DEPARTMENT OF ECOLOGY
State of Washington

Standard Operating Procedure EAP033, Version 2.2

Standard Operating Procedures for Hydrolab® DataSonde®, MiniSonde®, and HL4 Multiprobes

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Purpose of this Document

The Washington State Department of Ecology develops Standard Operating Procedures (SOPs) to document agency practices related to sampling, field and laboratory analysis, and other aspects of the agency's technical operations.

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SIGNATURES AVAILABLE UPON REQUEST

Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which the Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Revision History	Summary of changes	Sections	Reviser(s)
6/2/2010	1	Minor changes and updates	All except 2 and 8	Trevor Swanson
7/1/2010		Recertified	All	Kammin
6/3/2016	2.0	Updates to all sections as well as reorganization. Updates provide inclusion of the new HL4 version. Major update to calibration section to match current procedures and sensors. Removal of several parts of section 6 that are no longer necessary or outdated. Title change.	All	Paul D. Anderson
12/19/2016	2.1	Cover page, footer, recertify	all	Kammin
6/18/2019	2.2	Transferred to new template Added section 4.2 Grammar correction Reworded Included link to USGS DOTABLES Note about field calibrations Updated 6.1.3.4 to 6.1.3.5 Added electrode description Sentence restructure Referenced SOP129 Sentence restructure Added reference to SOP023 Added SOP023	All 4.2 6.1 6.1.3.1 6.1.4.3 6.1.3.3.1 6.1.3.3.3 6.1.4.5 6.1.4.10 6.2.2 8.1 8.2.2.2 10.3	Wolfe
7/9/2019	2.2	Recertified	All	Kaza

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for using Hydrolab® DataSondes®, MiniSondes®, and HL4s. DataSondes®, MiniSondes®, and HL4s are multi-parameter water quality probes used by the Environmental Assessment Program (EAP) to measure pH, dissolved oxygen (DO), DO percent saturation, conductivity, temperature, depth, rhodamine dye concentration, oxidation-reduction potential (ORP), and total dissolved gas (TDG) data. They can be used for discrete measurements as the user moves from site to site throughout the course of a day, depth profiling, or short and long-term unattended monitoring at specified time intervals.

1.2 Currently, EAP does not use Hydrolabs® to gather chlorophyll *a*, blue-green algae, ambient light and photosynthetically active radiation (PAR), turbidity, ammonium, chloride, or nitrate/nitrite data, but these non-standard sensors are available through Hach/Hydrolab® if needed.

1.3 The information in this SOP pertains to cleaning, calibration, general use, storage, and equipment protection (against theft) of Hydrolab® multi-parameter water quality probes. Each new Hydrolab® user is required to be trained by a Hydrolab® custodian or other designated proficient Hydrolab® user. Hydrolab® user's manuals should be consulted for detailed instructions, where noted.

1.4 If the Hydrolab® user's manual does not provide adequate information, consult a Hydrolab® custodian or call technical support. The Hydrolab® user's manual and the custodian should be consulted for information on maintenance, deployment, and troubleshooting of Hydrolabs®. For information on using rhodamine, TDG, ORP, and other non-standard sensors, please consult the appropriate Hydrolab® manual, or view Hach's website at www.hydrolab.com, and contact a Hydrolab® custodian.

2.0 Applicability

2.1 This SOP must be followed when using Hydrolab® multi-parameter water quality probes. Hydrolab® equipment is expensive and must be treated and maintained carefully. Anyone not following proper procedures is subject to losing rights to future use. ORP, TDG, and rhodamine sensors are non-standard and are not covered in this SOP.

3.0 Definitions

3.1 Calibration — to standardize or correct sensors after determining, by measurement or comparison with a standard, the correct value.

3.2 Clark Cell — The Clark Cell dissolved-oxygen sensor consists of two electrodes surrounded by an electrolyte solution and covered with an oxygen permeable membrane. As oxygen crosses the membrane, it is consumed in a chemical reaction which generates a small electrical current between the electrodes. The measured current is directly proportional to the amount of oxygen in the water sample.

3.3 Conductivity — a measure of the ability of water to pass an electrical current. This parameter indicates the amount of dissolved substances (salts) present in the water.

