Load Duration Curve

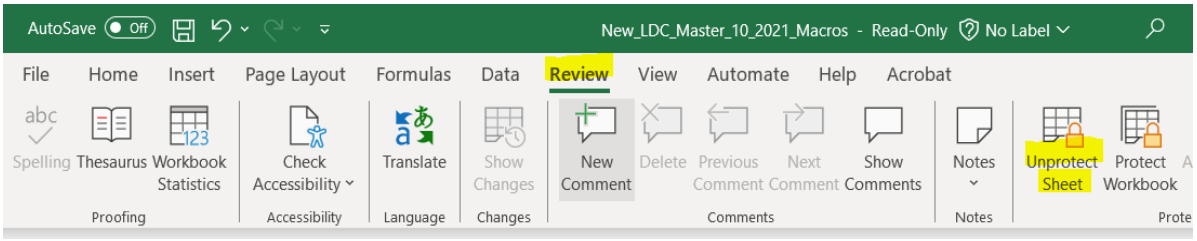
If you experience any problems while navigating through this tool, please reach out to your Watershed Specialist or a TMDL Writer at IDEM.

Contents

Let's Get Started

1. Find and save a copy of the NEW Load Duration Curve excel sheet found on the Models/Load Reductions webpage and on the Planning webpage.
2. Within the excel sheet, enable content.

❖ If you have issues updating a tab or cell, be sure to look at the 'Review' tab at the top of the excel sheet and select 'Unprotect Sheet'.



Watershed Names Tab

In this tab you will compile all the surface area (SA) and drainage area (DA) values within the watershed of interest. The spreadsheet is broken down by subwatershed (HUC 12) and watershed (HUC 10) boundaries and includes upstream drainage if applicable. In these instructions only public resources will be used to find this information.

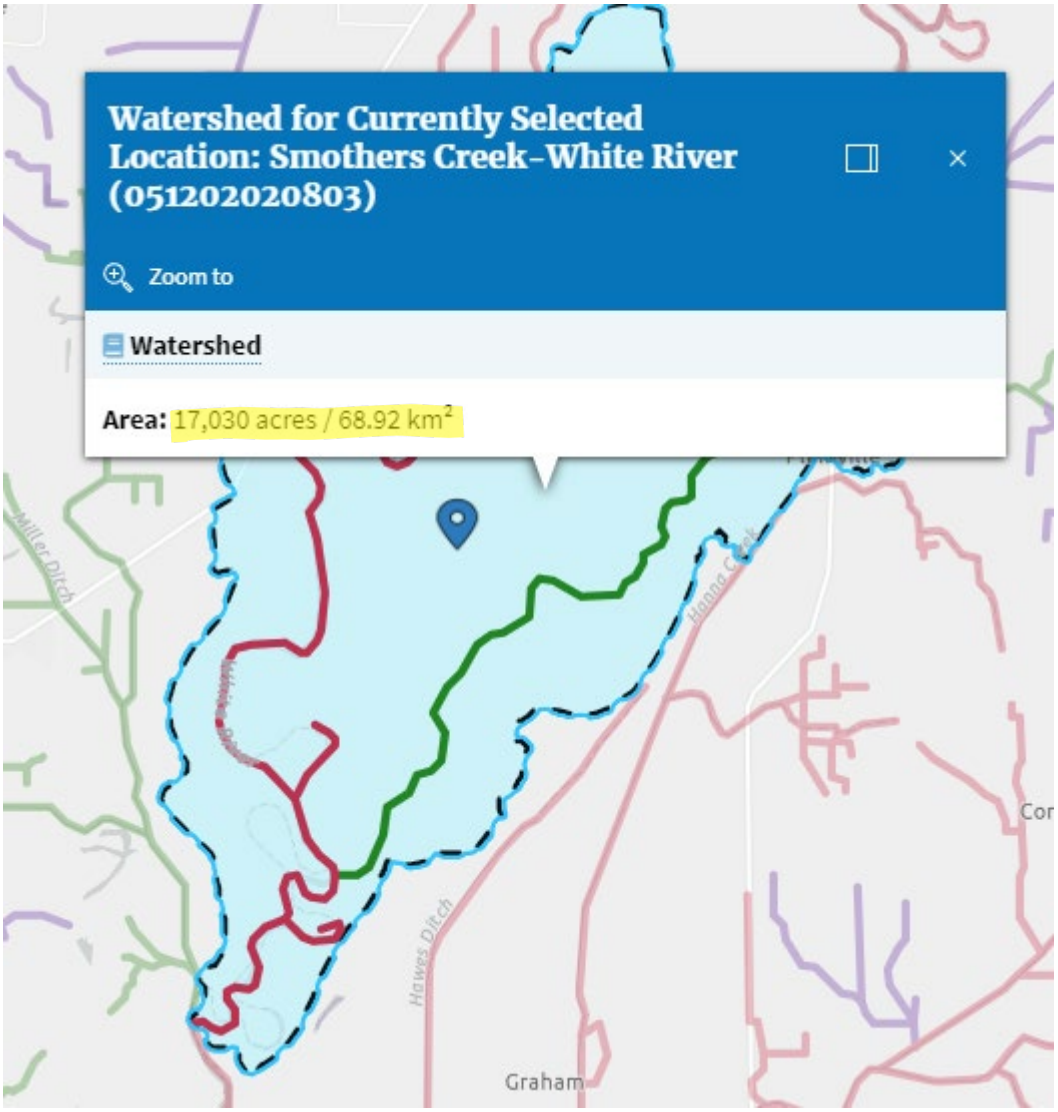
	Name	Drainage Area (sq_mi)	Surface Area (sq_mi)
HUC10 Watershed Name	HUC10	5077.22	99.36
Upstream Drainage	Upstream Drainage	4977.86	4977.86
SW1	Bens Creek	5077.22	16.65
SW2	Pickel Ditch	30.63	30.63
SW3	Smothers Creek	5030.40	26.6
SW4	Pollard Ditch	25.48	25.48

	Name	Drainage Area (sq_mi)
USGS Gauge	WHITE RIVER NEAR EDWARDSPORT, IN	5015

StreamStats and ATTAINS

Find the Surface Area

1. Open ATTAINS (HowsMyWaterway) https://mywaterway.epa.gov/
2. Search for a HUC 12 in the watershed of interest. Once it populates, right click within the HUC 12 to see the area.

