

# Introduction to U.S. Geological Survey Water Science in the Pacific Islands

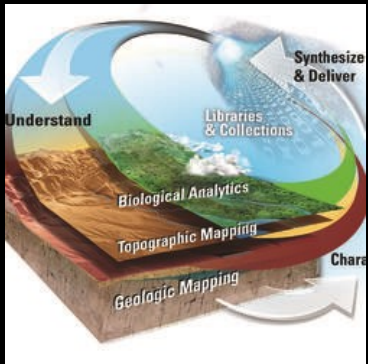
Chris Curran – Assistant Center Director for Hydrologic Data  
U.S. Geological Survey

EARTH 2023 Workshop  
July 11, 2023

# USGS – Our Focus & Structure

“As the Nation's largest water, earth, and biological science and civilian mapping agency, we collect, monitor, analyze, and provide science about natural resource conditions, issues, and problems. Our diverse expertise enables large-scale, multidisciplinary investigations and provides impartial scientific information to resource managers, planners, and our customers.”

## USGS Mission Areas



Core Science  
Systems



Ecosystems



Water  
Resources



Natural  
Hazards



Energy &  
Minerals

[Mission Areas | U.S. Geological Survey \(usgs.gov\)](https://www.usgs.gov/science/mission-areas) <https://www.usgs.gov/science/mission-areas>

# Water in the Headlines!

LOCAL NEWS

## Drought conditions endanger Hawaii's cattle industry

by: [Manolo Morales](#)

Posted: Nov 23, 2021 / 06:49 PM HST

Updated: Nov 23, 2021 / 06:49 PM HST

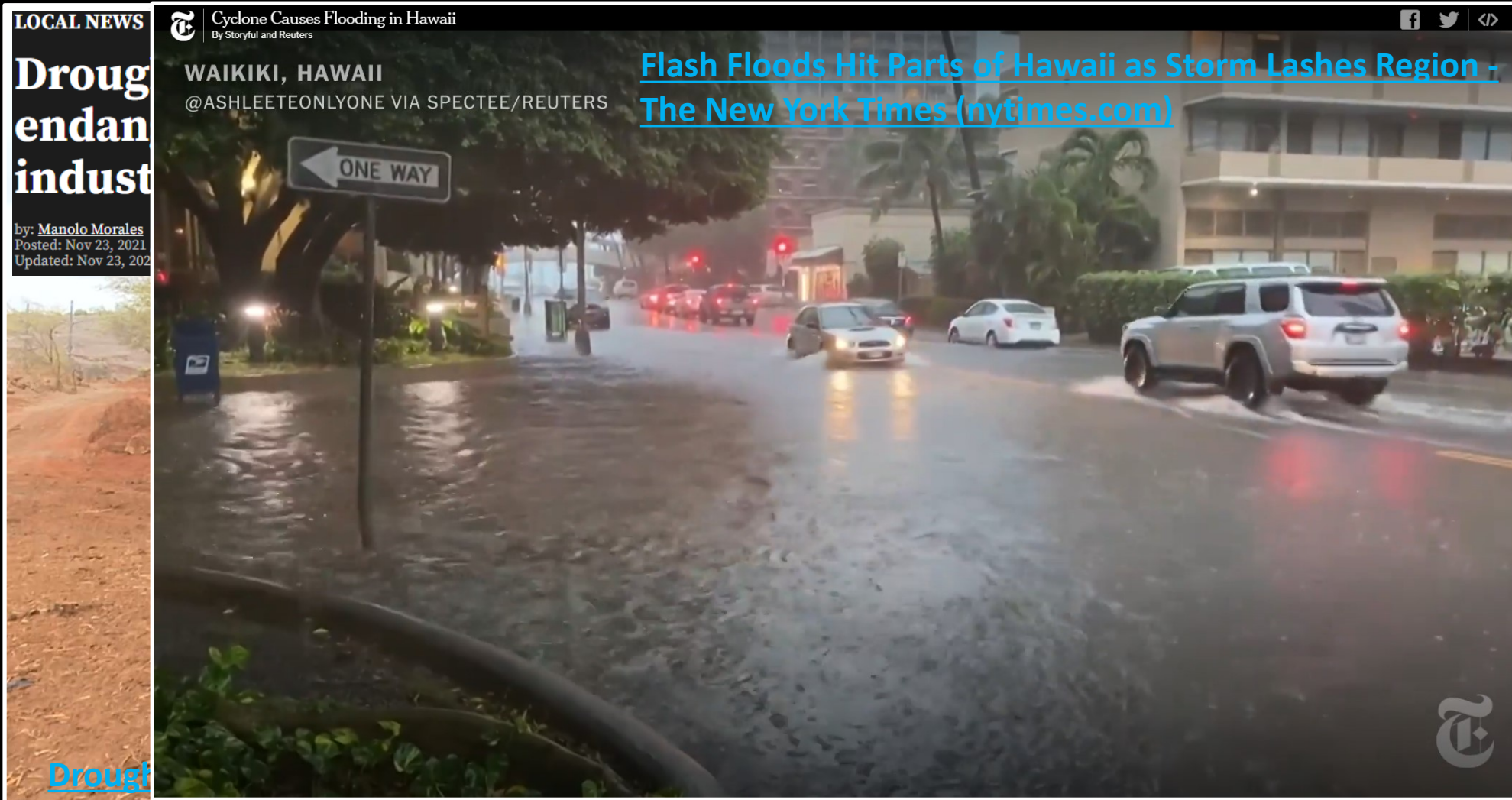


[Drought conditions endanger Hawaii's cattle industry | KHON2](https://www.khon2.com/local-news/drought-conditions-endanger-hawaiis-cattle-industry/)

<https://www.khon2.com/local-news/drought-conditions-endanger-hawaiis-cattle-industry/>



# Water in the Headlines!



# Water in the Headlines!

**LOCAL NEWS**

## Drought endangering indust

by: [Manolo Morales](#)  
Posted: Nov 23, 2021  
Updated: Nov 23, 2021



 Cyclone Causes  
By Storyful and Reuters

WAIKIKI, HA  
@ASHLEETEON



[Fear over contaminated water grows across Oahu | Local | kitv.com](#)




**KITV 4 abc**  
ISLAND NEWS  
6:09 78°  
**RESIDENTS WORRY ABOUT TAINTED WATER**  
OAHU

**WATER WOES**

[https://www.kitv.com/news/local/fear-over-contaminated-water-grows-across-oahu/article\\_e00a6bfc-58c0-11ec-b36c-af416a07b365.html](https://www.kitv.com/news/local/fear-over-contaminated-water-grows-across-oahu/article_e00a6bfc-58c0-11ec-b36c-af416a07b365.html)





# USGS Water Mission Area



USGS  
science for a changing world

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Latest Earthquakes | 



WATER RESOURCES MISSION AREA

About

[Water Resources - About | U.S. Geological Survey \(usgs.gov\)](https://www.usgs.gov/mission-areas/water-resources/about)  
<https://www.usgs.gov/mission-areas/water-resources/about>



HOME

SCIENCE

PROGRAMS

DATA

Water information is fundamental to national and local economic well-being, protection of life and property, and effective management of the Nation's water resources. The USGS works with partners to monitor, assess, conduct targeted research, and deliver information on a wide range of water resources and conditions including streamflow, groundwater, water quality, and water use and availability.



