USGS
science for a changing world

Groundwater Availability, Molokaʻi, Hawaiʻi

Department of Hawaiian Home Lands
October 19, 2020

Delwyn S. Oki, U.S. Geological Survey

U.S. Department of the Interior
U.S. Geological Survey

Outline

1. Background
2. Motivation for study
3. USGS groundwater study

USGS

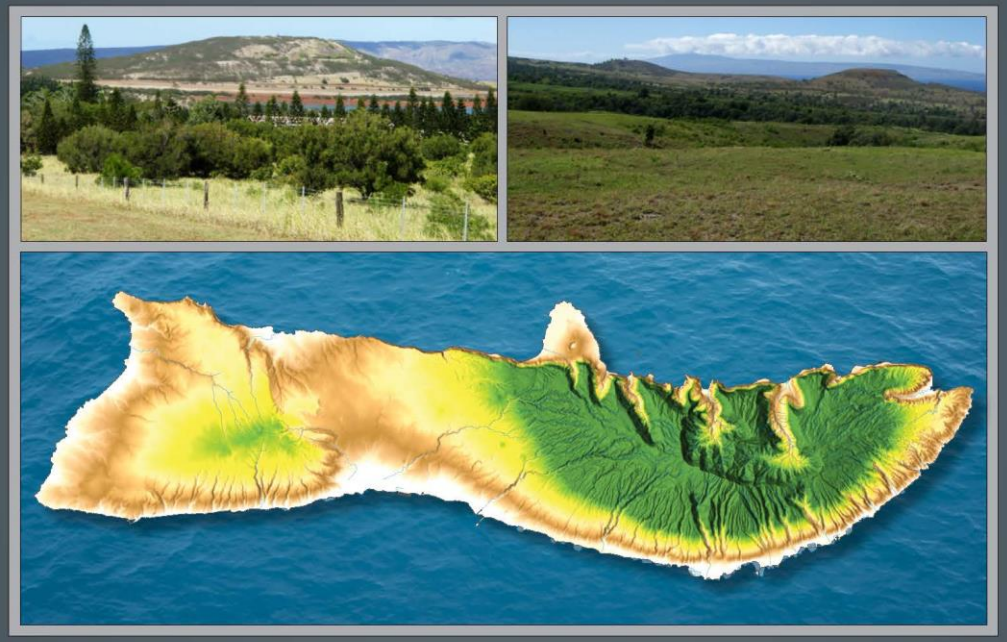
Published Report

https://doi.org/10.3133/sir20195150

USGS
science for a changing world

Prepared in cooperation with the State of Hawai‘i Department of Hawaiian Home Lands, State of Hawai‘i Office of Hawaiian Affairs, and County of Maui Department of Water Supply

Numerical Simulation of Groundwater Availability in Central Moloka‘i, Hawai‘i



Scientific Investigations Report 2019–5150

U.S. Department of the Interior
U.S. Geological Survey

USGS

Generalized Geology

0 5 MILES
0 5 KILOMETERS

West Moloka‘i volcano
Rift zone
Rift zone
Kualapu‘u Reservoir
Caldera area
East Moloka‘i volcano
Hālawa Bay

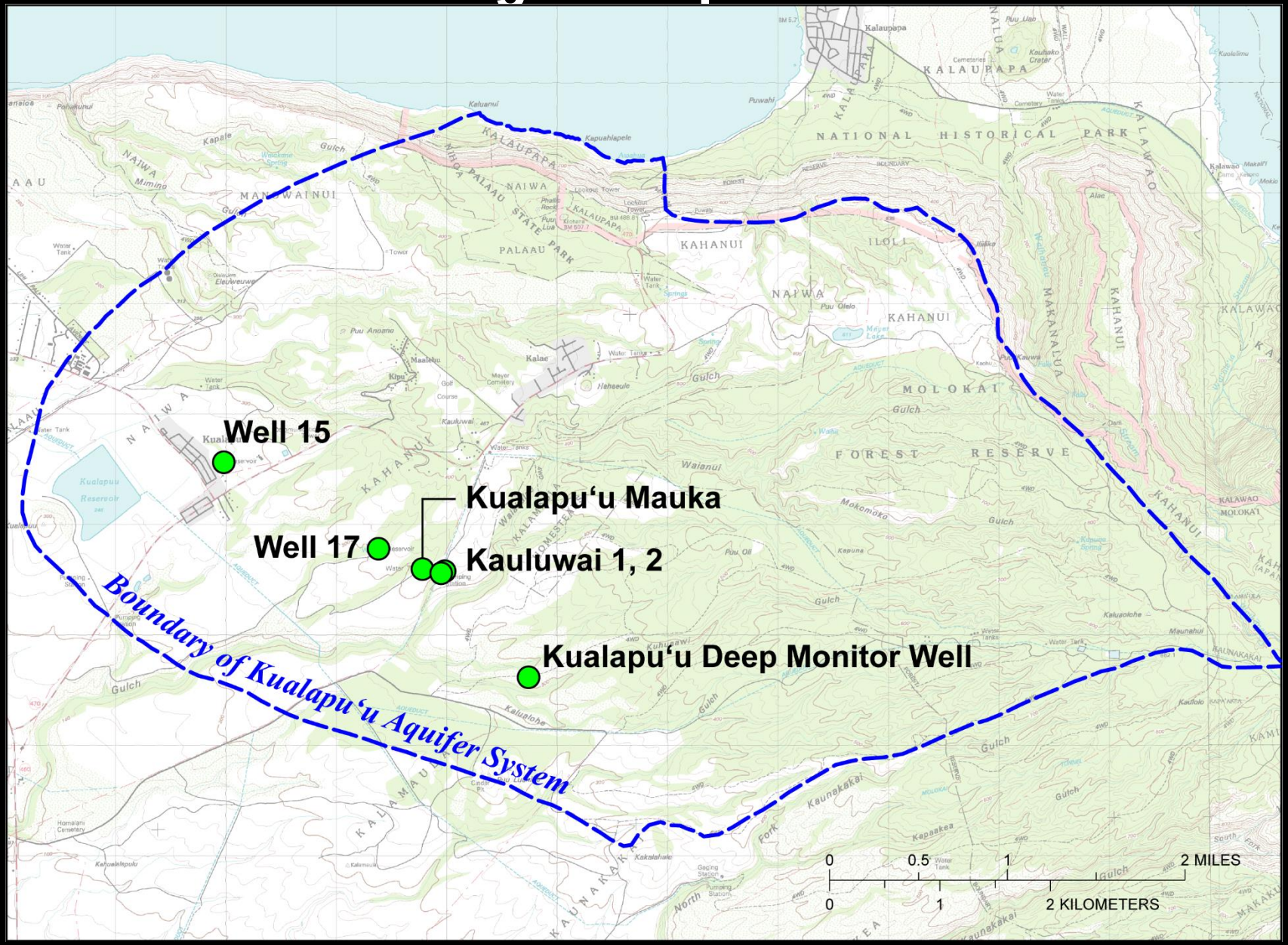
EXPLANATION

- Sedimentary deposits
- Kalaupapa Volcanics
- East Moloka‘i Volcanics
- West Moloka‘i Volcanics
- Volcanic vent
- Dike
- Kualapu‘u aquifer-system boundary
- Well in the Kualapu‘u aquifer system

