DEPARTMENT OF ECOLOGY
State of Washington

Standard Operating Procedure EAP097, Version 1.2

Collection of Longitudinal Stream Depth Profiles

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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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Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedures for Collection of Longitudinal Stream Depth Profiles

Version 1.2

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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.

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	Rev number	Summary of changes	Sections	Reviser(s)
8/10/2015	1.0	Minor editorial to EAP097	Cover page	Kammin
10/23/2018	1.1	Minor editorial changes	All	Stuart
12/21/2018	1.1	Accessibility and formatting updates	All	Froese
12/1/2021	1.2	Recertified	All	Kaza

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for Collection of Longitudinal Stream Depth Profiles using a small watercraft such as a canoe, kayak, or raft.

1.2 Stream water quality models, such as those used for Total Maximum Daily Load (TMDL) studies, depend on having an accurate representation of channel geometry, including depth, width, and velocity. Channel survey techniques utilized only at selected locations often do not provide an adequate characterization of depth. In many streams, depth can vary greatly within small distances, and the use of a supposed "average" depth condition in a variable system can greatly confound modeling efforts. This SOP provides a method for collecting a continuous depth profile along the length of a stream (longitudinally).

1.3 This technique also has other applications. For example, continuous profiles of temperature, conductivity, and dissolved oxygen can also be collected simultaneously, and this data can be used to pinpoint springs and groundwater inputs.

2.0 Applicability

2.1 This SOP should be followed when collecting a longitudinal profile of stream depth from a small watercraft such as a canoe, kayak, or raft. It is intended primarily for use on creeks and small to medium-sized rivers.

3.0 Definitions

3.1 Longitudinal – data along the length of a stream

3.2 GPS – Geographic Positioning System

3.3 PVC – Polyvinyl chloride

4.0 Personnel Qualifications/Responsibilities

4.1 This type of field work requires two technicians to safely perform.

4.2 Staff performing this task need to be trained and have experience using Hydrolab® multiprobes. (See EAP SOP033) Hydrolab experience should include creating and downloading log files.

4.3 Staff performing this task need to be experienced using whatever type of small watercraft is selected, and have the ability to use the craft safely in challenging situations.

5.0 Equipment, Reagents, and Supplies

5.1 Canoe, Kayak, or Raft

5.2 Small outboard motor (optional, more commonly used with raft)

5.3 Paddles or oars

5.4 Personal flotation devices (PFDs)

5.5 Hydrolab Tow Setup:

5.5.1 Hydrolab MiniSonde® equipped with depth sensor (preferably a smaller-range depth sensor, such as 25m with a minimum of 0.01m resolution)

5.5.2 Screw-on weighted sensor cage for MiniSonde®.

5.5.3 Hydrolab Surveyor® deck unit equipped with GPS and internal memory, fully charged. EAP has two of these deck units, one at HQ and one at ERO. As of 2014, Hach® no longer offers the GPS option on Surveyors. However the new surveyor HL will include this option.

5.5.4 GPS receiver antenna to plug into deck unit

5.5.5 10-meter Hydrolab cable (note that normal Hydrolab cables are only 5 meters)

5.5.6 "Split" or "Y" Hydrolab cable, which connects to the deck unit, to the 10-meter Hydrolab cable, and to the external battery

5.5.7 "Double serial" Hydrolab cable, for connecting deck unit to laptop

5.5.8 Hydrolab external 12-V battery

5.5.9 Hydrolab accessories, such as repair toolkit and calibration standards

5.5.10 Wooden "clamp block" with wing nuts, for securing tension in the length of Hydrolab cable that is inside the PVC tube

5.6 Alternate Tow Setup:

5.6.1 Pressure transducer/logger (submerged at stream bottom) – minimum <0.3 ft accuracy (Figure 4 – left).

5.6.2 Pressure transducer/logger with barometric pressure (in boat) (Figure 4 – right).

5.6.3 Optional: Fast response temperature logger – minimum <0.3°C accuracy; <20 sec response time (Figure 5).

5.6.4 GPS device with route tracking capability

5.6.5 Well vented plastic container for barometric pressure transducer.

5.7 20-ft PVC tube, which generally consists of two 10-ft sections that screw together in the middle.