# Competing Needs for Water in Hawai'i

Commercial agriculture  
Dole Plantation, O'ahu



Native species  
'O'opu nōpili



Diversions for irrigation  
Kauaula Stream, Maui

Aesthetics  
Waimoku Falls,  
Maui, HI



Domestic supply  
Kahuku, O'ahu



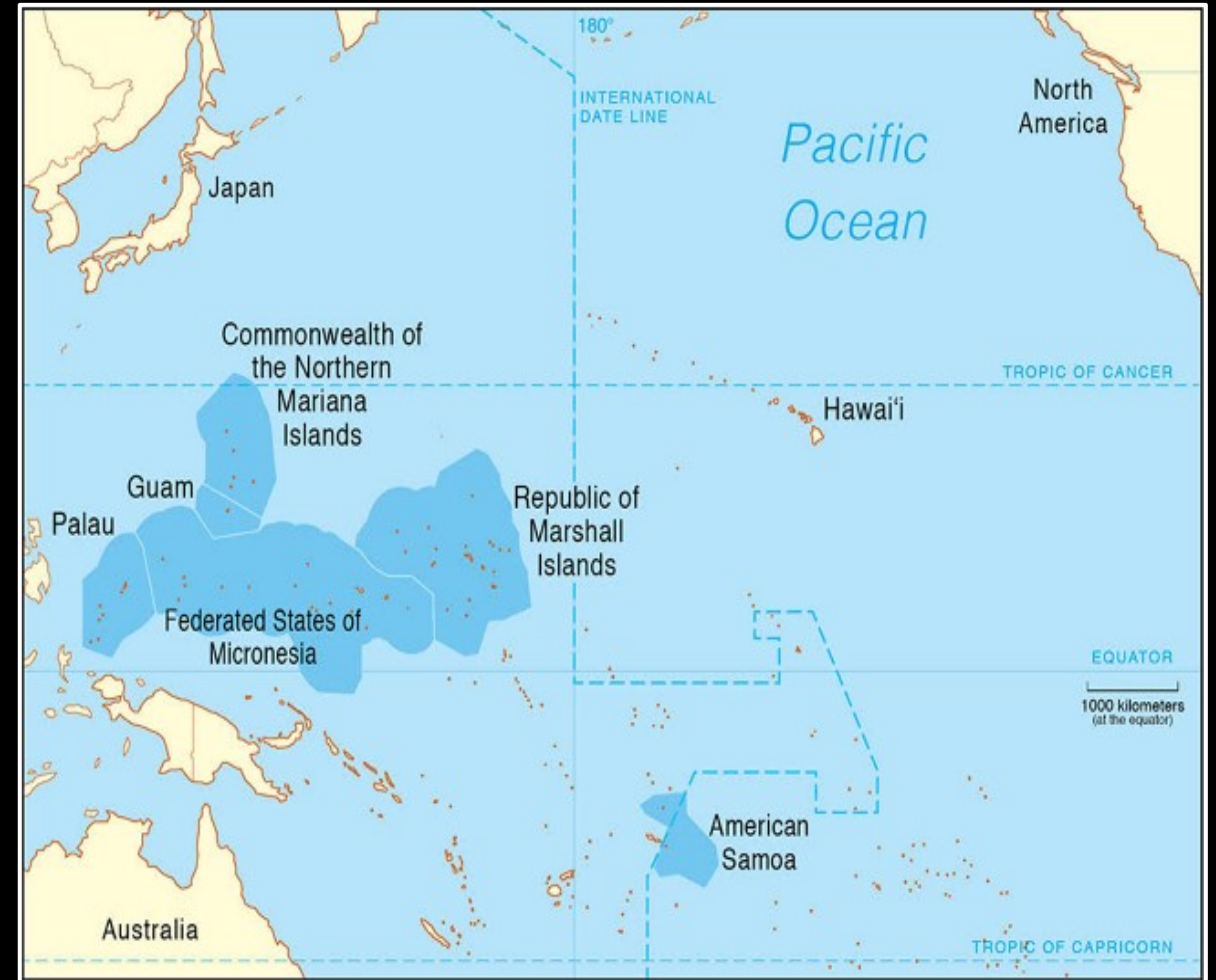
Cultural practices – kalo lo'i  
Kahana Vallay, O'ahu



# USGS Pacific Islands Water Science Center (PIWSC)—Mission

## Mission and Vision

- Collect, analyze, and disseminate impartial hydrologic data to wisely manage water resources for the people of Hawai'i, Guam, Commonwealth of the Northern Mariana Islands and other U.S. Affiliated Pacific Islands.
- Conduct studies to increase hydrologic understanding and inform resource-management decisions.
- Maintain publicly available real-time and historical data bases and publish unbiased peer-reviewed data and science
- Partner with Federal, State, and local agencies, and other public organizations to assure our work is relevant and useful





# PIWSC Science Focus Areas

## Focus Areas

- Hydrologic monitoring
- Quantity and variability of streamflow
- Groundwater availability/sustainability
- Water quality (surface water and groundwater)

Climate variability and change are factors that can influence each of these science focus areas.



Pesticide sampling, Waihee Stream, O'ahu, HI



Streamflow measurement, Wailuku R. at Pi'ihonua, Hawai'i, HI



Rainfall gaging station at 1,000 ft altitude Moanalua, O'ahu, HI



Conductivity, temperature and depth profiling at monitoring well EX-9, Guam



# Hydrologic Monitoring

USGS has been collecting hydrologic data in Hawai'i since the early 1900s and in Guam since the 1950s.

These data are:

- Used as a reference to assess long-term trends in streamflow, groundwater levels and water availability
- Used by water-resource management agencies to assess changes in water use
- Used by emergency managers during floods to help protect life and property
- Based on nationally consistent methods
- Publicly accessible via NWISWeb



Poamoho Rain Gage  
near Wahiawa,  
O'ahu, HI



Streamflow measurement  
at Waihe'e River near  
Waihe'e, Maui, HI



Groundwater-level  
measurement at Tripler Army  
Medical Center, O'ahu, HI



+ Find a place

Home

Layers

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Tools

Kaua'i

Ni'ihau

Kālaheo

O'ahu

Honolulu

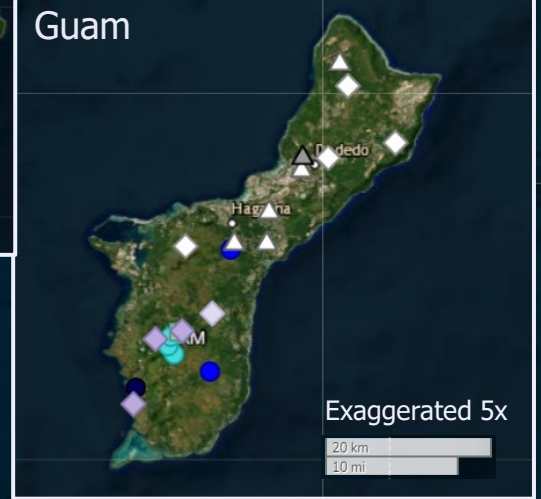
Moloka'i

Maui

Lana'i

Kaho'olawe

Island of Hawai'i  
'Big Island'



- Streamgages (89)
- Reservoir Gages (8)
- ◆ Precipitation Gages (30)
- ▲ Groundwater Wells (14)
- ▼ Water Quality Sites (12)



Halawa Stream Moloka'i, HI – (1917-2023)