USGS

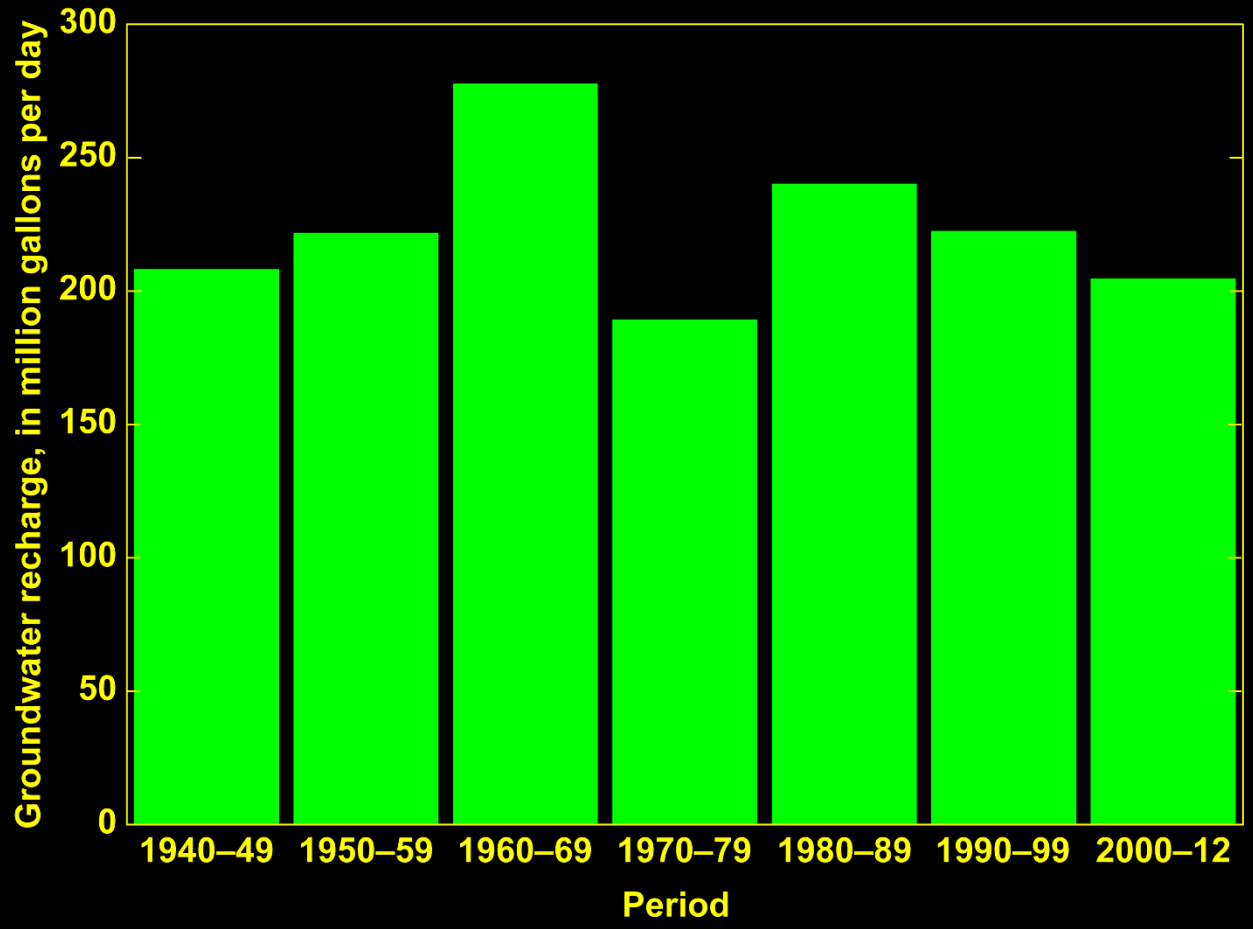
(modified from Sherrod and others, 2007; Langenheim and Clague, 1987)

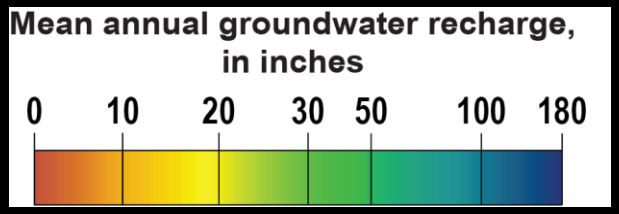
Existing Kualapu‘u Wells

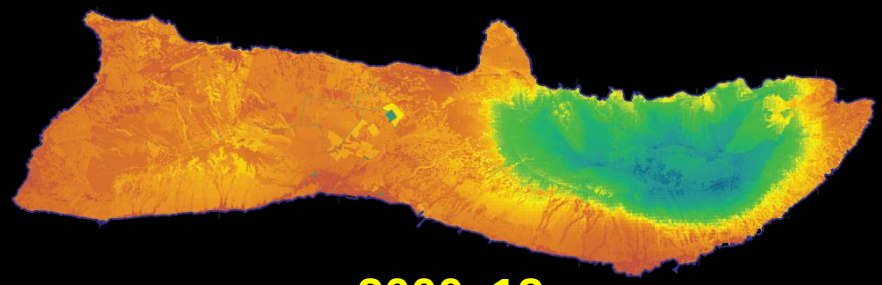


USGS

Recharge By Decade







2000–12

USGS

Motivation for Understanding Groundwater Availability

1. Groundwater is the main source of drinking water

2. Demand for groundwater is expected to increase

3. Groundwater resources are limited
   - Limited rainfall and recharge in developed areas
   - Salinity increased in some wells

4. Effects of additional groundwater withdrawal are uncertain
   - Will proposed withdrawals affect salinity of other wells?
   - Will reduction in freshwater discharge to nearshore ecosystems be acceptable?

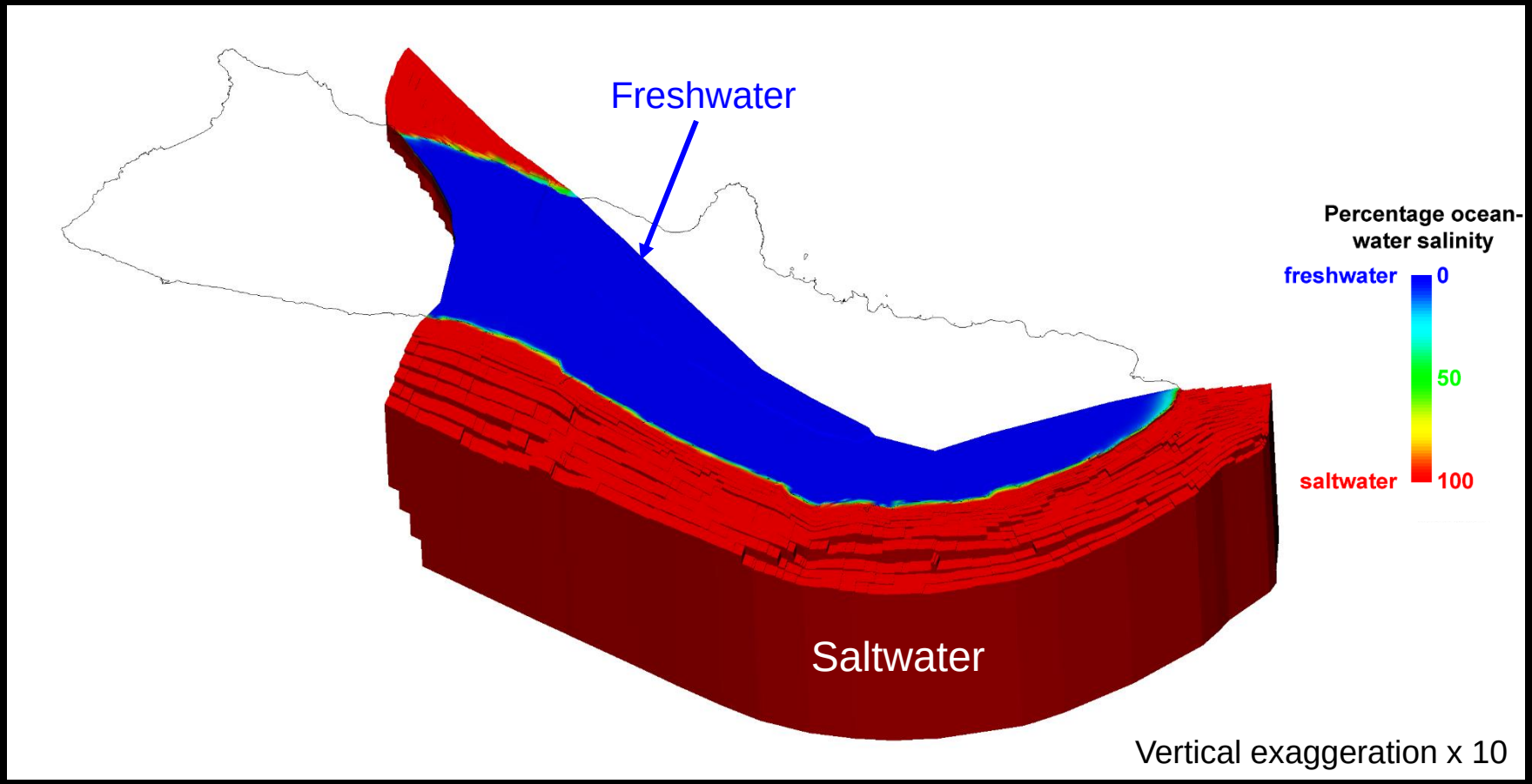
USGS

USGS Study

- Overall objective is to evaluate groundwater availability in central Molokaʻi
- Objective met by developing a numerical groundwater model capable of quantifying changes in salinity and flow to nearshore areas
- Numerical model used to simulate selected withdrawal scenarios developed with input from State and County agencies