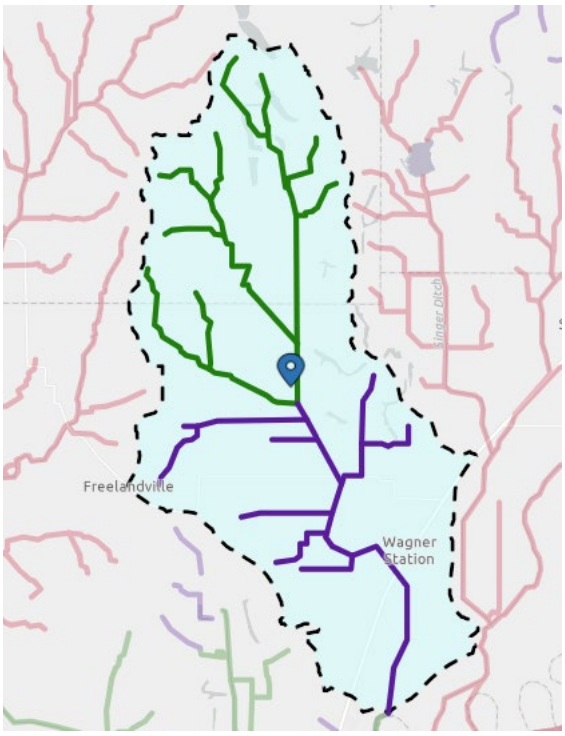


3. This will provide the area of the HUC 12 in km^2. Use Google, or the conversion chart found in the WatershedNames tab of the LDC tool, to convert km^2 to mi^2. Alternatively, divide the km^2 value by 2.59. Repeat this step to fill in all of the HUC 12 SA cells.

Conversion Chart	
sq. km	sq. Miles
68.92	26.61003861
Acres	sq. Miles
	0

	A	B	C	D
		Name	Drainage Area (sq_mi)	Surface Area (sq_mi)
1	HUC10 Watershed Name	HUC10		
2	Upstream Drainage	Upstream Drainage		
3	Subwatershed 1	SW1		26.6
4	Subwatershed 2	SW2		
5	Subwatershed 3	SW3		

4. Once all the HUC 12 SA cells are filled in, combine them to get the SA of the entire HUC 10
   - ❖ The SA and the DA values are the same where there is no upstream drainage.

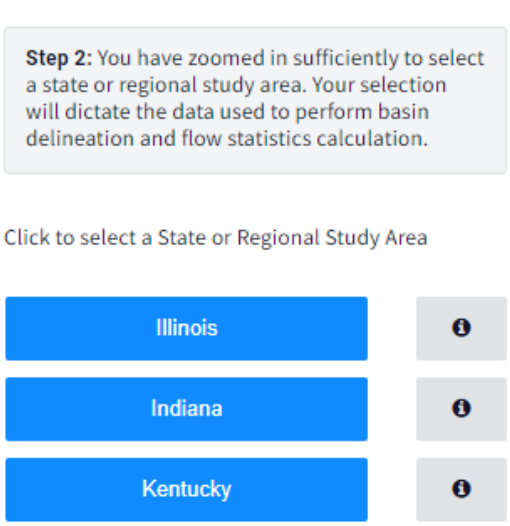


- ❖ This subwatershed has a SA of 25.5 sq mi and does not have any upstream drainage (rivers or streams draining into it). This means that the DA will only include the area of that subwatershed.

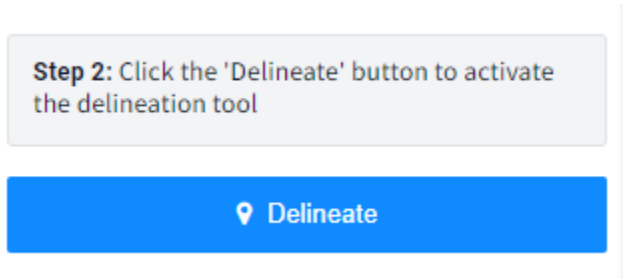
A	B	C	D
	Name	Drainage Area (sq_mi)	Surface Area (sq_mi)
HUC10 Watershed Name	HUC10		
Upstream Drainage	Upstream Drainage		
Subwatershed 1	SW1		26.6
Subwatershed 2	SW2	25.5	25.5

5. Once all the SA cells are filled in (and any DA cells for HUC 12s that don't have upstream drainage), open StreamStats: https://streamstats.usgs.gov/ss/
6. Navigate to the HUC 10 of interest.

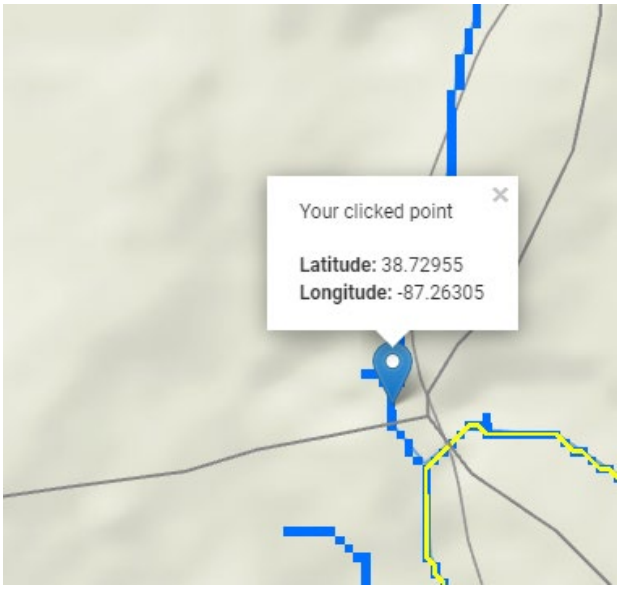
7. Zoom in enough that the option to select a state/region should populate. Select Indiana



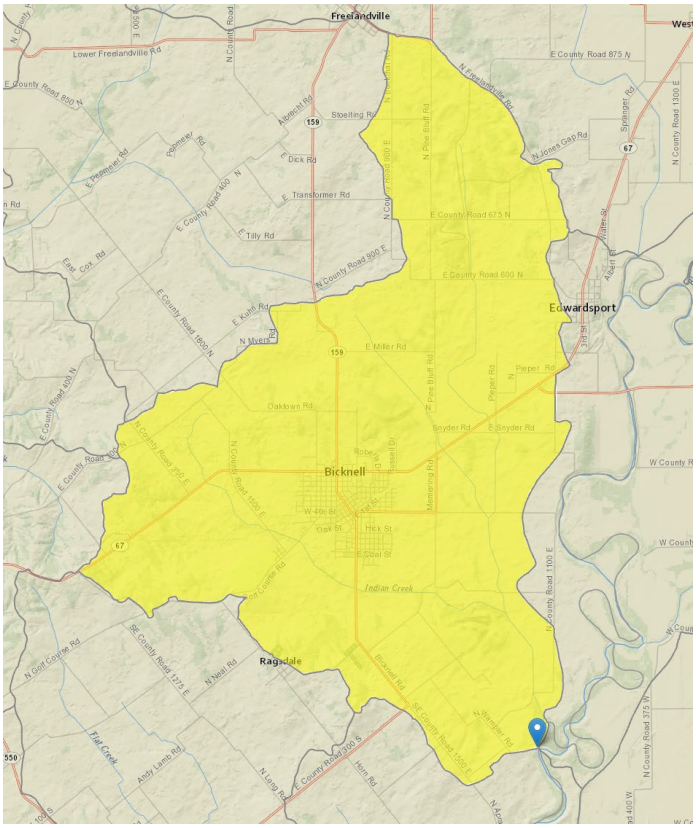
8. Zoom in to the most downstream portion of one of the HUC 12s within the HUC 10
   - ❖ Once zoomed in enough, the option to delineate should appear



