	<p style="text-align: center;">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</p> <p style="text-align: center;">Last Revised: December 31, 2020 Revision Cycle: Every 4 years Originally Effective: August 1, 2017</p>
---	---

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

I approve and authorize this technical standard operating procedure:



Scott Zello-Dean, Environmental Manager
Office of Water Quality, Probabilistic Monitoring Section

12/22/2020

Date



Michelle Ruan, Environmental Manager
Office of Water Quality, Probabilistic Monitoring Section

12/29/2020

Date



Kayla Werbianskyj, Environmental Manager
Office of Water Quality, Targeted Monitoring Section

12/29/2020

Date



Stacey Sobat, Section Chief
Office of Water Quality, Probabilistic Monitoring Section

12/23/2020

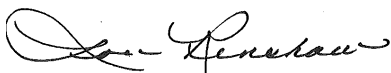
Date



Kristen Arnold, Section Chief
Office of Water Quality, Technical and Logistical Services Section

12/30/2020

Date



Marylou Renshaw, Branch Chief
Office of Water Quality, Watershed Assessment and Planning Branch

12/29/2020

Date

This technical standard operating procedure is consistent with agency requirements.



James E. Bailey, Quality Assurance Staff
Office of Program Support

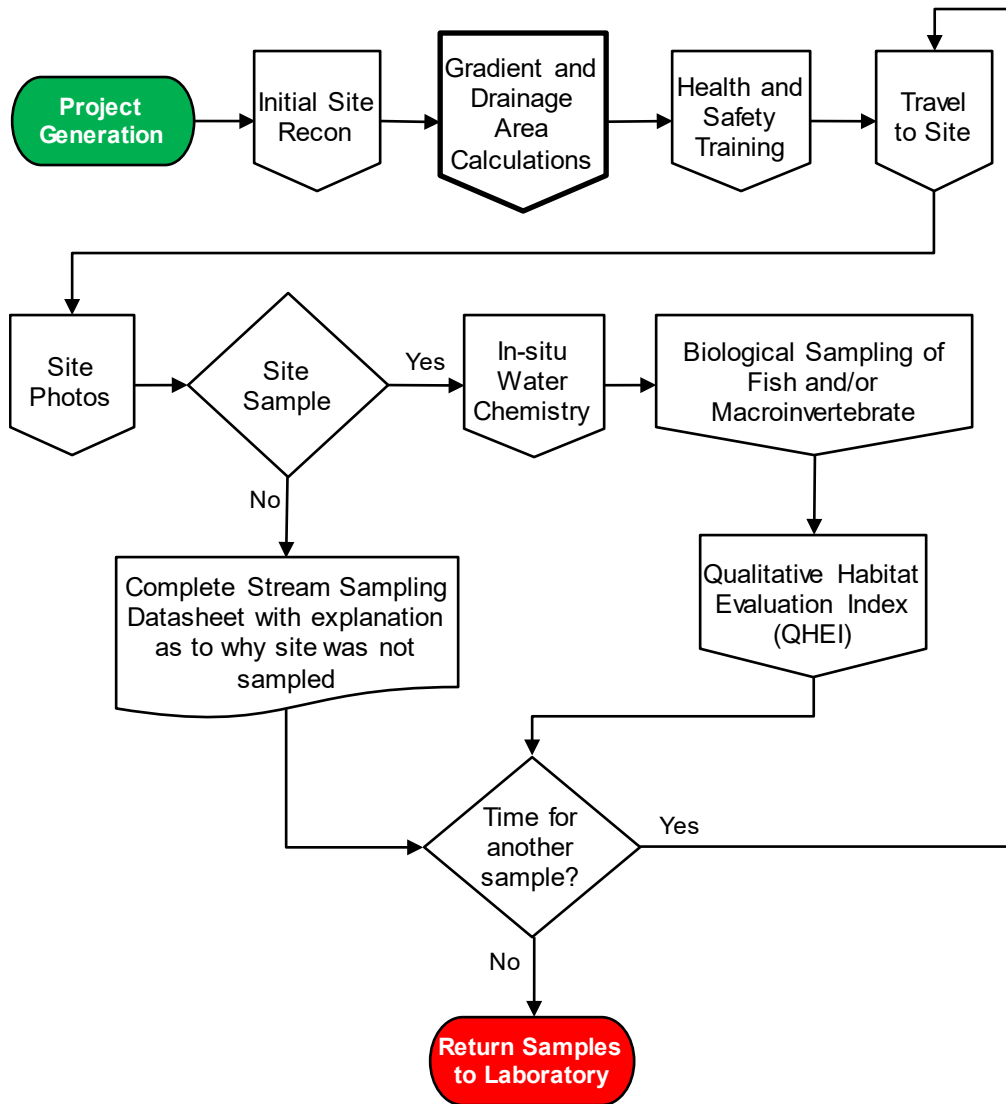
06 Jan 2021

Date

Table of Contents

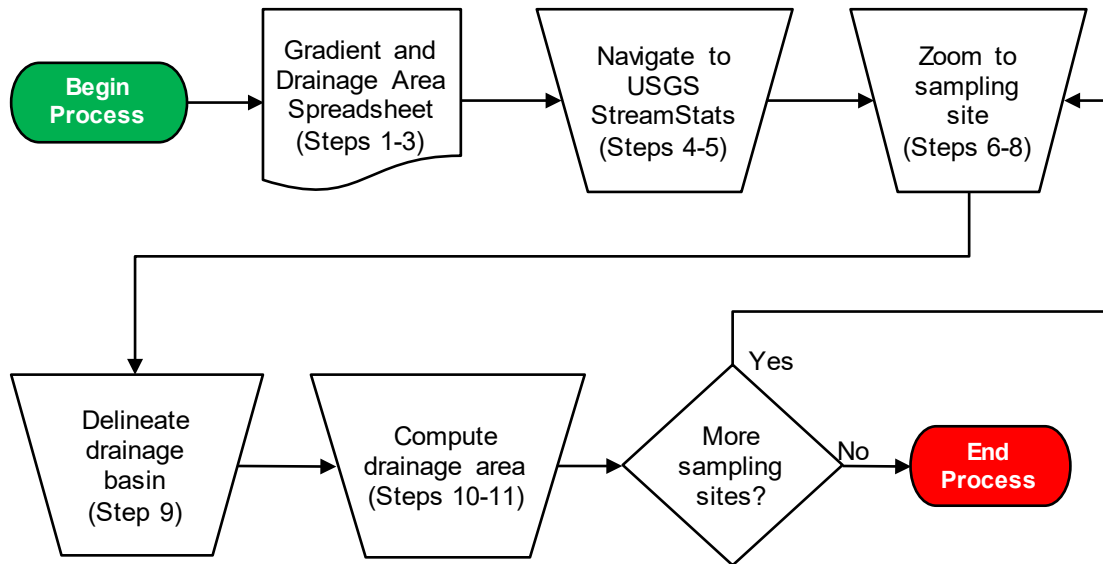
Purpose (of the TSOP).....	1
This TSOP should be used by:.....	1
Authorizing Signatures	2
1.0 Overview Flowchart.....	4
2.0 Procedure.....	5
2.1 Procedural Flowchart:	5
2.2 Procedural Steps:.....	5
2.3 Related Technical Issues:	10
3.0 Roles	11
4.0 List forms, equipment, and/or software to be used.....	12
5.0 Records Management	12
6.0 Definitions.....	12
7.0 Quality Assurance / Quality Control.....	13
8.0 References	13
9.0 Appendices.....	14

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): Latitude, Longitude, L-Site, Stream Name, Description, Site Number, Easting, and Northing. 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 Latitude, Longitude, L-Site, Stream Name, Description, and Site Number 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 drainage area (mi²) values is the same spreadsheet used to record gradient values. Check with other staff to see whether this document has been created to eliminate duplicating an existing file.

