

Calculation of Drainage Area

B-005-OWQ-WAP-XXX-20-T-R1

Technical Standard Operating Procedure (TSOP)

Office: Office of Water Quality

Branch: Watershed Assessment and Planning Branch

Section: All

Last Revised: December 31, 2020 Revision Cycle: Every 4 years Originally Effective: August 1, 2017

Purpose (of the TSOP)

This technical standard operating procedure (TSOP) provides instructions in using the United States Geological Survey's (USGS's) StreamStats web application to compute the drainage area of sampling sites. Drainage area of a stream at a specified location is the area measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream. Drainage area calculations are used in several water quality models and indices.

This TSOP should be used by:

This TSOP applies to agency staff in the Office of Water Quality (OWQ) Watershed Assessment and Planning Branch (WAPB) who are responsible for calculating drainage areas and performing quality control (QC) of the measurements.

Authorizing Signatures

Office of Program Support

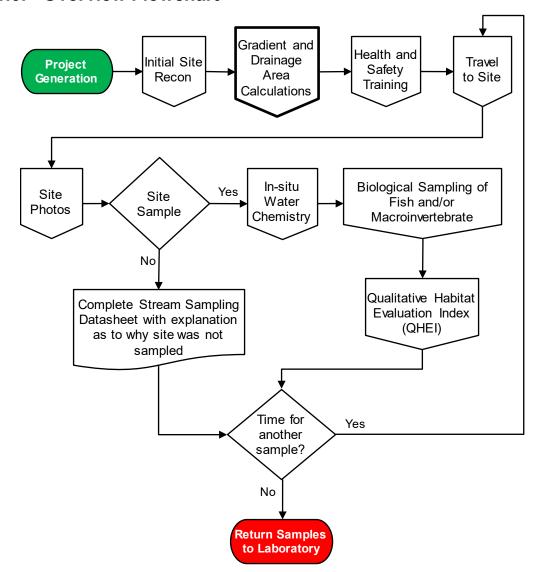
I approve and authorize this technical standard operating procedure:

S.E. Zllo-Cean	12/22/2020			
Scott Zello-Dean, Environmental Manager	Date			
Office of Water Quality, Probabilistic Monitoring Section				
Michelle Ruan	12/29/2020_			
Michelle Ruan, Environmental Manager Office of Water Quality, Probabilistic Monitoring Section	Date			
Layla Wertsiansmy	12/29/2020_			
Kayla Werbianskyj, Environmental Manager Office of Water Quality, Targeted Monitoring Section	Date			
Stacey 2 Sobat	12/23/2020			
Stacey Sobat, Section Chief	Date			
Office of Water Quality, Probabilistic Monitoring Section				
Krister arnale	12/30/2020			
Kristen Arnold, Section Chief	Date			
Office of Water Quality, Technical and Logistical Services S	Section			
Lenelaw	12/29/2020			
Marylou Renshaw, Branch Chief	Date			
Office of Water Quality, Watershed Assessment and Plann				
This technical standard operating procedure is consistent w	vith agency requirements.			
Quality Assurance Staff	06 Jan 2021			
Quality Assurance Statt	Date			

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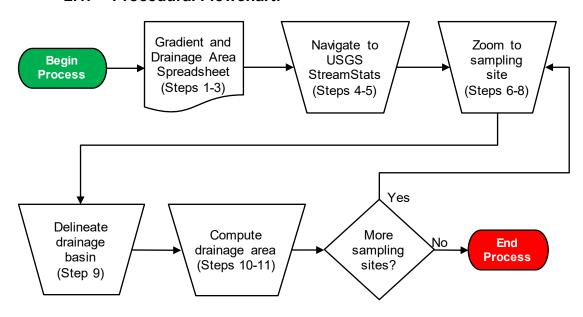
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1.0. Overview Flowchart



2.0. Procedure

2.1. Procedural Flowchart:



2.2. Procedural Steps:

Step 1. A WAPB staff member completes all steps. Query the following site data from the Assessment Information Management System (AIMS): <u>Latitude</u>, <u>Longitude</u>, <u>L-Site</u>, <u>Stream Name</u>, <u>Description</u>, <u>Site Number</u>, <u>Easting</u>, and <u>Northing</u>. Save the unaltered queried data using a filename which includes the year and sampling basin, such as

2019OhioRiverBasin_GradientDrainageArea_GIS.