USGS

Study Area 3-D Model—Oblique View

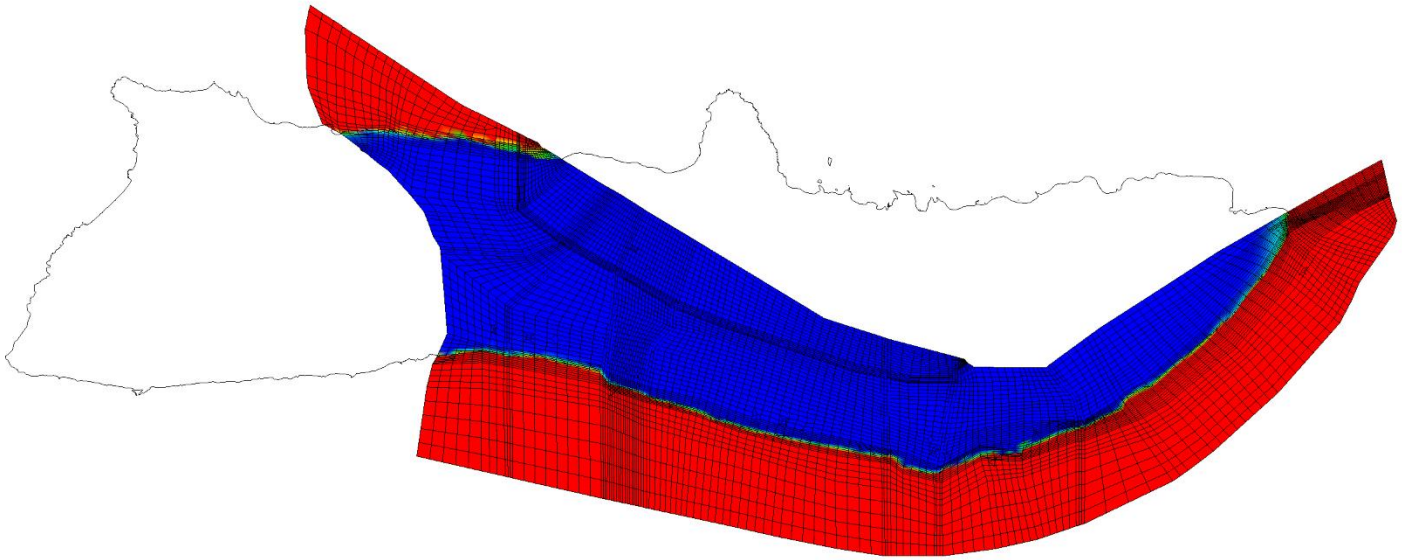


3-D computer model:

- Integrates available geologic and hydrologic information
- Simulates flow and salinity in aquifer and discharge to nearshore areas

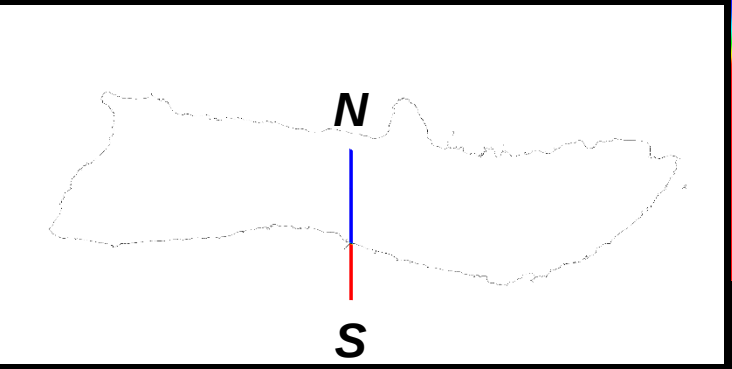
USGS

1940–2012 Animation of Freshwater Volume



USGS

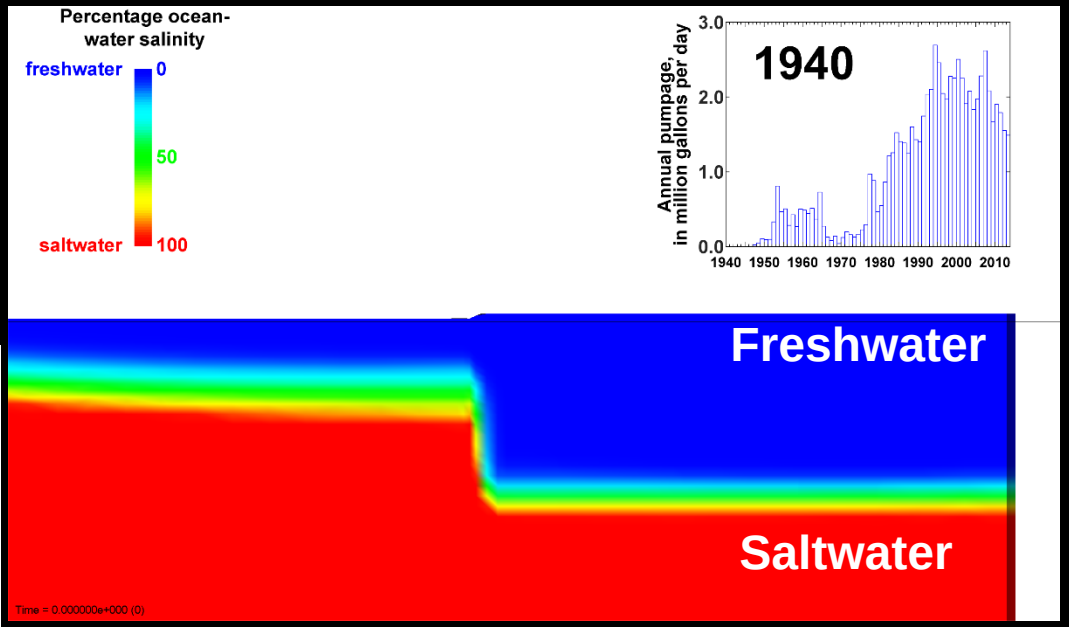
1940–2012 Animation Explanation

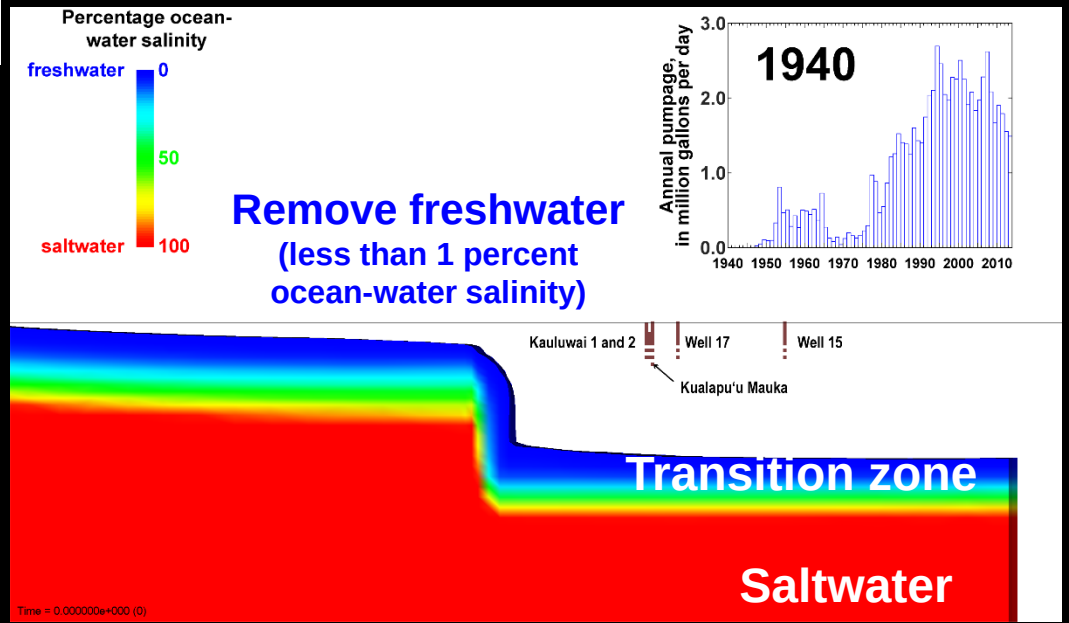


Cross section (slice of aquifer) view from top

South *North*

Cross section—view from side (east to west)



