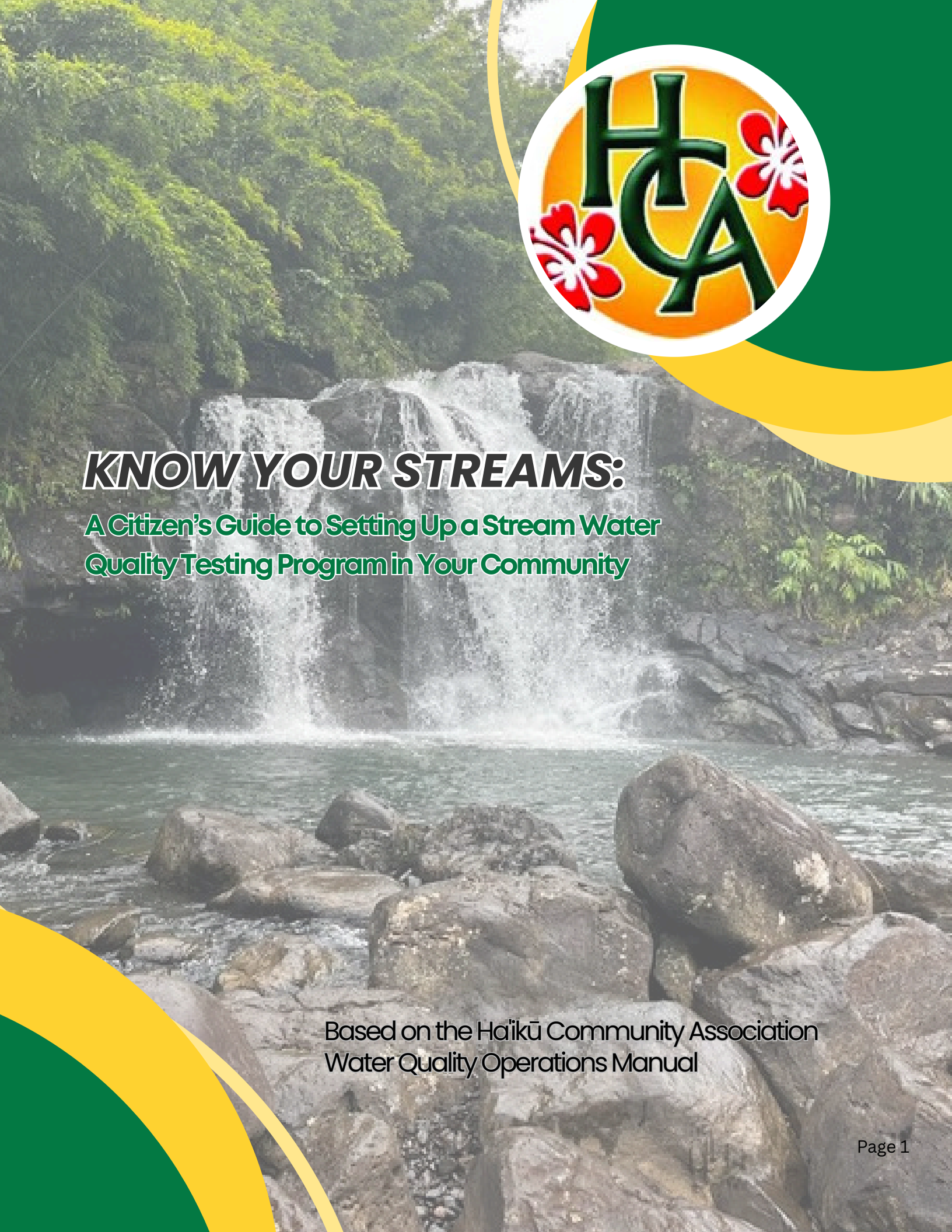


KNOW YOUR STREAMS:

A Citizen's Guide to Setting Up a Stream Water Quality Testing Program in Your Community

Based on the Haʻikū Community Association Water Quality Operations Manual

Haʻikū
Community
Association

Table Of CONTENTS

DEDICATION

This community water monitoring manual was made possible through the generosity and commitment of our sponsors, whose support has sustained HCA's stream monitoring project. Their contributions have allowed the Ha'ikū Community Association Water Monitoring Program to flourish as both a scientific initiative and a living act of care for our waterways. We are now honored to pass this knowledge on to other communities and future generations, and to make it available to inspire and guide other communities.

