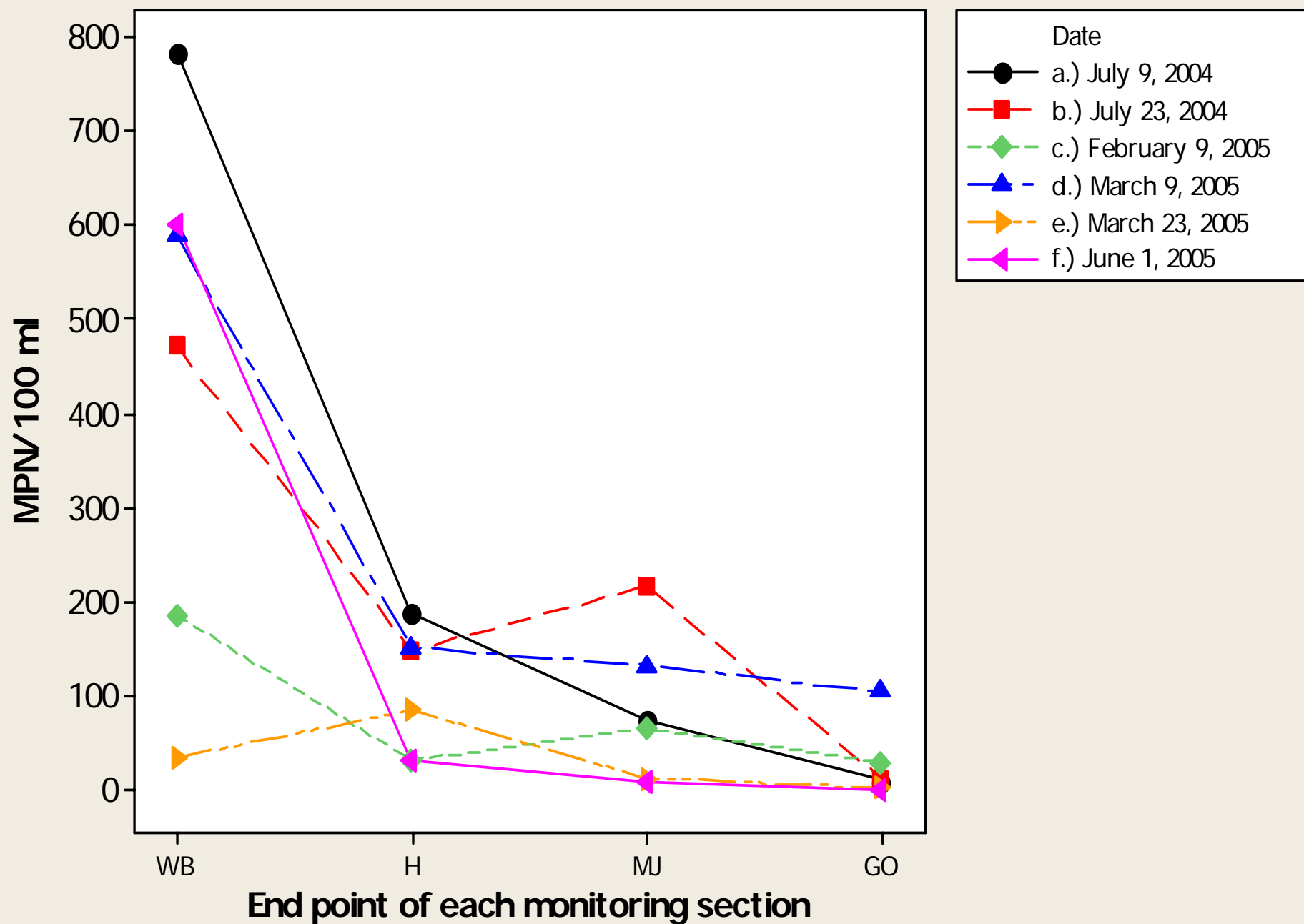




# Waipā Watershed



## Geometric mean of water samples tested for enterococci along Waipā stream







Fenced and unfenced runoff plots to study water quality impacts of feral pigs. Roundtop site, Manoa, (Browning, Bruland, Evensen, 2008)



# Land-Based Pollution Threats to Coral Reefs

Sediments, nutrients and other pollutants from a variety of land-based activities threaten coral reef ecosystems in Hawaii and globally



**Soil Runoff, Maui (USGS)**



**Reef, Hanalei, Kaua'i**



# Future Uncertainties

- **Growth & Development / Preservation**  
(urban vs. agricultural land use, green space, conservation land)
- **Impacts of Climate Change**
  - Rainfall amounts & distribution
  - Sea level rise / saltwater intrusion
- **Energy Sources**  
(transport costs, self sufficiency)