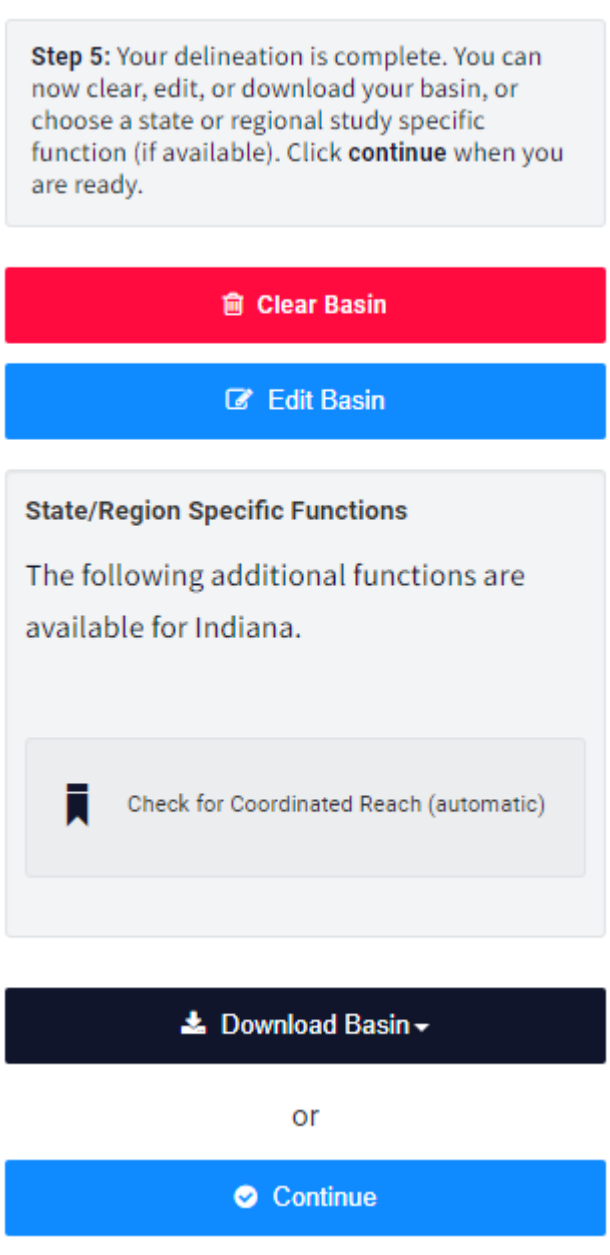
9. Select delineate
10. Make a point as downstream as possible without leaving the HUC 12 boundary
    - ❖ Make sure you are the main stem of the stream/river as opposed to a tributary. You will know you've selected an adequate point if the entire HUC 12 is highlighted once the delineation is complete. You will know you have not selected an adequate point if only a small area is highlighted within the HUC 12.



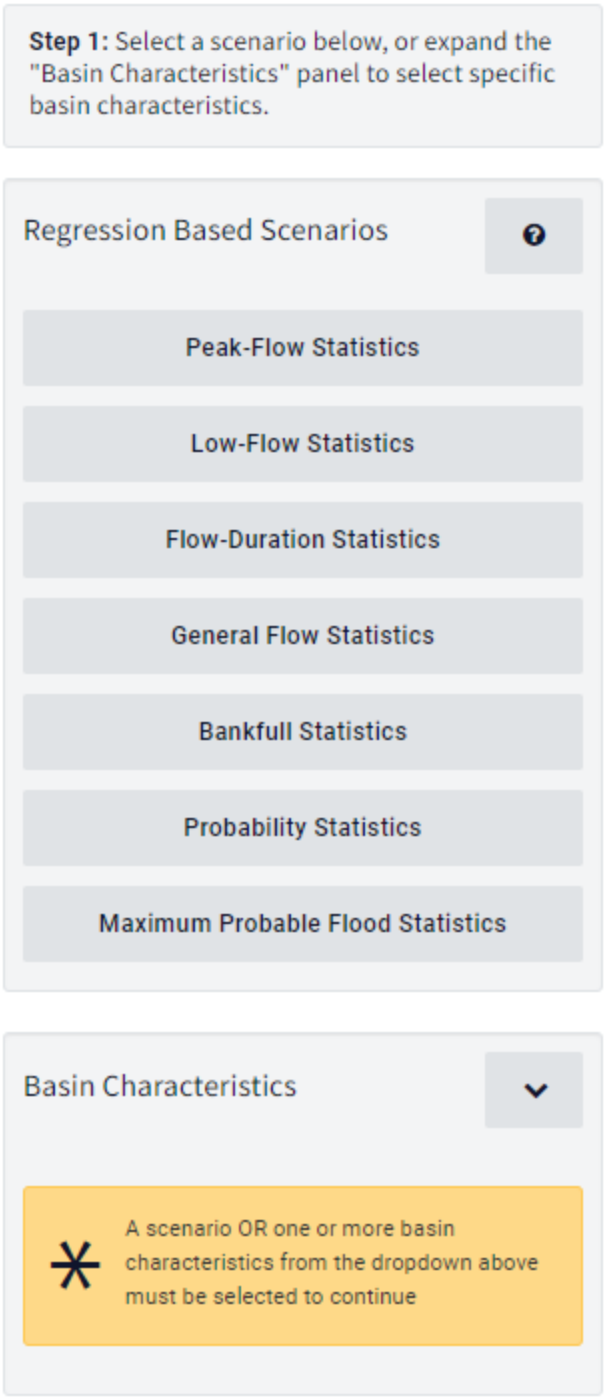
11. Wait while the program runs the delineation



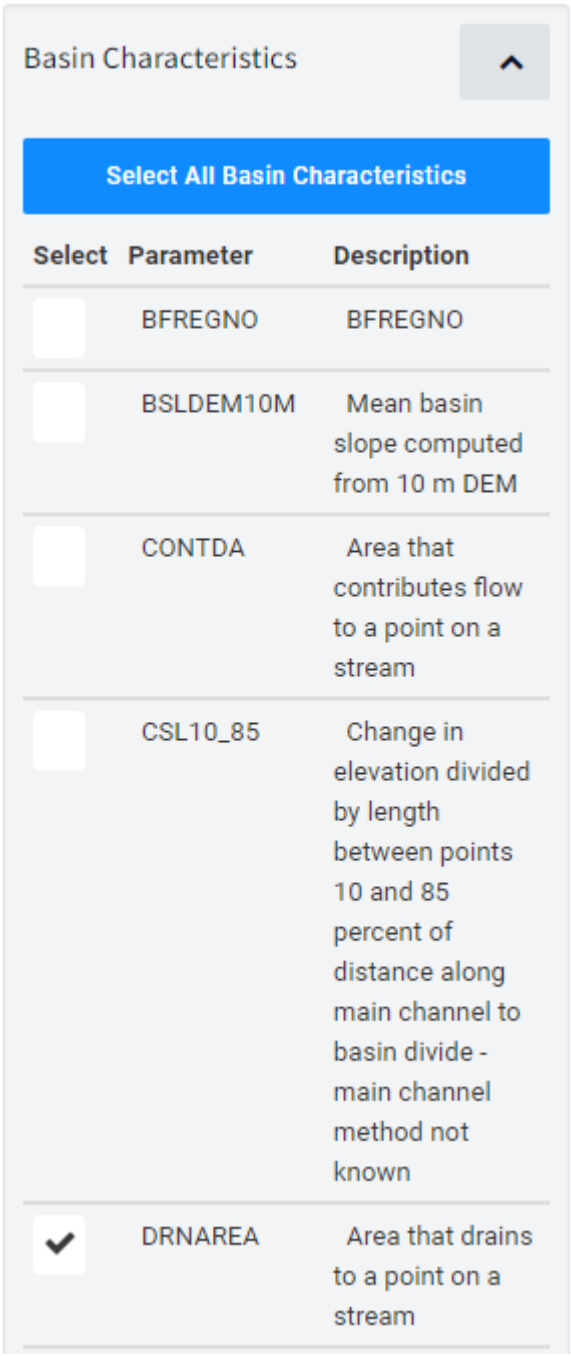
12. Once the delineation is complete and the HUC 12 is highlighted, select continue