By investing in this work, our sponsors have helped ensure that our community can gain direct knowledge of the health of our life-giving recreational streams. This, in turn, allows us to share what we have learned with other communities seeking to better understand the condition of their streams and coastal ecosystems. Expanding stream testing programs across Maui and Hawai'i strengthens our collective ability to protect clean water, support informed decision-making, and uphold responsible stewardship of natural resources.

We offer our deepest gratitude to each sponsor who believed in the importance of consistent monitoring, transparency, and community-based science. Your contribution directly supports the protection of water as a shared and sacred resource, one that sustains life, culture, and connection across our islands. This manual reflects what is possible when science, community, and shared responsibility come together. Mahalo for your support!

TERAN JAMES YOUNG FOUNDATION

TWIN FALLS AT WAILELE FARM

MAYOR'S OFFICE OF ECONOMIC DEVELOPMENT MAUI COUNTY

SIERRA CLUB OF HAWAI'I MAUI GROUP

Environmental Protection & Sustainability Division COUNTY OF MAUI

UNIVERSITY of HAWAI'I at MĀNOA WATER RESOURCES RESEARCH CENTER

WHY WE WANT TO TEST OUR STREAMS: Background and Purpose

TThe Hā‘iku Community Association (HCA) Water Quality Program tests freshwater streams within the Hā‘iku zip code area. The primary purpose is to protect human health, as many of these streams are used for recreation and it is important to understand their water quality. Streams are also used culturally and agriculturally and support aquatic life. Community stream testing programs provide useful information to recreational users, ecological researchers, and state and county agencies responsible for managing natural and cultural resources. We hope other communities will be inspired to learn more about the streams in their own areas.

This guide shares our experience as a practical “How-To Manual” that can serve as a model for community-based monitoring efforts. The HCA program visits several streams weekly, all on the same day. We conduct in situ (on-the-spot) measurements using field instruments and collect samples for later laboratory analysis. Results are shared with the community.

Each community will need to assess its own needs, opportunities, and capacity, and decide on the scope, locations, and frequency of testing. This manual provides guidelines to support those decisions.

PART I: WHAT TO TEST FOR

The first decision for a community is determining which stream data is most useful and how equipment and lab costs will be covered. Common testing programs are outlined below.

Nutrient Testing – Dissolved Inorganic Nutrients (DIN)

- Tests for nitrogen (nitrates/nitrites), ammonia, phosphorus, and silicon
- High levels can indicate pollution (wastewater, agriculture, landscaping, golf courses)
- Excess nutrients can harm stream life, cause algal blooms, and lower oxygen
- High nitrate or ammonia can pose health risks if water is used for consumption

Requirements

- Labeled sample bottles
- Ice chest (32–42°F)
- Access to a testing lab
- Lab costs (~$27 per sample at UH Maui Lab, 2024)

Turbidity Testing – Muddy Runoff

- Measures water cloudiness
- High turbidity linked to erosion and sediment runoff
- Invasive plants can increase sediment in streams and coastal waters
- Important for streams used for recreation or consumption
- Kalo loʻi can help filter sediments

Requirements

- Turbidity meter
- Reusable sample bottles
- Smartphone or tablet for data recording

Stream Characteristics Testing

- Measures temperature, pH, salinity, and dissolved oxygen (DO)
- Healthy streams: cool temperatures, near-neutral pH (~7.0), high DO
- Indicators are interconnected and reflect overall stream health
- Low DO may signal nutrient or pathogen pollution

Requirements

- YSI probe instrument
- Probe maintenance supplies
- Smartphone or tablet for data recording

Program note

- Many community programs start with turbidity or turbidity + basic stream characteristics (no lab needed)
- With funding and training, programs can expand to lab-based testing

Bacteria Testing – Enterococcus & E. coli

What these tests indicate

- Presence of human or animal waste
- Elevated levels in freshwater can impact human health
- Important if stream water is used for:
  - Recreation
  - Drinking water
  - Food production

