DEPARTMENT OF
ECOLOGY
State of Washington

**Standard Operating Procedure
EAP107, Version 1.0**

**Measuring Transect Coordinates with a
Global Positioning System (GPS)**

Publication information

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Purpose of this document

The 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.

Washington State Department of Ecology

Environmental Assessment Program

Watershed Health Monitoring: Standard Operating Procedures for Measuring Transect Coordinates with a Global Positioning System (GPS)

Version 1.1.0

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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.

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	Rev number	Summary of changes	Sections	Reviser(s)
12/29/16	1.0	Draft Status	All	Jenny Wolfe
10/8/18	1.0	Peer review	All	Meghan Rosewood-Thurman
10/8/18	1.0	Certified	All	Arati Kaza

Environmental Assessment Program

Watershed Health Monitoring: Standard Operating Procedures for Measuring Transect Coordinates with a Global Positioning System (GPS)

1.0   Purpose and Scope

1.1   This document is the Environmental Assessment Program's (EAP) Standard Operating Procedure (SOP) for capturing Global Positioning System (GPS) field coordinates of rivers and streams during a Data Collection Event (DCE) for the Watershed Health Monitoring (WHM) Program. It includes procedures for both the "narrow protocol" and the "wide protocol." The narrow protocol is typically accomplished by wading upstream. The wide protocol is typically accomplished by floating downstream on rafts.

2.0   Applicability

2.1   This SOP is used in conjunction with several others to complete a DCE for the WHM program. This method is applied to the area within the main channel at multiple locations throughout the site. Follow the method outlined in this SOP only after the site verification and layout procedures have been completed using EAP106 (Merritt, 2017).

3.0   Definitions

3.1   Bankfull Stage: This stage is delineated by the elevation point of incipient flooding, indicated by deposits of sand or silt at the active scour mark, break in stream bank slope, perennial vegetation limit, rock discoloration, and root hair exposure (Endreny, 2003).

3.2   Bankfull Width: Horizontal distance between the bankfull stage on the left bank and the bankfull stage on the right bank. For WHM, this is measured to the nearest tenth of a meter.

3.3   DCE: The Data Collection Event is the sampling event for the given protocol. Data for a DCE are indexed using a code which includes the site ID followed by the year, month, day, and the time (military) for the start time of the sampling event. For example: WAM06600-000222-DCE-YYYY-MMDD-HH:MM. One DCE should be completed within one working day, lasting 4 - 6 hours, on average.

3.4   Ecology: The Washington State Department of Ecology

3.5   GIS: A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface (National Geographic Society, 2017a).

3.6   GPS: A global positioning system (GPS) is a network of satellites and receiving devices used to determine the location of something on Earth (National Geographic Society, 2017b). The WHM crew references the GPS to identify coordinates using a hand-held receiver or an onboard receiver within the data recording tablet.

3.7   Index Station: The distinct point location mapped by the site coordinates obtained from the Washington Master Sample List. The index station is called "X" and is generally located at major transect F; however the point may occur at any elevation in the stream between transects A and K (see Table 1 and Figure 2).

3.8   Main Channel: Channels in a stream are divided by islands (dry ground that rises above bankfull stage). Main channels contain the greatest proportion of flow.

3.9   Major Transect: One of 11 equidistant transects across the length of a site. These transects run perpendicular to the thalweg and are labeled as follows: A (furthest downstream), B, C, D, E, F, G, H, I, J, and K (furthest upstream) (see Table 1 and Figure 2).

3.10   NAD83: The North American Datum of 1983 is one of various models that use thousands of survey monuments and triangulation to create reference frames for Earth. These reference frames (datums) allow mappers to accurately place locations on Earth with latitude and longitude (GISGeography, 2017). Datums can be set on Garmin GPSmap 62 handheld units using "menu," "setup," and "position format."

3.11   Narrow Protocol: The set of Watershed Health Monitoring (WHM) SOPs that describe data collection at wadeable sites with an average bankfull width of less than 25 m at the index station.

3.12   QAMP: Quality Assurance Monitoring Plan. The QAMP for WHM is Cusimano *et al.* (2006). An updated version will be available in early 2019.

3.13   Site: A site is defined by the coordinates provided to a sampling crew and the boundaries established by the protocol's site layout method: Hartman, 2017, SOP EAP105, for the Wide Protocol and Merritt, 2017, SOP EAP106 for the Narrow protocol. Typically, a site is centered on the index station and equal in length to 20 times the average of 5 bankfull width measurements. Sites cannot be longer than 2 km nor shorter than 150 m. Narrow protocol sites range from 150 m to 500 m long. wide protocol sites are up to 2 km long. The most downstream end of a site coincides with major transect A; the most upstream end coincides with major transect K.