- Step 3. Add columns for Gradient, Gradient QC, Gradient QC2, Drainage Area (mi²), Drainage Area QC, and Drainage Area QC 2. Directly underneath the list of sites, add a row for Initial/Date. A staff filling in the Drainage Area (mi²) and QC columns, initials and dates the completed columns in the Initial/Date 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 [StreamStats](#) website.
- Step 5. Click on StreamStats in the StreamStats Application section on the Overview 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 StreamStats 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 Search for a place search bar. A dropdown menu with the coordinate will appear. Click the coordinates which appear in the Results box (Figure 1). StreamStats will then zoom in on the coordinates. The coordinates are marked with a red dot.

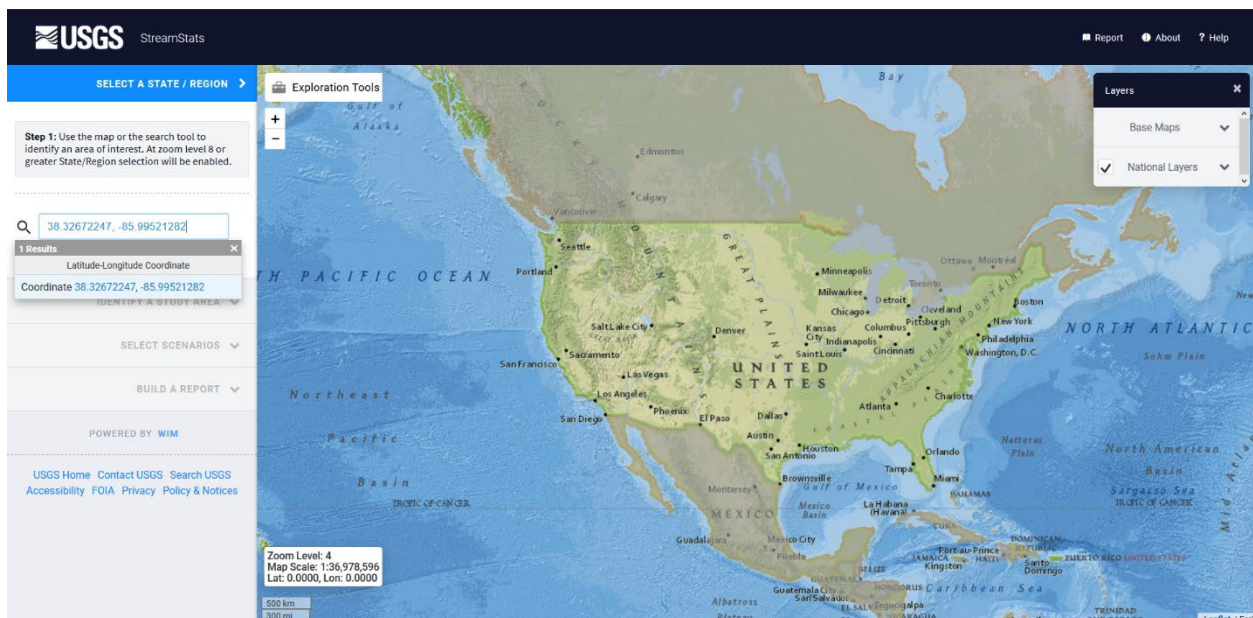


Figure 1

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

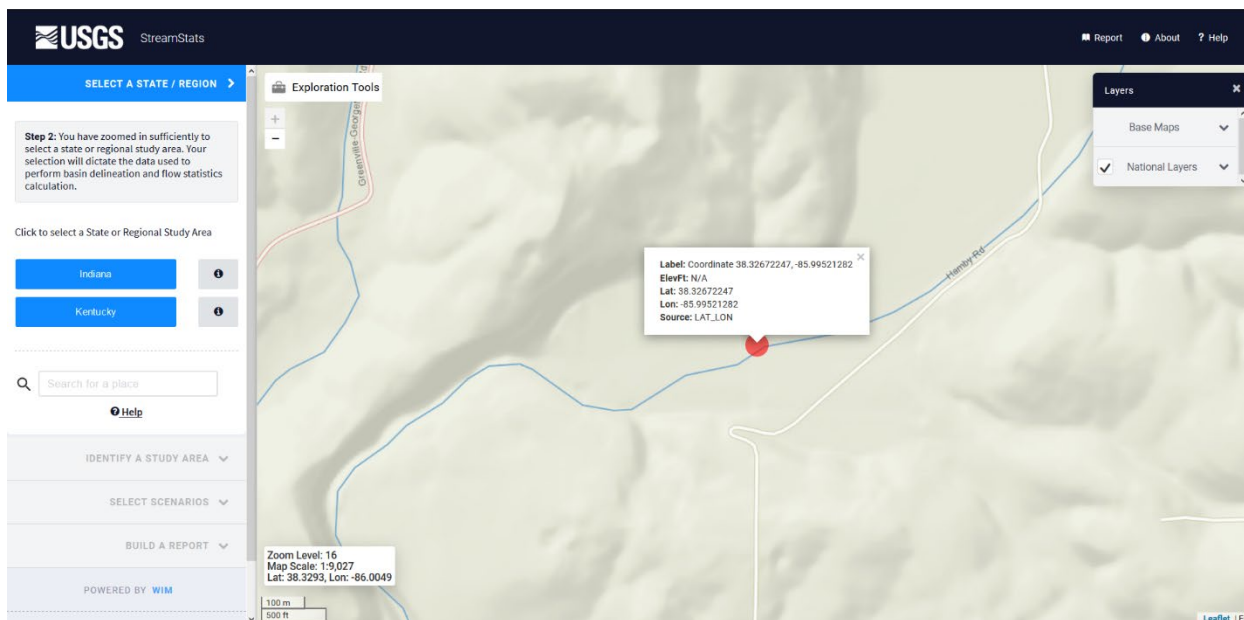


Figure 2

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.