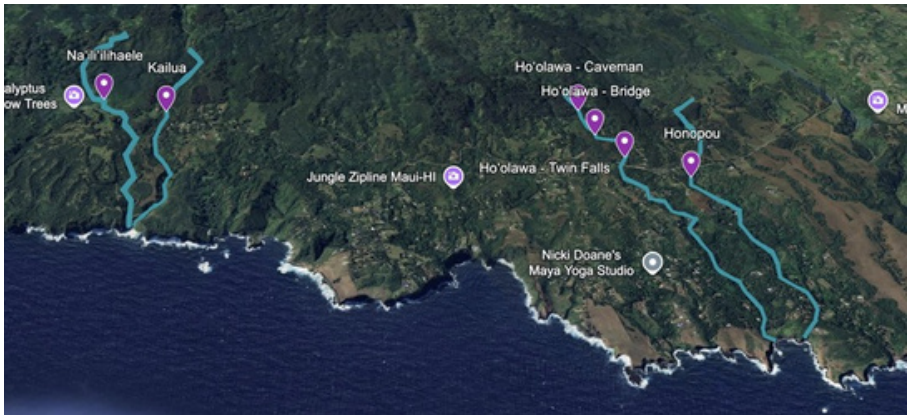
Equipment & requirements

- Labeled, sterile sample bottles
- Ice chest for sample storage
- Testing access within 24 hours of collection
- Lab analysis funding (~$45 per sample in 2024)

Note

- Other bacteria may be present, but testing is typically much more expensive and not common in community-based programs. Bacteria testing is a strong, cost-effective investment for community monitoring

PART II: WHERE AND WHEN TO TEST



HCA's weekly stream sampling sites are shown on this map and posted online.

Selecting Monitoring Locations

- Choose locations based on program goals
  - Human health: Near swimming holes, community water intakes, kalo lo'i
  - Stream health: Near fishing areas or traditional gathering sites

Best practices

- Start with one or two streams
- Record GPS coordinates
- Decide on one or multiple sites per stream
- Obtain access permission if needed
- Select safe access points and parking areas

Common testing schedules include: Monthly, quarterly, or once or twice per year. Test consistently at same location

Testing Frequency

- More frequent testing helps track changes over time
- Less frequent testing may be needed due to cost or staffing limits
- Frequency often depends on volunteer availability or paid staff hours

Part II continued: PLANNING YOUR TESTING PROGRAM

Water quality monitoring has distinct sets of activity that happen regularly:

- **Realtime Measuring-** These are *in situ* measurements, that is, measurements taken directly in the field with no further processing required. These are usually done with a dedicated, portable instrument.

- **Post Sampling Lab Analysis-** Measurements that cannot happen in situ are gathered for later analysis in a lab. The lab can either be a contracted private lab or the project can purchase their own lab equipment.

- **Data Analysis and Reporting-** This activity happens after all the measurements have been done. Securing the data, checking data quality, and making the data presentable to the public through charts. This role is also responsible for data archiving and producing an annual report.

- **Public Engagement-** The public is the typically the final consumer of the data and it is important to have multiple ways of getting the results in front of the public. The options are typically a website, email, newsletters, social media, and presentations at public events.

- **Administration-** There can be a fair amount of admin activities. These include: fund raising, managing volunteers (if the project uses volunteers), paying employees or contractors (if the project is using paid workers), ordering supplies, helping with public engagements depending on how work is divided up, and if funding is through a grant, reporting to the funding agency.

- **Reporting-** If funding is through a grant, reporting to the funding agency.

PART III: GETTING INTO THE STREAMS
Personnel & Volunteer Training

- Fieldwork is conducted by trained volunteers or contractors
- Personnel are familiar with test sites and proper use of testing equipment
- Online training resources are available (see Resources in Appendix)
- Many Hawaiian Islands have existing community water testing programs that train volunteers *(see Appendix for links)*

Reccomendations

- Establish a core group of trained volunteers or staff who understand the testing equipment and protocols
- This trained core group can mentor and train new volunteers
- Provide hands-on support during testing until proper techniques are consistently followed

Administrative tasks include equipment maintenance, supply ordering, sample transport (if needed), lab fee payments, field data management, and coordination of volunteers or contracted staff.