3.4 DO — dissolved oxygen in water, measured in mg/L.

3.5 DO % — the percent saturation of dissolved oxygen in water.

3.6 LDO — Luminescent dissolved oxygen. The Hach LDO sensor cap is coated with a luminescent material. Blue Light from an LED strikes the luminescent chemical on the sensor. The luminescent chemical instantly becomes excited. As the excited chemical relaxes, it releases red light. The higher the oxygen concentration, the less red light is given off by the sensor cap. The red light is detected by a photo diode. The time it takes for the chemical to return to a relaxed state is measured. The oxygen concentration is inversely proportional to the time it takes for the luminescent material on the sensor cap to return to a relaxed state. Between flashes from the blue LED, a red LED of known intensity is flashed. The red LED acts as an internal standard for reference comparison to the red light given off by the luminescent sensor cap. This comparison allows the sensor readings to remain stable for long periods of time.

3.7 m — meter.

3.8 Multi-parameter — the combination of several sensors or sensor assemblies into a complete, stand-alone piece of equipment, which simultaneously measures multiple parameters for profiling, spot-checking, or logging readings and data.

3.9 NIST — National Institute of Standards and Technology.

3.10 ORP — oxidation-reduction potential (also known as Redox). A measurement of the voltage at an inert electrode, reflecting the extent of oxidation of the water sample. The more positive the ORP of a solution, the more oxidized are the chemical components of the water (less positive indicates less oxidized, or more reduced).

3.11 PAR — a specific type of ambient light known as photosynthetically active radiation.

3.12 pH — a measure of the hydronium ion concentration of a solution. Solutions with a pH less than 7 are considered acidic, while those with a pH greater than 7 are considered basic. The pH is the negative logarithm of the hydronium ion concentration in solution. For example, if the hydronium ion concentration is 10^{-7}, the pH is 7.

3.13 Post-check — assessing the performance of a sensor — after use — by noting the variation from a standard, to ascertain necessary correction factors.

3.14 Profiling — lowering a multi-parameter water quality probe through a water column to measure changes in parameter values with depth.

3.15 Rhodamine — A synthetic red to pink dye having brilliant fluorescent qualities. It is often used as a tracer in water to determine the rate and direction of flow and transport. Rhodamine dyes fluoresce and can thus be measured easily and inexpensively with fluorometers or with a Hydrolab® rhodamine sensor.

3.16 TDG — Total dissolved gas. The total pressure of gaseous compounds dissolved in water, measured directly in units of mmHg, and also expressed as percent of saturation (ratio of dissolved gas pressure to ambient barometric pressure).

4.0 Personnel Qualifications/Responsibilities

4.1 Individuals must be properly trained to use any Hydrolab® equipment. A Hydrolab® custodian or company representative can help fulfill the training requirement. See your supervisor for further details. Ecology field staff must also complete annual field safety training.

4.2 Job classifications that typically perform this work: Natural Resource Scientist 1/2/3, Environmental Engineer 1/2/3, Environmental Specialist 1/2/3/4/5, Hydrogeologist 1/2/3/4.

5.0 Equipment, Reagents, and Supplies

5.1 pH buffer solution (2 – 3 low or normal ionic strength buffers) that span the typical range of the water to be measured.

5.2 Conductivity standard, typical to the range of water to be measured.

5.3 DO water bath equipped with an aquarium pump and air stone.

5.4 1 liter poly bottle.

5.5 Tap and deionized water.

5.6 DataSonde®, MiniSonde®, or HL4 instrument.

5.7 Surveyor (deck unit) or Surveyor HL with charger.

5.8 5 m cable (calibration or discrete measurements).

5.9 10 m, 25 m, or 25 m cable (profiling).

5.10 Calibration/Storage cup.

5.11 Calibration stand.

5.12 Weighted sensor guard.

5.13 Barometer.

5.14 DataSonde® or MiniSonde® bail kit or HL4 mooring cap (profiling).

5.15 Laptop or tablet (for communication with instrument).

5.16 Hydras 3LT communication software or Hydrolab® Operating Software (HL4).

5.17 Hydras 3LT manual, Surveyor manual, Hydrolab® manual (model-specific).

5.18 Toolbox containing:

- Spare parts: (O-rings, screws, calibration cups, etc.)
- Soft wipes
- Cotton swabs
- Silicone grease
- pH reference electrolyte solution
- pH potassium chloride pellets
- Ethyl alcohol

- Phillips and flathead screwdrivers
- Toothbrush
- Pliers
- Crescent wrench
- Tweezers
- Electrical tape
- "AA," "C," and/or "D" cell batteries
- Allen wrenches
- If using a Clark Cell-equipped Hydrolab®: DO electrolyte, DO membranes, and small scissors

6.0 Summary of Procedure

6.1 Calibration

6.1.1 Recommended Calibration Order

6.1.1.1 DO (LDO or Clark Cell) — can be moved after pH if preferred.

6.1.1.2 Temperature is factory-calibrated (it can be checked against a NIST standard during the DO calibration if using a water bath).

