



# Volunteer Handbook

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## **CHAPTER 1 - General**

### **1.1 Introduction**

Long term measurements to collect physical and chemical water-quality data are needed to assess current conditions in the coastal waters of Maui Island, to detect and quantify temporal trends in water quality, and to support water-quality management decisions.

The Hawaii Department of Health - Clean Water Branch (HI-DOH-CWB) monitors beach water quality at stations around the state, but with limited resources DOH monitors can't be everywhere. That's where we come in. Our group regularly measures coastal waters for pollutants that can harm our coral reefs and human health. We compare our findings with water quality standards set by the state and are able to inform our communities and decision-makers when our ocean water needs our kōkua (help).

This handbook has been created to assist volunteers with the collection, testing, transporting and storing of water quality samples that have been collected in the field. The procedures included in this handbook must be followed precisely to ensure that the data generated is quality-assured and therefore useful to governmental agencies, researchers, and the general public.

#### **Who are we?**

Hui O Ka Wai Ola (Association of The Living Waters) is a community-based, quality-assured coastal-monitoring program based on Maui Island. The project was initiated in 2014 by the following partner organizations: The Nature Conservancy (TNC), Maui Nui Marine Resource Council (MNMRC), West Maui Ridge- to-Reef Initiative, and University of Hawai'i-Maui College (UHMC), with assistance from NOAA's Hawaiian Islands Humpback Whale Sanctuary.

The mission of Hui O Ka Wai Ola is to generate quality-assured coastal water-quality data, and to provide this data to Hawaii Department of Health (HIDOH), other resource agencies, non-governmental organizations, researchers and the public.

Specific goals of Hui O Ka Wai Ola are: 1) to increase community capacity for long-term monitoring of water quality in Maui coastal waters; 2) to generate quality-assured reliable data that can be used to assess coastal water quality conditions and detect temporal trends that can augment HIDOH-CWB beach monitoring program sampling; 3) thereby empowering community and government resource managers to take action to improve coastal water quality, benefiting the coral reef ecosystem and people alike.

#### **Volunteer Monitoring Teams**

The Hui O Ka Wai Ola program consists of monitoring teams, each with a team leader, who are supported by a centralized group that provides project management, data management, and technical advice. Each team monitors one of the following sections of Maui coastline: West Maui (Honolua to Papalaua), and South Maui (Ma'alaea to 'Āhihi Kina'u). All teams use identical calibration, operating and handling procedures.

Volunteer monitoring team members carry out water-quality monitoring tasks and some laboratory tasks, all under the supervision of the monitoring team leaders. Specific responsibilities of the team members are:

- Make field measurements in accordance with the QAPP (Quality Assurance Program Plan) and associated SOPs (Standard Operating Procedure).

- Collect, store, and process samples in accordance with the QAPP and associated SOPs.
- Record monitoring information and sample custody information on data sheets and chain-of-custody (COC) forms accurately and completely.
- Assist team leader with lab duties as requested
- Complete annual training under the supervision of the Training Leader, and biannual check-ups with the Monitoring Team Leader.

Each team consists of at least 2 volunteers, who will pick up the equipment from the regional lab and collect samples at 5 sampling sites, every three weeks. Sampling sessions last 2-3 hours in the mornings, and all volunteers are expected to be comfortable performing all tasks. Each team is assigned one region (5 sites), and samples the same day of the week each sampling period. As a volunteer, being available to help out during most sessions is important, so the procedures and protocols are not forgotten.

## 1.2 Sampling Design

### Monitoring sites

The following criteria are used to evaluate monitoring sites with community partners:

- Access is safe
- Location is adjacent to a public access point, or permission to cross private property is granted
- Samples can be taken in areas of well-mixed water,
- Location corresponds to a CWB monitoring site, particularly a site where monitoring has been discontinued, or monitored at a significantly reduced periodicity
- Location represents an area with high recreational use, high importance for food gathering, or high community concern about perceived water-quality problems, and/or
- Location coincides with environmental research areas with potential for data-sharing.

### Sampling schedule

Two general monitoring modes are used: regularly scheduled monitoring at fixed sites, and unscheduled (opportunistic) monitoring in response to rain and runoff events at fixed sites.

The pre-scheduled monitoring takes place regardless of current and antecedent weather conditions, unless safety is a concern. This sampling mode produces an unbiased estimate of average water-quality conditions at each site. Samples are taken at the same time of day on a predetermined day and time of the month, depending on the weather. Safety concerns will limit sampling if the conditions are unsafe. Sampling will be delayed by a day or more if there is high surf making sampling unsafe.

Opportunistic monitoring will be used to measure water-quality conditions during and after large, infrequent rainstorms, to generate information about water quality during brown-water periods and about relationships between runoff and water quality.

## Parameters

Instantaneous temperature, salinity, dissolved oxygen (DO), pH, and turbidity measurements will be made at the monitoring sites by the monitoring teams using hand-held instruments. Nutrient parameters: ammonia nitrogen (NH<sub>4</sub>), nitrate + nitrite nitrogen (NNN), total nitrogen and phosphorus (TN and TP), and dissolved silica will be measured at the SOEST Analytical Laboratory in samples collected, filtered and shipped by the monitoring teams. Total Suspended Solids (TSS) will be measured by the monitoring team leads at laboratory facilities on Maui.