PART IV: GETTING THE RIGHT TOOLS
Instruments, Equipment & Comparative Costs

Sample Type	Instrument
Turbidity	Hach Turbidmeter 2600Q
Dissolved Oxygen, Conductivity, pH	YSI Quatro Pro w/sondes for Dissolved Oxygen, Temperature, pH, and Conductivity
E coli, Enterococcus	IDEXX Colilert/Enterolert system
Nitrates, Nitrites, Phosphates, Silicon (DIN)	University of Hawai'i Maui Campus Lab

What lab instruments do we use?

HCA's water quality program uses equipment and replacement parts commonly available online, though other equipment options are available. The categories in the table above represent the most commonly measured water quality indicators for both fresh and salt water in Hawai'i. Additional measurements are typically handled by specialized testing labs, such as those at the University of Hawai'i.

From left to right: Hach, IDEXX Colilert and YSI Quatro Pro (UH Lab not pictured) For programs that collect data regularly, owning testing instruments is often more cost-effective than relying solely on lab services. See the "Costs" section below for more information.

USING INSTRUMENTS TO TEST WATER QUALITY

A commonly used Hach model is battery-powered and designed for quick, easy field use.

Turbidity

- Turbidity: Water is collected in a reusable sample bottle and placed in the sampling port
- Instrument is calibrated with a known turbidity standard
- Results are read directly from the display
- Cost: $500–$5,000, depending on sensor sensitivity
- Example model: Hach 2100Q portable turbidimeter

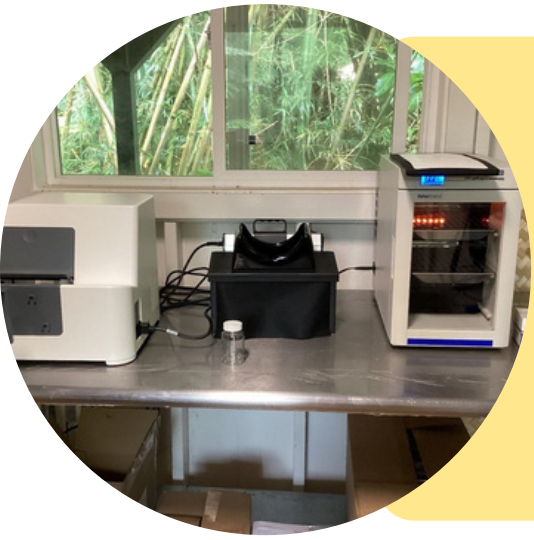
For more information, see: https://www.hach.com/p-2100q-portable-turbidimeters/2100Q0

Conductivity

- Xylem EXO YSI Datasonde: Portable handheld unit with a wand placed directly in the water
- Uses interchangeable sensors for dissolved oxygen, pH, temperature, and conductivity
- Sensors are purchased separately and have a limited shelf life
- Cost: ~$4,000 for a meter kit with three sensors; $500–$800 per individual sensor

For further information on this product, see: https://www.ysi.com/products/multiparameter-sondes.

Three-port YSI wand with a sponge-lined case to keep sondes from drying out; special calibration fluids must also be ordered.



CoBacteria – E. coli and Enterococcus

- System: IDEXX three-step lab testing; samples kept on ice and tested within 24 hours
- Process: Collect in sterile bottles → mix with reagents, fill tray, incubate 24 hrs → read in desktop chamber
- Equipment shown: Sealer, Reading Chamber, Incubator (sample bottle in front)
- Cost: ~$10,000 to set up lab; ~$18 per sample for supplies

For further information on this product, see: hFor more information, see: https://www.idexx.com/en/water/

The IDEXX three-step E. coli and Enterococcus testing system is shown, including the Sealer, Reading Chamber, and Incubator (left to right), with a sample bottle in front of the reader.

Commonly called Dissolved Inorganic Nutrients (DIN), labs (such as the University of Hawai'i) test water samples for all components under a single lump fee.