Scale 1:964,488 Lat 18.7405 Lon -154.6702

50 km

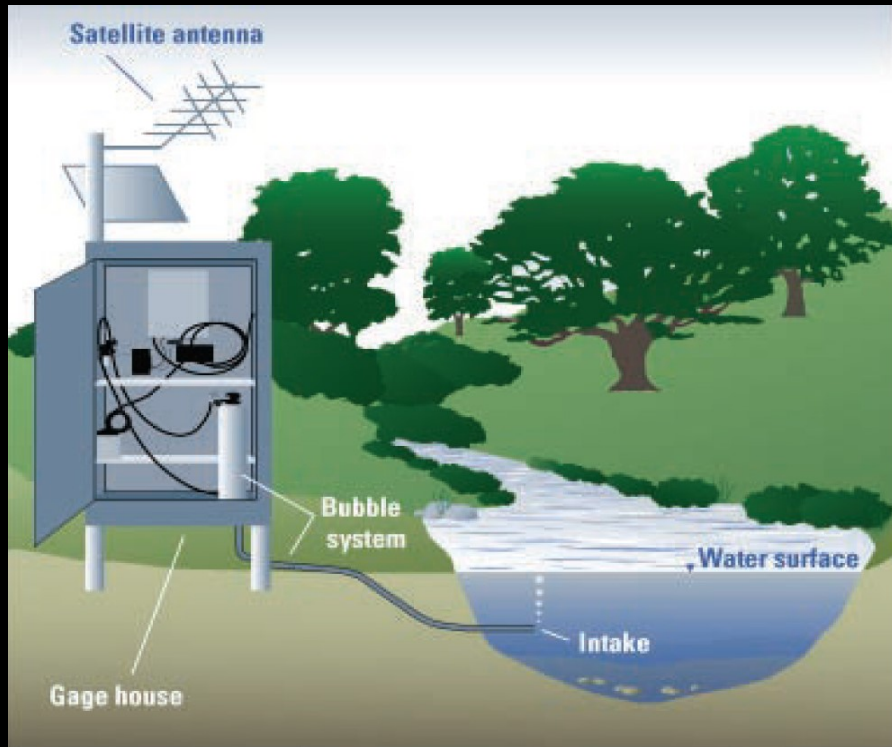
50 mi



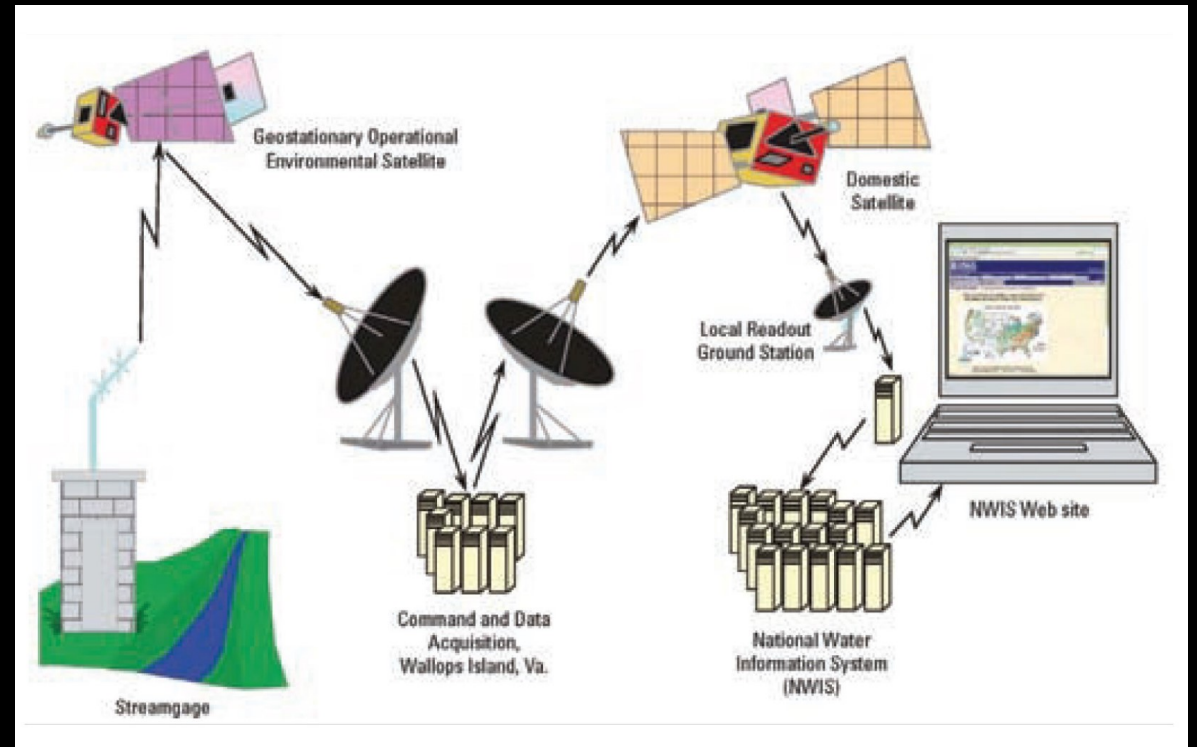
# What is a Streamgage?

[Streamgaging Basics | U.S. Geological Survey \(usgs.gov\)](https://www.usgs.gov/mission-areas/water-resources/science/streamgaging-basics)

<https://www.usgs.gov/mission-areas/water-resources/science/streamgaging-basics>



A streamgage measures and records the water level (called stage or gage height) of a stream or river.



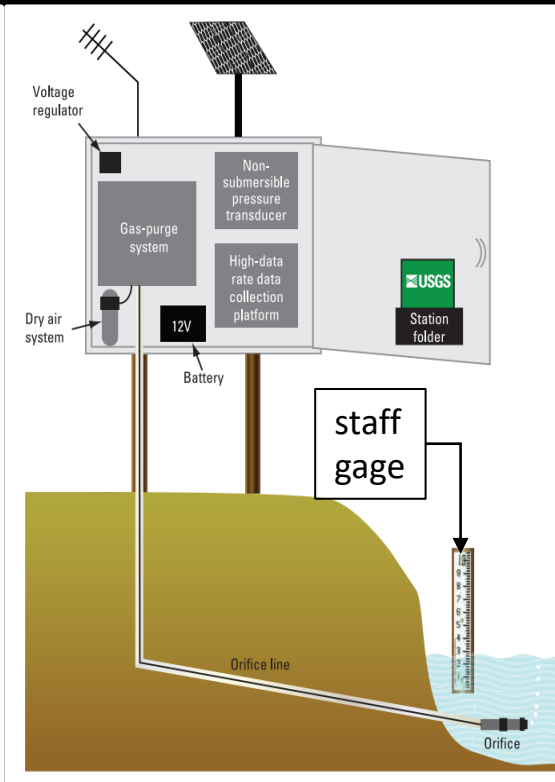
Data from the streamgage are transmitted via satellite to ground stations and relayed to USGS servers that host NWIS Web, a publicly accessible database.



# How do we Measure Stage?

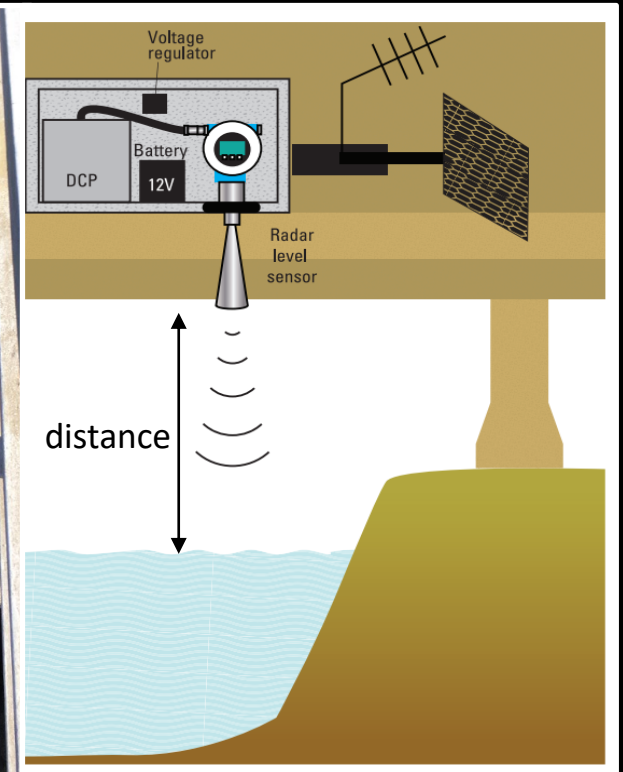
*Continuously, every 5-15 minutes*

## Method 1: Pressure sensors



USGS Station Hanalei River near  
Hanalei, Kaua'i

## Method 2: Radar



USGS Station Wailuku River at Iao  
Valley Rd., Maui

# What is Streamflow?

- Also called '**discharge**', it's the volume of water passing through the width of a stream at a specific location in a specific amount of time.
- USGS usually reports streamflow in cubic feet per second (cfs or  $\text{ft}^3/\text{s}$ )
- Public utilities usually report water consumption in millions of gallons per day (MGD)
- 1 MGD = 1.55 cfs

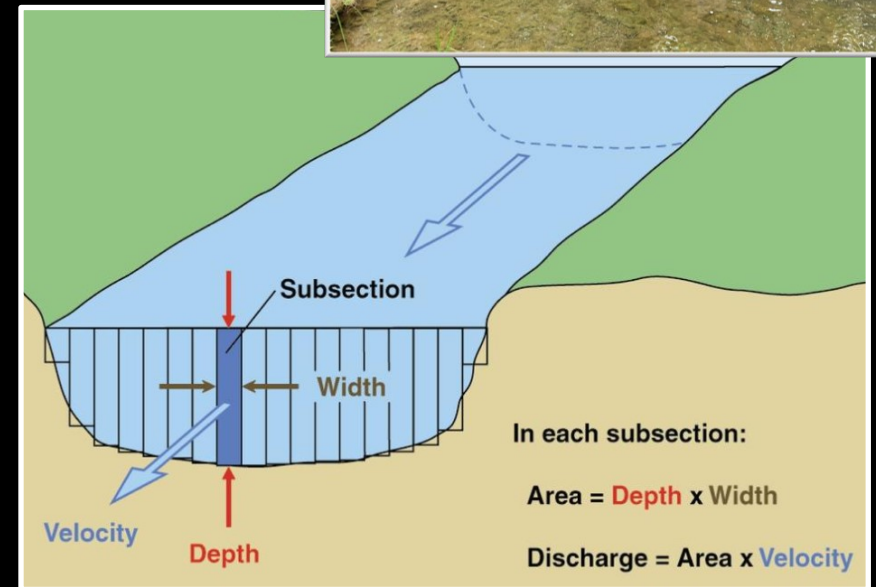




# How do we Measure Discharge?

1. A measuring tape is stretched across the stream width
2. A hydrographer wades in the stream and divides the width equally into about 25 “subsections”
3. The depth and width of each subsection are measured and used to compute the area
4. The average water velocity in each subsection is measured with a velocity meter
5. The discharge in each subsection is computed as area multiplied by velocity
6. The total discharge in the stream is the sum of discharges for all the subsections