## Ocean Chemistry

Coral reefs are fragile ecosystems, and are susceptible to even the slightest changes in ocean chemistry. Coral reefs can be severely damaged when ocean temperatures become too warm, ocean water becomes too acidic, and/or too much freshwater enters the reef ecosystem. Changes in ocean chemistry can be caused by both global level impacts (such as climate change), and localized events. Measuring samples for salinity, pH, temperature, and dissolved oxygen (DO) allow us to compare changes in reef health to changes in water quality.

- **Temperature:** Given the frequency of bleaching events in 2015 and 2016, collecting water temperature can help identify when an area might be in danger of entering a bleaching event, and can track localized variations in temperature for comparison between sites.
- **Salinity:** Salinity is a key factor affecting the physical make-up of a water body, and is defined as the concentration of dissolved salts in the water, usually expressed in parts of salt per thousand parts of water (ppt). Seawater averages 27 to 35 ppt in coastal waters. The surface salinity levels within the ocean, especially near the coast, vary with many factors, including the tides and the volume of fresh water flowing into the area. Salinity tends to decrease during times when there is heavy rainfall, or a release of groundwater, or a nearby stream is flowing all of which may combine to greatly increase the amount of fresh water in the ocean.
- **Dissolved Oxygen:** DO is one of the most important indicators of the quality of water for aquatic life, as it is essential for the basic metabolic processes of animals and plants. Dissolved oxygen is measured in milligrams per liter (mg/L). The maximum amount of oxygen water can hold depends a great deal on its temperature and salinity. A DO test tells you how much oxygen is dissolved in the water. When water holds all the dissolved oxygen that it can at a given temperature and salinity, it is said to be 100% saturated with oxygen.
- **pH:** This parameter is a measure of how acidic or basic a solution is. Pure distilled water has a pH of 7.0 and is said to be neutral. The pH values of natural waters are controlled by the salts and gases dissolved in them. Seawater typically has a pH of 8.1- 8.3. Because its pH is greater than 7.0, it is said to be basic or alkaline (the two terms are synonymous).

## **Turbidity/Sediments**

Sediments can be carried from the land to the ocean by streams, flooding, and storm water runoff. When large amounts of sediment are deposited into the ocean, the near shore waters can turn brown – leading to a “brown water event”. Sediments block sunlight from reaching reefs and can smother corals. Brown water events often indicate that there are issues up-slope, including grading or clearing of land.

## **Nutrients**

Nutrients, including nitrogen and phosphorus, can indicate agricultural runoff and sewage pollution. Once in the ocean, these nutrients can lead to an overgrowth of algae. Algae, particularly invasive species, quickly out-compete coral reefs for sunlight and overrun large tracts of living reef. Water quality monitoring allows us to identify areas of high nutrients, and then pinpoint up-slope areas that need to be addressed as sources.

## **CHAPTER 2 - Preparation**

### **2.1 At the lab**

We work in two regional labs: Lahainaluna High School Science Building on the West Side, and Hawaiian Humpback Whale National Marine Sanctuary on the South Side. Our labs are equipped to store supplies and chemicals, prepare sampling sessions and process samples.

#### **Field equipment**

The day before sampling, the team lead will prepare all the necessary equipment and supplies to be picked up by one of the volunteer team members. Meters and probes will be calibrated and/or verified, bottles will be labeled, and other supplies will be packed.

When picking up the equipment, volunteers should double check the “field equipment checklist” to ensure all sampling tools are present. The following list can serve as a guideline:

#### General supplies:

- |  |                              |
|--|------------------------------|
| 1. Carry case                            | 9. Pens, sharpies            |
| 2. One-gallon buckets with lids (2)      | 10. Label tape               |
| 3. Distilled water (1) and tap water (2) | 11. Kimwipes                 |
| 4. Field guide and field notebook        | 12. Utility towels           |
| 5. Data sheets and clipboard             | 13. Scissors                 |
| 6. Volunteer time log                    | 14. Cell phone (with camera) |
| 7. Cooler with blue ice (3)              | 15. First Aid kit            |
| 8. Extra batteries for meters            |                              |

#### Collection supplies:

1. 60-mL syringe with Luer Lock tip
2. Syringe filters (0.2 um disposable filters)
3. Nutrient sample bottles (HDPE, 125mL, acid-washed) – pre-labeled
4. Turbidity sample bottles (100 ml clear bottles) – no labels
5. Sediment sample bottles (500 ml square bottles) – labeled in field if taken

#### Meters and probes:

1. Hach 2100Q turbidimeter
2. Hach HQ40d meter with the following probes:
  - a. IntelliCAL LDO101 DO sensor
  - b. IntelliCAL CDC401 conductivity probe (Salinity)
  - c. IntelliCAL PHC101 pH electrode

### **Bottle labeling**

Any samples that will be brought back to the local laboratory either for testing or shipping to a lab must be labeled. Hui O Ka Wai Ola has a strict labeling scheme to prevent sample mix-ups.

