DEPARTMENT OF ECOLOGY
State of Washington

# Standard Operating Procedure EAP064, Version 1.1

# Determining Canopy Closure Using a Concave Spherical Densiometer

## Model C for the Type N Experimental Buffer Treatment Study in Incompetent Lithologies

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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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# Standard Operating Procedure for Determining Canopy Closure using a Concave Spherical Densiometer, Model C for the Type N Experimental Buffer Treatment Study in Incompetent Lithologies

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SIGNATURES AVAILABLE UPON REQUEST

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*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) |
|---|---|---|---|---|
| 5/20/2009 | 1 | Numerous edits | All | Liz Werner |
| 11/17/2009 | 1.0 | Removed Underlining | All | Bill Kammin |
| 2/27/2016 | 1.0 | Recertified | All | Bill Kammin |
| 2/13/19 | 1.1 | Accessibility changes | All | Stephen Nelson |
| 7/19/2019 | 1.1 | Formatting and accessibility updates | All | Ruth Froese |
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## 1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for determining canopy closure using a Model C Concave Spherical Densiometer on streams.

1.2 Riparian canopy cover plays a vital role in moderating stream temperatures through shading. The extent of riparian canopy cover as measured by a densiometer is an important covariate of stream temperature.

## 2.0 Applicability

2.1 This SOP was adapted from the Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) Field Manual for Wadeable Streams (Peck et al., 2003) for use on streams in the Type N Experimental Buffer Treatment Study in Incompetent Lithologies. This procedure may be applicable for other studies assessing canopy closure on streams.

2.2 The full 180$^{o}$ view provided by hemispherical photos taken with a fish eye lens may provide a more accurate assessment of canopy closure than a densiometer, which provides a narrower view. However, densiometers are often chosen to assess canopy closure for their ease of use, efficiency, and transportability.

## 3.0 Definitions

3.1 Type N: Non-fish-bearing perennial and seasonal streams under Washington State's current stream typing system (WAC 222-16-030).

3.2 Canopy closure: the amount of forest overstory measured with a densiometer from the center of the bankfull channel.

3.3 Left bank: left hand side when facing downstream.

3.4 Right bank: right hand side when facing downstream.

3.5 Spherical densiometer: a pocket-sized instrument that employs a mirror with curvature, either convex (outward) or concave (inward), enabling the reflection of a large overhead area. See Figure 1.

Figure 1. Concave Spherical Densiometer – Model C

3.6 Transect: a line that crosses perpendicular to stream flow across the bankfull channel; each site in the Type N project has a stream cover transect every 40 meters along the stream channel.

## 4.0 Personnel Qualifications/Responsibilities

4.1 Knowledge of the contents of all SOPs related to the Type N project.

4.2 Staff members must be adequately trained in how to position their bodies relative to stream flow, hold densiometers, and take canopy closure readings in order to maintain consistency in results.

4.3 The staff member's aptitude for field tasks is more important than job class.

## 5.0 Equipment and Supplies

5.1 Concave Spherical Densiometer - Model C

5.2 Waterproof tablet with StreamCover Excel datasheet or equivalent

5.3 Measuring tape (metric)

5.4 Wading Boots and Chest Waders

## 6.0 Summary of Procedure

6.1 Determine and record canopy closure for each transect. Each transect has an identifying code that consists of the basin number, the section of stream (main stem, left bank tributary, right bank tributary), and the distance along that section of stream where the transect is located.

6.1.1 Transect 1, Upstream

6.1.2 Stand mid-channel at the transect and face upstream. Hold the densiometer at elbow height above the water level. (Recognize that use of this procedure may result in different readings due to different heights of operators.)

6.1.3 Hold the densiometer at a distance away from your body so that your forehead is visible in the mirror, but not within the grid area (see Figure 2).