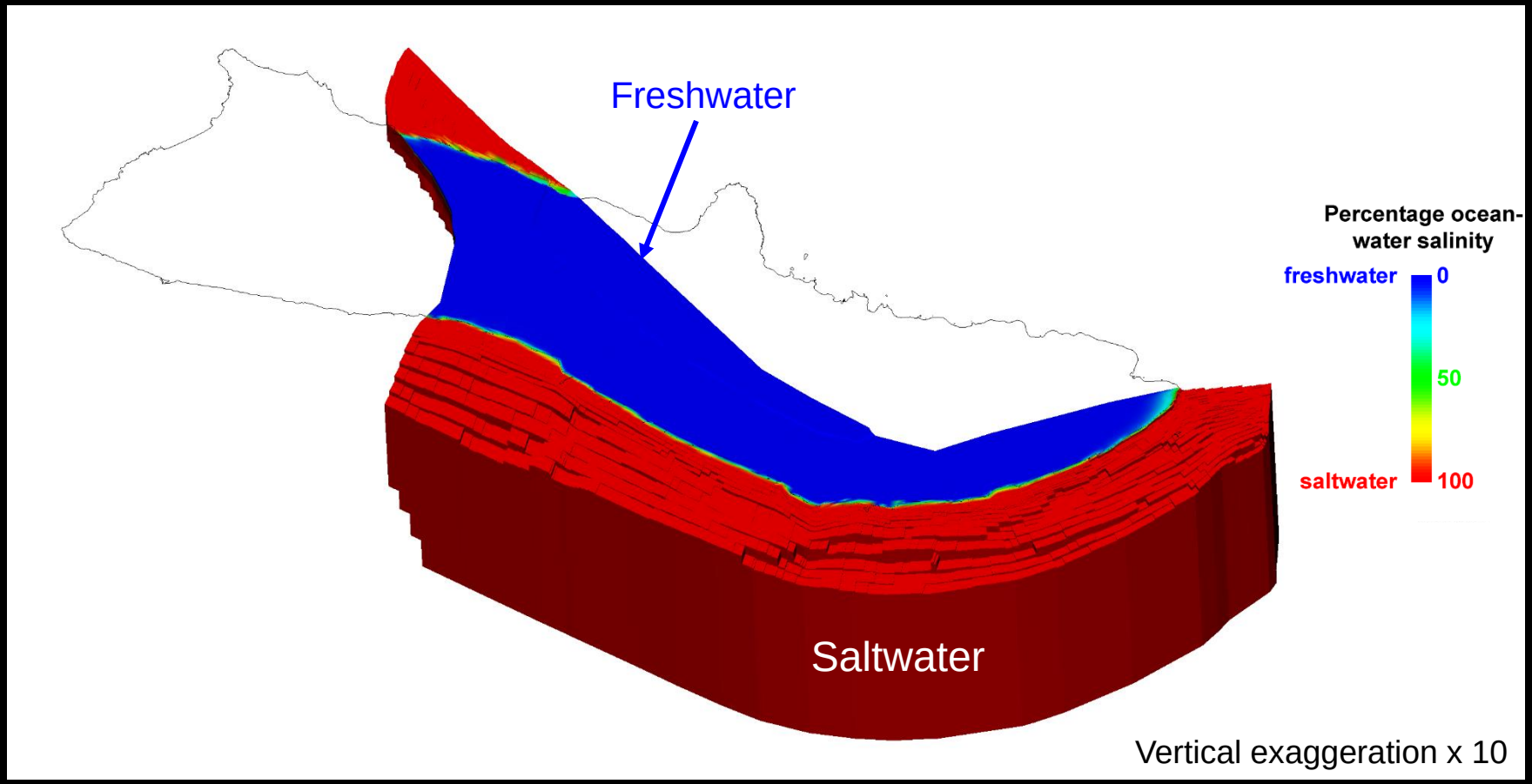


USGS

1940–2012 Animation of Freshwater Volume

USGS

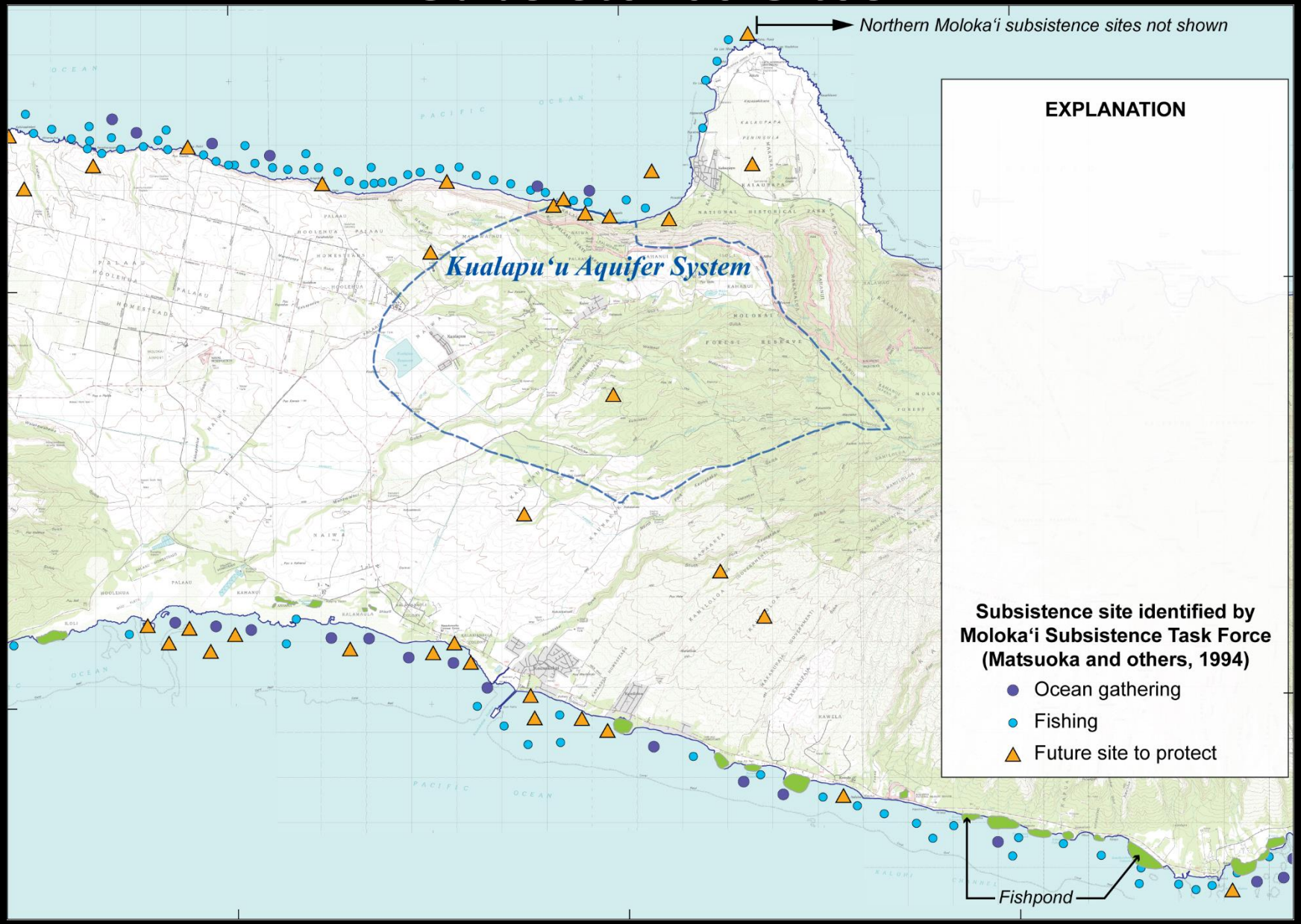
Application of Model



- Quantify changes in salinity
- Quantify changes in discharge to nearshore areas