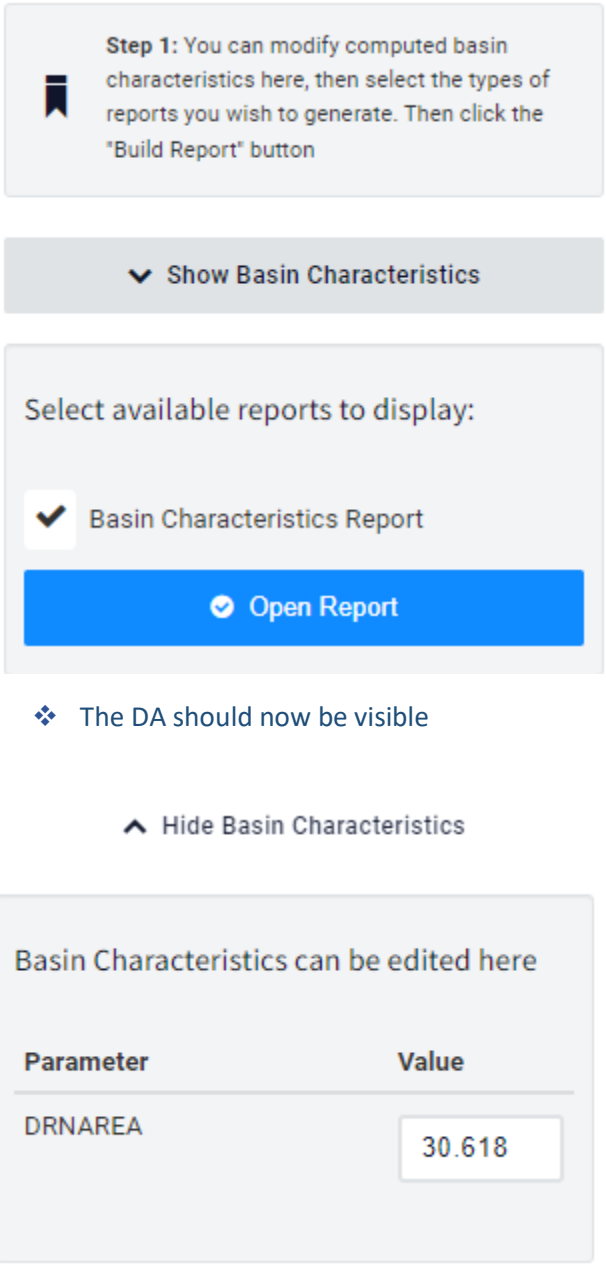
13. Now select 'Basin Characteristics'



14. Scroll down to and select ‘DRNAREA’ then select continue



15. Next select ‘Show Basin Characteristics’



- The DA should now be visible

16. If interested, select 'Open Report' and download the delineation report.
17. Repeat these steps for each HUC 12.

Find the Upstream Drainage

1. Subtract the HUC 10 SA from the HUC 10 DA to get the upstream drainage values.

$$HUC\ 10\ DA - HUC\ 10\ SA = Upstream\ drainage$$

	Name	Drainage Area (sq_mi)	Surface Area (sq_mi)
HUC10 Watershed Name	HUC10	5077.22	99.36
Upstream Drainage	Upstream Drainage		
SW1	Bens Creek	5077.22	16.65
SW2	Pickel Ditch	30.63	30.63
SW3	Smothers Creek	5030.40	26.6
SW4	Pollard Ditch	25.48	25.48

5077.22 – 99.36 = 4,977.86

	Name	Drainage Area (sq_mi)	Surface Area (sq_mi)
HUC10 Watershed Name	HUC10	5077.22	99.36
Upstream Drainage	Upstream Drainage	4977.86	4977.86
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SW4	Pollard Ditch	25.48	25.48

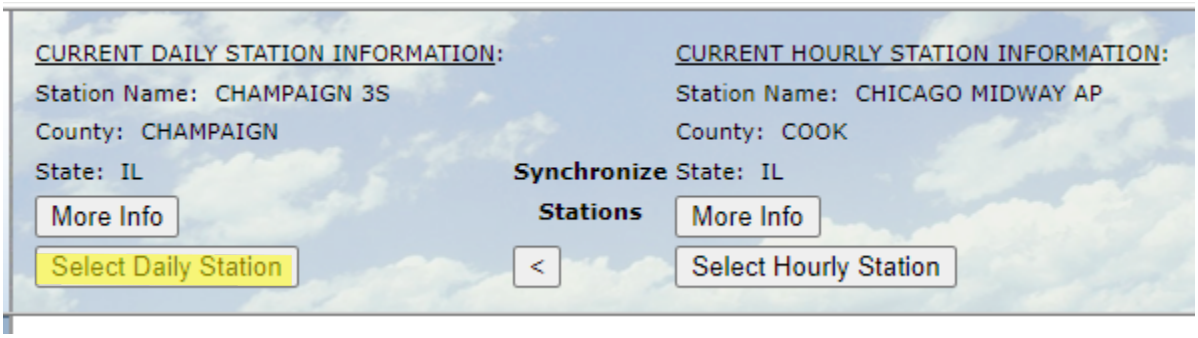
- The upstream drainage is looking at the flow that is coming in from outside the watershed. The DA combines the upstream drainage and the drainage within the watershed. If there were no upstream drainage, the SA and the DA would be the same. Therefore, subtracting the SA of the watershed from the DA of the watershed isolates the drainage that is coming from outside the watershed.