Measuring  
discharge at  
Maulup R.,  
Guam



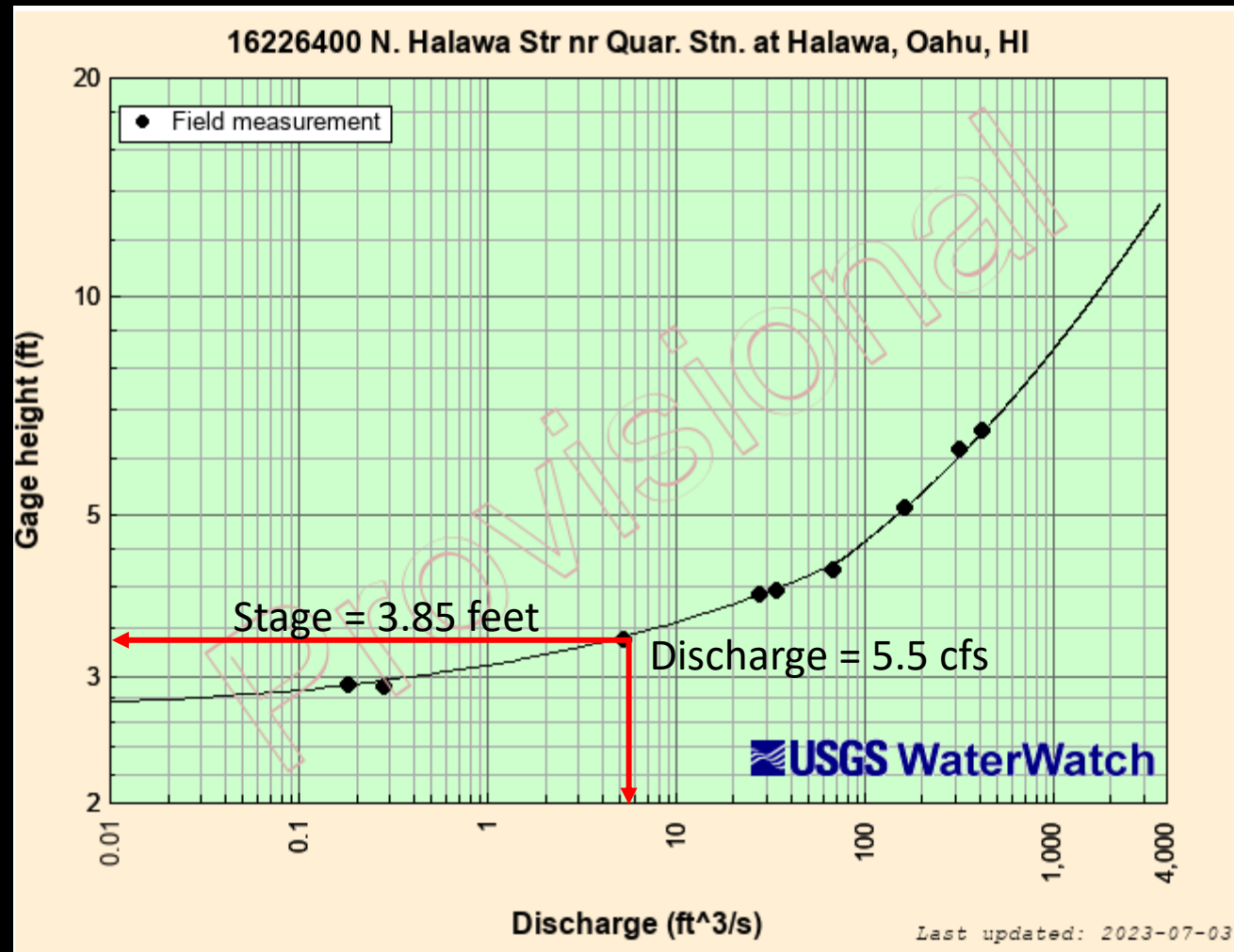
[Streamgaging Basics | U.S. Geological Survey \(usgs.gov\)](https://www.usgs.gov/mission-areas/water-resources/science/streamgaging-basics)

<https://www.usgs.gov/mission-areas/water-resources/science/streamgaging-basics>

# How are Stage and Discharge Related?

## Stage-Discharge Rating Curves

Developed after making many streamflow measurements over time



Curves are developed by graphically fitting the data

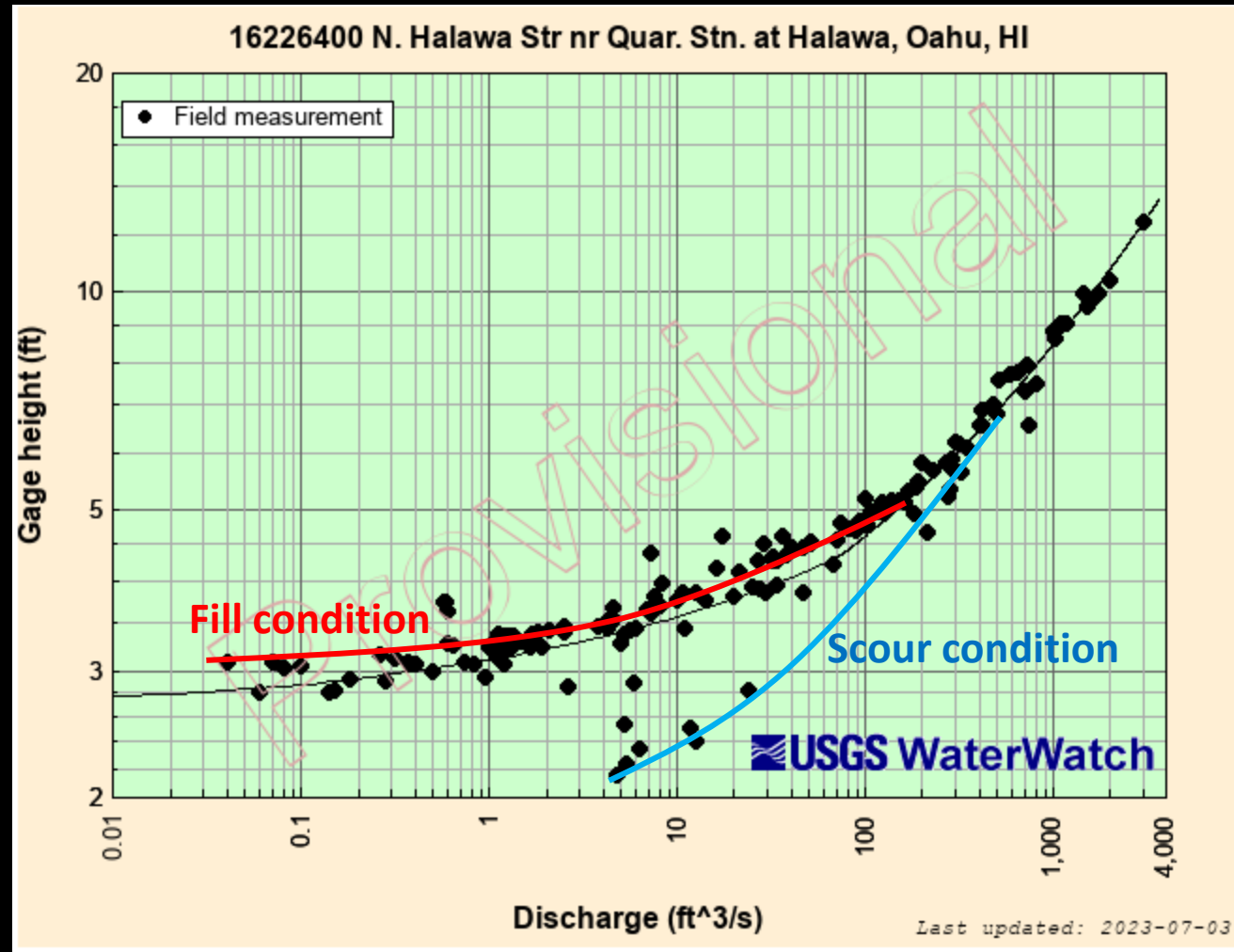
[USGS WaterWatch -- Streamflow conditions](https://waterwatch.usgs.gov/index.php?id=ww)  
<https://waterwatch.usgs.gov/index.php?id=ww>



# Rivers and Streams are Dynamic and Change with Time

Stage-Discharge  
Rating Curves  
also change with  
time

Most natural  
streams have  
sediment – sand,  
gravel, cobbles,  
boulders



Sediment and  
debris can fill a  
stream channel  
after high flows  
caused by storms