NITRATES, PHOSPHATES, & SILICON

- DIN tests can indicate biological activity, such as leaking septic systems or agricultural runoff
- Samples must be collected in specially treated bottles provided by the testing lab
- Some DIN components can be measured in-stream with a YSI field probe, but lab testing is more accurate
- Samples must be kept cold during transport to the lab
- Cost: $27 per sample (2026 UH lab price); requires an ice chest and ice

Sample Type	Measurement Type	Costs
Turbidity, Dissolved Oxygen, Conductivity, pH	Dedicated field instrument	Labor, capital costs of field instrument
E coli, Enterococcus	Dedicated lab instrument	Labor, capital costs for lab equipment, reagents
Nitrates, Nitrites, Phosphates, Silicon (DIN)	Private Lab Service	Labor, Lab fees

HCA estimates program costs by combining equipment or lab fees with labor for sample collection, with total costs increasing as the number of samples increases.

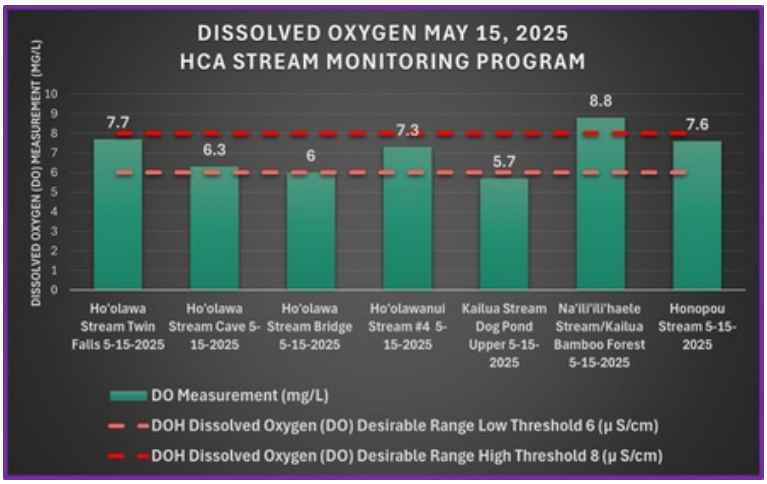
Comparing Water Testing Program Costs

- 2026 estimate: HCA cost is approximately $43 per sample for labor, fees, and supplies, with about $25 attributed to labor
- Labor costs can be reduced in volunteer-staffed programs and when test sites are close to labs, reducing travel time
- Labor includes all activities described at the end of Part II in the Activities and Methodology section

Cost Comparisons for Water Testing Programs – General Guidelines

- Least expensive: In-stream measurements (e.g., turbidity, temperature) using owned or borrowed field instruments
- Cost-effective options: Bacteria testing (E. coli, Enterococcus) when done infrequently through a lab or with in-house equipment and supplies
- Most expensive: DIN testing via private labs, unless samples are submitted infrequently
- DIN considerations: Highly contamination-sensitive, require strict storage, and usually private lab analysis
- Other costs: Data management tools; mobile data loggers can be costly but are generally cost-effective for programs processing 200+ samples per month

PART V: DATA ANALYSIS & QUALITY CONTROL



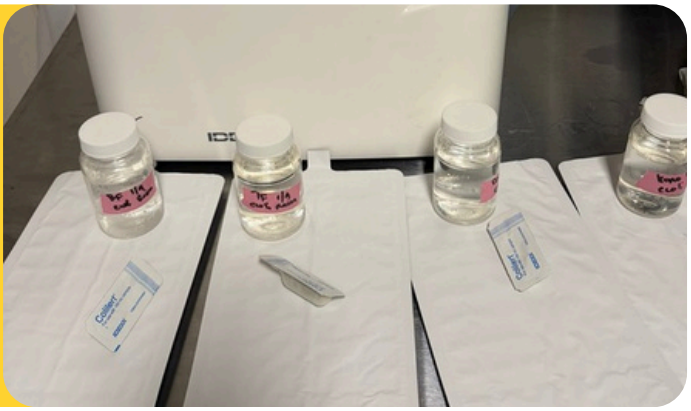
Raw data can be shared publicly but often needs processing, ranging from simple visual presentation to more advanced statistical analysis.