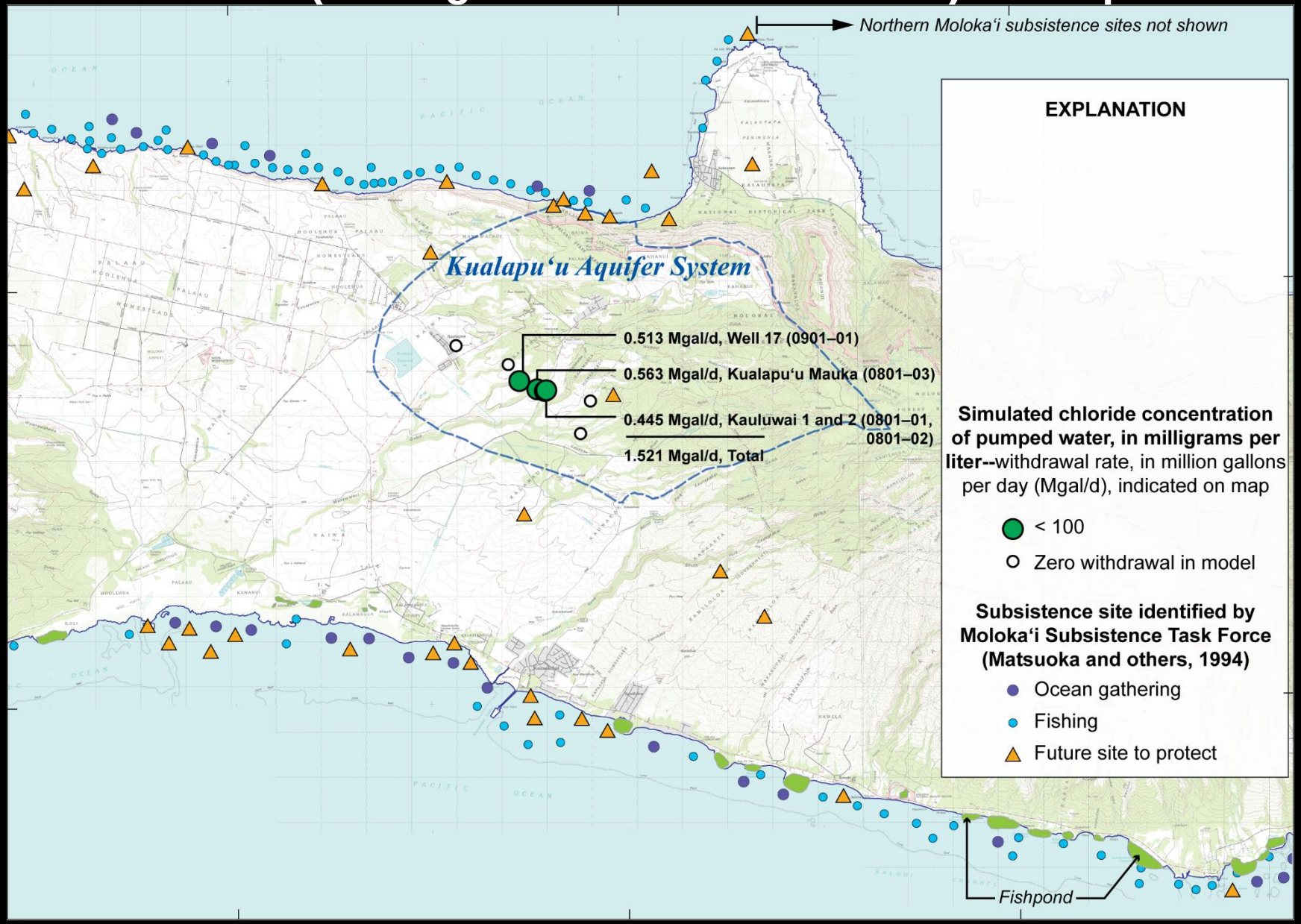
USGS

Subsistence Sites



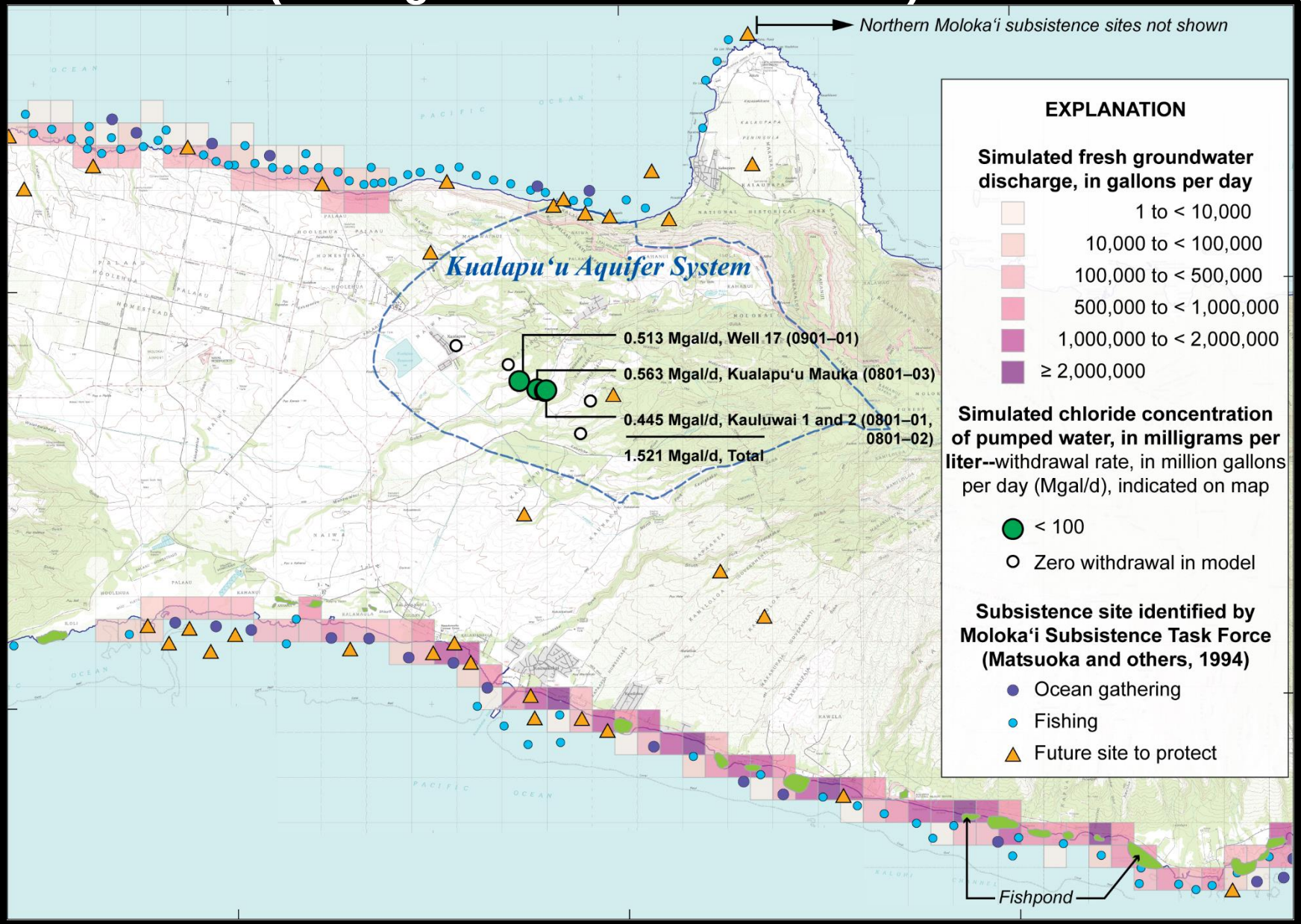
USGS

Base Scenario (Average 2016–17 Withdrawals)—Pumped Wells



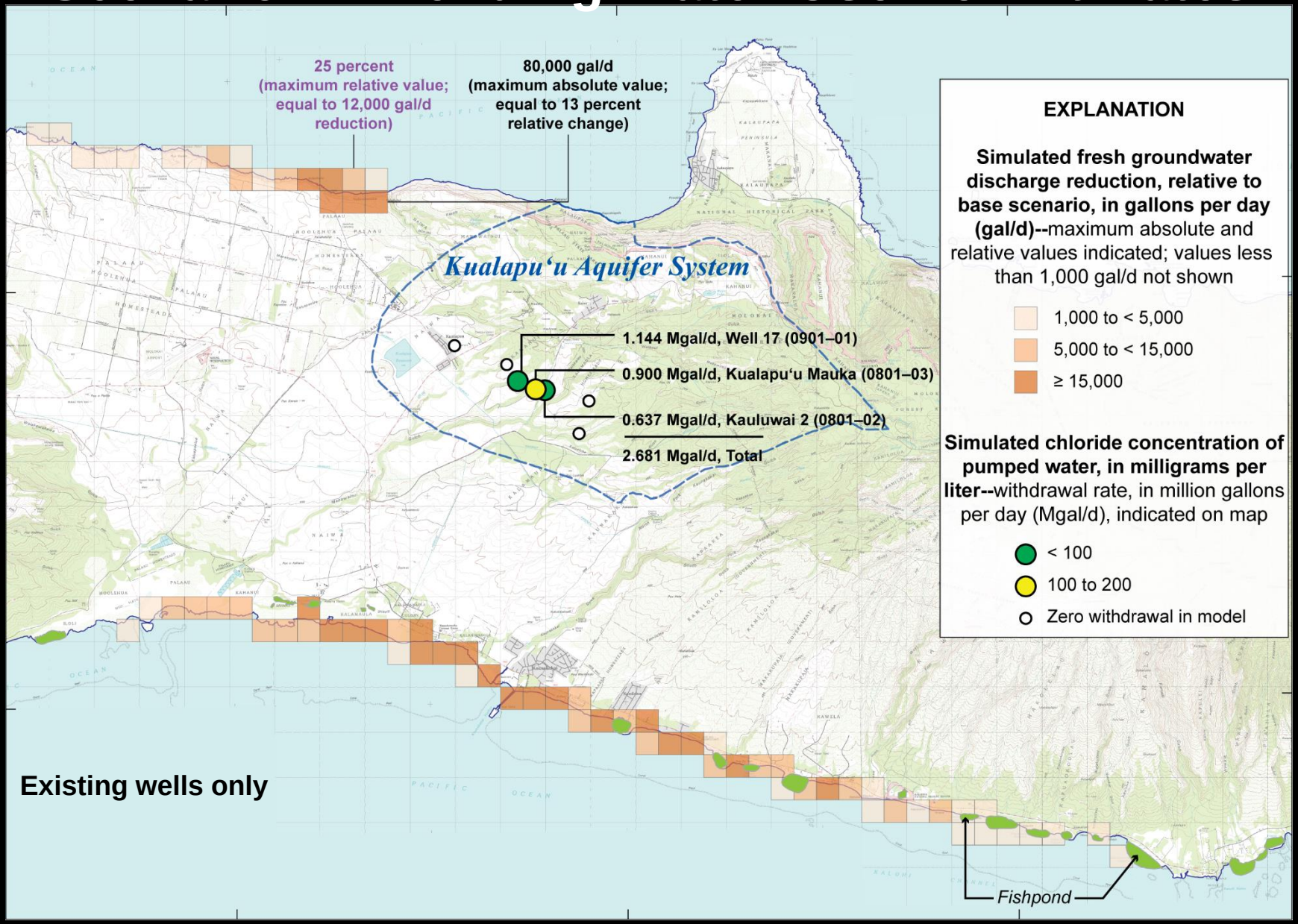
USGS

Base Scenario (Average 2016–17 Withdrawals)—Coastal Discharge