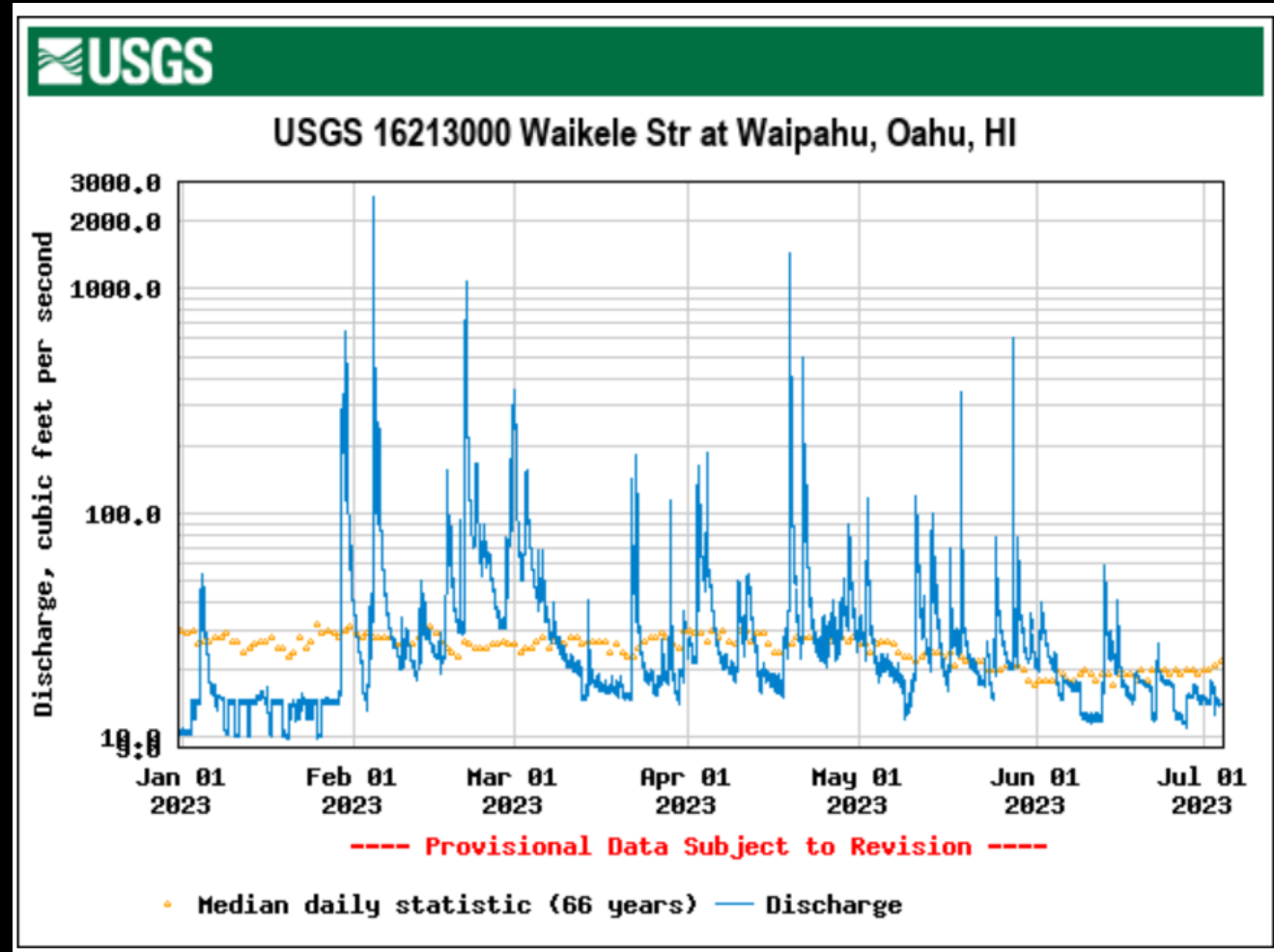
Or high flows  
can scour a  
channel and  
remove  
sediment

[USGS WaterWatch -- Streamflow conditions](https://waterwatch.usgs.gov/index.php?id=ww)  
<https://waterwatch.usgs.gov/index.php?id=ww>

# What is a Hydrograph?

A time-series plot of stream data, either stage (gage height) or streamflow (discharge)

A streamflow hydrograph requires a rating curve to compute discharge from gage height



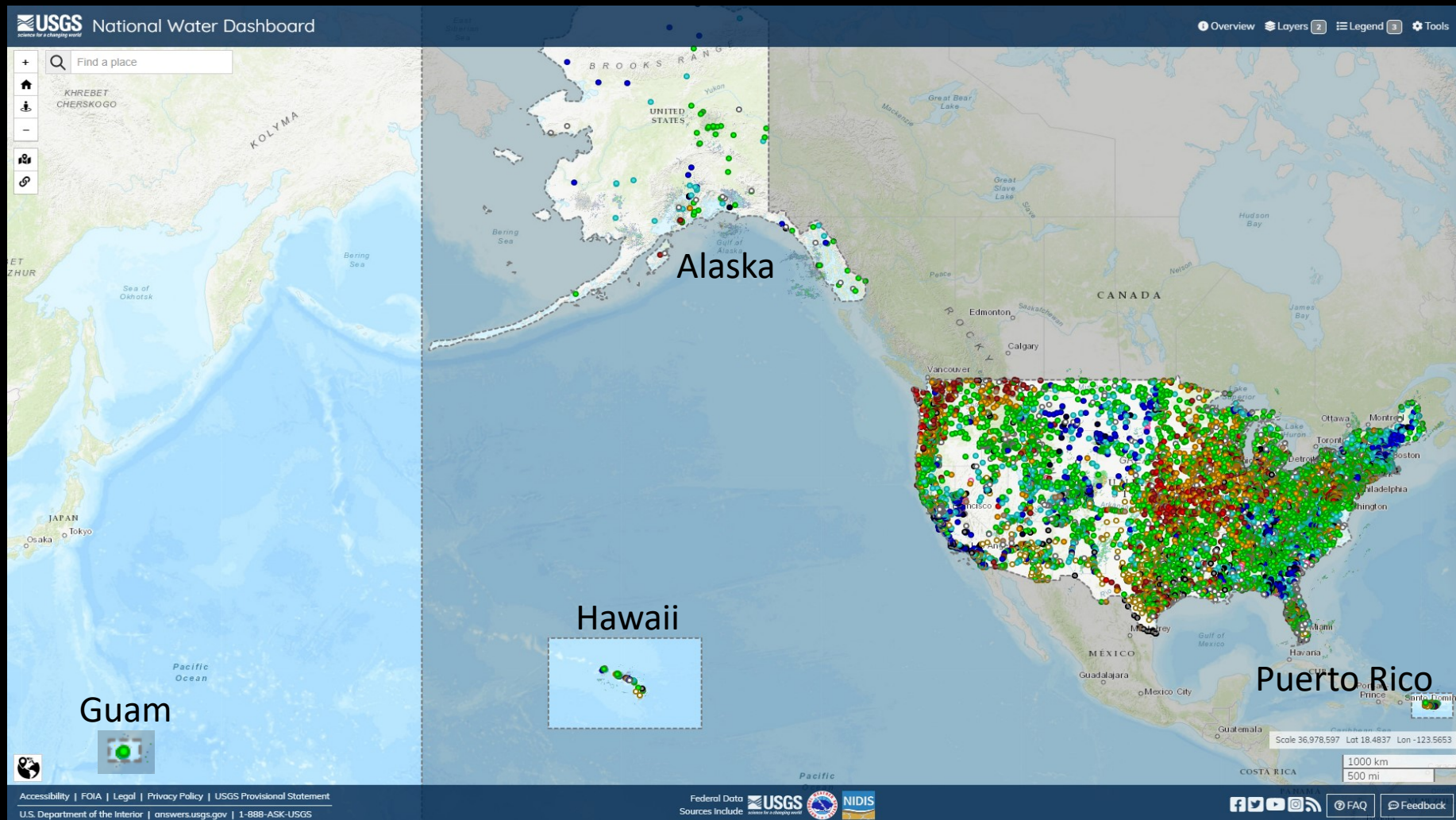
[Waikele Str at Waipahu, Oahu, HI - USGS Water Data for the Nation](https://waterdata.usgs.gov/monitoring-location/16213000/#parameterCode=00065&period=P7D)

<https://waterdata.usgs.gov/monitoring-location/16213000/#parameterCode=00065&period=P7D>



# USGS National Water Dashboard

[USGS | National Water Dashboard](https://dashboard.waterdata.usgs.gov) <https://dashboard.waterdata.usgs.gov>