Each sample collected will be labeled with a unique sample number containing the following information:

- a. place of collection
- b. date and time of collection
- c. sample type
- d. sample number

The sample number will follow this format: 3-letter site location code, two-digit year, two-digit month, two-digit day – sample type code (N for nutrients, S for suspended sediment) – sample number.

For instance, a nutrient sample at Ukumehame Beach Park might be:

**OUB150601-N-1**

**OUB:** Olowalu team, Ukumehame Beach

**150601:** 2015, June, 1<sup>st</sup>

**N:** Nutrient sample

**1:** sample number 1 (a duplicate would be 2)

## **2.2 In the field**

### **Safety**

One of the most critical considerations for a citizen monitoring program is the safety of its volunteers. All volunteers are trained in safety procedures and should carry a first aid kit along with a set of safety instructions and the phone number of their monitoring team leader. Safety precautions cannot be overemphasized.

The following are some basic safety rules.

- Always monitor with at least one partner. Always let your monitoring team leader know where you are, when you intend to return, and what to do if you do not come back at the appointed time. Do not rely on cell phones, as a site may lack adequate reception.
- Know any important medical conditions of team members (e.g., heart conditions or allergic reactions to bee stings). Keep the first aid kit and emergency contact information clipboard in your vehicle whenever you are conducting field sampling.
- Listen to weather reports. Never compromise your safety if severe weather is predicted or if a storm occurs while at the site.
- Use caution when entering the water. Never turn your back to the surf and waves. You should not be sampling in water greater than knee deep. **If you are uncomfortable with the level of surf and are concerned for your safety do not go in the water!** The most important thing is your safety. Data can be collected at another time.

- If you drive, park in a safe location. Ensure your car does not pose a hazard to other drivers and do not block traffic.
- Never cross private property without the permission of the landowner. For sites requiring access via private property, Hui O Ka Wai Ola will obtain permission for our volunteers, but you may need to check-in before you monitor such a site. Use the Hui O Ka Wai Ola parking placard when parking on private property so the property owner will know that you are collecting samples.

### Initial set up



Fig 1: Car parked in a way that the hatchback provides shade.

- Try to park the car in a shady area, so the sun doesn't affect the physical measurements.
- Upon arrival to the first sampling site, make sure the data sheet is filled in with the team name, team members names, date, instrument numbers (meters and probes), date and sampling time.
- Data and observations will be filled as samples are taken. Make sure you double-check each value input into the datasheet for accuracy. It is a good habit for the note taker to repeat the value out loud, after the team member reading the meter announces it.

### Pre-Verification: Turbidity meter, Hach 2100Q

The Hach 2100Q turbidimeter should be checked with the secondary Gelex standards before and after each field session. The pre-verification will be performed by the volunteer teams out in the field, the post-verification will occur in the laboratory after returning from sample collection.

Dirt, grease and fingerprints on the glass vial to be read will interfere with the accuracy of the turbidity measurement. Make sure to handle the Gelex standards and the sample cell by the lid, avoiding touching the sides of the glass vial.



Fig 2: Turbidity meter, Hach 2100Q. Showing the case, 6 sample bottles (far left), Gelex Standards (middle, red top), oil dropper, and meter

**Procedure:**

1. Power the turbidimeter on.
2. Read the Gelex Standards:
  - a. Insert the Gelex standard into the well with the arrow pointing forward, close the lid.
  - b. Push the READ button. Record the value on the Turbidity Verification box.
  - c. Repeat the process with all three Gelex standards (low, med and high).
3. Read the blank:
  - a. Insert the sample cell containing distilled water into the turbidimeter.
  - b. Press ‘READ’ and record the value. The blank should read 0.1 NTU or less. If it does not, try cleaning the cell with a Kimwipe and/or black cloth, and re-read. If it is still higher than 0.1 NTU, report to the team lead.
4. Turn the turbidimeter off.

## CHAPTER 3 - Datasheets

Datasheets are the way we communicate our findings in the field to everyone. It is imperative that all fields are filled accurately, and the values are legible. See the Appendix for a blank copy of the field data sheet.

### Initial Considerations

All team members should be familiar with how to fill in a datasheet.

Values are read from the screen by the volunteer performing the measurement, and repeated out loud by the note taker, as a way to minimize errors. Reading both the value and the unit out loud (i.e.: 35 ppt) will let the note taker know the reading is a salinity value, and thus record it in the correct column.

All fields of the data sheet should be filled in completely. If any readings are missing, make a note explaining the reason (i.e.: Couldn't sample Maluaka Beach due to high surf).

All data entry is to be made using a pen. Please write the values carefully so they can be read easily. If a mistake is made on an entry, draw a single line through the incorrect entry and record the correct number above or below. It is good to write the entries small initially in case an entry needs to be corrected. Initial any changes made to a data sheet.