Making Your Data Useful – Common Approaches
:

- Graph results over time
- Compare results to health or regulatory standards
- Calculate basic statistics (e.g., mean, variance) to show trends
- Identify correlations with rainfall, stream flow, or water level
- Compare data across multiple monitoring sites
- Share data with the scientific community or similar programs

Data Management Tools

- Data logging: Secure, well-labeled records using tools from low-cost options (e.g., cell phone photos) to advanced platforms like ArcGIS
- Data archiving: Store data in accessible formats such as Excel or shared Google Docs
- Graphing: Use Excel or tools like Canva for clear, effective data visualization



Quality control is essential for accurate, reliable water measurements and is a shared, ongoing responsibility for all participants.

Sample Type	Quality Control Measures	Implementation Actions
Turbidity	Calibration	follow manufactures specs
Dissolved Oxygen		
Conductivity		
pH	Calibration	follow manufactures specs
E coli	Avoid Contaminants, Calibration	follow manufactures specs; use nitrile gloves to handle samples; use sterile bottles
Enterococcus		
Nitrates	Avoid Contaminants	use acid washed sample bottles
Phosphates	Avoid Contaminants	use acid washed sample bottles
Silicon dioxide	Avoid Contaminants	use acid washed sample bottles

The table above summarizes the sample types covered in this guide and how quality control measures apply to each; all require data integrity protections and prevention of systematic errors.

Quality Control: Accurate Readings & Record Keeping

- Calibration: Regularly calibrate instruments per manufacturer guidance and verify against known standards (e.g., pH solutions)
- Contamination control: Keep equipment and hands clean to prevent false readings
- Data integrity: Securely record and protect data from loss, alteration, or corruption
- Systematic errors: Follow clear, consistent sampling and workflow protocols
- Cross-checking: Verify results to ensure accuracy

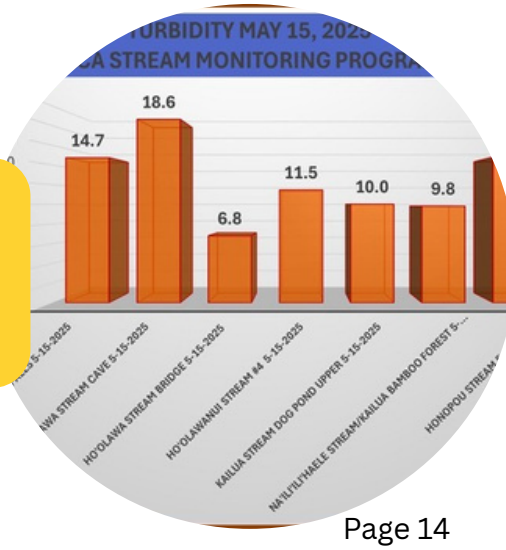
PART VI: PRESENTATION OF RESULTS

- Social media: Widely used and often replaces traditional websites for many users

- Public events: In-person outreach with posters and conversations; QR codes can link to websites or newsletter sign-ups

Public events are one way to share community water testing results; other common sharing methods are listed below.

- Email newsletters: Effective for known audiences; tools like Mailchimp help manage distribution and subscriptions



- Combined approach: Host detailed data on a website, share summaries on social media with links, and use newsletters to keep audiences engaged over time

PART VII: WATER TESTING PROGRAM CHECKLIST

Technical tips for a good workflow and reliable test results

OVERVIEW: WHY WORKFLOW MATTERS

A successful community stream testing program depends on an effective workflow. Workflow means the specific steps taken to implement the program. A consistent and well-documented testing process produces high-quality data, repeatable results, and a smoothly running program. *(use the checklist below as a practical guide)*

TESTING PROGRAM DESIGN

- Determine the number of sites and the specific location of each one
- Determine what to test for and sampling frequency
- Adopt basic safety practices for testing personnel

RESPONSE TO ENVIRONMENTAL FACTORS

- Set clear policies to guide personnel during:
- Bad weather
- Very high or very low stream flows
- Other hazardous conditions

EQUIPMENT PROTOCOLS

Decide who is responsible for:

- Cleaning, maintaining, and calibrating test instruments (and how often)
- Storage of testing instruments.
- Managing supplies, back-up batteries, and replacement parts

SAMPLING PROTOCOL

- Investigate options for sampling protocols
- Adopt Standard Operating Procedures (SOPs) that best serve your program
- Helpful resources are available from the U.S. Environmental Protection Agency (EPA) and other agencies.