6.1.1.3 Conductivity

6.1.1.4 pH

6.1.1.5 Depth (if needed)

6.1.1.6 TDG, ORP, and rhodamine (if needed)

6.1.2 Preparation of Hydrolab®(s) for calibration

6.1.2.1 Remove battery cover, and install new batteries. Properly dispose of old batteries.

6.1.2.2 Put a thin layer of silicone grease on the O-rings to seal the battery compartment.

6.1.2.3 Re-install the battery cover making sure to only tighten it snug to the O-rings. **IMPORTANT**: Over tightening the battery cover can cause leaking at the O-rings and can crack the battery cover sleeve. These types of damage can cause catastrophic failure of the instrument, resulting in data loss and broken equipment.

6.1.2.4 Inspect the housing and all installed probes for any obvious damage or deficiencies and cleanliness. If there is damage to the housing or probes that would make the Hydrolab® unusable, do not use it, and notify the custodian as soon as possible. If the Hydrolab® is dirty, proceed to 6.1.2.4.1. If the Hydrolab® is visually clean, proceed to 6.1.2.4.2.

6.1.2.4.1 Clean the Hydrolab® housing and probes with a mild detergent and a soft toothbrush. Make sure to clean in between all of the probes. Take care not to scrub the ends of the probes with the toothbrush. This is especially important if the Hydrolab® is equipped with a Clark Cell for DO.

6.1.2.4.2 Gently clean the tip of the DO probe (LDO or Clark Cell) with a dampened cotton swab or soft wipe. Both types of DO sensors can be damaged if too much pressure or vigor is used during cleaning. LDO probes require little maintenance and should only be cleaned under the guidance of a custodian or experienced user. If the membrane of the Clark Cell is torn, wrinkled, or otherwise compromised, replace it following the instructions in the Hydrolab® manual (model specific). Make sure to soak the Clark Cell for at least 4 hours after replacement.

6.1.2.5 Gently clean the glass bulb of the pH sensor and the pH reference electrode with a dampened cotton swab. If the glass bulb and sensor area are really dirty, a soft bristled toothbrush can be used. The glass bulb is fragile, so take care to not break the bulb while cleaning. **Do not use alcohol for cleaning**. If the Hydrolab® has not been used for a long period of time or has had issues with calibration in the past, replace the reference electrolyte and KCl tablets in the reference electrode following the instructions in the Hydrolab® manual (model specific).

6.1.2.6 Firmly wipe the conductivity electrodes with a dampened cotton swab. Alcohol may be used, if necessary.

6.1.2.7 If the Hydrolab® is equipped with a stirrer, remove all iron shavings from in and around the stirrer.

6.1.2.8 Inspect the depth port (pressure sensor) to ensure that there are no blockages. Rinse out if necessary. Do not put anything down the port as the membrane damages easily.

6.1.3 DO Calibration

6.1.3.1 There are several different methods for calibrating a DO sensor. To limit confusion, two options will be presented. The first is the preferred method and the other is a secondary method that can be used if the preferred method is not able to be performed. The preferred method is air saturated water using a water bath and the secondary method is air saturated water by shaking water in a 1 liter bottle. The preferred method provides increased precision and accuracy during calibration. Oversaturation will not occur as long as the water bath is kept at a stable temperature.

6.1.3.2 Whether you have an LDO or Clark Cell, it is recommended that, if there is a large change in elevation between the site of calibration and site(s) of use, the DO probe is calibrated at the site of use to account for changes in barometric pressure.