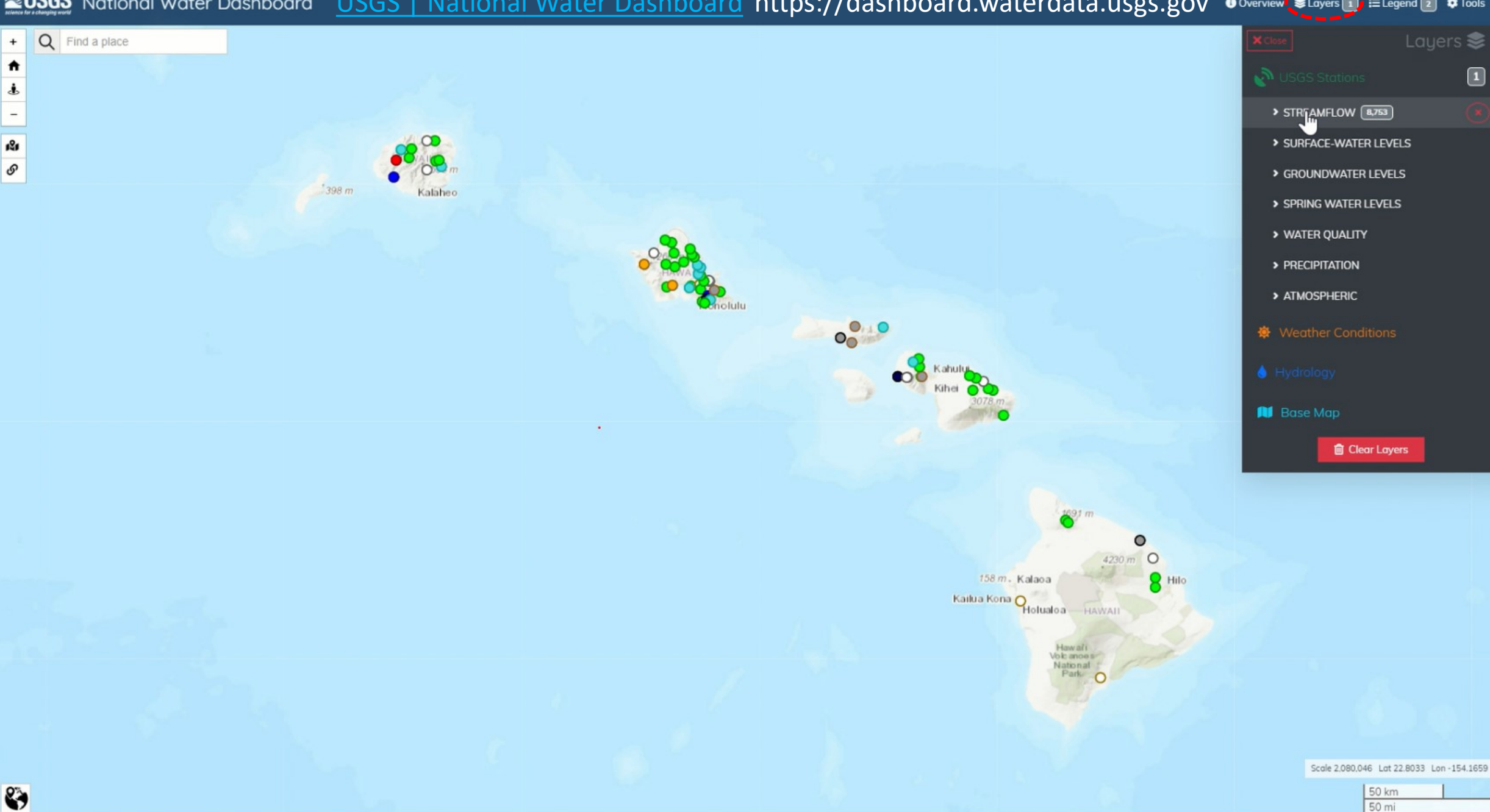
+ Q Find a place

Home

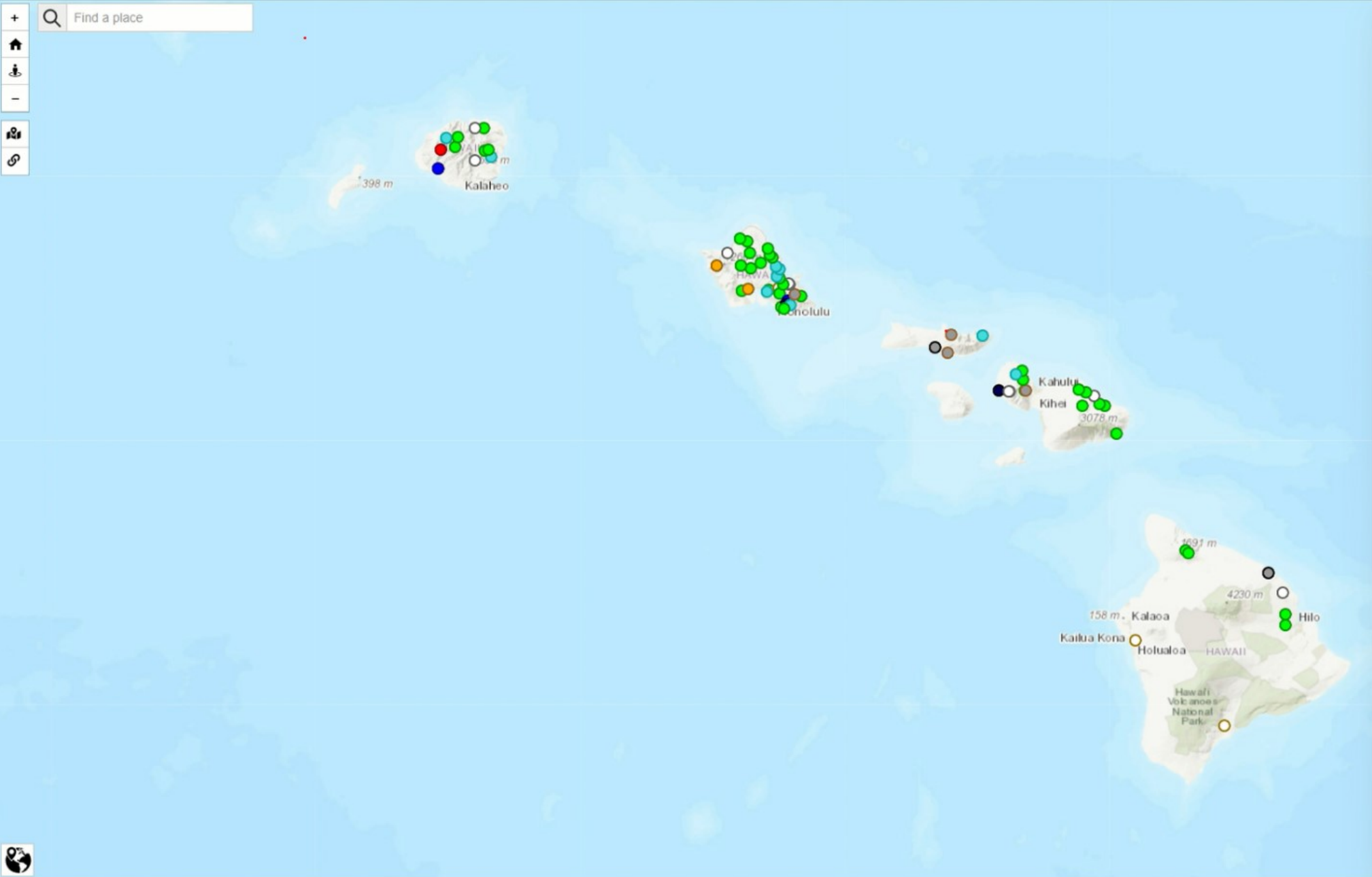
Layers

Full Screen

Share







CloseLegend

### Streamflow: Status

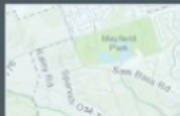
- Above flood stage
- All-time high for this day 100<sup>th</sup> percentile (maximum)
- Much above normal >90<sup>th</sup> percentile
- Above normal 76<sup>th</sup> - 90<sup>th</sup> percentile
- Normal 25<sup>th</sup> - 75<sup>th</sup> percentile
- Below normal 10<sup>th</sup> - 24<sup>th</sup> percentile
- Much below normal <10<sup>th</sup> percentile
- All-time low for this day 0<sup>th</sup> percentile (minimum)
- Not flowing
- Not ranked
- Measurement flag
- Recent measurement unavailable

**Comments:** Marker color indicates the current streamflow condition. Categories are based on the percentile of existing streamflow records on this day-of-the-year. A streamgage is not ranked when there is less than 10 years of record or a current streamflow value is unavailable. Flood stages are maintained by the National Weather Service (NWS) and are not established for all USGS streamgages.

**Data Source:** [USGS Water Data for the Nation](#)

i Click streamflow stations to access real-time data, time-series graphs, and station information.