### Field Datasheets

Our field datasheets have 5 main sections:

<b>Basic Info</b>	Team		Samplers (Last Name, 1st Initial)		Meters and Probes ID																															
	Session	Date			HQ40d:	2100Q:																														
				pH:		DO:	Salinity:																													
<b>Field Measurements</b>	Location Name Sample ID	Streams Flowing (Y/N)	Time	Temp (°C)	Salinity (ppt)	Dissolved Oxygen (mg/L) (%)		pH	Turbidity (NTU)	People (within 100 ft)																										
										water	beach	camp																								
<b>Notes and Comments</b>	NOTES AND COMMENTS (trends, equipment problems, errors, concerns). Use the back of the form if needed.																																			
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4">TURBIDITY VERIFICATION</th> </tr> <tr> <td></td> <td>Blank (must be &lt;0.10)</td> <td>Low</td> <td>Med</td> <td>High</td> </tr> <tr> <td>Standard</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Pre-sampling</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Post-sampling</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>												TURBIDITY VERIFICATION					Blank (must be <0.10)	Low	Med	High	Standard					Pre-sampling					Post-sampling				
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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="3">CHAIN OF CUSTODY INFORMATION</th> </tr> <tr> <td></td> <td># of samples</td> <td>Relinquished to</td> <td>Contact</td> </tr> <tr> <td>Sediment</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Nutrients</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Bacteria</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="2">Signature (Team Lead):</td> <td colspan="2">Printed Name:</td> </tr> </table>												CHAIN OF CUSTODY INFORMATION				# of samples	Relinquished to	Contact	Sediment				Nutrients				Bacteria				Signature (Team Lead):		Printed Name:			
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Bacteria																																				
Signature (Team Lead):		Printed Name:																																		
<b>Turbidity Verification</b>																																				
<b>Chain of Custody and Signature</b>																																				

You will be entering information in this order:

### 1. Basic info

- Team, Session, Date: Team and session number. These are usually pre-filled by the team lead.
- Samplers: Fill the last name and first initial of the team members.
- Meters and Probes ID: These are usually pre-filled by the team lead.

### 2. Turbidity Verification

- Standard row:
  - Blank: The day before a sampling day, a team lead will measure distilled water at the lab, and will fill this field with the measured value. It will always be under 0.1 NTU.
  - Low, Med and High: These are written on a sticky note inside the turbidity meter case. These values change every time the meter is calibrated, and they are different for each instrument, and are usually pre-filled by the team lead.
- Pre (verification) row: To be filled by the volunteers as with the values obtained from the turbidimeter pre-verification procedure (See ‘Chapter 2.2 - In the Field, Pre-verification Procedure’ for a detailed description on how to perform the pre-verification).
- Post (verification) row: This row will be filled in at the lab after each sampling day.

### 3. Field measurements

- Location Name/Sample ID: This field is always pre-filled by the team lead.
- Streams Flowing (Y/N): Be familiar with the sites you sample, whether they have streams or outflows that could be flowing or not. If it’s not currently flowing but you see signs that it might have been recently, make a note.
- Time: The time at which the first sample is taken. Always have a watch with you, so you can record it accurately.
- Temp (C): The sample temperature in degrees Celsius read off of the Salinity probe. It appears on the right-hand side of the screen, next to the salinity value. In the photo this value is 25.4°C.
- Sal (ppt): Refers to the salinity in parts per thousand of the sample. The value is in the middle of the screen under a lock icon. In the photo this value is 36.1 ppt.
- DO (mg/L): Refers to the dissolved oxygen in milligrams per liter. The value is in the middle of the screen under a lock icon. In the photo this value is 6.47 mg/L.
- DO (%): This parameter is the dissolved oxygen percent saturation. It appears on the right-hand side of the screen, next to the mg/L value. In the photo this value is 96.7%.
- pH: This reading is the pH of the sample. It has no units.

- Turbidity (NTU): Read the same sample three times (taking the vial out of the meter and swirling it in between readings) and write all three values on the data sheet in the three boxes provided.
- People (within 100ft): Make your best estimate of the amount of people within 100ft. If the beach is smaller than that, then count all the people on the beach (but not on the parking lot, lawn area, etc).

#### 4. Notes and Comments

Make all the notes and comments you think they might be relevant. If more space is needed, use back of the form. Be specific, keep in mind that people reading the notes are not seeing what you see. Write comments down as soon as you can, so you don't forget any details. If you write on the back of the sheet, be sure to note this on the front page so your team lead and others will know to look on the back.

Stories, for example:

- Surfer close to shore, right in front of sampler and just “hanging out” during sampling process; gets out of water immediately after we have sampled.
- Snorkelers entering the water may have stirred up sediment in area of collection.
- Dogs were running in and out of the water in the vicinity of our collection site.

Unusual events:

- Fires
- Different water color
- Swimming pools draining into storm drain
- Bad smells
- Clear erosion problems
- Streams running

Heavy rains within 24 hours of sample collection, especially rains that are local in nature.

#### 5. Chain of Custody and Signature

To be filled in by the team lead. It describes the number of samples taken and where they are relinquished, and appropriate signature.



Fig 3: Multi-meter, Hach HQ40d. Salinity, DO and pH probes can be plugged in, two at a time. Notice that the values on top correspond to the probe connected on the left; the values on the bottom, to the probe on the right.

## **CHAPTER 4 - Sample Collection**

### **Equipment**

We use different containers for each sample type:

- Turbidity: clear unlabeled 125ml bottle (wide mouth).
- Nutrients: 60ml syringe, disposable filter, and 125ml, acid washed, labeled bottle (narrow mouth).
- Physical parameters (temperature, salinity, DO and pH): 1-gallon bucket.
- Sediment: 500ml square bottle.