RECORDING INSTRUMENT DATA

Choose the best method to capture field data from testing instruments:

- Cellphone photo of the reading
- Writing it down on paper
- Using a cellphone app
- Entering it into a data-logger app
- Using a Google document

DATA AND SAMPLE HANDLING

- Decide who delivers samples to labs
- Follow SOPs for handling samples after collection and keep accurate records
- Decide where collected data is sent and stored
- Decide who is notified by labs and test personnel about data results

DATA ANALYSIS AND DISTRIBUTION

- Choose a program to graph and archive data
- Check data quality and establish protocols for handling suspicious data

Determine:

- Where data is posted
- Who is responsible for deciding when and where data is distributed

PART VIII: APPENDIX– Resources & Useful Links

How to learn about monitoring for bacteria
https://owl.cwp.org/safe-waters-healthy-waters-a-guide-for-citizen-groups-on-bacteria-monitoring-in-localwaterways/

How to use the Hach Turbidimeter instrument tutorial:
https://youtu.be/Pv7xlwfOHQk

How to use the YSI instrument tutuorial
https://youtu.be/v6FDWwiqPF8

How to use Excel to analyze and display data

Main Tutorial (Entering Data & Graphs): https://www.youtube.com/watch?v=LgXzzu68j7M

Complete Beginner Course: https://www.youtube.com/watch?v=wbJcJCkBcMg

2024 "Made Easy" Guide: https://www.youtube.com/watch?v=fzdn1vcHPsA

Quick 7-Minute Basics: https://www.youtube.com/watch?v=UR2830RUWmQ

How to find state and local water quality standards

EPA's National Water Standards for Human Health • https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table

Note: this table includes maximum acceptable levels for many substances that can only be tested by qualified labs

Link to State Department of Health 2024 Water quality Report
https://health.hawaii.gov/cwb/files/2024/02/IR-2024-public-comment-draft.pdf

Note: this report has sections for each island. Very little data is available for freshwater quality

How to look up state monitored flow levels for Hawaii streams

Stream flow can significantly influence water quality. By linking stream flow conditions with water quality test results, we can better understand patterns and variations in selected streams across Hawai'i, O'ahu, Maui, and Moloka'i.

https://datacwrm.aquaticinformatics.net/Data/Map/Parameter/Discharge/Statistic/LATEST/Interval/Latest

PART VIII continued: APPENDIX- Resources & Useful Links

Water quality monitoring programs that train volunteers

Most of the Hawaiian islands have existing community-based water testing programs.

Blue Water Task Force (Maui, Kaua'i and O'ahu), sponsored by Surfrider Foundation has helpful information for planning a water testing program and accepts and trains volunteers in testing protocols for Enterococcus and E coli.contact: Jaime LeDuc, Surfrider's Blue Water Task Force Manager at jleduc@surfrider.org.

Fhttps://www.surfrider.org/pages/planning-a-water-testing-program

Hui o Ka Wai Ola program (Maui) accepts and trains volunteers to test ocean water for nutrients, turbidity and general water quality characteristics

https://www.mauireefs.org/discover-mauis-reefs/volunteer/

Ha' iku Community Association Stream Testing program (Maui) offers volunteer train year and has more in depth information on water quality monitoring on its website: https://www.haikumaui.org/haiku-water-quality/

Videos on using the IDEXX system for analyzing for bacteria in water

https://youtu.be/88YzdfjsJGA
https://youtu.be/8al-hGaUvaM
https://youtu.be/Vu-HooCxxg4

Other

Testing for Enterococcus and E coli is most reliably done using lab equipment. UH Maui College has lab equipment that can perform the tests, but there are very specific requirements for storage and the logistics of sample handling of E coli and Enterococcus. Samples need to be collected in sterilized bottles, kept on ice and transported to the lab within 24 hours of their testing date. Test costs around $43 a sample. Separate samples are needed to test for both Enterococcus and E coli bacteria.

Find out more: https://maui.hawaii.edu/waterlab

If your project is a long way from the UH Lab, it may only be practical to test for bacterial levels with your own machine set up, or one that is nearer to your project area