6.1.3.2.1 Preferred Method: To calibrate using the preferred air saturated water method, assemble a water bath with an air stone and aquarium pump at least 30 minutes prior to calibration. To achieve an accurate calibration, it is important that the temperature of the water bath not change more than 0.5 degrees C during calibration. To achieve a stable temperature in the water bath, let the water sit out overnight so that it can equilibrate to the temperature of the room. A battery operated portable aquarium pump is recommended for field calibrations. Note: For field calibrations, try to maintain stable temperatures by using a larger volume of water and/or calibrating in a vehicle with the AC/heat on and the windows closed.

Place the Hydrolab® in the water bath and let it sit for a minimum of 5 minutes to allow the temperature to equilibrate. To ensure the probes are not damaged during this calibration, make sure that a clean sensor guard is on the Hydrolab®.

To finish the calibration proceed to 6.1.4.

6.1.3.2.2 Secondary Method: Set out a 1 liter bottle half full of tap water with the cap slightly threaded on. Make sure the bottle is out long enough to equilibrate to room temperature. This is best achieved by letting the water sit out overnight.

Install the calibration cup on the Hydrolab® and place it in the calibration stand with a 5 meter cable connected to a Surveyor or Hydras 3 LT.

Tighten the cap and shake the bottle for 40 seconds. Pour the water from the bottle into the calibration cup up to the bottom of the threads. Set the calibration cup cap on top of the calibration cup upside down.

Wait for equilibration, which may take several minutes. Proceed to 6.1.4 to complete the calibration.

6.1.4 If not already completed, connect to a Surveyor or Hydras 3 LT using a 5 meter calibration cable. For specific instructions on connecting to a Hydrolab®, refer to the appropriate user's manual.

6.1.4.1 Once connected to the Hydrolab®, navigate to calibration, and choose the percent saturation option. Record the pre-calibration reading.

6.1.4.2 Record and then enter the current local barometric pressure in millimeters of mercury (mm Hg). If the available barometric pressure is in inches Hg, multiply it by 25.4 to get mm Hg. For detailed steps on calibration of DO using a Surveyor or Hydras 3 LT, consult the corresponding user's manual.

6.1.4.3 Before leaving the DO calibration screen make sure to record the post calibration reading.

6.1.4.4 Use temperature and barometric pressure and the USGS oxygen solubility tables (https://water.usgs.gov/software/DOTABLES) to verify that the calibration was accurate. Record the value from the USGS table. If the calibration was not successful, repeat the calibration process. If a valid calibration cannot be achieved, maintenance on the DO probe is required.

6.1.5 Conductivity Calibration

6.1.5.1 If not already connected, connect the Hydrolab® to a Surveyor or Hydras 3 LT and navigate to the calibration screen. Choose specific conductance. For detailed instructions on how to connect to a Hydrolab® using a Surveyor or Hydras 3 LT and getting to the calibration section of the software consult the corresponding user's manual.

6.1.5.2 Rinse thoroughly with deionized water. It is recommended to remove the calibration cup and pour copious amounts of deionized water from a clean container over the sensors to avoid contamination from the pH reference sensor. The pH reference sensor contains a high conductivity solution used in measuring pH. When rinsing the sensors with the calibration cup attached to the Hydrolab® this solution can be drawn out and contaminate the sensors and cup.

6.1.5.3 After rinsing, reinstall the calibration cup. Note: If expected range is low ~100 µS/cm or less, then do a single point calibration with a zero check in air. If the range exceeds 200 µS/cm, a two point calibration should be performed in addition to a zero check in air.

6.1.5.4 To ensure no pH reference solution has contaminated the calibration cup or sensors, perform an extra deionized water rinse and zero check in air.

6.1.5.5 Tilt the Hydrolab® at a 45-degree angle with the conductivity cell facing down and slowly pour deionized water into the calibration cup until the conductivity cell is barely covered, while avoiding submerging the top of the pH reference electrode (marked by the red line).

6.1.5.6 If the specific conductance is less than 5 µS/cm proceed to 6.1.4.7. If not, carefully pour out the deionized water, and repeat the previous step until the specific conductance is less than 5 µS/cm.

6.1.5.7 After reaching a specific conductance of less than 5 µS/cm, carefully pour out the deionized water and drain any residual water drops by turning the Hydrolab® upside down until water stops dripping. Make sure nothing is trapped inside the conductivity cell.