Turbidity	Nutrients	Physical Measurements	Sediment
			

### **Initial Considerations**

It is important that the water collection for water quality measurements happens at the same place, approximately the same time and from the same pool of water each time. Be familiar with the exact collection location of all of your sites.

Because it can be hazardous to stand in the ocean where the surf is breaking while using a hand-held meter, water for field measurements will be collected in a bucket and taken back to the car to test for temperature, salinity, pH, and dissolved oxygen. Water for the turbidity measurements will be collected in a smaller bottle that enables gentle re-mixing before reading the sample.

Always collect water samples with the water moving towards you. Face away from the shoreline at a depth no more than knee to thigh deep and rinse the bucket/turbidity bottle and cap three times with the water to be tested. When collecting the sample, avoid disturbing any silt that may have settled on the bottom. The container should be rinsed with the seawater three times, before taking the sample.

Measurements on water samples should be made in the vehicle in a shady area if possible, avoiding direct sunlight. The samples should be tested as quickly as possible once the water is removed from the water body to ensure the temperature measurement is minimally affected. Thus, it is best to collect the bucket sample last.

For nutrient sample collection, keep the syringes and syringe filters in a plastic bag and avoid touching them until needed for sampling to prevent contamination. When collecting the nutrient sample, remove the plunger from the syringe and rinse both the plunger and the syringe body three times with the ocean water before collecting the sample by submerging the syringe into the water and putting the plunger in place while the syringe body is still under the water. When filtering the water into the acid-washed bottle, remove the cap just before discharging the syringe, and quickly place the bottle cap back on the bottle once the sample is completely discharged. Avoid touching the inside of the bottle or the cap and the Luer Lock end of the syringe and filter.

Sediment samples will be collected whenever the turbidity value exceeds a particular threshold, which may vary depending upon location. The team leader will advise you of the turbidity threshold before a sampling session begins.

A minimum of 2 team members is necessary to take a water sample. Team member #1 will collect the water sample, team member #2 will assist, holding supplies (bottles, syringes, filters, etc.) and taking notes. If a third member is present, this will be the note taker.

## Field Procedure

1. Before starting, check that all nutrient sample bottles are labeled correctly.
2. Team member #1 will approach the water with a bottle, syringe and/or bucket to take the sample. Only collect one sample type at a time.
  - a. Being aware of inbound waves, carefully wade in about knee high to thigh deep. Collect the sample about one foot under the water if possible. Avoid sampling too near the bottom to minimize stirring up sediment or sand.



Fig 4: Volunteers in the ocean, knee deep, taking samples.

- b. Unscrew the cap, and rinse sample bottle and cap, syringe and plunger, and bucket **3 times** before collecting the sample.
  - c. Wait until the surf is bringing water in towards you, to minimally impact the sample you are grabbing.
  - d. Leave the water and transport the samples to the car for analysis or storage.
3. Samples to be collected:
- a. **Turbidity sample:** Fill the white cap bottle leaving only a small bit of empty space at the top of the bottle before capping the bottle.
  - b. **Nutrient sample:** Fill a syringe and place the plunger underwater. Once out of the water, screw a filter on, holding the filter from the sides to prevent contamination. Slowly wet the filter with sea water by discharging approximately 5 mL of sea water onto the ground (make sure you leave 55-60 mL in the syringe). Filter the water into the nutrient sample bottle (labeled). Screw the bottle cap back on. The filtering may be done back at the car if preferred.
  - c. **Physical measurements:** Fill the bucket up completely under the water. Once safely on shore or back at the car, empty the bucket down to the line on the side of the bucket (about half way) to prevent the top of the probe and cable from getting wet.
  - d. **Sediment sample:** Fill the bottle to the neck of the square bottle and cap the bottle.
4. Carry the samples back to the car:
- a. Store the nutrient and sediment samples upright in the cooler immediately, in between blue ice packs to keep them cool. These samples must be stored upright in the cooler. Arrange the blue ice so that the samples remain upright even while driving. Nutrient samples will be shipped to the SOEST lab on Oahu, sediment analysis will be done at the regional labs.
  - b. Proceed with turbidity and physical measurements in a shady area.



Fig 5: Volunteers filtering the nutrient sample into the acid-washed bottle.

## CHAPTER 5 - Field Measurements

Reef safe sunscreen is important when you are out in the field, however make sure that all traces of sunscreen have been removed from your hands before working with the field equipment. Use a towel to dry hands before handling the meters and probes, salt water is very corrosive.

Probes need at least 2 minutes to stabilize before taking any readings. Therefore, it is convenient to place them in the bucket as soon as volunteers get back to the car. While waiting, turbidity measurements can be taken.

Before placing the pH probe into the bucket, make sure to rinse the KCl solution that the probe is stored in off of the probe tip, otherwise the pH of the sample may be affected. Take the pH probe out of the KCl storage bottle, rinse it with distilled water and pat it dry with a Kimwipe before placing it in the bucket.

### 5.1 Turbidity Measurement

#### Equipment

To measure turbidity, we use the Hach 2100Q turbidimeter. A turbidity meter consists of a light source that illuminates a water sample and a photoelectric cell that measures the intensity of light scattered at a 90-degree angle by the particles in the sample. It measures turbidity in nephelometric turbidity units (NTU). The meter can measure turbidity over a wide range, from 0 to 1000 NTUs. These values can jump into hundreds of NTUs during runoff or flood events.