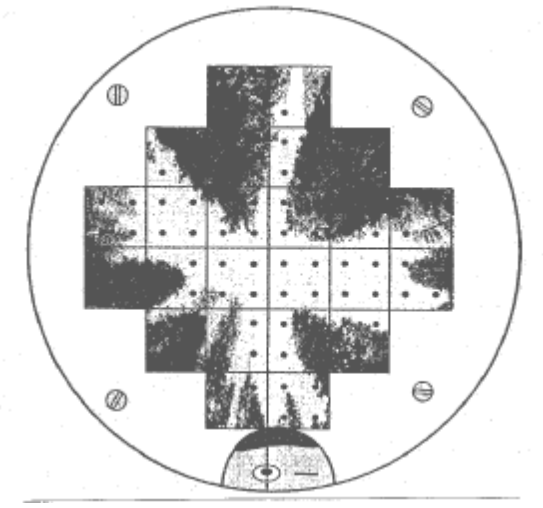

Figure 2. View of densiometer mirror showing placement of operator's head and with the 96 imaginary dots represented. (Pleus & Shuett-Hames, 1998)

6.1.4 Using the bubble in the lower right corner of the instrument as a guide, hold the densiometer level.

6.1.5 The spherical densiometer consists of twenty-four ¼-inch squares engraved onto a concave mirror. Each square of the grid must be subdivided mentally into four smaller squares and represented by an imaginary dot in the center of each of the smaller squares (See Figure 2). A total of 96 dots can be counted within the grid. Densiometer readings can range from 0 (no canopy cover) to 96 (maximum canopy cover).

6.1.6 Using only the dominant eye (keeping the other eye closed), count how many dots in each engraved square are blocked by canopy cover. Enter the total number of dots blocked into the appropriate cell on the datasheet (see example sheets in Appendix A). Conversely, count the number of dots that are not occupied by canopy and subtract this total from 96.

6.1.7 If woody debris or slash completely block the stream channel, take the readings while standing on or near the debris and note that the channel was obscured.

6.1.8 If sun glare is interfering with the view of the densiometer grid, block the sun's image by placing your finger in a position so that your finger is covering the sun in the densiometer's mirror.

6.1.9 Enter densiometer reading records into the *Canopy Cover* section of the *Stream_Cover_Measurements* tab in the "StreamCover" Excel form. Write all additional notes in the Notes section of the datasheet.

6.2 Transect 1, Left Bank, Downstream, and Right Bank

6.2.1 Repeat steps 6.1.2 through 6.1.9 for the Left Bank, Downstream, and Right Bank of Transect 1.

6.3 Review field data for completeness before leaving the transect.

6.4 Repeat steps 6.1.1 through 6.3 for the remaining transects.

## 7.0 Records Management

7.1 Excel datasheets are saved to the Type N Soft Rock folder in the Y drive. They are in a folder labeled with the collection date at the end of each field day.

7.3 At the end of the field season, the data from the current year is added to the StreamCoverData_MASTER file.

## 8.0 Quality Control and Quality Assurance Section

8.1 Data collection

8.1.1 Select 10% of the total number of sites for QA and take all field measurements twice; the second time with a different staff member collecting data. Record the QA measurements on separate data sheets. For the sake of efficiency, reassess the site immediately after the first assessment.

8.1.2 Ensure data sheets are completely filled out.

8.2 Data entry

8.2.1 Check all data entered into the database for accuracy and completeness.

## 9.0 Safety

9.1 Safety Equipment

- Hard hat
- Field vest
- Wading boots / chest waders
- Compass
- Whistle
- First aid kit
- Weather protection (i.e., raingear, sun protection, extra clothing)

9.2 Field team must always consist of at least two staff members.

9.3 Applicable Ecology Safety Policies

9.3.1 Accessing Private Property: Follow Ecology Executive Policy 1-11.

9.3.2 Field work Notification Procedures: Follow procedure outlined in EAP Safety Manual on pages 1-19 through 1-22 (EAP, 2019).