3.14   Thalweg: Path of a stream that follows the deepest part of the channel (Armantrout, 1998). For WHM, we emphasize Armantrout's use of the word "path" because the thalweg longitudinal profile excludes (sometimes deeper) side pools that are not part of the dominant flow path.

3.15   WHM: Watershed Health Monitoring, a status and trends monitoring program within the Environmental Assessment Program at the Washington State Department of Ecology.

3.16   Wide Protocol: The set of WHM SOPs that describes the sample and data collection at non-wadeable sites or sites wider than 25 m bankfull width. It is an abbreviated version of the Narrow protocol and is typically accomplished by use of rafts.

4.0   Personnel Qualifications/Responsibilities

4.1   This SOP pertains to all Natural Resource Scientists, Environmental Specialists, Interns, and Technicians in Ecology's EAP Program or any staff using WHM protocols.

4.2   All field staff must comply with the requirements of the EAP Safety Manual (Ecology, 2017).

4.3   All field staff must have completed the annual WHM program field training and be familiar with the set of SOPs that combine to describe the narrow and wide WHM protocols.

4.4   All field staff must be familiar with the electronic data-recording tablet and WHM web-based field forms.

4.5   The field lead directing sample collection must be knowledgeable of all aspects of the project's Quality Assurance Monitoring Plan (QAMP) to ensure that credible and useable data are collected. All field staff should be briefed by the field lead or project manager on the sampling goals and objectives prior to arriving on the site.

4.6   All field staff must comply with EAP Policy 1-15, "Minimizing the Spread of Invasive Species."

5.0   Equipment, Reagents, and Supplies

5.1   Computer with GIS or web-based mapping capability.

5.2   Field tablet, electronic field forms.

5.3   GPS unit with batteries.

5.4   Replacement batteries.

5.5   Access gear (boats, or waders and boots). This should be pre-cleaned to avoid the spread of invasive species. Follow SOP EAP070 (Parsons et al., 2018). See EAP Policy 1-15 for more information.

6.0   Summary of Procedure

6.1   Pre-Sampling Preparation

6.2   File an 'Ecology Field Plan'. Forms are available and should be posted on the EA Program SharePoint site: http://teams/sites/EAP/Pages/Default.aspx.

6.3   Before using the GPS unit for navigating or capturing locations, be sure the datum is set to NAD83.

6.3.1　　　　Determine the appropriate protocol to use (narrow vs. wide) before accessing the site. Follow the methods outlined in this SOP only after completing site verification and layout procedures either at the site (narrow) or in the office (wide). See SOPs EAP105 and EAP106 (Merritt, 2017 and Hartman, 2017).

6.4　　　　General Considerations and Cautions

6.4.1　　　　Never compromise your personal safety or that of field partners to complete a DCE. Always plan ahead to avoid falling and drowning hazards.

6.4.2　　　　Be aware of wildfire activity. It may pose a safety threat or may change or limit access to certain areas.

6.5　　　　Narrow Protocol Method for Collecting GPS Measurements

6.5.1　　　　Navigate to the site index station using a GPS that has been loaded with the coordinates. For random sites, index station coordinates are from the Master Sample.

6.5.2　　　　Once the index station has been located, follow the procedures in SOP EAP106 (Merritt, 2017) to lay out the sampling site.

6.5.3　　　　While laying out the site, **obtain** coordinates with a GPS (decimal degrees in NAD83) at each of the three transects: A (bottom of site), F (normally near the index station), and K (top of site).

6.5.4　　　　*Note: Ensure you give the GPS unit time to find satellites and average readings, for greater accuracy and precision. Ideally, the accuracy should be within 10 m, but sometimes topography can inhibit reception.*

6.5.5　　　　**Record** the coordinates in the e-forms on the tablet. On the field tablet, navigate to the *GPS Page* (Figure 1), and enter the coordinates for transects A, F, and K.

6.5.6　　　　*Note: If you do not have the tablet when measuring coordinates, you can write them with a permanent marker on the transect flagging, so that the tablet operator can read them later.*

6.5.7　　　　Enter the accuracy amount, accuracy units, and collection method for the above transects.

	Lat/Long	Latitude	Longitude	Accuracy	Acc. Units	Method
A0	Capture	46.32803	-123.25383	11	m	Other Device
F0	Capture	46.32915	-123.23504	16	m	Other Device
K0	Capture	46.32964	-123.25513	9	m	Other Device

GPS　　　　WAM06600-005081-DCE-2014-1008-08:30　　　　Save　　Navigate

Note:

Figure 1: *GPS Page for the Narrow Protocol*

6.6   <u>Wide Protocol Method for Collecting GPS Measurements</u>

6.6.1   Complete the site layout during the preseason, following SOP EAP105 (Hartman, 2017). Determine transect coordinates and bank locations.