Note: Check with other staff to see whether this document has been created earlier, to eliminate duplicating an existing file.

Step 2. Create a new Microsoft Excel spreadsheet with the <u>Latitude</u>, <u>Longitude</u>, <u>L-Site</u>, <u>Stream Name</u>, <u>Description</u>, and <u>Site Number</u> for sites approved through site reconnaissance (Appendix A). Save this file in the project folder on the shared drive using a filename which includes the year and sampling basin, such as 2019 Ohio River Basin Gradient and Drainage Area.

Notes: The spreadsheet created to record <u>drainage area (mi²)</u> values is the same spreadsheet used to record <u>gradient</u> values. Check with other staff to see whether this document has been created to eliminate duplicating an existing file.

- Step 3. Add columns for <u>Gradient</u>, <u>Gradient QC</u>, <u>Gradient QC2</u>, <u>Drainage Area (mi²)</u>, <u>Drainage Area QC</u>, and <u>Drainage Area QC 2</u>. Directly underneath the list of sites, add a row for <u>Initial/Date</u>. A staff filling in the <u>Drainage Area (mi²)</u> and QC columns, initials and dates the completed columns in the <u>Initial/Date</u> cell below the last calculation. Each set of columns should include three different initials.
- Step 4. Open a web browser and navigate to USGS's <u>StreamStats</u> website.
- Step 5. Click on <u>StreamStats</u> in the <u>StreamStats Application</u> section on the <u>Overview</u> tab to open the most current version of the application. Make sure popups are enabled, because a popup window will open when you click on <u>StreamStats</u> to inform you of any issues or technical difficulties affecting the web application.
- Step 6. Copy and paste latitude and longitude information for the approved site into the <u>Search for a place</u> search bar. A dropdown menu with the coordinate will appear. Click the coordinates which appear in the <u>Results</u> box (Figure 1). StreamStats will then zoom in on the coordinates. The coordinates are marked with a red dot.



Figure 1

Step 7. Click <u>Indiana</u> under the <u>Click to select a State or Regional Study</u>
<u>Area</u> heading (Figure 2).

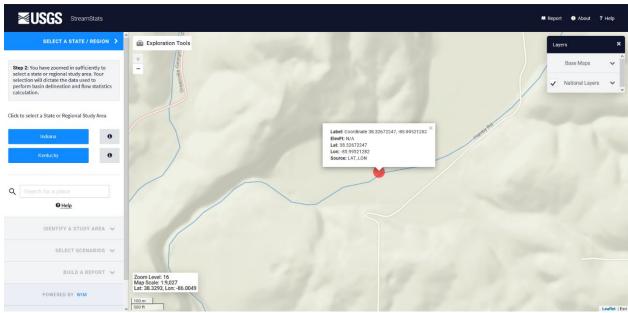


Figure 2

Step 8. Confirm the coordinates are on or near the specified waterbody (Figure 3). For example, to ensure the computed drainage area is for a site located on main stem Indian Creek and not tributary of Indian Creek.



Figure 3

Step 9. Under the <u>IDENTIFY A STUDY AREA</u> menu, click on the <u>Delineate</u> button. After clicking the button, the <u>Delineate</u> button will turn red, and the cursor will be a crosshair. Use the tool to click on a stream grid cell (the blue boxes which represent the

stream path) which is closest to the site. StreamStats will take a couple of minutes to delineate the drainage boundary. The drainage area will be displayed on the map in a yellow opaque color (Figure 4). Be sure to thoroughly check the delineated basin for accuracy before clicking the <u>Continue</u> button. You can pan the map by left clicking and moving the mouse. You can also Zoom In (+) and Zoom Out (-) to check whether all the drainage area is captured in the area highlighted for delineation.

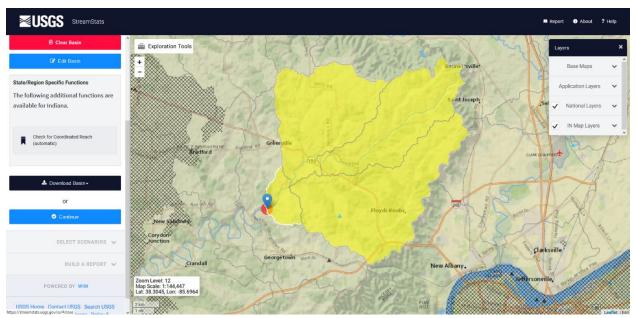


Figure 4

Step 10. Under the <u>SELECT SCENARIOS</u> menu, click on the <u>Basin</u>

<u>Characteristics</u> heading. In this menu, select the DRNAREA parameter. When selected, a checkmark will appear in the white box in the Select column (Figure 5). Click the <u>Continue</u> button at the bottom of the menu to obtain drainage area.