#### Initial considerations

To minimally affect the measurements being taken, the 2100Q turbidity meter should be placed on a dry flat surface. Also, take care not to lean on the car while reading turbidity, as movement may affect the value.



Fig 7: Always hold the sample cell with a Kimwipe to avoid fingerprints.

Always hold the sample cell by the lid and use a Kimwipe to handle the

glass portion. Avoid touching the glass vial with bare hands; keep it as clean and fingerprint-free as

possible. Pat the sample cell dry (instead of wiping) to avoid scratching the surface with salts from the water. Before taking a reading, inspect the glass to ensure it is clean and free of dirt and smudges.



Fig 6: Turbidity meter, Hach 2100Q.

## Field Procedure

1. Re-suspend sediments: Before filling the glass vial, re-suspend any sediment in the turbidity bottle by gently and slowly inverting or swirling the sample bottle several times. Do not shake the bottle to avoid bubbles.
2. Fill the glass vial: Always hold the vial above the white line to avoid fingerprints. Empty the contents of the vial, rinse the sample cell 3 times with the sample; fill the vial a 4th time to read it. Make sure there are no water drops on the sample cell threads before capping the cell. Blot any water on the threads with a Kimwipe and ensure the glass vial is clean on the outside (no fingerprints, scratches, dirt). Blot the sample cell dry rather than wiping to prevent scratches.
3. Read the sample: Insert the sample cell into the meter, aligning the arrows. Close the lid until it clicks. Press 'READ'. Record the value on the data sheet.
4. Re-read the same sample two more times: Take the sample vial out, re-suspend sediments and read it again. Be gentle when inverting or swirling the sample cell, as to not introduce bubbles into the sample. Record all three values.
5. Remove the vial from the meter and store it (with the sample) in the foam holder while you go to the next site to be sampled. Make sure the foam holder remains dry.

## 5.2 Temperature, Salinity, Dissolved Oxygen and pH Measurements

### Equipment

To take physical measurements we use the Hach HQ40d multimeter, and IntelliCAL probes (Dissolved Oxygen, Salinity and pH). All three probes measure temperature.

### Initial Considerations

The probes we are using are laboratory probes, not field probes. Make sure water doesn't go above the orange tape on any of the probes or the probe could be ruined.

When taking readings, probes should not be sitting on the bottom of the bucket. Swirl probes in the sample to ensure no bubbles are present, and then hold them still and up off the bottom before pressing the 'READ' button.

Salt water is corrosive! After all the values are read, rinse all 3 probes well with tap water and then with distilled water, to minimize the amount of time the probes are subjected to seawater. Make sure to keep any liquid away from the probe connectors.



Fig 8: Multimeter, Hach HQ40d, with three probes.

## Field Procedure

Refer to ‘Chapter 3 - Datasheets’ for a detailed explanation on how to record the data.

1. Connect the **dissolved oxygen** and **salinity** probes to the meter at the same time. The dissolved oxygen measurement is dependent upon temperature, atmospheric pressure, and the salinity of the sample.
2. After allowing the probes to sit for at least 2 minutes in the sample being tested, swirl them in the sample to eliminate possible bubbles, and press ‘READ’. Make sure the probes are held up off of the bottom of the bucket while reading the values. Once the lock icon appears for both probes, record the values on the data sheet. DO units are mg/L and % saturation, and salinity values are in ppt (parts per thousand). Record the temperature value from the salinity probe (°C).
3. Disconnect one of the probes, connect the pH probe, and press ‘READ’. Make sure the pH probe is held off of the bottom during the read process. Record the value on the datasheet.
4. Observe the temperature on all the probes when making measurements. If the temperature sensors on the three probes differ more than 0.2°C, make a note on the bottom of the data sheet.
5. If you notice a value that seems odd, take another measurement. If you don’t get the same measurement each time, continue taking readings until you get 3 readings that are the same value. If this continues to be an issue with a particular probe, make a note of it. Report any equipment concerns to your team lead.
6. Once done, discard the water from the bucket, rinse each probe with tap water and then distilled water. Dry the probes and place them in their case. Always put the pH probe back in the KCl solution when it is not being used. Ensure that both meters are dry and proceed to the next site.
7. When you are finished with the last site, ensure all probes are securely held in the case. The pH probe is allowed to be loose in the depression by the field meter. This allows the probe to stay hydrated in the 3M KCl solution.

## 5.3 Data Quality

- If any reading from the multimeter probes (Salinity, Temperature, DO or pH) seems suspicious, either much higher or much lower than most readings for that parameter, additional readings should be taken.
- It is always acceptable to read the Salinity, DO or pH probes more than once. If the readings on the probes differ each time the ‘READ’ button is pressed, then it is possible that the probe has not had enough time to settle. If successive readings are exactly the same, you can be confident in the measurement.
- Temperature: If there is a difference of 1°C or greater between the three probe measurements, read the probes again. If the difference between the 3 probes persists, notify the team lead and make a note on the datasheet.