5.8 Flared PVC cage with holes drilled in sides, which screws into lower end of 20-ft tube.

5.9 PVC repair materials in case of PVC breakage at remote location. This should include spare PVC fittings, PVC primer and glue, and a hacksaw.

5.10 Rope for attaching upper end of 20-ft PVC tube to watercraft

5.11 Foam weather-stripping

5.12 Duct tape (copious quantities)

5.13 Electric tape

5.14 1-gallon Ziploc bags

5.15 Cooler or other object to function as desk (optional, depends on watercraft being used)

5.16 Bungee cords (optional, to secure Surveyor® deck unit and GPS antenna to top of cooler)

5.17 Drybag

5.18 Rite-in-the-rain notebook and pencils

5.19 Laptop computer equipped with HyperTerminal, TerraTerm, or equivalent communications software. (Only needed for downloading data after the float)

5.20 High quality ("hiccup" free) Serial-to-USB adapter (if laptop does not have a serial port)

6.0 Summary of Procedure

6.1 Important considerations before embarking on float *Watercraft selection*. For most streams, and particularly those that tend to be shallow and rocky, a plastic canoe is ideal. Plastic canoes are relatively light, can handle a large amount of scraping against rocky substrate, and have adequate space to store and set up equipment. However, canoes are not very stable and do not handle well at all in fast-moving water, whitewater, standing waves, etc. For larger or faster streams, where stability may be an issue, but where shallow riffles with rocks (which might tear a raft) are not expected to be an issue, a raft may be a better choice. Kayaks have also been used successfully. Note that this protocol requires carrying electrical equipment, not all of which is waterproof, inside the craft. Therefore, capsizing may well lead to a loss of equipment and/or data, and is to be avoided.

6.1.2 *Flow conditions.* Some streams are floatable across a variety of flow conditions. In these streams, the float may be timed for a flow condition that is closest to what is desired for modeling purposes, e.g. low flow conditions. Some streams are only floatable during certain specific flow conditions. For example, some streams may be very unsafe to float during high-flow conditions, but too shallow to float at low flow. In such streams there may be a medium-flow condition that is low enough to be safe, but high enough to avoid excessive "getting out and push" over shallow sections. Some streams may never be safe to float.

6.1.3 *Distance that can be covered*. On most streams, it is possible to float 10 miles in a long day, sometimes more. However on streams with many obstacles that require portaging or pushing, the distance that can be covered in a day may be less than 10 miles.

6.1.4 *Tow setup selection*. Two options are available: 1). Hydrolab multiparameter sonde or 2). Pressure transducers with separate temperature logger.

6.1.4.1 *Hydrolab sonde:* Advantages of this setup are: 1). all parameters are displayed live on the surveyor, allowing the operator to troubleshoot potential sensor issues; 2). The GPS and water quality data are automatically synced and download on to one file. 3) Water quality parameters such as specific conductance, dissolved oxygen, and pH are available to provide additional information about potential groundwater inputs. The disadvantages are: 1) the sonde is not designed for this type of deployment, and even with protective measures, damage to equipment may occur; replacement or repair is expensive. 2) an external power source is required which adds weight to the craft and could be damaged if craft capsizes or takes on water.

6.1.4.2 *Pressure transducer:* Advantages of this setup are: 1). Highly accurate depth data; 2). No need for external power source; 3) The equipment is rugged and relatively inexpensive to replace; 4) a smaller diameter, more flexible PVC can be used in the setup. The disadvantages are: 1) the data is logged with no display, user must remove from tow pipe and download to view data; 2) times and logging intervals on the pressure transducer, temperature logger, and GPS unit must be synced before survey and data from all three sources must be combined later.