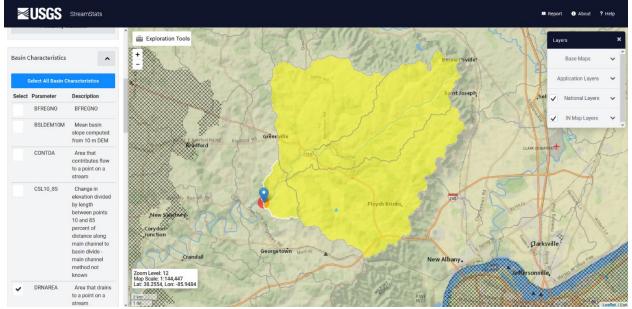


Figure 5

Step 11. Under the <u>BUILD A REPORT</u> menu, click the <u>Continue</u> button under the <u>Select available reports to display</u> heading. A popup containing the <u>StreamStats Report</u> will appear. Scroll down to the <u>Basin Characteristics</u> box. Drainage area is displayed in square miles, which is exactly as expected result (Figure 6). Copy and paste the value into the appropriate cell in the spreadsheet.



Figure 6

Step 12. Repeat Steps 8 to 11 for the remaining approved sites. To start over, click the <u>SELECT A STATE/REGION</u> heading. Copy and

paste latitude and longitude information for the additional approved site into the <u>Search for a place</u> search bar (Figure 7). Indiana will remain the study area unless changed or until the application is closed.

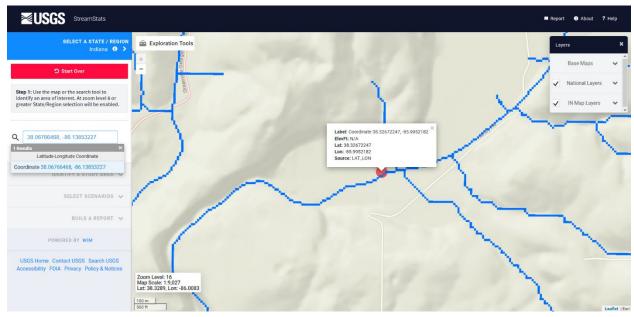


Figure 7

2.3. Related Technical Issues:

A. Health and Safety Warnings: Not applicable. This TSOP does not involve travel or field work. All steps are to be completed in an office setting on a computer workstation.

B. Cautions:

- Do not use StreamStats if the status window indicates whether technical difficulties or incorrect outputs exists. Check back later.
- Enter coordinates for each site accurately into StreamStats, ensuring coordinates are for the appropriate site and not for the one above or below in the spreadsheet.
- Enter the drainage area for each site accurately onto the spreadsheet, ensuring the area corresponds to the appropriate coordinates.
- Be mindful of where the point to delineate the drainage basin is placed. Zoom in to select the closest stream grid to the site of interest. Delineating the drainage basin on a larger scale may result in incorrect boundaries. Selecting a stream grid which is upstream or downstream of the site of interest may also result in incorrect

boundaries. For example, if the site of interest is downstream of a tributary and the point to delineate the drainage basin is placed upstream of the tributary, this will result in a smaller drainage basin and drainage area. If the point to delineate the drainage basin is placed downstream of the site of interest, this will result in a larger drainage basin and drainage area.

 Only perform drainage area calculations on sites with confirmed coordinates. Latitude and longitude can change following GPS verification and can result in incorrect drainage area calculations.

C. Interferences:

Not applicable.

D. Calibration:

Staff are not responsible for calibrating StreamStats which is maintained by USGS. However, staff should stay updated on which version of StreamStats is available and read the appropriate literature on USGS's website prior to using the web application.

E. Troubleshooting:

- Read the literature provided on USGS's website.
- Visit USGS's StreamStats Troubleshooting webpage for further assistance.