– Normal values:

<i>Parameter</i>	<i>Normal values in coastal waters</i>
pH	8.00 – 8.30
Salinity	30 – 35 ppt
Dissolved Oxygen	85 – 105 %
Turbidity	Variable

- \* pH: The normal range of pH measurements within coastal waters is between 8.00 and 8.30. If the pH reading is outside this range, take additional readings. Measurements should stabilize within three minutes. Some sites may occasionally have pH values of less than 8.00, especially if there is a lot of fresh water coming into the site.
- \* Salinity: If the salinity reading is less than 30 ppt or greater than 35 ppt, repeat the reading. Lower salinity values can occur when it has been raining or when stream water is flowing into the ocean. Fresh water seeps can also cause lower salinity values. Higher salinity values may be indicative of a problem with the probe.
- \* Dissolved Oxygen: If the DO saturation is less than 85% or more than 105%, repeat the reading. However, normal values can exceed these ranges. Lower DO readings will typically be seen in areas where there is little wave activity. Higher DO readings are observed when there is large surf.
- \* Turbidity: If there is a substantial difference between any of your three measurements you should take additional measurements. Generally, larger differences between readings will occur when larger particulate matter is in the sample. Even if you take more than 3 turbidity readings, record only 3 readings on the data sheet.

## **CHAPTER 6 - Post collection procedure**

After finishing at the last site, one of the field volunteers will return the samples and equipment to the regional lab. A team lead will be at the lab to receive the equipment and samples. At the lab, the volunteer will assist the team lead with post collection procedures.

### **Samples**

- Upon return to the lab, place nutrient samples in the freezer (as soon as possible).
- Return the blue ice packs to the freezer, unless the equipment is going out again the next day. In that case, leave the packs in the cooler.

### **Data sheets**

Check data sheets to make sure you have filled in all the data required. Ensure you have noted which meters were used, what samples were collected, and that all comments are legible. Make entries in the field notebook that might be significant but are not required on the data sheet (unusual activity, unusual smells, etc.)

### **Equipment**

#### **Post-Verification: Turbidity meter, Hach 2100Q**

Repeat the procedures done at the first sampling site to verify the turbidity meter. Record the results on the verification box of the field datasheet, under “post”.

1. Read standards: Take readings of the 3 gel standards and record the results.
2. Read blank:
  - a. Dump the last sample from the sampling cell and rinse it under running tap water. Rinse both the inside and outside very well, and also rinse the cap.
  - b. Rinse the sample cell three times with grocery store bought distilled water, and then fill it up to the white line. Be sure to rinse the cap with distilled water as well.
  - c. After wiping the cell dry with a Kimwipe, use the black oilcloth to clean the exterior of the sample cell. Examine it for smudges.
  - d. Take a reading of the distilled water. If the reading is 0.09 NTU or less, record the reading on the data sheet. If the reading is  $> 0.1$  NTU, repeat the rinsing process and take another reading. A reading of 0.1 NTU or less indicates that the sample cell is clean. Check that the foam holding the sample cell is dry before returning the bottle.

### **Clean probes**

1. Fill the 1000 ml glass beaker approximately half way with distilled water. Soak the three probes together for 5 minutes to remove any remaining salts, which can affect the accuracy of measurements.
2. Dry the outside of the probes carefully with Kimwipes; tap each probe carefully against a Kimwipe to remove any water droplets that might remain inside. Place the pH probe back in the KCl solution and use parafilm to seal the soaker bottle to the probe. Place the probes back in the case. Make sure the case and the meter are clean and dry before storing them in the cabinet.

### **Field collection supplies**

#### **Collection container clean up**

1. In a dishpan, dissolve a small amount of lab soap (Alconox) in tap water, to wash syringes and turbidity bottles.
  - a. Wash syringes first. Place them by themselves in the soapy water and wash the insides using a test tube brush. Rinse them three times in tap water first, and then in a bath of distilled water. Set them in a dish rack to dry. Discard disposable filters in the trash.
  - b. Wash up turbidity bottles and place them in the rack to dry. Set the bottle lids on a microfiber towel to dry and cover them up to prevent contamination.
  - c. Rinse and dry the dishpans.
2. Rinse and dry the two buckets used in field to prevent corrosion on the handles.

### **Field Equipment Preparation**

If another team is scheduled to collect samples the following day, prepare the equipment and supplies to be picked up. Follow the procedures described under ‘Chapter 2: Preparation’ of this handbook.

## **CHAPTER 7 - Troubleshooting**

Mistakes can happen when field sampling. Most mistakes are easily correctable but because this is a quality assured program we need to know when a mistake is made and how it was resolved. After dealing with any problem, remember to make a note on the datasheet and report it to your team lead.

### **7.1 Equipment**

#### **Meters and probes**

- If a meter doesn't turn on, you may need to replace the batteries. Extra batteries can be found in the cooler front pocket or in the turbidity meter case. When the batteries are replaced, you will have to re-enter the date and time on the meter BEFORE you connect any probes.
- If a meter turns off mid-sampling, it might be that the battery flap is not tightly closed, and the batteries are not secure in the compartment. Shut the compartment door tightly, and re-enter the date and time.
- Sometimes the probes are sensitive to movement. If the probe takes longer than usual to lock the value, try not to stir the water too much when pressing the 'READ' button.
- If by mistake, the pH probe doesn't get rinsed off before placing it in the bucket, discard the sample and collect a new one.