6.1.5.8 With no liquid in the calibration cup, record the specific conductance reading from the calibration screen. The Hydrolab® should be reading less than 1 µS/cm. If it is higher, repeat 6.1.4.5 – 6.1.4.7 until the specific conductance is less than 1 µS/cm.

6.1.5.9 With the calibration cup in place, rinse the probes 3 times with standard to be used for the calibration. Make sure to follow the instructions from 6.1.4.5 as well as carefully pour out the standard rinse.

6.1.5.10 After rinsing, fill the calibration cup following 6.1.4.5 and carefully place the Hydrolab® in the calibration stand. The concentration of conductivity standard used for calibration will be determined by the expected range of conductivity of the water being studied.

6.1.5.11 Wait 1-2 minutes for a stable reading. If the reading is within 5% of the standard, record the temperature and pre-calibration specific conductance reading from the calibration screen. If the reading is greater than 5% of the standard repeat 6.1.4.9 – 6.1.4.11 until within 5%.

6.1.5.12 Once the Hydrolab® is reading within 5% of the standard, enter the value of the conductivity standard and calibrate the sensor. Record the post calibration reading from the calibration screen. If the calibration fails, the conductivity sensor is in need of maintenance. Note: Saving the used calibration standard for rinsing in future calibrations will save calibration standard.

6.1.5.13 If doing a multi-point calibration follow these steps-After rinsing, reinstall the calibration cup. Note: If expected range is low ~100 µS/cm or less, then do a single point calibration with a zero check in air. If the range exceeds 200 µS/cm, a two point calibration should be performed in addition to a zero check in air.

6.1.5.14 To ensure no pH reference solution has contaminated the calibration cup or sensors, perform an extra deionized water rinse and zero check in air.

6.1.5.15 Tilt the Hydrolab® at a 45-degree angle with the conductivity cell facing down and slowly pour deionized water into the calibration cup until the conductivity cell is barely covered, while avoiding submerging the top of the pH reference electrode (marked by the red line).

6.1.6 pH Calibration

6.1.6.1 The pH sensor can be calibrated with a 2- or 3-point calibration. It is most common for users to use a 2-point calibration. Calibrate the sensor to bracket the expected field readings. A pH 7 buffer must always be the first point in the calibration sequence followed by the 4 or 10 buffer. If doing a 3-point calibration, start with the 7, follow it with the 10 buffer, and then finish with 4 buffer.

6.1.6.2 If not already connected, connect the Hydrolab® to a Surveyor or Hydras 3 LT and navigate to the calibration screen. Choose a 2- or 3-point calibration. For detailed instructions on how to connect to a Hydrolab® using a Surveyor or Hydras 3 LT and getting to the calibration section of the software consult the corresponding user's manual.

6.1.6.3 With the calibration cup installed, rinse the sensors 3 times with deionized water. To do this partially fill the calibration cup with deionized water, cap and shake vigorously for 6 seconds. Empty and repeat.

6.1.6.4 After the deionized water rinse, triple rinse the sensors with each pH buffer prior to the individual calibration. Follow the procedure from 6.1.5.3.

6.1.6.5 Triple rinse the sensors with the pH 7 buffer and then place the Hydrolab® in the calibration stand. Fill the calibration cup with the pH 7 buffer so that it covers the pH sensor by at least one centimeter.

6.1.6.6 Record the pre-calibration reading and temperature from the calibration screen. Enter the temperature corrected value for the pH 7 buffer in the calibration window. Let the sensors sit until a stable reading is achieved, usually within 3-5 minutes.

6.1.6.7 After a stable reading has been achieved calibrate the pH sensor and record the post-calibration reading. If the calibration fails repeat 6.1.5.5 and 6.1.5.6 with a fresh bottle of pH buffer. If repeating the calibration with a fresh bottle of pH buffer does not work, then the pH sensor needs maintenance.

6.1.6.8 For a 2 point or 3 point calibration, repeat 6.1.5.4 – 6.1.5.7 with the selected pH buffer (4 or 10).

6.1.7 <u>Depth Calibration (If needed)</u>

6.1.7.1 It is recommended that for the most accurate depth data that the calibration be done in the field.

6.1.7.2 If not already connected, connect the Hydrolab® to a Surveyor or Hydras 3 LT and navigate to the calibration screen. Choose depth. For detailed instructions on how to connect to a Hydrolab® using a Surveyor or Hydras 3 LT and getting to the calibration section of the software consult the corresponding user's manual.