Rainflow_Raw Tab

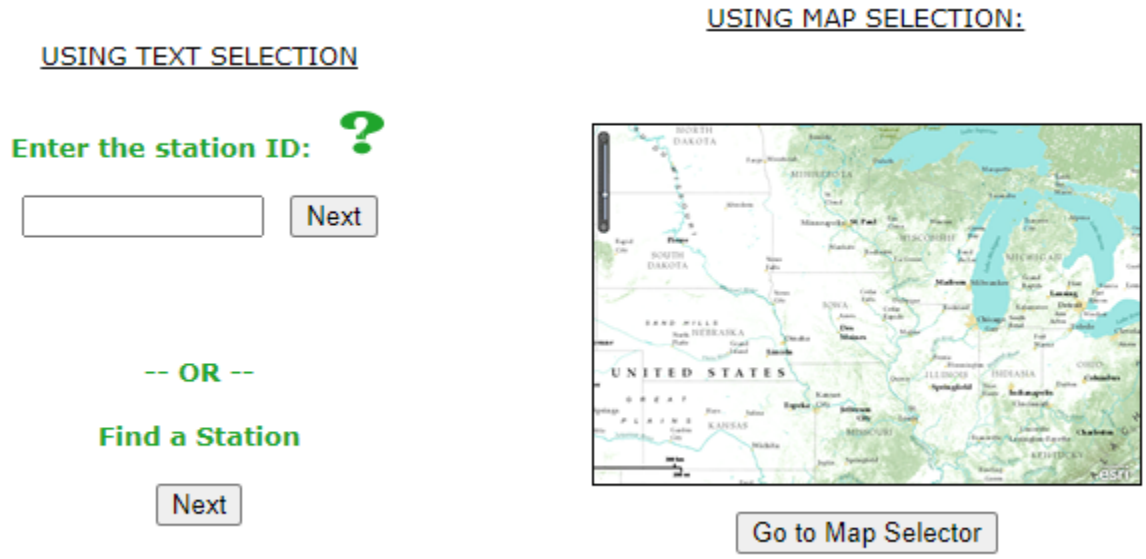
1. Open Cli-MATE
2. If you do not have an account, register for free.

- This option can be found on the Cli-MATE home page

3. Once registered, login
4. Change the location by clicking ‘Select Daily Station’

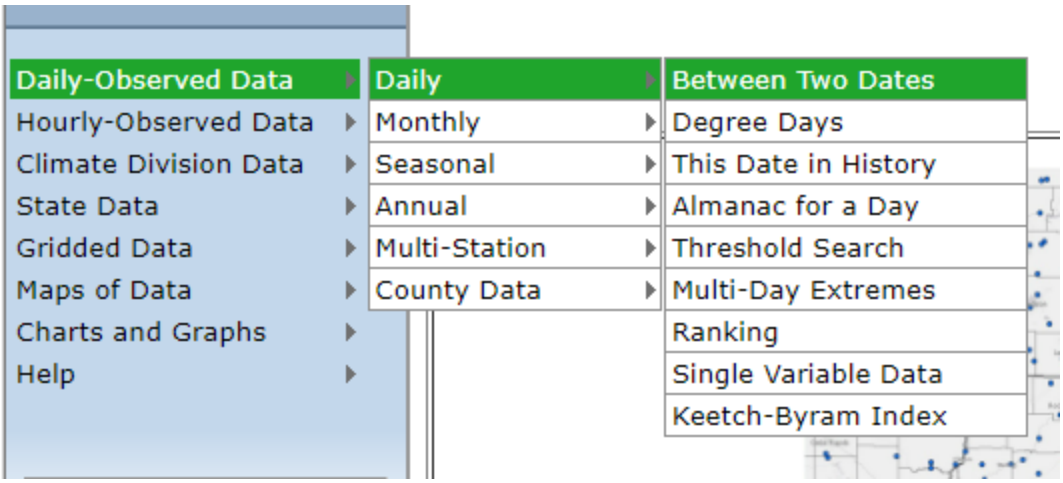


5. Do one of the following to select a station:
    a. Enter station ID
    b. Find a station
    c. Go to Map Selector

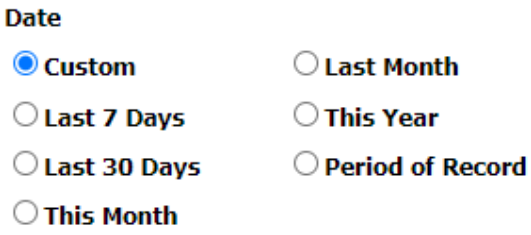


- If you don't know the station ID, the 'Map Selector' tool is likely going to be easier to use than the 'Find a Station' tool. Using the 'Map Selector' tool you can navigate to your watershed by entering a nearby town name or address. Try to find a station within or near your watershed for the most accurate data. Additionally, choose a site that is still currently in use. You will want data from the same period of time are your sampling data was collected.

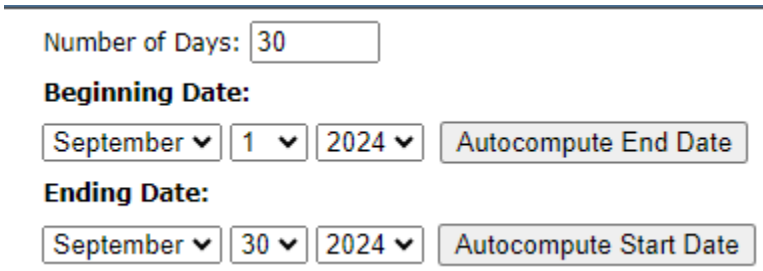
6. Once a station has been selected, select 'Daily-Observed Data'- 'Daily'- 'Between Two Dates'



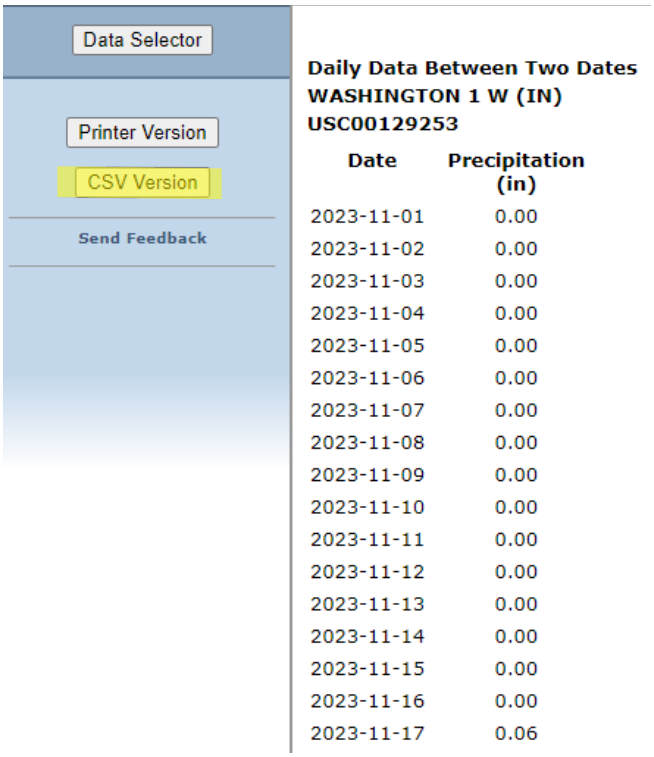
7. Select ‘Custom’



8. Set the dates to the start and end dates of sampling for the project



9. Under variables, select only ‘Precipitation’
10. Select ‘Get Tabular Data’
11. Select ‘CSV Version’ to download the data and format that can be copied into the RainfallRaw tab