6.2 Equipment set-up – Hydrolab Sonde

6.2.1 Calibrate conventional parameters on Hydrolab minisonde®. (See EAP SOP033). This step is optional if you are only interested in depth data and not planning to use any other parameters. However, it is highly recommended to go ahead and calibrate dissolved oxygen, pH, and conductivity, as these data often turn out to be useful. Make sure the MiniSonde has 8 fresh AA batteries in it.

6.2.2 At the put-in site, within easy carrying distance of water, assemble the PVC equipment that rides behind the watercraft and carries the MiniSonde along the channel bottom. Attach the two 10-ft sections that form the 20-ft length of pipe that separate the watercraft from the cage. These two sections have a threaded connection that can be twisted together. Then attach the PVC cage to the end away from the watercraft. This also has a threaded connection. Figure 1 shows how the PVC setup should look. However, do not rope the front end of the pipe to the watercraft yet.

Figure 1. PVC assembly for carrying Hydrolab MiniSonde® along streambed behind small watercraft.

6.2.3 Feed the 10-m Hydrolab cable through the PVC assembly so that the underwater connection is sticking out through the end of the PVC cage, and the serial end is sticking out the end of the pipe near the watercraft.

6.2.4 Attach the MiniSonde to the underwater end of the cable using the threaded connector. Remove the calibration cup from the MiniSonde and replace it with the weighted Hydrolab cage if you have not already done so.

6.2.5 Wrap the O-ring joints on the MiniSonde several times with electric tape. (If you hold the MiniSonde with the probes facing down, there is one joint just above where the weighted cage screws on, and another at the lower edge of the battery case.) Alternately, wrap the entire MiniSonde (except of course the weighted cage) with electric tape.

6.2.6 Wrap the MiniSonde (except of course the weighted cage) in weather stripping. Wrap the weather stripping around the MiniSonde in a spiral pattern. Note that you do not want to entirely cover the MiniSonde in weather stripping—three or four wraps to span the length of the MiniSonde is about right. The thickness of weather stripping to use for this depends on the amount of airspace between the MiniSonde body and the inside of the upper (skinny) part of the PVC cage. If you cannot get the MiniSonde all the way into the PVC cage, try using thinner weather stripping or wrapping fewer times. If the MiniSonde is loose or wiggles in the PVC cage, try thicker weather stripping or wrapping more times.

6.2.7 Insert the MiniSonde into the PVC cage. This is generally a two-person job. One person inserts the MiniSonde (with weather stripping) into the PVC cage using a twisting motion. The weather stripping essentially functions as screw threads, and the MiniSonde gets screwed into the cage. The other person stands at the opposite end of the PVC pipe holds the Hydrolab cable, keeping a bit of tension in it. Figure 2 shows how the MiniSonde inside the PVC cage looks once this is done.

Figure 2. Hydrolab MiniSonde® properly seated inside PVC cage.

6.2.8 Making sure that the length of Hydrolab cable inside the PVC pipe is taut, attach the wooden clamp block to the cable such that the block rests against the end of the pipe, and prevents the cable inside the pipe from going slack. Notice that there are two things that prevent the MiniSonde from sliding out of the PVC cage during the float: 1.) the weather stripping; and 2.) the tension in the Hydrolab cable, anchored by the clamp block.

6.2.9 Connect the front end of the PVC pipe to the stern of the watercraft with rope, leaving some slack. See Figure 1.

6.2.10 Connect the Hydrolab electronics. The serial connection at the upper end of the 10m cable (the end now sticking out of the PVC tube, near the watercraft) connects to the corresponding end of the "split" cable. The round connecter end of the split cable connects to the 12V Hydrolab battery. The remaining serial connector on the split cable connects to the deck unit. The GPS antenna plugs into the round port next to the serial port on the deck unit. Figure 3 shows a schematic of how the electronics connect.