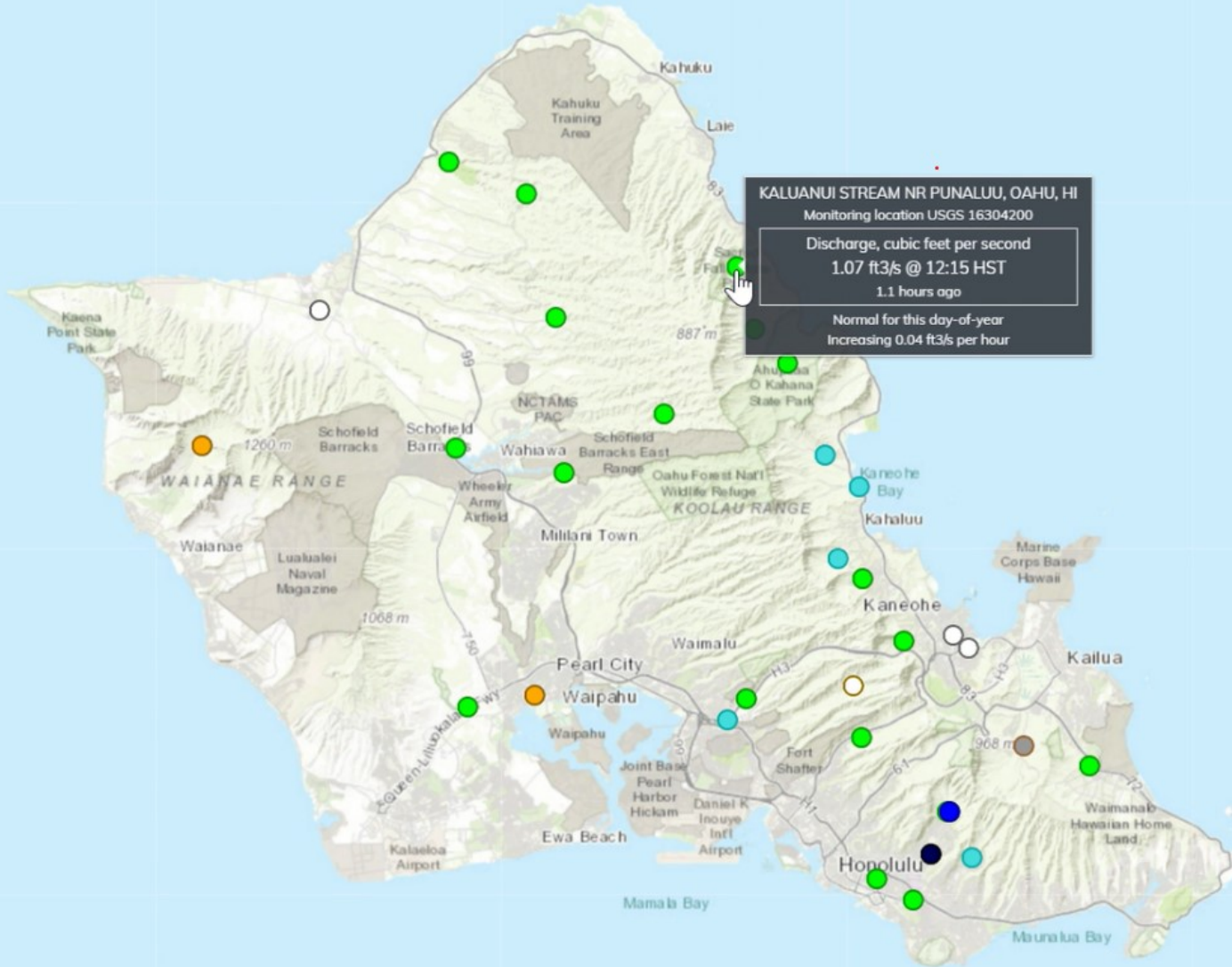
### Topographic Base Map



**Comments:** This base map includes administrative boundaries, cities, water features, physiographic features, parks, landmarks, highways, roads, railways, and airports.

50 m



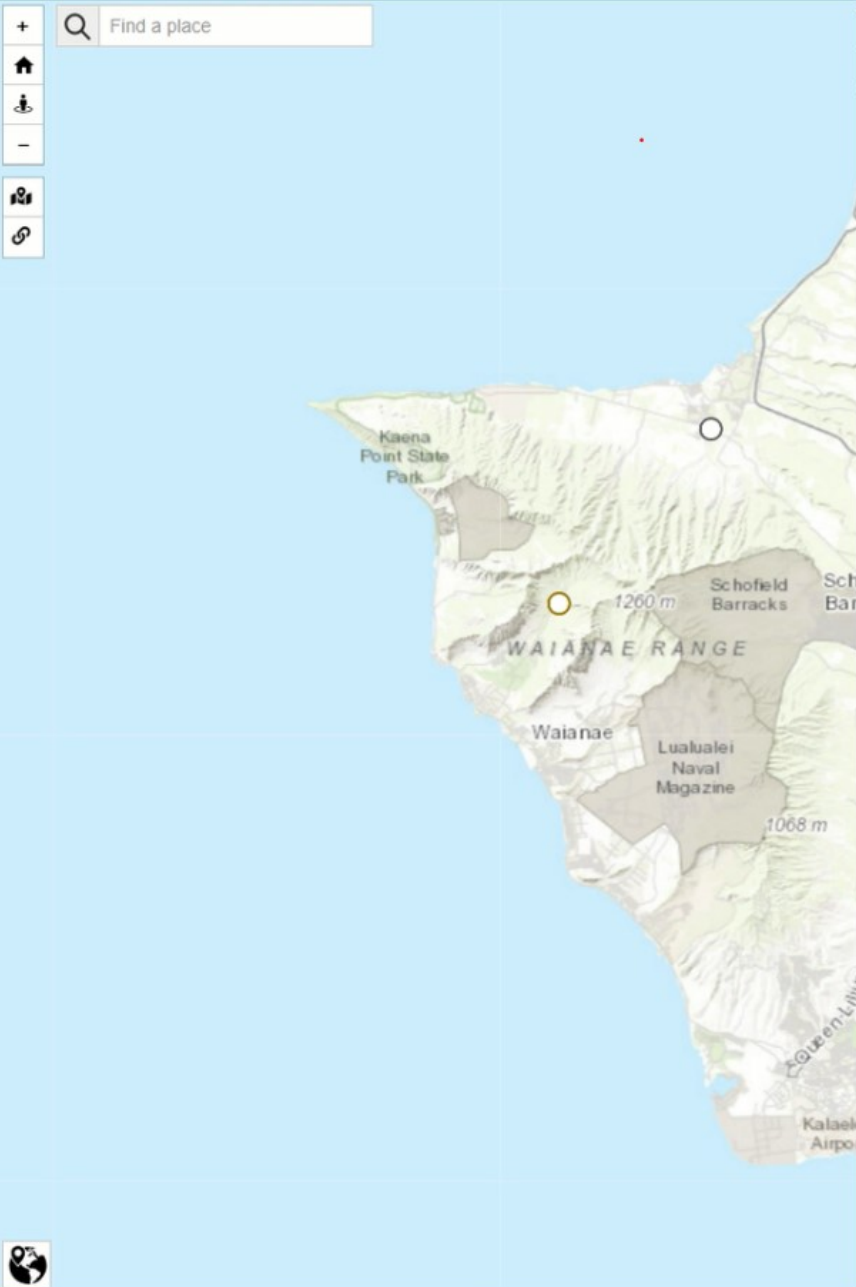


Scale 260,006 Lat 21.5849 Lon -157.9084







Click to hide News Bulletins

- Explore the NEW [USGS National Water Dashboard](#) interactive map to access real-time water data from over 13,500 stations nationwide.
- [Full News](#)