#### **Supplies**

- If a sample is collected in the wrong container type (i.e.: a turbidity sample gets collected in an acid washed bottle), discard it and start over with a new set of containers. This is especially important in the case of the nutrient bottle. Spare syringes, filters and bottles are in the front pocket of the cooler. Make sure you label the nutrient sample correctly, using the lab tape and sharpie provided.

### **7.2 Data**

- If a reading is very different from what you expect, wait a minute, and take another reading. If the probes didn't have enough time to stabilize, readings might not be accurate. If the value stays the same, record it on the datasheet and make a note about it.
- When taking turbidity readings, make sure all three readings are relatively close together. If one of the readings is much higher or lower than the other two, take a fourth (or more) reading, and replace the value(s) you think may be less accurate. Draw a single neat line through the discarded reading and write the replacement reading neatly under/over the discarded reading.

## 7.3 Safety

### Weather conditions

- Safety first! If you don't feel comfortable getting in the water, just DON'T! It doesn't matter if surf is big or small, trust your gut, err on the side of caution and don't take the sample.
- If it's raining too much, to the point that it is impossible to actually make measurements in the back of the vehicle without everything getting wet, you might need to skip that location. Rain conditions change rapidly, so you may want to wait and see, or skip the site altogether. You can always come back to it later. Use your judgment and make a note about it on the data sheet.

### Injuries

- Familiarize yourself with the contents of the First Aid kit and the safety protocol, which can be found in the folder inside the backpack.
- If a non-life-threatening injury occurs, our first aid kit contains bandages, antibiotic ointments, gloves, etc. Make sure you fill out an incident report form, and give the report to your team lead. The team lead will need to let the steering committee know about any injury incidents.
- If there is an emergency, call 911 and either your team lead or a regional coordinator.



## APPENDIX

### A.1 Field Datasheet

<b>Team</b>		<b>Samplers</b> (Last Name, 1st Initial)	<b>Meters and Probes ID</b>									
<b>Session</b>			HQ40d:					2100Q:				
<b>Date</b>			pH:			DO:			Salinity:			

  

Location Name Sample ID	Streams Flowing (Y/N)	Time	Temp (°C)	Salinity (ppt)	Dissolved Oxygen		pH	Turbidity (NTU)	People (within 100 ft)		
					(mg/L)	(%)			water	beach	camp

  

<b>NOTES AND COMMENTS</b> (trends, equipment problems, errors, concerns). Use the back of the form if needed.	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="5">TURBIDITY VERIFICATION</th> </tr> <tr> <th></th> <th>Blank (must be &lt;0.10)</th> <th>Low</th> <th>Med</th> <th>High</th> </tr> </thead> <tbody> <tr><td>Standard</td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>Pre-sampling</td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>Post-sampling</td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4">CHAIN OF CUSTODY INFORMATION</th> </tr> <tr> <th></th> <th># of samples</th> <th>Relinquished to</th> <th>Contact</th> </tr> </thead> <tbody> <tr><td>Sediment</td><td> </td><td> </td><td> </td></tr> <tr><td>Nutrients</td><td> </td><td> </td><td> </td></tr> <tr><td>Bacteria</td><td> </td><td> </td><td> </td></tr> </tbody> </table> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>Signature (Team Lead):</span> <span>Printed Name:</span> </div>	TURBIDITY VERIFICATION						Blank (must be <0.10)	Low	Med	High	Standard					Pre-sampling					Post-sampling					CHAIN OF CUSTODY INFORMATION					# of samples	Relinquished to	Contact	Sediment				Nutrients				Bacteria			
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Nutrients																																														
Bacteria																																														

### A.2 Sampling sites

#### West Maui

**North Ridge to Reef**  
 Honolua Bay  
 Oneloa Bay  
 Kapalua Bay  
 Ka'opala Bay  
 Kahana Village

**South Ridge to Reef**  
 Napili Bay  
 Pohaku  
 Kaanapali Shores  
 Canoe Beach  
 Wahikuli

**Polanui**  
 505 Front St  
 Lindsey Hale  
 Lahaina Town  
 Olowalu Pier

**Olowalu**  
 Martin Hale  
 Camp Olowalu  
 Ukumehame  
 Papalua Beach  
 Papalua Pali



**South Maui**

**North Kihei**  
 Haycraft Park  
 Kealia Pond  
 Sugar Beach  
 Kihei Canoe Club  
 Mai Poina ‘Oe Ia’u

**Kamaole**  
 Kalepolepo North  
 Waipuilani Park  
 Kihei South  
 Kalama Park  
 Cove park

**Wailea**  
 Kilohana Dr  
 Keawakapu Beach  
 Ulua Beach  
 Palauea  
 Poolenalena  
 (Chang’s Beach)

**Makena**  
 Makena Landing  
 Maluaka Beach  
 Oneuli  
 Ahihi North  
 Ahihi South

**A.3 Contact info**

<b>Name</b>	<b>Position</b>	<b>Phone Number</b>	<b>Email Address</b>
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