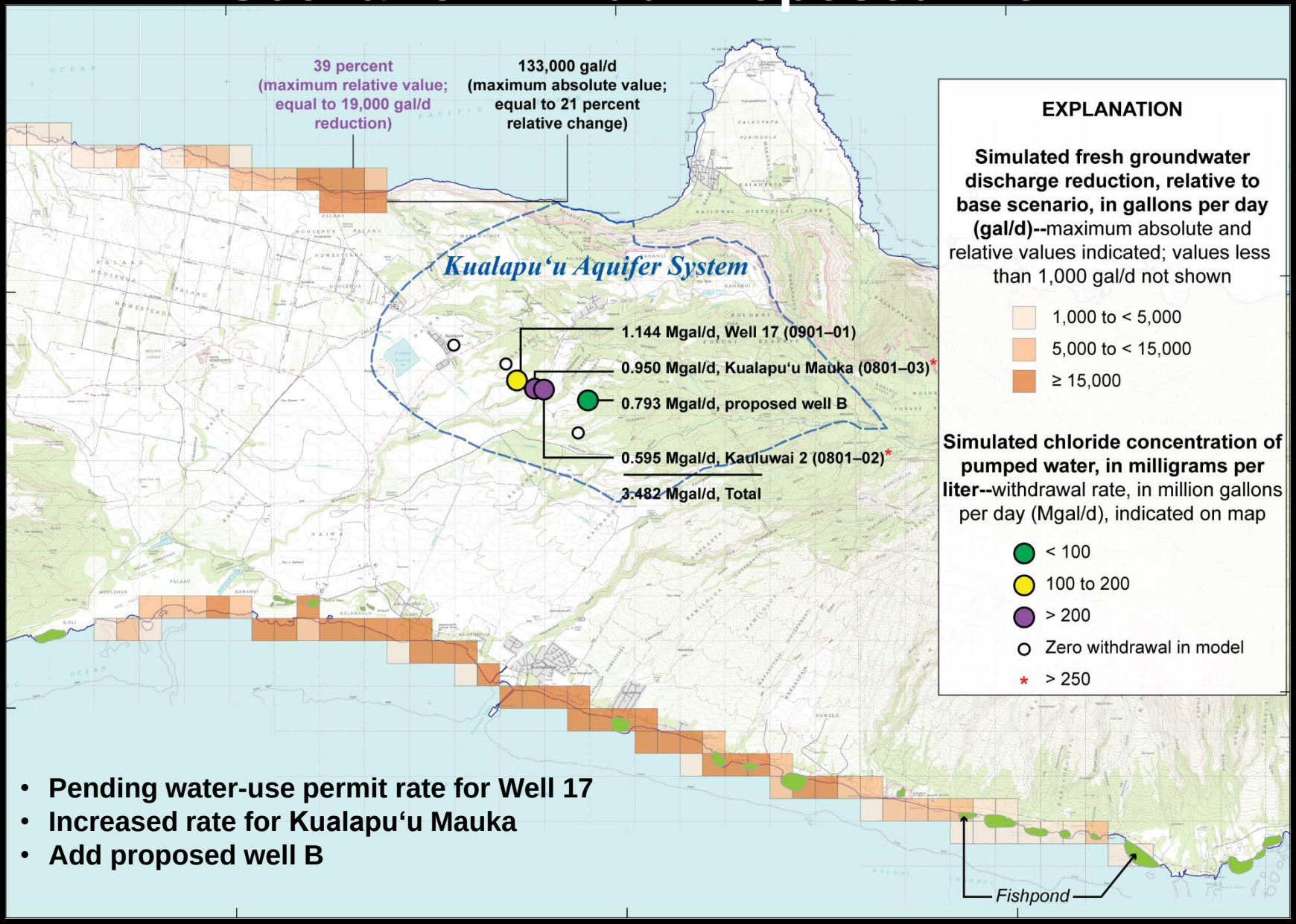
USGS

Scenario 2—Pending Water-Use Permit Rates



USGS

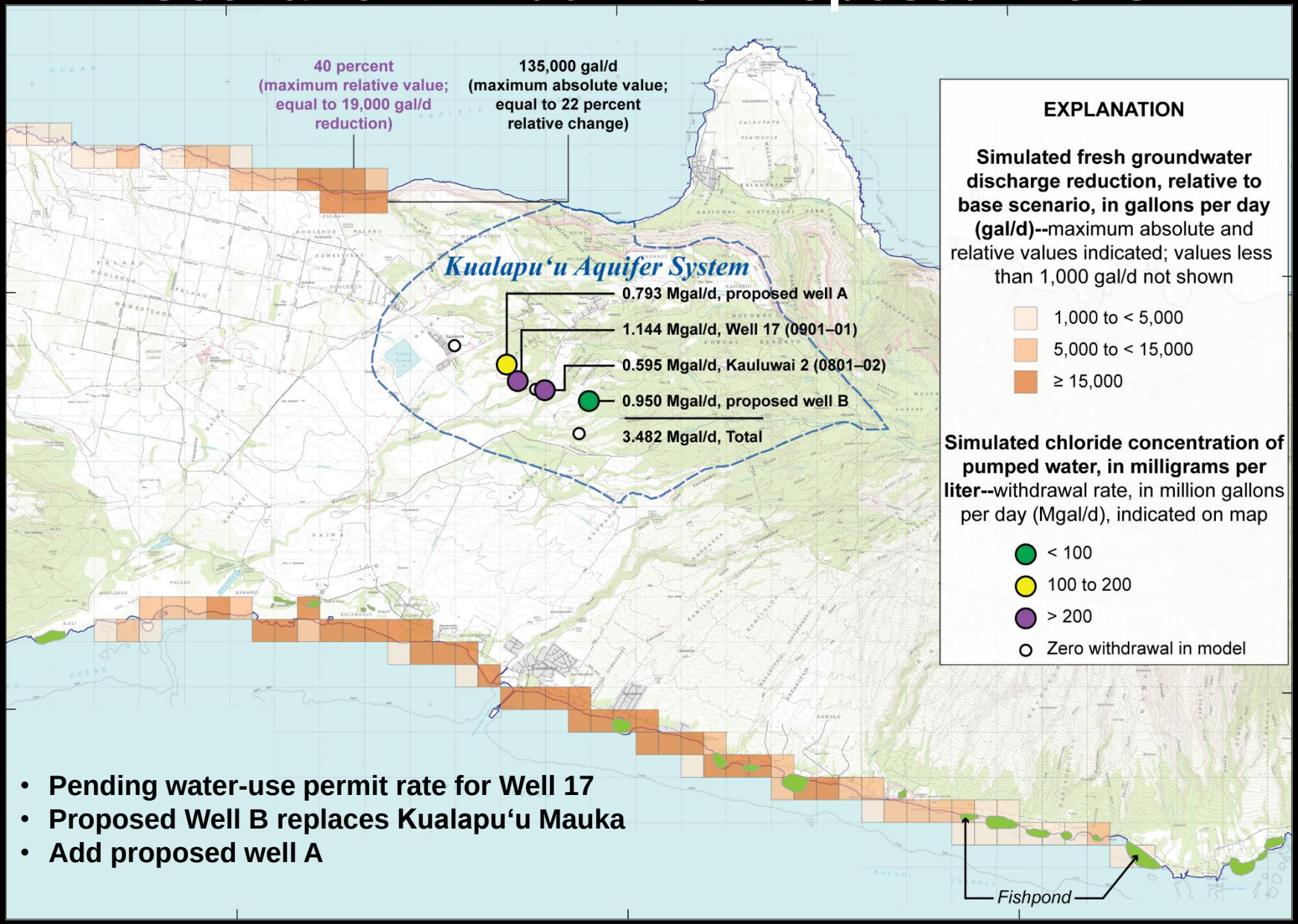
Scenario 4—Add Proposed Well



- Pending water-use permit rate for Well 17
- Increased rate for Kualapu‘u Mauka
- Add proposed well B