USGS 16304200 Kaluanui Stream nr Punaluu, Oahu, HI

Available data for this site SUMMARY OF AVAILABLE DATA

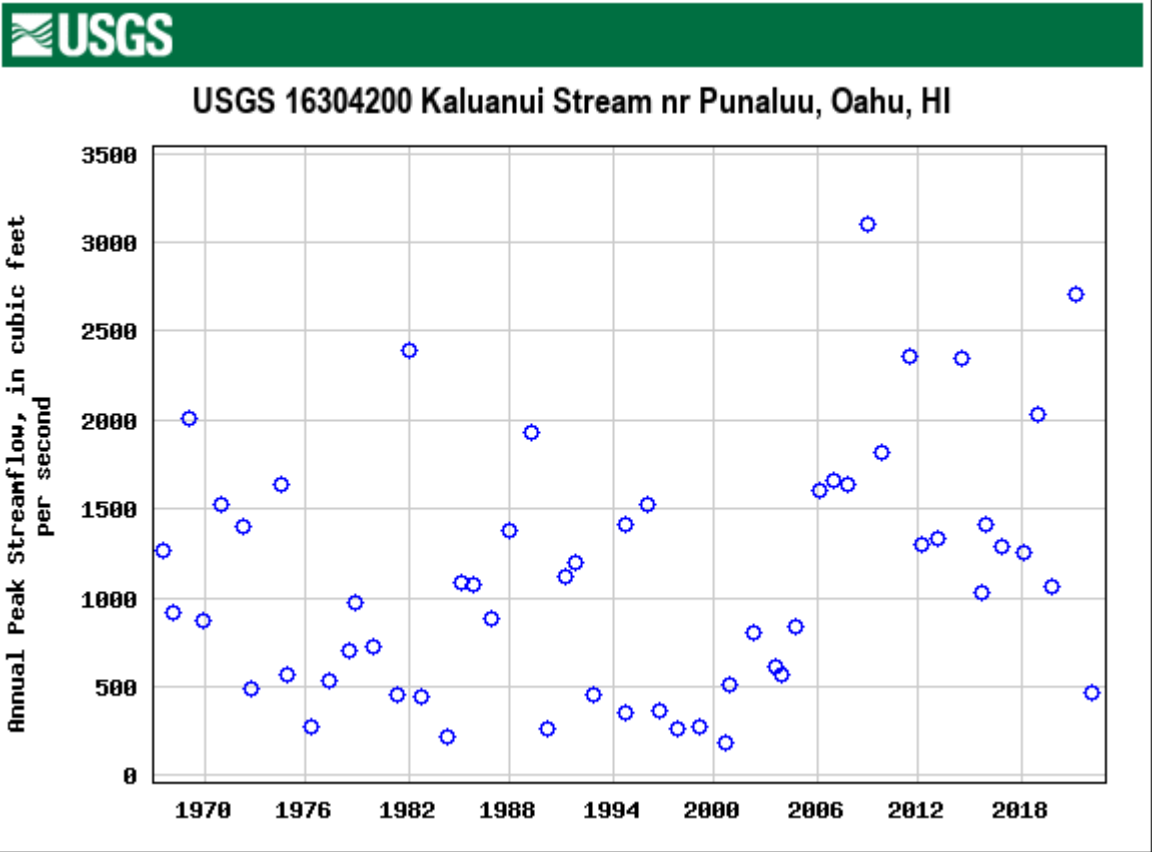
Stream Site

DESCRIPTION:

Latitude 21°35'10.0", Longitude 157°54'29.0" NAD83  
Honolulu County, Hawaii, Hydrologic Unit 20060000  
Drainage area: 1.09 square miles  
Datum of gage: 110 feet above LMSL.

AVAILABLE DATA:


Data Type	Begin Date	End Date	Count
<a href="#">Current / Historical Observations</a> ( <a href="#">availability statement</a> )	1981-09-29	2023-07-04	
<a href="#">Daily Data</a>			
Temperature, water, degrees Celsius	1999-04-07	2000-09-04	1143
Discharge, cubic feet per second	1967-05-01	2023-07-03	20518
<a href="#">Daily Statistics</a>			
Temperature, water, degrees Celsius	1999-04-07	2000-09-04	381
Discharge, cubic feet per second	1967-05-01	2023-03-13	20406
<a href="#">Monthly Statistics</a>			
Temperature, water, degrees Celsius	1999-04	2000-09	
Discharge, cubic feet per second	1967-05	2023-03	
<a href="#">Annual Statistics</a>			
Temperature, water, degrees Celsius	1999	2000	
Discharge, cubic feet per second	1967	2023	
<a href="#">Peak streamflow</a>	1967-08-09	2022-03-09	56
<a href="#">Field measurements</a>	1968-03-13	2023-03-14	290
<a href="#">Field/Lab water-quality samples</a>	1970-05-12	2000-09-12	85
<a href="#">Water-Year Summary</a>	2006	2022	17
<a href="#">Revisions</a>	Available (site:1) (timeseries:0)		






# Accessing USGS Water Data

USGS Water Data for the Nation: [waterdata.usgs.gov/nwis](https://waterdata.usgs.gov/nwis)

science for a changing world



USGS Home  
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Search USGS

National Water Information System: Web Interface

USGS Water Resources

Data Category: Home

Geographic Area: United States

GO

[Click to hide News Bulletins](#)

- Explore the [NEW USGS National Water Dashboard](#) interactive map to access real-time water data from over 13,500 stations nationwide.
- [Full News](#)

USGS Water Data for the Nation


Search for Sites With Data

Current Conditions

Sites with real-time or recent surface-water, groundwater, or water-quality data.

Site Information

Descriptive site information for all sites with links to all available water data for individual sites.



Map of all sites with links to all available water data for individual sites.

Frequent Searches By Data Category

Surface Water

Water flow and levels in streams and lakes.

Groundwater

Water levels in wells.

Water Quality

Chemical and physical data for streams, lakes, springs, wells and other sites.

Water Use

Water use information.

Introduction

These pages provide access to water-resources data collected at approximately 1.9 million sites in all 50 States, the District of Columbia, Puerto Rico, the Virgin Islands, Guam, American Samoa and the Commonwealth of the Northern Mariana Islands. Online access to this data is organized around the categories listed to the left.

The USGS investigates the occurrence, quantity, quality, distribution, and movement of surface and underground waters and disseminates the data to the public, State and local governments, public and private utilities, and other Federal agencies involved with managing our water resources.

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Title: USGS Water Data for USA

URL: <https://waterdata.usgs.gov/nwis/>

Page Contact Information: [USGS Water Data Support Team](#)

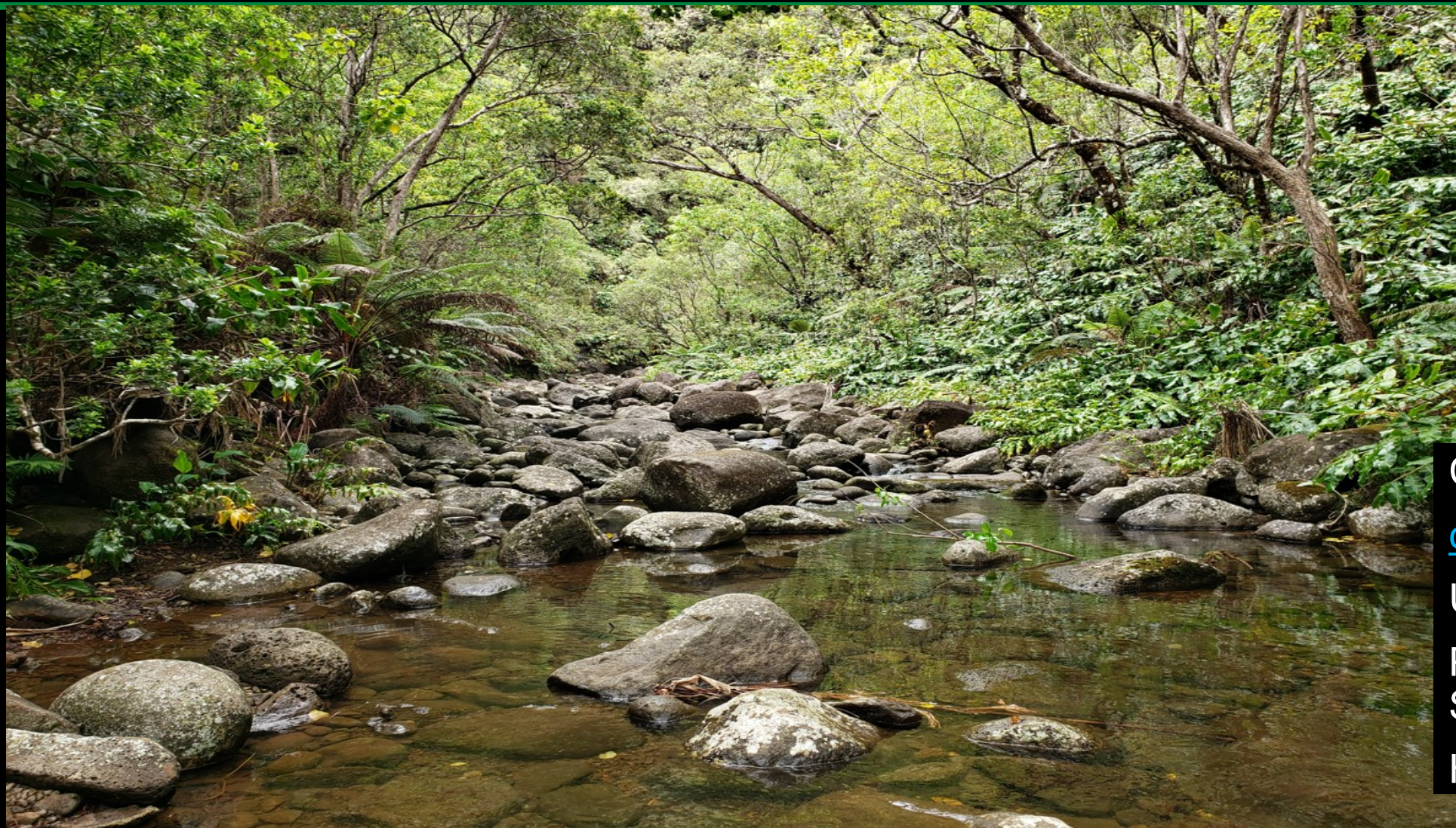
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# *MAHALO*



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U.S. Geological Survey

Pacific Islands Water  
Science Center

Honolulu, Hawai'i