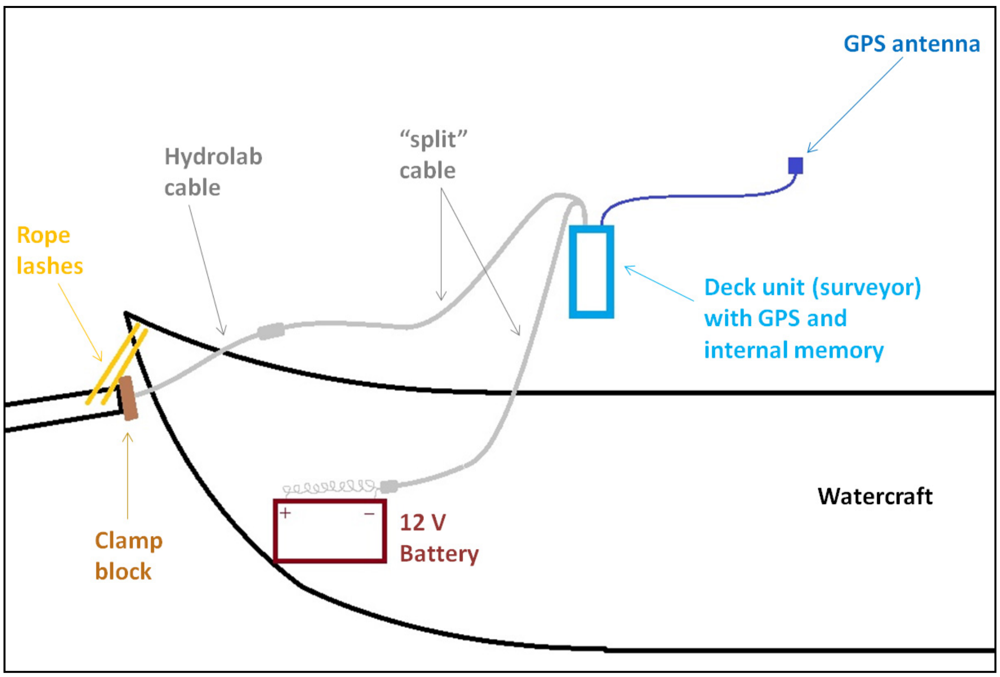

Figure 3. Arrangement of Hydrolab cables and electronics at the stern of the watercraft.

6.2.11 Cover all PVC joints and sharp edges with copious amounts of duct tape. Figures 1 and 2 show how this will look. The purpose of this is to prevent blunt or sharp PVC edges from catching on sharp rocks while being dragged along the streambed.

6.2.12 Turn on Surveyor deck unit. Disable automatic time-out for display and for total shut-down. Set up the tabular display on the deck unit so that it includes D/TSvr4, IBVSvr4 (Internal Battery Voltage), XBVSvr4 (External Battery Voltage), LatitudeDMS, LongitudeDMS, Depth in meters, and any other parameters you desire to log. Ensure that all parameters being sent from the MiniSonde are displaying values correctly. Ensure that LatitudeDMS and LongitudeDMS are displaying, and are correctly defining your location. Ensure that XBV reads somewhere near 12 volts, which indicates that the external battery is connected and working properly.

6.2.13 Once you have confirmed that the external 12V Hydrolab battery is working properly, make a semiwatertight pouch for the battery. This is done using two one-gallon Ziploc bags. Making sure the battery is in its padded cloth carrying case, and that the top flap is velcroed down, insert one end of the battery into one of the Ziploc bags, as far as it will go. Cover the other end with the other bag, overlapping the bags as much as possible. Stuff the battery cable into the bag, to the point where the connection between the battery cable and the split cable is inside the bag. Then, duct tape the whole thing together, so that all the joints between the bags are covered, and only the split cable is sticking out of the pouch. Place the pouch in a drybag, securely close the drybag so only the cable is sticking out of it, and put the drybag in a secure place in the stern of the watercraft where the cable will reach. Note that the purpose of all this is to protect the battery from water splashing into the watercraft. This will probably not save your equipment if you capsize.

6.2.14 Set up log file using the controls on the Surveyor. Note that unlike most Hydrolab deployments, where the log file is stored in the sonde, in this case the log file needs to be stored in the deck unit. It is suggested to use a logging interval of 30 seconds, which is the smallest logging interval the surveyor will accept.