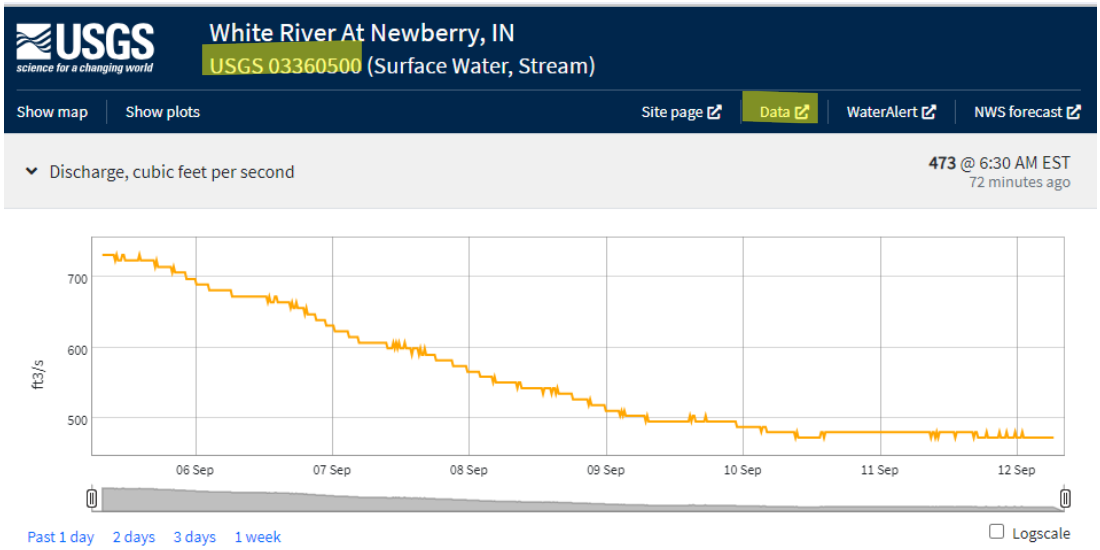


- You should end up with something like this once you've pasted the data into the Rainfall_Raw tab:

Daily Data Between Two Dates	
WASHINGTON 1 W (IN)	
USC00129253	
Date	PRCP
11/1/2023	0
11/2/2023	0
11/3/2023	0
11/4/2023	0
11/5/2023	0
11/6/2023	0
11/7/2023	0
11/8/2023	0
11/9/2023	0
11/10/2023	0
11/11/2023	0
11/12/2023	0
11/13/2023	0
11/14/2023	0
11/15/2023	0
11/16/2023	0
11/17/2023	0.06
11/18/2023	0

RawFlowData Tab

1. Open USGS | National Water Dashboard
2. Zoom-in to the area of interest and select a site that is located as close as possible to that the HUC 10. Ideally this site will be at the most downstream point of the HUC 10.
3. Once selected, a window should open that provides the gauge name and site number



4. Open the ‘Data’ tab (highlighted in the screenshot example above).
5. Ensure that the site offers daily data over a 10-yr period. Under ‘Available Data’ look for ‘Daily Data’ and make sure the ‘Begin Date’ is at least 10 years before the end of sampling and the ‘End Date’ is current.

❖ You will need 10 years worth of daily data from the point sampling ended for your project for best results. For example, if sampling for your project ended in September 2024, you will need daily data starting from September 2014. If there is a gauge within your watershed, but it does not have the correct daily data, choose a different gauge. A gauge that is used in place of a gauge within the watershed is called a surrogate gauge. Try to find a surrogate gauge that has a similar DA to the total DA for your watershed.

6. If the correct data is available, find the DA and plug it into excel.

DESCRIPTION:

Latitude 38°55'41.2", Longitude 87°01'09.4" NAD83
Greene County, Indiana, Hydrologic Unit 05120202
Drainage area: 4,688 square miles
Datum of gage: 465.08 feet above NAVD88.

AVAILABLE DATA:

Data Type	Begin Date	End Date	Count
Current / Historical Observations (availability statement)	1987-11-02	2024-09-12	
Daily Data			
Discharge, cubic feet per second	1928-10-01	2024-09-11	35045
Daily Statistics			
Discharge, cubic feet per second	1928-10-01	2024-05-28	34939
Monthly Statistics			
Discharge, cubic feet per second	1928-10	2024-05	
Annual Statistics			
Discharge, cubic feet per second	1929	2024	
Peak streamflow	1897-03-05	2022-02-22	116
Field measurements	1939-04-19	2024-08-20	288
Water-Year Summary	2006	2023	18
Revisions	Available (site:1) (timeseries:0)		

	Name	Drainage Area (sq_mi)
USGS Gauge	WHITE RIVER AT NEWBERRY, IN	4688

- Next, download flow data

7. Open USGS Water Data for the Nation
8. Select 'Surface Water'
9. Select 'Daily Data'
10. On the 'Choose Site Selection Criteria' page, select the following:
    1. Site Location: State/Territory
    2. Site Identifier: Site Number
    3. Site Attribute: Blank
    4. Data Attribute: Blank
11. Submit
12. Enter the USGS Gauge site number acquired in step 3 and select Indiana

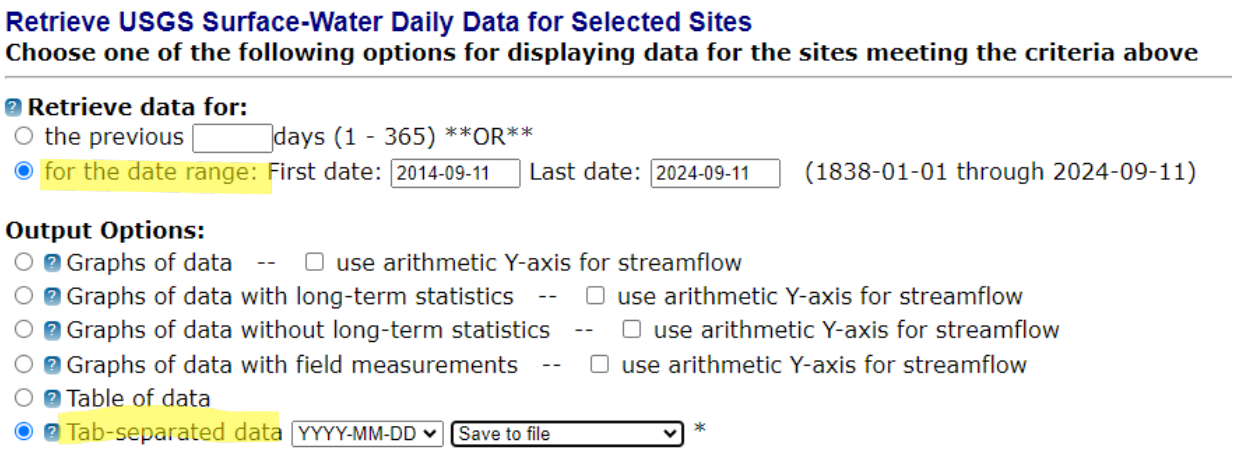
Select sites which meet all of the following criteria:

Define one or more values for each of the following site-selection criteria: --- or select new criteria

Site Number -- enter a full or partial site ID (*optional*)
03360730 (•) exact match ( ) match from the start ( ) match any part