6.1.7.3 Remove the calibration cup and install the weighted sensor guard. Turn the Hydrolab® so that the sensors are pointing down.

6.1.7.4 Navigate to the depth calibration screen and record the pre-calibration reading.

6.1.7.5 Enter 0 for the calibration standard and calibrate the pressure sensor. Record the post calibration reading. If the calibration fails, the pressure sensor needs maintenance.

6.2 General Field Use

6.2.1 Using a Hydrolab® for discrete measurements or profiling requires a field tablet with the operating software for the selected Hydrolab® or the handheld Surveyor or Surveyor HL (HL4). The user will also need the appropriate length of cable to connect the Hydrolab® to the field tablet or handheld. If the Hydrolab® is to be lowered in any way, a bail kit or mooring cap (HL4) is required for instrument safety. Detailed information on using Hydrolabs® for discrete measurements or profiling is covered in the training. Basic information is also covered in the user's manual.

6.2.2 Using a Hydrolab® for unattended deployments is complex and highly variable and will be covered in training. Basic information is covered in the user's manual. Tips for collecting more precise and accurate data while in the field are located in the Hydrolab® section of EAPs SharePoint site. Further detailed guidance for unattended deployments can be found in EAP SOP 129 (Mathieu and Stuart, 2019). Note: If a Hydrolab® being used for an unattended deployment is equipped with a Clark Cell for measuring DO, it is best to place it in an area around 1 cubic foot per second of water flow.

6.2.3 After using any Hydrolab®, make sure to clean it following the procedures in 6.1.2 and note and communicate any deficiencies to the custodian.

6.3 Short-term storage (1 day to 3 months)

6.3.1 If not already completed, clean the Hydrolab® following procedures in 6.1.2. Keep a minimal amount of tap water or pH 4 buffer (about ½ inch) in the calibration cup. A clear pH 4 buffer without red dye is recommended for Hydrolabs® equipped with a rhodamine sensor. Do not use any other type of water unless it's the only water available.

6.4 Long-term storage (over 3 months)

6.4.1 Follow section 6.3 procedures. In addition, remove external batteries, but do not remove the lithium battery which powers the Hydrolabs® internal time clock.

6.5 Equipment protection (theft)

6.5.1 Hydrolabs® deployed in small creeks and clear rivers are easily seen. To avoid problems with theft and vandalism, hide them carefully. Deploy Hydrolabs® upstream or downstream of public access areas, private property, or places where boaters and swimmers can see them. Under overhanging vegetation or behind instream rocks and fallen trees are often good places to hide them, as long as water circulation is not limited.

6.5.2 Do not use large floats or anchors in smaller streams; they attract attention. Instead, note where the Hydrolab® is and cover it as much as possible while maintaining good water flow past the sensors. Small cement blocks work well as anchors. If the Hydrolab® is deployed in a large river, floats, line, and larger anchors may be necessary. See an experienced Hydrolab user for further details.

6.5.3 If you cannot find a Hydrolab® and suspect theft is the cause, visit the local police station and fill out a report. Ecology has also located lost equipment by running ads in local papers.

7.0 Records Management

7.1 Reservations and problem reports will be made in the Hydrolab® section of the EAP's SharePoint site.

7.2 Calibration forms and any field forms will be stored electronically or in hardcopy form by the project manager in a designated location. In addition, if there are any calibration files available from the Hydrolab® these files will be downloaded and stored in a location designated by the project manager.

7.3 If the Hydrolab®(s) are used for a deployment, the log files created will be downloaded from the Hydrolab® and stored in electronic format in a location designated by the project manager.

8.0 Quality Control and Quality Assurance

8.1 Hydrolabs® should be calibrated before each use and then checked against standards after each use. Post checking against standards should be completed following the procedures in the calibrations section. The post check process differs in that it involves measuring the value of the standard, not calibrating to them. All calibration and post use data should be recorded in a field form (paper or electronic) and stored in a location designated by the project manager.

8.2 In addition to calibration prior to use and post checks after use, intermediate checks should be conducted. These checks will differ if the Hydrolab® is being used for discrete measurements or has been deployed.

8.2.1 Intermediate checks for discrete measurements should include Winkler samples at the beginning, middle, and end of the day for DO. For the other parameters, an end-of-day standards check is recommended. These checks should be done for each day of discrete use.