6.2.15 If you are not already there, move the watercraft to the edge of the water and prepare to launch. It may be convenient to set a cooler or other object in front of the person sitting in the stern for use as a desk, and to bungee cord or duct tape the deck unit and GPS antenna to this surface.

6.2.16 The very last thing to do before launching is to zero the depth probe. Make sure the PVC pipe and cage assembly are laid out flat behind the watercraft, with the MiniSonde sitting out of the water. The deck unit commands for zeroing the depth probe are the same as for calibrating any other parameter.

6.3 Equipment setup – pressure transducer

6.3.1 Calibrate pressure transducers (Figure 4), one for water depth and one for barometric pressure, following manufacturer’s instructions and EAP SOP 074: Standard Operating Procedure for the use of Submersible Pressure Transducers during Groundwater Studies (Sinclair and Pitz, 2010).

Figure 4. (Left) example of basic pressure transducer with adequate vertical accuracy for stream bottom deployment. (Right) example of pressure transducer with barometric pressure for use in watercraft (or bottom).

6.3.2 Perform a calibration check on temperature logger (Figure 5) following EAP SOP 044: Standard Operating Procedure for continuous temperature monitoring of fresh water rivers and streams conducted in a Total Maximum Daily Load (TMDL) project for stream temperature (Bilhimer and Stohr, 2009).

Figure 5. Example of fast-response temperature logger with external probe.

6.3.3 Sync depth and temperature logger times with computer system time. If computer is not connected to a network, verify that system time is accurate using world atomic clock (can be found on the internet). Setup all three loggers with exact same start time and logging interval. A minimum of 30-second logging interval is recommended to accurately capture changes in depth and temperature.

6.3.4 Prepare GPS unit: 1) make sure two sets of batteries are fully charged, store spare batteries in dry bag; 2) make sure that GPS device system time is synced with laptop or computer system time used to set the time on depth and temperature loggers; 3) turn on GPS connection and establish satellite connection, verify that connection has been established and coordinates change with movement; 4) open GPS software, save and name new file, and begin route tracking (as boat begins to move downstream verify that route tracking is working properly). If possible, set route tracking interval to match logger recording interval.

6.3.5 Assemble PVC equipment following section 6.2.2.

6.3.6 Feed a steel cable or rope through the PVC assembly so that the one end is sticking out through the end of the PVC cage and one end is sticking out the end of the pipe near the watercraft

6.3.7 Attach one pressure transducer and the temperature logger to the underwater end of the cable/rope. Attach temperature logger first with probe facing back up the PVC pipe; use a small loop of wire to connect pressure transducer to end of safety line. Cover any exposed wire that is near or touching the loggers with electrical tape.

6.3.8 Wrap the entire body of the loggers in electrical tape. Do not cover the hole in the transducer or external probe on the temperature logger. Wrap each sensor with enough weather stripping to fit snugly in the PVC cage assembly; apply weather stripping on top of electrical tape.

6.3.9 Insert loggers into PVC cage (temperature first, then depth) similar to section 6.2.7.

6.3.10 Attach PVC pipe to watercraft following section 6.2.9, then attach logger safety line to watercraft.

6.3.11 Cover all PVC joints and sharp edges with duct tape following 6.2.11.

6.3.12 Place barometric pressure transducer inside well-vented container and attach securely somewhere inside the watercraft.

6.3.13 Move the watercraft to the edge of the water, and prepare to launch.

6.3.14 Move the PVC cage out above the water, where the depth is several feet deep. Gently release cage at surface. If the cage sinks quickly, then the setup likely has negative or neutral buoyancy and is float-ready. If the cage sinks slowly or floats, the buoyancy needs to be reduced. Two options: 1) drill additional pressure relief holes in the submerged PVC pipe above the cage; 2) add additional weight inside the pipe; this can be accomplished by placing steel rebar inside, but requires placing a cross bolt through the pipe to prevent the rebar from sliding down to the sensors.