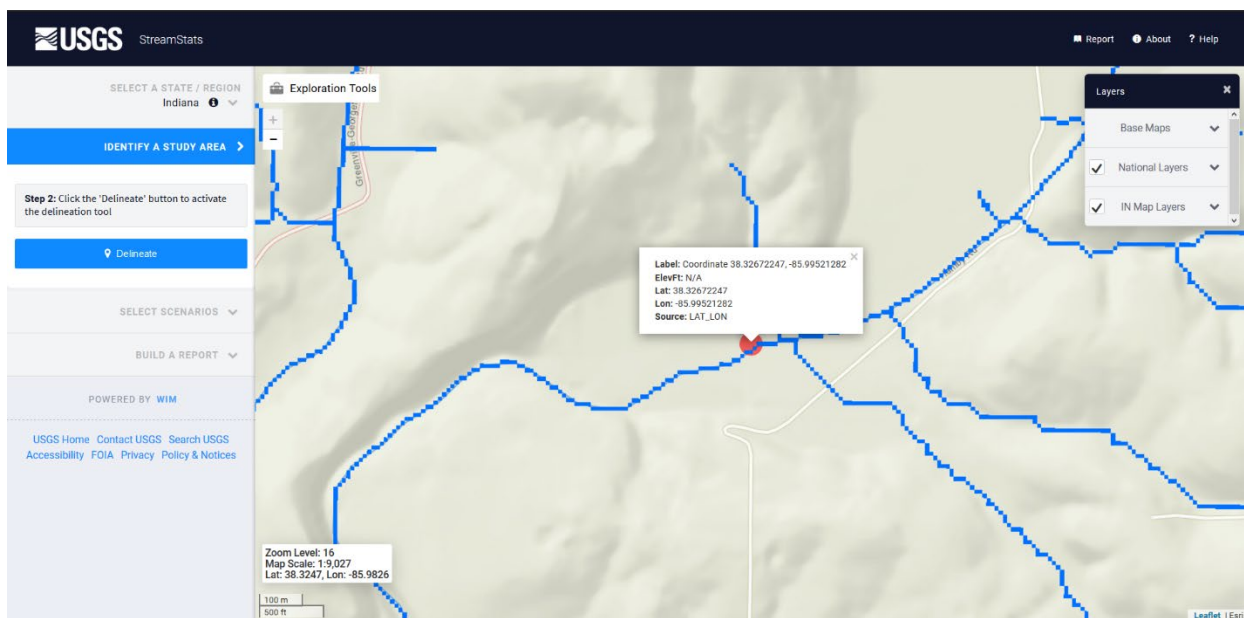


Figure 3

Step 9. Under the IDENTIFY A STUDY AREA menu, click on the Delineate button. After clicking the button, the Delineate 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 Continue 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.

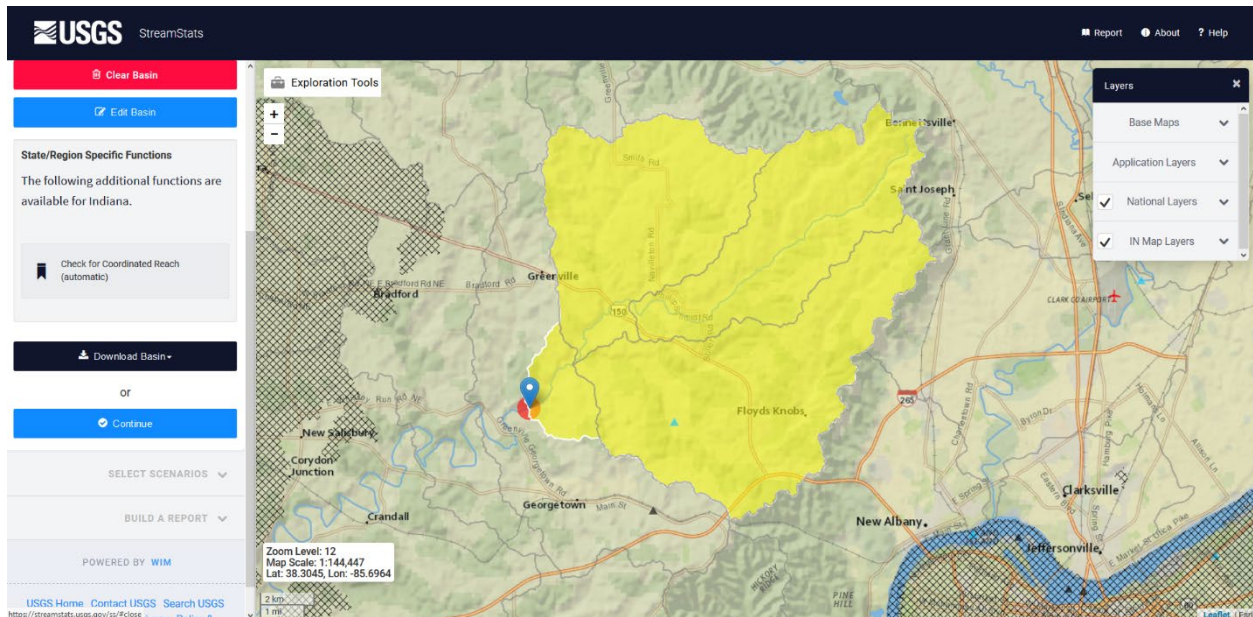


Figure 4

Step 10. Under the SELECT SCENARIOS menu, click on the Basin Characteristics 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 Continue button at the bottom of the menu to obtain drainage area.