3.0. Roles

3.1. Responsibilities:

- A. WAPB staff member
 - 1. Reviews and follows this TSOP.
 - 2. Prepares the Gradient and Drainage Area spreadsheet.
 - 3. The staff member assigned to Drainage Area QC Round 2 will discuss value discrepancies with staff who performed calculations and finalize which drainage area calculations to enter into AIMS.

3.2. Training requirements:

- A. USGS StreamStats
 - 1. WAPB staff member
- B. AIMS database management
 - WAPB staff member

4.0. List forms, equipment, and/or software to be used

4.1. Forms

A. Gradient and Drainage Area Spreadsheet

4.2. Equipment:

A. Computer workstation

4.3. Software:

- A. Internet capabilities
- B. USGS StreamStats
- C. AIMS database

5.0. Records Management

Information recorded in the Gradient and Drainage Area Spreadsheet is entered into the AIMS database. The Gradient and Drainage Area Spreadsheet is stored electronically in the project folder on the shared drive.

6.0. Definitions

- **6.1.** "Agency staff" Any employee or representative of Indiana Department of Environmental Management (IDEM) including regular employees, temporary employees, contractors, and interns.
- **6.2.** "Assessment Information Management System database (AIMS database)" IDEM database containing information related to water chemistry, aquatic habitat, macroinvertebrate, fish, algae communities, fish tissue analyses, sediments, and *E. coli* bacteria data collected by agency staff from watershed sampling events.
- **6.3.** "L-Site" A unique site ID generated by the AIMS database for each sampling site, and is linked with location information (stream name, description, latitude, longitude, county, HUC12, HUC14, etc.,).
- 6.4. "Quality control" The overall system of technical activities which measures the attributes and performance of a process, item, or service against defined standards to verify they meet the stated requirements established by the customer; operational techniques and activities used to fulfill requirements for quality. In other words, QC involves measuring the "thing produced" against a standard to ensure it is a quality product meets the identified need.

- **6.5.** "Reconnaissance" Obtaining information about a site through visual observations and investigating routes to safely access the site, as well as gathering property owner information and access permission if private property is involved.
- **6.6.** "Site number" The designated program area specific numeral given to an environmental location of interest.
- **6.7.** "Technical standard operating procedure (TSOP)" A standard operating procedure involving environmental data generation, manipulation, or compilation of an analytical process.

7.0. Quality Assurance / Quality Control

New WAPB staff should review this TSOP prior to calculating drainage areas. Before entering data into the AIMS database quality checks are performed. Assign a WAPB staff member to perform Drainage Area QC Round 1 by going through Steps 3 to 12 of Section 2.2. Follow with a different WAPB staff member, experienced in utilizing StreamStats, performing Drainage Area QC Round 2 by first going through Steps 3 to 12 of Section 2.2. Then discuss value discrepancies with staff who performed calculations. When all discrepancies are resolved and drainage area values are finalized, enter the data into the AIMS database. Following data entry, perform two rounds of quality control on the database entries to ensure they reflect the Gradient and Drainage Area Spreadsheet. As necessary, perform additional rounds of quality control. When quality control on the database entries is complete, the data is available for use in other work products.