6.3.15 After launching, pay close attention to the look and feel of the PVC cage. Ideally, you should be able to feel the cage gently bouncing on the bottom. The goal is to optimize the buoyancy of your equipment setup so that the cage stays on the bottom but doesn't provide a lot of drag on the watercraft and can easily move over objects on the streambed. Faster moving water will require more weight (less buoyancy) and slower moving waters will require less weight (more buoyancy).

6.4 FloatingNavigate the watercraft down the stream channel, trying to stay in the thalweg as much as possible.

6.4.2 Avoid letting the PVC cage track beside or ahead of the watercraft. This places stress on the PVC joints and can cause damage to the PVC setup. In wadeable areas, step out of the watercraft and reposition the cage behind the watercraft; in non-wadeable areas, paddle to the nearest stream bank and reposition the cage there.

6.4.3 In areas with visual evidence of GW input (seeps, orange staining, etc.) or in large pools, allow the watercraft to drift slowly to thoroughly characterize the depth and water quality of these features.

6.4.4 Periodically check the GPS coordinates to verify that they are changing, a connection is still established, and the route is still tracking. For pressure transducer setup, make sure to save the GPS file frequently to avoid potential data loss.

6.4.5 Every couple of hours, or if there has been a significant change in elevation, stop and pull the cage containing the MiniSonde out of the water. Check to make sure that the depth still reads 0.00 when the MiniSonde is out of the water. If not, make a note and re-zero the probe. Inspect all equipment and re-tape any joints where the duct tape has worn down.

6.4.6 For Hydrolab setup, after the float, connect the deck unit to the laptop using the "double serial" cable. Download the log file from the deck unit to the laptop using an Xmodem transfer. This will require use of TeraTerm, HyperTerminal, or other similar communications software on the laptop.

6.4.7 For pressure transducer setup, after the float save the GPS file and then disconnect device. Remove the loggers and download to laptop or field PC using appropriate docking stations or equipment cables. If floating multiple days, download the loggers each evening to safeguard against data loss. Data from the barometric pressure transducer is used to correct the unvented transducer on the stream bottom. Most equipment software is setup to allow for easy correction of this data. For details on manual correction see EAP SOP 074 (Sinclair and Pitz, 2010).

7.0 Records Management

7.1 Keep all notes in a Rite-in-the-Rain notebook. These notes should include depth probe calibration checks, observations, pictures taken, or any other ancillary data collected.

7.2 By far the most important record generated during the float is the log file that is recorded on the deck unit. After downloading the log file to the laptop, this log file should be placed on a shared drive location. An original, unedited version of the log file should always be retained, and any data calculations should be made in a copy.

7.3 As of 2018, it is not possible to enter float data into EIM. This is because EIM accepts discrete or continuous data that is linked to particular locations. This procedure generates data that is "spatially continuous," consisting of a dense series of points that define locations along the length of a stream, each with attached data values. This type of dataset is not compatible with the format of EIM.

8.0 Quality Control and Quality Assurance Section

8.1 The depth probe used by Hydrolab MiniSondes is an unvented probe. This means that it is sensitive to changes in barometric pressure and elevation. It is important to realize that calibrating or zeroing this probe at the OC and then driving to the put-in site will most likely result in a calibration shift. That is why this SOP specifies that the probe is to be zeroed at the launch site, immediately prior to launch. Any time the zero point is checked and/or the probe is re-zeroed during the float, a note should be made and retained.

8.2 All other parameters that are being logged should be calibrated prior to the float, and checked afterward, per EAP SOP 033.

8.3 If dissolved oxygen data is to be used, then either 1.) an LDO probe needs to be used; 2.) the circulator needs to be turned on to use a Clark cell probe. Note that circulator use during a float can be problematic because of the tendency of the magnetic circulator paddle to pick up iron shards from the streambed. On the other hand, LDO probes have a greater power draw than Clark cell probes, which could be an issue, since the sonde is continuously powered up during the float. If dissolved oxygen data is to be used for model calibration, regulatory, or other uses that require accuracy better than ~1 mg/L, then a few Winkler dissolved oxygen samples should be taken alongside the probe measurements. See EAP SOP 023

8.4 A common source of data loss during depth floats is Hydrolab power failure. The MiniSonde and the deck unit are powered up continuously for the duration of the float, creating significant power needs. The best approach to avoid power loss is to make sure that 1.) there are fresh AA batteries installed in the MiniSonde; 2.) the deck unit is fully charged; and 3.) the external battery is fully charged and all connections are good. This way, even if one battery/set of batteries fails, the equipment can continue to operate on the remaining power sources at least for a little while.