USGS

Scenario 7—Add Two Proposed Wells



- Pending water-use permit rate for Well 17
- Proposed Well B replaces Kualapu‘u Mauka
- Add proposed well A

USGS

Summary

1. Groundwater model developed to evaluate withdrawal scenarios

2. Model results indicate additional groundwater in the Kualapuʻu area may be available

3. The distribution and rate of withdrawals are important factors controlling groundwater availability

4. Additional withdrawals will have an impact—managers and stakeholders must evaluate whether the impacts are acceptable

USGS

Study Limitations

1. Groundwater model is regional in scale and may not accurately represent local conditions

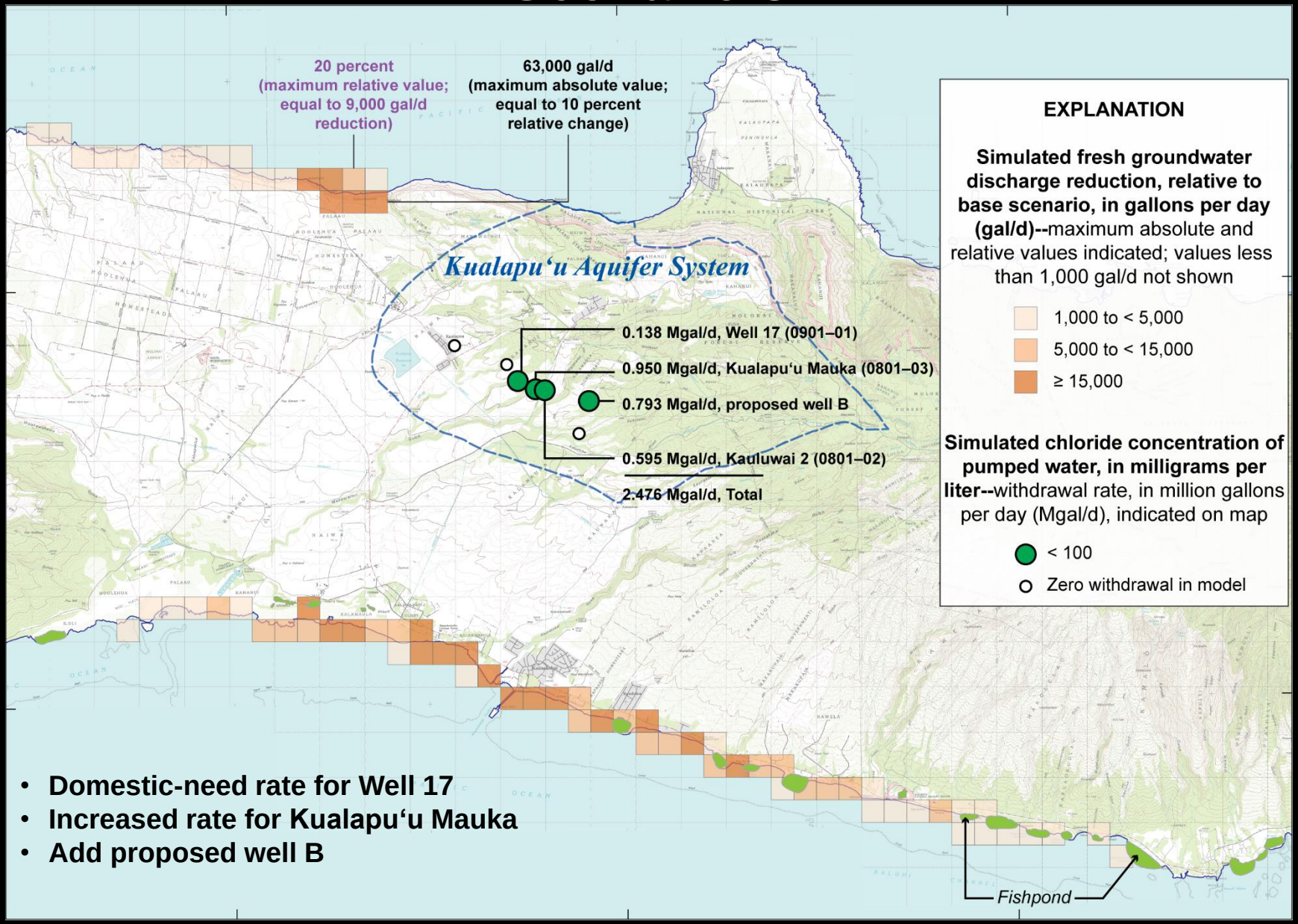
2. Groundwater model contains uncertainty
   A. subsurface geology poorly known
   B. additional data from wells would help to constrain model
   C. water-budget components uncertain
   D. model can be updated as information becomes available

3. No wells available in parts of the Kualapuʻu aquifer system

USGS


Questions?

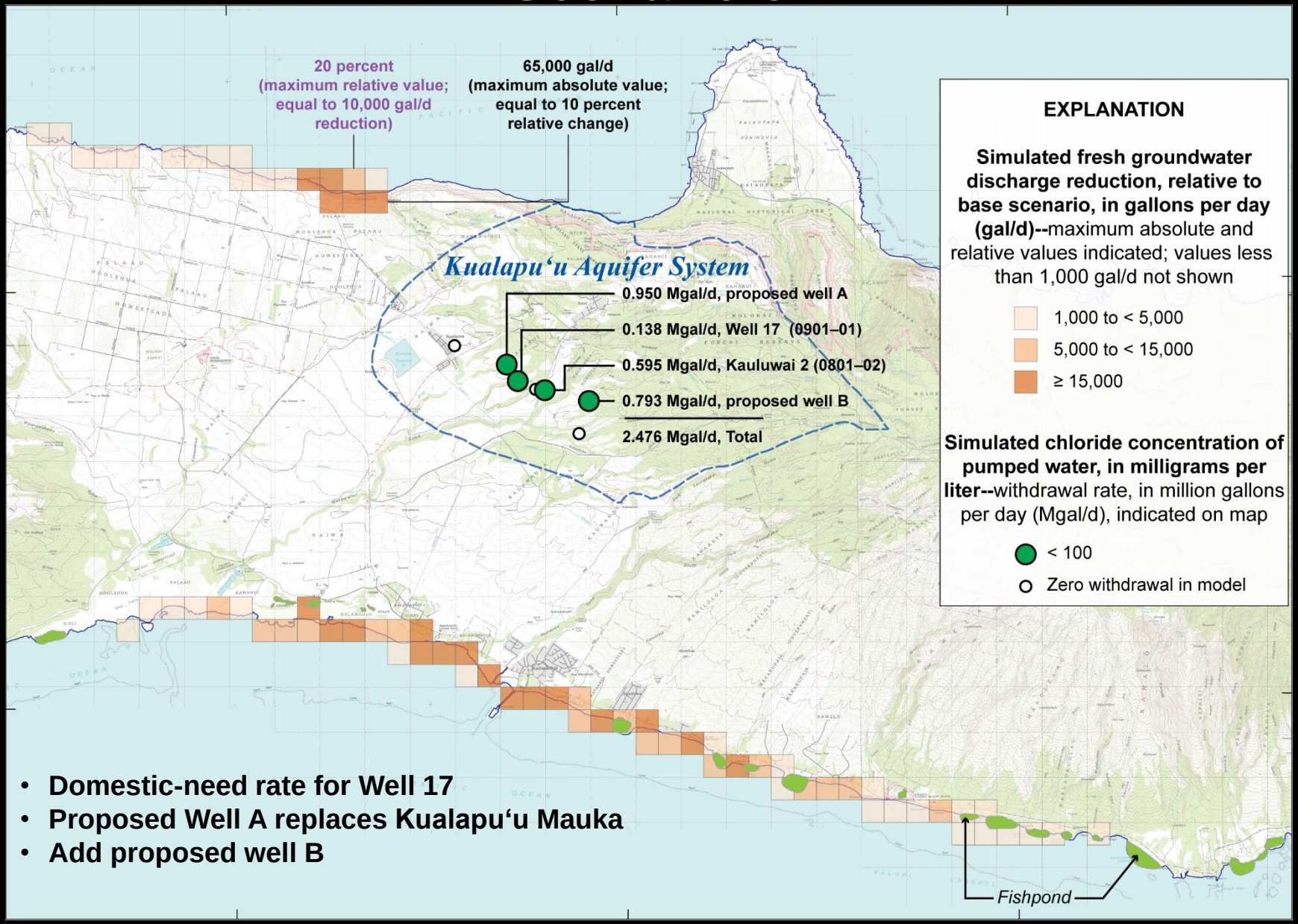
Scenario 3



- Domestic-need rate for Well 17
- Increased rate for Kualapu‘u Mauka
- Add proposed well B