8.0. References

8.1. **USGS**

A. StreamStats.

8.2. Other Guidance

A. Hoggatt, R.E. 1975. <u>Drainage areas of Indiana streams</u>. U.S. Geological Survey, Indianapolis, Indiana.

9.0. Appendices

Appendix A – Example of a Gradient and Drainage Area Spreadsheet

		С	D	E	F	G	Н		,	K	
atitude	Longitude	Other Site ID	StreamName	Description	SiteID	Gradient	Gradient QC	Gradient QC 2	Drainage Area (sq. mi)	Drainage Area QC	Drainage Area QC 2
38.53727		6 WEL-15-0008	EXAMPLE	EXAMPLE	18T002	13.966	8.197	14.167	4.019	4.006	
38.3129118		9 OSK-08-0014	Silver Creek	Gutford Road	INRB19-002						
39.1566356		1 OML-03-0004	Tanners Creek	Kelsey Road	INRB19-003						
38.2812303		4 OBS-04-0001	Indian Creek	State Road 335	INRB19-005						
38.4433985		6 OSK-04-0004	Fourteenmile Creek	Charlestown State Park	INRB19-006						
38.0705309		8 OLP-03-0008	Theis Creek	Atlanta Road	INRB19-007						
38.0443139		9 OLP-10-0006	Otter Creek	Degonia Road	INRB19-008						
38.7806538		7 OML-09-0004	Indian Creek	Posten Road	INRB19-009						
38.3056568		5 OBS-11-0002	Otter Creek	Mifflin Community Church	INRB19-011						
38.5542677		7 OBS-07-0022	Blue River	Cauble Road	INRB19-013						
38.9996144		4 OML-06-0002	Boyd Branch	Grelle Road	INRB19-014						
38.0062825		3 OHP-03-0001	Pigeon Creek	Stream Valley Park	INRB19-016						
38.0676646		7 OBS-02-0002	Buck Creek	Squire Boone Caverns	INRB19-017						
38.352287		4 OBS-03-0001	Indian Creek	Old Vincennes Road	INRB19-018						
39.2487281		8 OML-03-0005	East Fork Tanners Creek	Dog Ridge	INRB19-019						
38.0438024		1 OLP-05-0002	Crooked Creek	County Road 1100 North	INRB19-020						
38.2550407		5 OSK-09-0001	French Creek	Two Mile Lane	INRB19-021						
38.4526966		5 OSK-08-0015	Sinking Fork	Brick Church Road	INRB19-022						
38.1286111		9 OLP-05-0001	Tributary of Crooked Creek	Old State Road 162	INRB19-023						
38.281075		7 OBS-11-0008	Little Blue River	Old State Road 37	INRB19-027						
38.2033710		1 OLP-09-0023	Tributary of Coles Creek	Scales Road	INRB19-028						
38.9563722		6 OML-06-0003	Laughery Creek	Cutter Road	INRB19-030						
38.1079905		5 OHP-03-0002	Bluegrass Creek	Warrick County Line Road	INRB19-032						
38.3027463	-86.0605383	5 OBS-04-0002	Indian Creek	State Road 335	INRB19-033						
38.3267224	-85.9952128	2 OBS-03-0002	Indian Creek	Hamby Road	INRB19-034						
38.0699613	-87.1120384	3 OLP-09-0024	Coles Creek	Wilson Lane	INRB19-036						
38.2925594		4 OSK-09-0002	Mill Creek	Ohio River Greenway	INRB19-037						
38.5005842	-85.6468146	9 OSK-04-0005	Dry Branch	Charlestown New Market Road	INRB19-038						
38.7958480	-85.2515507	1 OSK-02-0025	Brushy Fork	Brushy Fork Road	INRB19-041						
39.0855593	-85.0565258	1 OML-04-0007	Allen Branch	Akes Road	INRB19-042						
38.2250048	-87.2797599	4 OHP-01-0002	Smith Fork	Spurgeon Road	INRB19-044						
38.5613413	-85.760983	3 OSK-08-0016	Miller Fork	US Highway 31	INRB19-045						
39.1689842	-84.9748300	3 OML-03-0006	West Fork Tanners Creek	Konvadi Road	INRB19-046						
37.9478307	-86.6437732	1 OLP-01-0001	East Deer Creek	Triplett Road	INRB19-047						
38.2177105	-86.1282437	9 OBS-04-0003	Indian Creek	Cedar Glade Avenue	INRB19-049						
38.4686150		8 OBS-06-0026	South Fork Blue River	Dalton Lane	INRB19-050						
38.1205686	-86.8036894	6 OLP-04-0019	Anderson River	Angelo Road	INRB19-051						
37.9964570		6 OLP-10-0007	Caney Creek	New Hope Road	INRB19-052						
39.2583775	-85.2413458	4 OML-05-0047	Little Laughery Creek	State Road 229	INRB19-053						
38.4643171	-85.715734	9 OSK-08-0017	Sinking Fork	Charlestown Memphis Road	INRB19-054						
38.2014034	-86.2912630	2 OBS-09-0004	Blue River	State Road 62	INRB19-055						
39.1462958	-85.2165367	3 OML-05-0049	Castators Creek	State Road 350	INRB19-058						
38.1834160	-86.4215645	9 OBS-11-0005	Little Blue River	Beechwood Road	INRB19-059						
37.9879706	-86.7304718	3 OLP-04-0016	Brushy Fork	Sagebrush Road	INRB19-063						
38.3531049		4 OBS-08-0001	Whiskey Run	Milltown Road	INRB19-064						
38.1338577	-86.7257459	5 OLP-03-0009	Middle Fork Anderson River	Huffman Road	INRB19-067						
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