9.3.3 Working in Rivers and Streams: Follow procedure outlined on pages 1-35 and 1-36 of the EAP Safety Manual.

9.4 Use a CB radio to communicate with traffic on logging roads.

## 10.0 References


10.1 EAP [Environmental Assessment Program]. 2019. Environmental Assessment Program, Safety Manual.

10.2 Peck, D., J.M. Lazorchak, and D.J. Klemm (editors). 2003. Environmental Monitoring and Assessment Program-Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams. U.S. Environmental Protection Agency, Western Ecology Division, Corvallis, OR. Pilot Study Field Operations Manual

10.3 Pleus, A.E. and D. Schuett-Hames. 1998. TFW Monitoring Program Methods Manual for the Reference Point Survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-98-002. DNR #104.

## 11.0 Appendices

11.1 Appendix A. Datasheets for recording densiometer readings for each transect.

Example 1

**ERST TYPE N F Westside MM/DD_____ 2009 CREW_____ Site ID #_____**

**Transect Dimensions, Canopy Closure, Riparian Vegetation Cover**

| Tr. | DIMENSIONS(m) WW | BFW | BAR | THD | CANOPY CLOSURE Up | Left | Down | Right | Notes: |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |

| RIPARIAN VEGETATION COVER | T - 1 LB | T - 1 RB | T - 2 LB | T - 2 RB | T - 3 LB | T - 3 RB | T - 4 LB | T - 4 RB | T - 5 LB | T - 5 RB | T - 6 LB | T - 6 RB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetation Type ( > 5m ) | | | | | | | | | | | | |
| Big Trees ( > 5m ) | | | | | | | | | | | | |
| Small Trees ( > 5m ) | | | | | | | | | | | | |
| Vegetation Type ( 5 - 0.5m) | | | | | | | | | | | | |
| Woody Plants ( 0.5 - 5m ) | | | | | | | | | | | | |
| Non-Woody Plants ( 0.5 - 5m ) | | | | | | | | | | | | |
| Woody Plants (< 0.5m) | | | | | | | | | | | | |
| Non-Woody ( < 0.5m ) | | | | | | | | | | | | |
| Barren, Bare Dirt or Duff | | | | | | | | | | | | |
| Unstable Bank ( % ) | | | | | | | | | | | | |

Vegetation Type (D = deciduous, C = coniferous, E = broadleaf evergreen, M = mixed, N = none). For big/small trees, woody/non-woody, dirt/duff use: 0 = Absent (0%), 1 = Sparse (<10%), 2 = Moderate (10-40%), 3 = Heavy (40-75%), 4 = Very Heavy (>75%)

Example 2

| Basin | Segmen | Distance | Crew | Date | SC_ID | BFW(cm | WW(cm | BAR(cn | Underst | LgWoo | SmWood | Up | Lef | Do | Rig | Canopy ( | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1873 | LB1 | 30 | | | 1873_LB1_30 | | | | | | | | | | | 100.00 | |
| 1873 | LB1 | 70 | | | 1873_LB1_70 | | | | | | | | | | | 100.00 | |
| 1873 | LB1 | 110 | | | 1873_LB1_110 | | | | | | | | | | | 100.00 | |
| 1873 | LB1A | 30 | | | 1873_LB1A_30 | | | | | | | | | | | 100.00 | |
| 1873 | LB1A | 70 | | | 1873_LB1A_70 | | | | | | | | | | | 100.00 | |
| 1873 | LB2 | 30 | | | 1873_LB2_30 | | | | | | | | | | | 100.00 | |
| 1873 | LB2 | 70 | | | 1873_LB2_70 | | | | | | | | | | | 100.00 | |
| 1873 | LB2A | 20 | | | 1873_LB2A_20 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 30 | | | 1873_Main_30 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 70 | | | 1873_Main_70 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 110 | | | 1873_Main_110 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 150 | | | 1873_Main_150 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 190 | | | 1873_Main_190 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 230 | | | 1873_Main_230 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 270 | | | 1873_Main_270 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 310 | | | 1873_Main_310 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 350 | | | 1873_Main_350 | | | | | | | | | | | 100.00 | |
| 1873 | Main | 440 | | | 1873_Main_440 | | | | | | | | | | | 100.00 | |