USGS

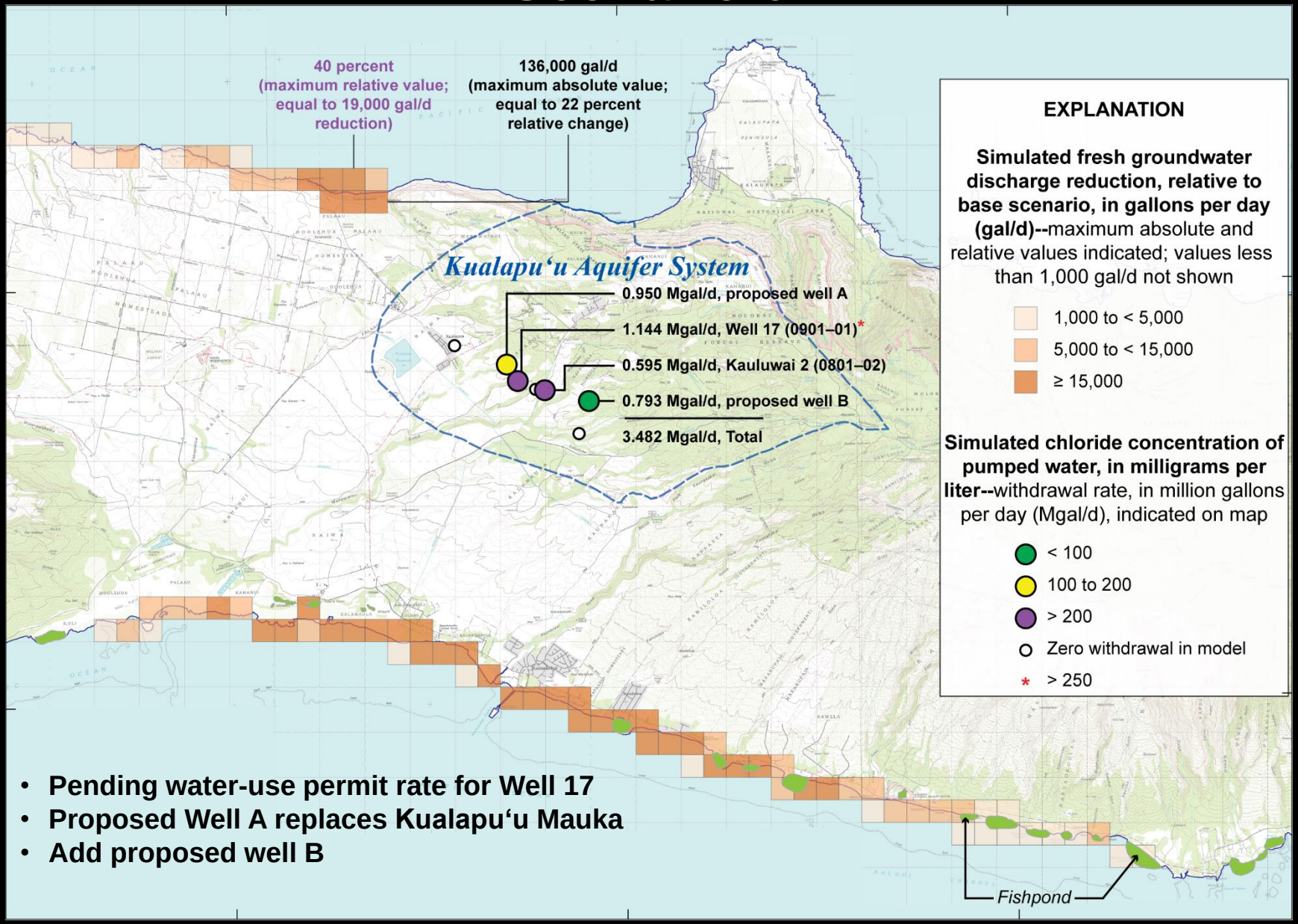
Scenario 5



- Domestic-need rate for Well 17
- Proposed Well A replaces Kualapu‘u Mauka
- Add proposed well B

USGS

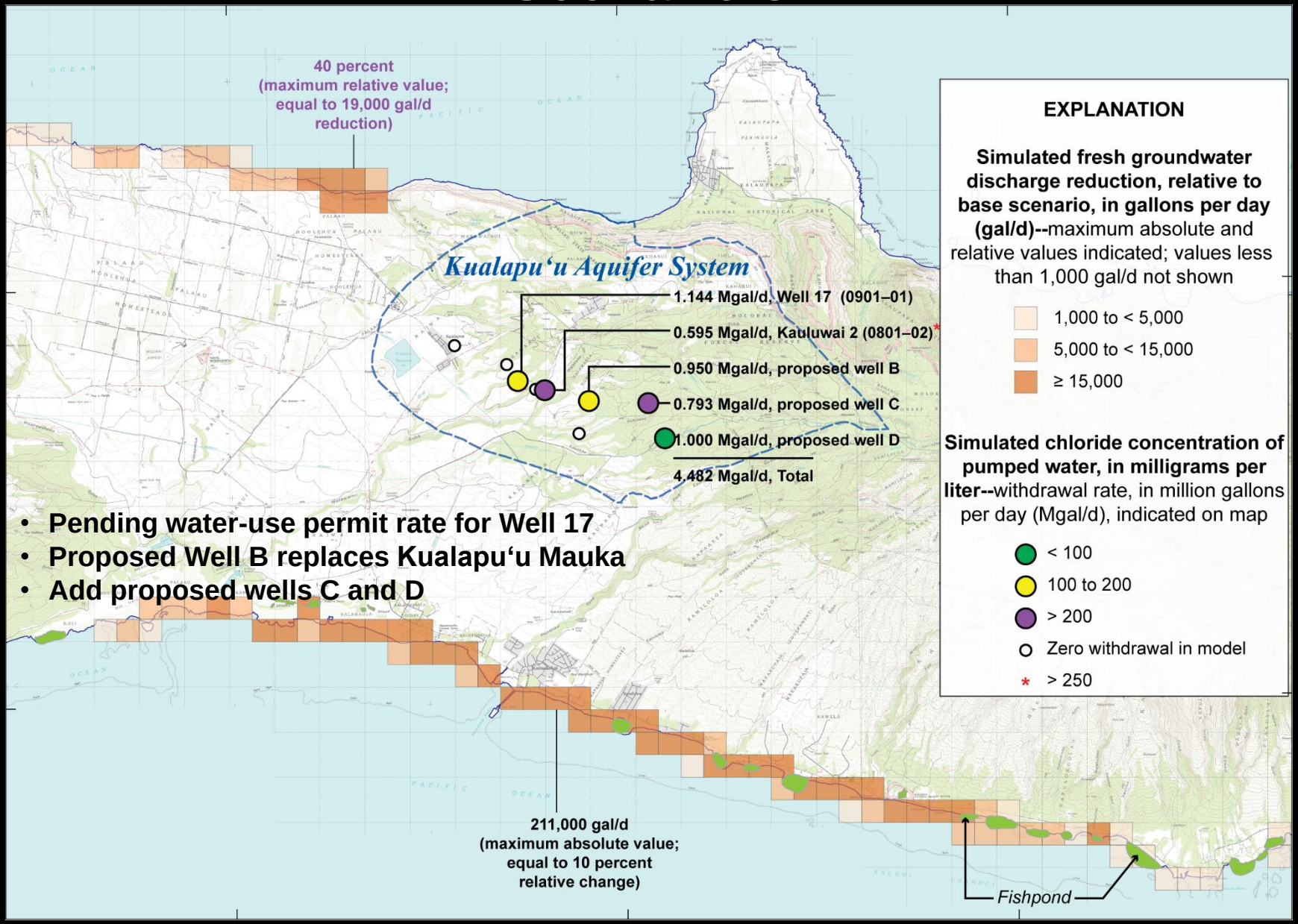
Scenario 6



- **Pending water-use permit rate for Well 17**
- **Proposed Well A replaces Kualapu‘u Mauka**
- **Add proposed well B**

USGS

Scenario 8



USGS