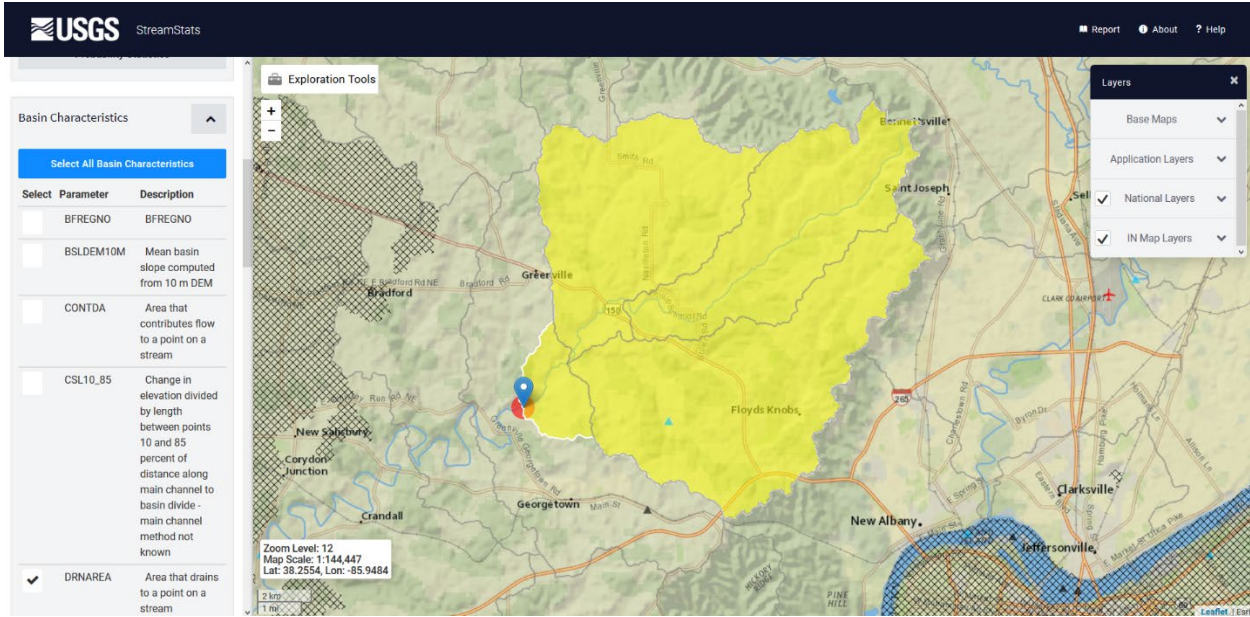


Figure 5

Step 11. Under the **BUILD A REPORT** menu, click the **Continue** button under the **Select available reports to display** heading. A popup containing the **StreamStats Report** will appear. Scroll down to the **Basin Characteristics** 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.