8.5 High aeration caused by rapids can interfere with accurate the accuracy of the depth probes. Areas of high aeration/whitewater should be recorded in field notes, and depth data from these areas should be reviewed to make sure it makes sense.

9.0 Safety

9.1 A personal flotation device (PFD) must be worn (Ecology, 2017).

9.2 Collecting a longitudinal stream depth profile can involve a variety of hazards and challenges. The streams and rivers where Ecology needs to collect depth data are often "off the beaten path." There is no guarantee that a given stream or river will be logistically feasible or safe to float. Streams and rivers can contain numerous obstacles and hazards:

- Larger-than-expected rapids
- Waterfalls – although large waterfalls are usually named, mapped, and well-known, smaller waterfalls and steps several feet high can often exist without being well documented. In certain geological regions, such as the channeled scablands of Eastern Washington, waterfalls can exist at surprising locations on otherwise low-gradient streams.
- Bridges too low for staff in a watercraft to duck under
- Logs across the channel, especially "spanners" in the air that may be too low to duck under
- Tree foliage that overhangs the channel, possibly creating "strainers" that could catch or capsize a watercraft.
- Sharp corners in high-velocity rapids that can throw the watercraft violently against the outside bank
- Boulders that sit just below the water surface
- Barbed-wire fences strung low across the stream
- Electric fences strung low across the stream
- Rocks and shallow riffles that the watercraft can get hung up on, requiring staff to get out and push.
- Stoppers or "keepers" where re-circulating current can trap the watercraft or boater; avoid whitewater where the rapids resemble a frowning mouth.
- Landowner confrontations. In Washington, the bedlands of rivers and streams which are defined as "navigable" are generally state owned, either to the Line of Navigability or to the Line of Ordinary High Water (DNR, 2010). However, there are exceptions. It is the responsibility of staff to make sure they either stay on public lands or have permission to be on any private lands. When floating state-owned streams, staff should be aware that some adjacent landowners may not know that the stream is state-owned, and that confrontations are still a possibility.

9.3 If staff are not intimately acquainted with the stream that is to be floated, then good reconnaissance is a very important safety step. This should include driving along the stream to get an idea of what the stream is like and look for hazards. Reconnaissance should also include familiarization with streamflow patterns. USGS gaging stations generally have records of individual streamflow measurements along with continuous flow data. These individual streamflow measurements usually contain ancillary data such as channel depth and channel velocity. These records can be used to get an idea of what depth and velocities might be expected at a given streamflow. This can help guide decisions about what flow conditions to float at. Also, it is strongly recommended that staff conduct a "virtual fly-over" using online or GIS orthophotos. This should be done at a resolution of about 1:1000, slowly scrolling along the course of the stream to be floated. This "virtual fly-over" can often identify hazards such as logjams and waterfalls.

9.4 Ultimately the decision about which stream reaches are safe to float, and at what streamflow conditions, is a complex one. The use of common sense is recommended.

9.5 Chemical Safety Data Sheets (SDSs) for all chemicals used in the procedures outlined in this SOP can be found on the EAP SharePoint site. Also, binders containing SDSs can be found in all field vehicles, vessels, Ecology buildings, or other locations where potentially hazardous chemicals may be handled. EAP staff that follow Ecology SOPs are required to familiarize themselves with these SDSs and take the appropriate safety measures for these chemicals. Refer to attached MSDS sheets if using PVC purple primer and PVC glue.

10.0 References

10.1 Ecology, 2017. Environmental Assessment Program Safety Manual. Washington State Department of Ecology, Olympia.

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