8.2.2 Intermediate checks for a deployed Hydrolab® should include:

8.2.2.1 Upon deployment, field staff should collect a Winkler sample and, for other parameters, a check measurement with another Hydrolab® or equivalent hand-held meter.

8.2.2.2 For DO, Winkler samples should be collected to bracket the expected high and low points for DO. With a minimum of one Winkler mid-deployment. Procedures for Winkler Samples should be followed as is outlined in the SOP Collection and Analysis of Dissolved Oxygen (Winkler Method) EAP023.

8.2.2.3 For the other parameters, checks with another Hydrolab® or equivalent hand-held meter should be conducted over the expected range of the parameter being measured. At a minimum, one intermediate check should be completed for a short deployment (one week or less).

8.2.2.4 The number of intermediate check measurements will be dictated by the length of deployment and the requirements described in the associated Quality Assurance Project Plan.

8.2.2.5 Upon retrieval of the deployed Hydrolab®, field staff should collect a final Winkler sample and, for other parameters, a check measurement with another Hydrolab® or equivalent hand-held meter.

8.2.2.6 This field check regime will provide a minimum of three checks per deployment and help identify if instrument drift occurs.

8.2.3 Additional quality checks for discrete or deployed use will be dealt with on a project by project basis in the Quality Assurance Project Plan.

8.3 Specific measurement quality objectives should also be developed in the QAPP. At a minimum the following objectives are recommended for post and intermediate checks:

Parameter	Units	Accept	Qualify	Reject
pH	Std. units	< or = ± 0.3	> ± 0.3 and < or = ± 1.0	> ± 1.0
Conductivity	µS/cm	< or = ± 10%	> ± 10% and < or = ± 20%	> ± 20%
Temperature	°C	< or = ± 0.2	> ± 0.2 and < or = ± 1.0	> ± 1.0
Dissolved Oxygen	mg/L	< or = ± 0.3	> ± 0.3 and < or = ± 1.0	> ± 1.0
Dissolved Oxygen	% saturation	< or = ± 5%	> ± 0.3 and < or = ± 15%	> ± 15%

8.4 When traveling from site to site, make sure the Hydrolab® sensors are kept moist so they don't dry out and become inaccurate. It is recommended to only use tap water in the calibration cup to keep the sensors moist. If site water is all that is available, make sure to change it out with tap water as soon as possible.

8.5 Although Hydrolab® equipment is robust and made for heavy field use, it should be handled with care at all times. This is especially true when removing and replacing the calibration cup and sensor guard.

9.0 Safety

9.1 Conductivity standards, pH buffers, DO and pH reference solutions are nontoxic, but can irritate eyes and other sensitive areas because of their high salt content. Rhodamine dye is also relatively nontoxic, but it stains everything it contacts.

9.2 Wash hands thoroughly after calibration or after use in contaminated waters.

9.3 When using a Hydrolab® in the field, be aware of your surroundings. Select an area in which you feel safe and secure from hazards.

9.4 For further field safety measures consult the EAP safety manual (EAP, 2019).

10.0 References

10.1 Environmental Assessment Program (EAP), 2019. Environmental Assessment Program Safety Manual. Washington State Department of Ecology, Olympia. Revised 03/19

10.2 Mathieu, M. and T. Stuart, 2019. Standard Operating Procedure EAP129, Version 1.0: Short-term Continuous Data Collection with a Multiparameter Sonde, Part 1: Field Procedures. Washington State Department of Ecology, Olympia. ecology.wa.gov/quality.

10.3 Ward, W. 2016. Standard Operating Procedure EAP023, Version 2.5: Collection and Analysis of Dissolved Oxygen (Winkler Method). Washington State Department of Ecology, Olympia. https://fortress.wa.gov/ecy/publications/SummaryPages/1703202.html.

Appendix A

Reservations for Lacey office Hydrolab® equipment must be made on EAP's SharePoint site. Click on "Reservations" and then "Hydrolab® Reservations" to reserve Hydrolabs® and related equipment on the reservations calendar. Equipment information and specifications are also on EAPs SharePoint site under "Hydrolab® Reservations." For use of Hydrolab® equipment from the Central or Eastern Regional offices, contact the appropriate custodian.