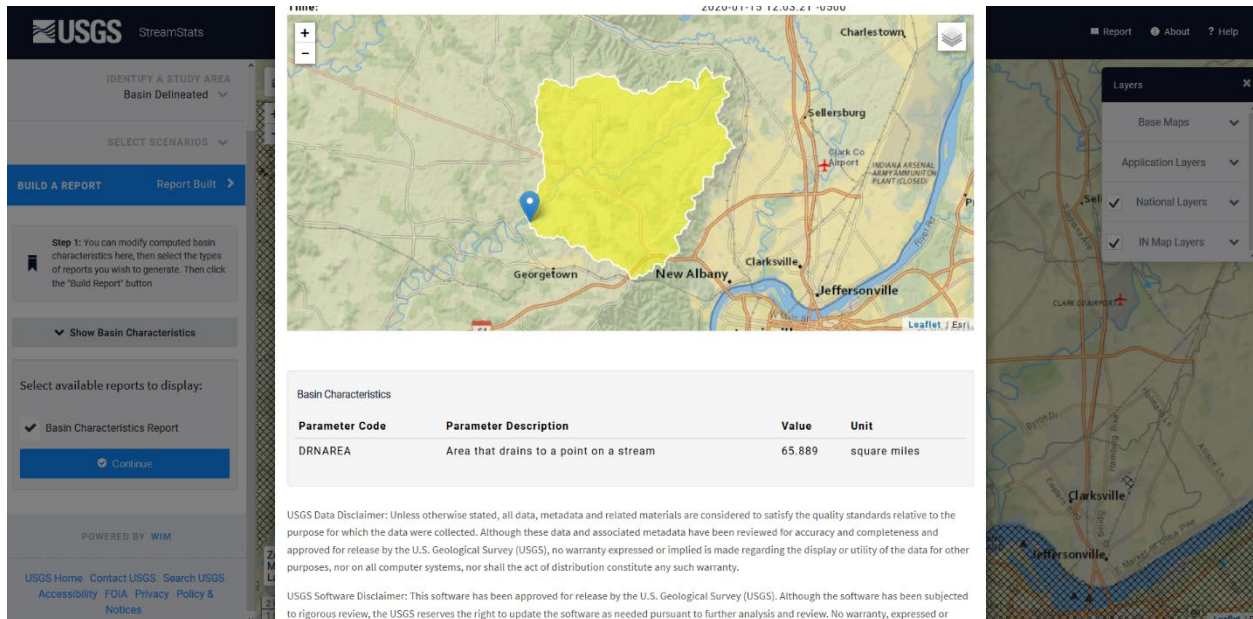


Figure 6

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

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

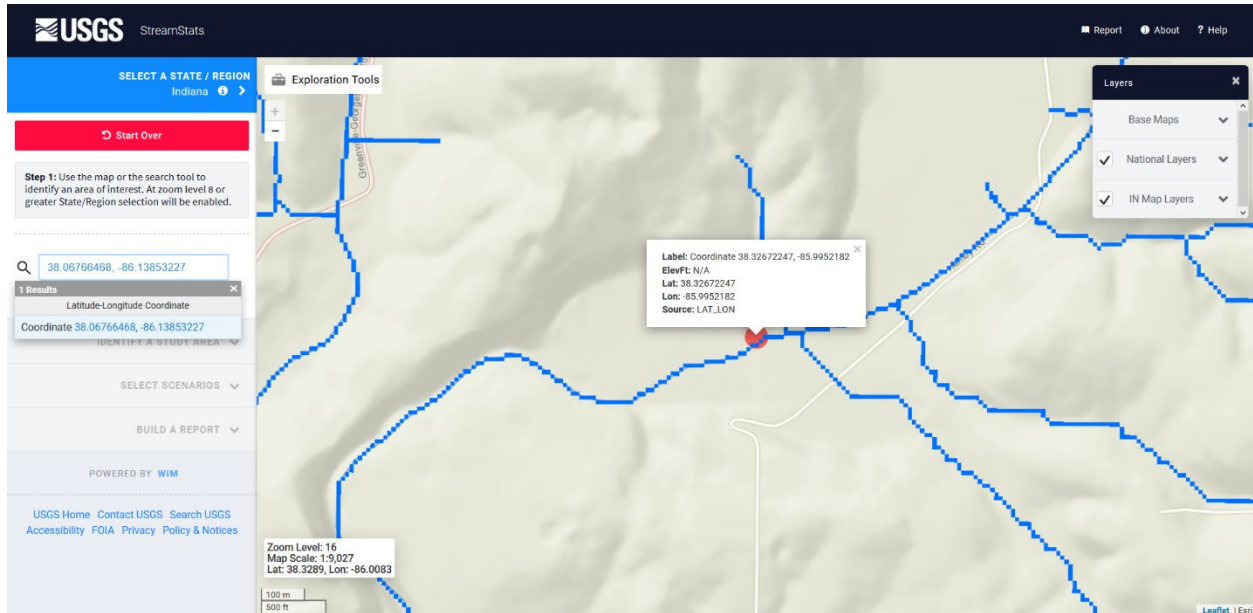


Figure 7

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

1. 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. [Drainage areas of Indiana streams](#). U.S. Geological Survey, Indianapolis, Indiana.