6.6.2   Using Table 1 for even Site ID numbers and Table 2 for odd Site ID numbers, determine preferred bank locations.

Table 1: Banks used for habitat measurements and GPS coordinates: Even Site ID #, Wide Protocol

Transect	Bank
A	Right
B	Right
C	Right
D	Left
E	Left
F	Right
G	Right
H	Left
I	Left
J	Right
K	Right

Table 2: Banks used for habitat measurements and GPS coordinates: Odd Site ID #, Wide Protocol

Transect	Bank
A	Left
B	Left
C	Left
D	Right
E	Right
F	Left
G	Left
H	Right
I	Right
J	Left
K	Left

Transfer the GIS-derived transect coordinates to a GPS unit, and print out any applicable maps that will help you locate transects (Figure 2). Also include the coordinates where you plan to launch and take out the raft.
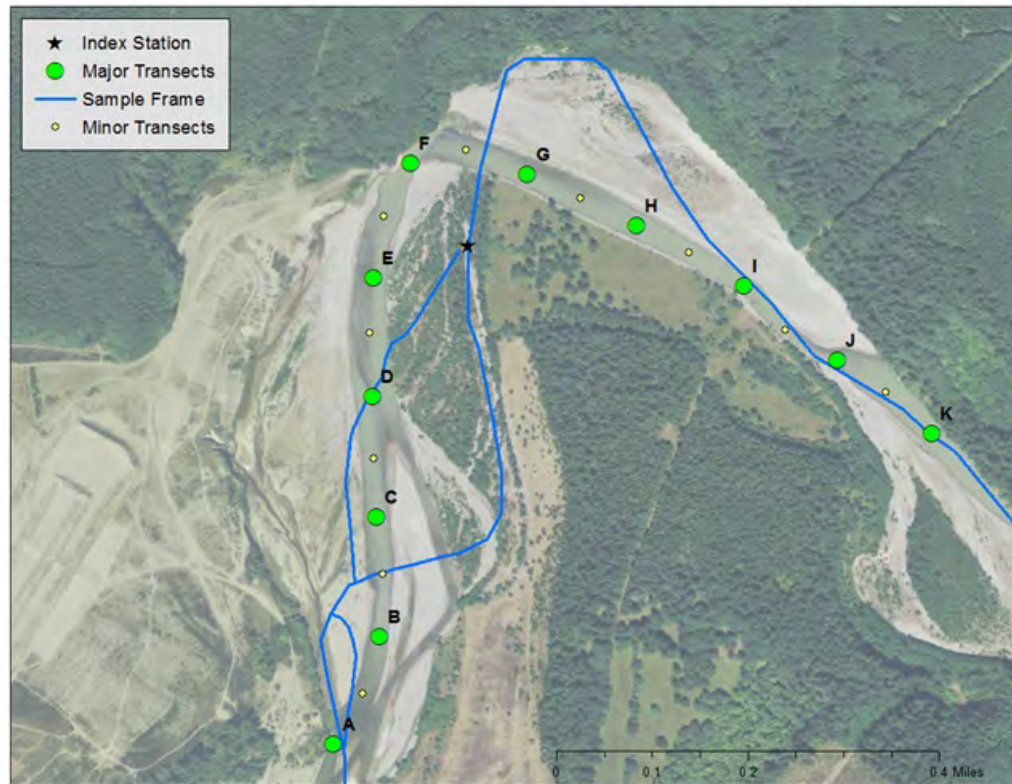

Figure 2: An example map for the Wide Protocol, generated pre-season (from SOP EAP105).

6.6.3   Use the pre-loaded GPS waypoints [from methods of SOP EAP105 (Hartman, 2017)] to locate each transect (K-A). Use Tables 1 and 2 to choose a bank where to beach the raft at each transect.

6.6.4   Upon arrival at each transect station, **obtain** the field coordinates (decimal degrees in NAD83) with a GPS.

6.6.5   **Record** the measured field position on the *GPS Page* (Figure 3), including accuracy and units. Also record bank location (left or right) and method used to obtain readings.

Figure 3: GPS Page for the Wide Protocol

7.0   Records Management

7.1   Refer to SOP EAP125 (Janisch, 2017), which describes the process for validating, loading, and committing completed WHM electronic field forms to the WHM database.

8.0   Quality Control and Quality Assurance Section

8.1   QA/QC is discussed in the Quality Assurance Monitoring Plan (Cusimano et al., 2006), expected to be re-approved in early 2019.

9.0   Safety

9.1   All field staff must comply with the requirements of the EAP Safety Manual (Ecology, 2017).

10.0   References

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