State/Territory -- select one or more
Hawaii
Idaho
Illinois
Indiana
Iowa
Johnston Atoll

13. Scroll to the bottom of the page. Under ‘Retrieve USGS Surface-Water Daily Data for Selected Sites’ change the ‘Retrieve Data for:’ to ‘for the date range:’ and enter a 10-yr span that ends at the same time sampling ended for the project.
14. Change the Output Options Format to ‘Tab-separated’

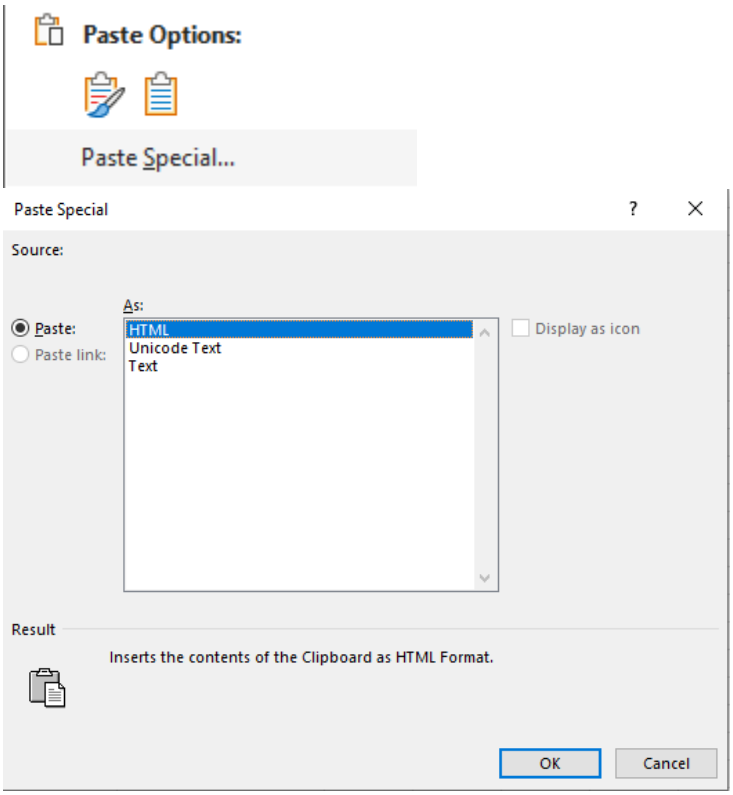


15. Submit
16. Go to downloads and open the downloaded data in a web browser. Copy data

```
# ---------------------------------- WARNING ----------------------------------------
# Some of the data that you have obtained from this U.S. Geological Survey database
# may not have received Director's approval. Any such data values are qualified
# as provisional and are subject to revision. Provisional data are released on the
# condition that neither the USGS nor the United States Government may be held liable
# for any damages resulting from its use.
#
# Additional info: https://waterdata.usgs.gov/provisional-data-statement/
#
# Contact:   gs-w_waterdata_support@usgs.gov
# retrieved: 2024-09-12 09:34:20 EDT       (vaww02)
#
# Data for the following 1 site(s) are contained in this file
#    USGS 03360500 WHITE RIVER AT NEWBERRY, IN
# -------------------------------------------------------------------------------
#
# Data provided for site 03360500
#           TS   parameter     statistic     Description
#        51815       00060     00003     Discharge, cubic feet per second (Mean)
#
# Data-value qualification codes included in this output:
#     A  Approved for publication -- Processing and review completed.
#     P  Provisional data subject to revision.
#     e  Value has been estimated.
#
agency_cd       site_no datetime        51815_00060_00003       51815_00060_00003_cd
5s      15s     20d     14n     10s
USGS    03360500        2014-09-11      1970    A
USGS    03360500        2014-09-12      3870    A
USGS    03360500        2014-09-13      5140    A
USGS    03360500        2014-09-14      4770    A
USGS    03360500        2014-09-15      4030    A
USGS    03360500        2014-09-16      3470    A
USGS    03360500        2014-09-17      3190    A
USGS    03360500        2014-09-18      2950    A
USGS    03360500        2014-09-19      2530    A
USGS    03360500        2014-09-20      2190    A
```

- Try opening the data in Internet Explorer. This web browser seems to offer the most consistent formatting when copy/pasting the data into excel.

17. Navigate to cell A1 in the RawFlowData tab and right-click. Select ‘Paste Special’-‘Text’-‘OK’



- Using this paste method will ensure that the data is formatted into separate columns

	A	B	C	D	E
1	# ---------- WARNING ----------				
2	# Some of the data that you have obtained from this U.S. Geological Survey database				
3	# may not have received Director's approval. Any such data values are qualified				
4	# as provisional and are subject to revision. Provisional data are released on the				
5	# condition that neither the USGS nor the United States Government may be held liable				
6	# for any damages resulting from its use.				
7	#				
8	# Additional info: https://waterdata.usgs.gov/provisional-data-statement/				
9	#				
10	# Contact: gs-w_waterdata_support@usgs.gov				
11	# retrieved: 2024-09-12 09:34:20 EDT (vaww02)				
12	#				
13	# Data for the following 1 site(s) are contained in this file				
14	# USGS 03360500 WHITE RIVER AT NEWBERRY, IN				
15	# ----------				
16	#				
17	# Data provided for site 03360500				
18	# TS parameter statistic Description				
19	# 51815 00060 00003 Discharge, cubic feet per second (Mean)				
20	#				
21	# Data-value qualification codes included in this output:				
22	# A Approved for publication -- Processing and review completed.				
23	# P Provisional data subject to revision.				
24	# e Value has been estimated.				
25	#				
26	agency_cd	site_no	datetime	51815_00060_00003	51815_00060_00003_cd
27	5s	15s	20d	14n	10s
28	USGS	3360500	9/11/2014	1970	A
29	USGS	3360500	9/12/2014	3870	A
30	USGS	3360500	9/13/2014	5140	A
31	USGS	3360500	9/14/2014	4770	A
32	USGS	3360500	9/15/2014	4030	A
33	USGS	3360500	9/16/2014	3470	A
34	USGS	3360500	9/17/2014	3190	A

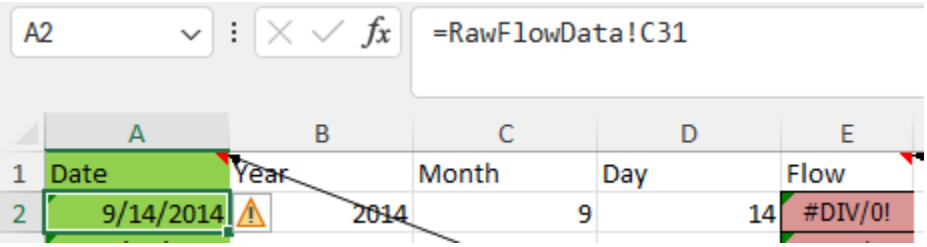
FlowPrep and Flow Data Tabs

These tabs should automatically populate with data from the RawFlowData tab. Double check that the data is being pulled from the correct rows. The FlowPrep tab and Flow Data tab both assume that the first date is in cell C31 in the RawFlowData tab. If the first date displayed in column A of the FlowPrep tab and column B of the Flow Data tab is not the first date in the RawFlowData tab, do one of the following:

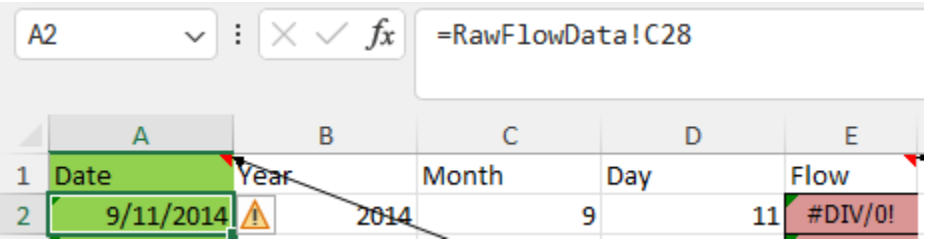
- ❖ If the data looks correct you can skip to the LDC section

Update formula

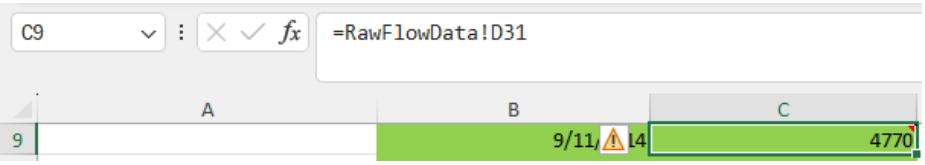
1. Go to the formula bar for cell A2 in the FlowPrep tab



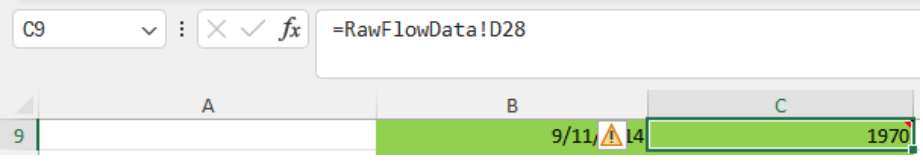
2. Delete 'C31' in the formula bar and replace it with the top-most cell in the date column (column C) of the RawFlowData tab



3. Double click in the bottom right-hand corner of the updated cell to update the rest of the cells in that column
4. Make the same update to column B in the Flow Data tab.
5. Go to the formula bar for cell C9 in the Flow Data tab



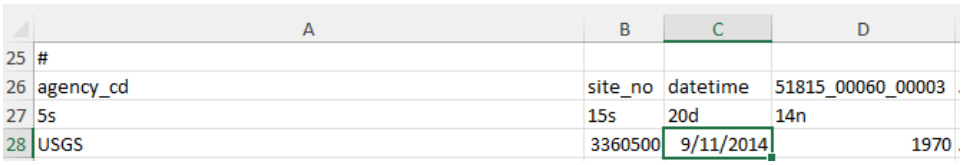
6. Delete 'D31' in the formula bar and replace it with the top-most cell in the flow column (column D) of the RawFlowData tab



7. Double click in the bottom right-hand corner of the updated cell to update the rest of the cells in that column

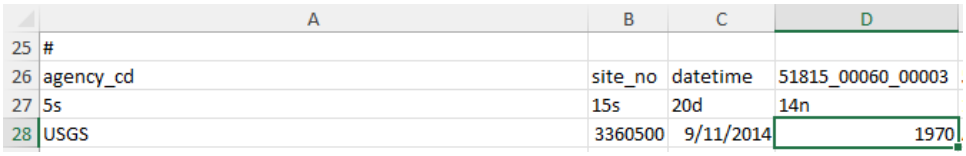
Copy and paste

1. Select the top-most cell in the date column (column C) of the RawFlowData tab



	A	B	C	D
25	#			
26	agency_cd	site_no	datetime	51815_00060_00003
27	5s	15s	20d	14n
28	USGS	3360500	9/11/2014	1970

2. Hold the CTRL+Shift+Down keys. This will select the entire column. Copy
3. Paste the date column to column A in the FlowPrep tab and column B in the Flow Data tab.
4. Select the top-most cell in the flow column (column D) of the RawFlowData tab



	A	B	C	D
25	#			
26	agency_cd	site_no	datetime	51815_00060_00003
27	5s	15s	20d	14n
28	USGS	3360500	9/11/2014	1970

5. Hold ctrl+shift+down key. This will select the entire column. Copy
6. Paste the flow column to column C in the Flow Data tab

❖ Double check that all the data in each of the columns from this section is correctly formatted before moving on.

LDC

The top of this tab should show the HUC 12, drainage, and flow data separated out by the following parameters: E. coli, Total Phosphorus, Total Suspended Solids, and Nitrogen, N+N, as well as various permit types. Graphs to the right will visually show the data for each table on the left. There are formulas that pull data from other tabs. You should not have to add anything in this tab.

90th Percentile

There are four 90th percentile tabs; each covers one of the following parameters: E. coli, TSS, TP, TN. These are optional Tabs that help calculate the 90th percentile concentration value based on flow.

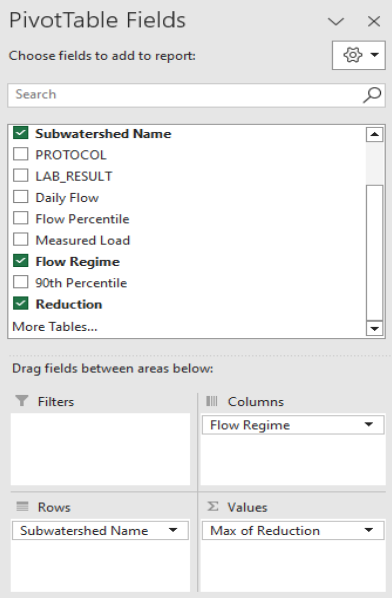
❖ Use the tabs with parameters relevant to your project

1. Use the Watershed Data_Pivot tab or raw sampling results to fill out columns A-F.
2. Once the data is entered, the pivot table on the right-hand side of the tab should populate. Right click the pivot table and select “Refresh” if it does not update automatically.

If Refresh does not work:

3. Right click the pivot table and select ‘Show Field List’
4. In the ‘Show Field List’ pane, make sure the following is true:
   Rows- Subwatershed Name
   Columns- Flow Regime
   Values- Reduction

5. Select the drop-down option next to ‘Reduction’ and select ‘Value Field Settings’
6. In the ‘Summarize Values By’ tab, select ‘Max’
7. Click ‘Ok’



SW1-12

These tabs are used to separate data by subwatershed in order to highlight impairments and create automatic graphs to display collected observed data.

1. Copy and paste each site’s sample dates, E. coli results, TP results, TSS results, and Nitrogen + results into the appropriate subwatershed tab.

Site #1				
Date	E. coli	Phosphorus, Total	Solids, Suspended Total, (TSS)	Nitrogen, Nitrate+Nitrite
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A

- ❖ The red columns should update once this data has been plugged in.

2. Once the data has been entered you should see graphs with a flow regime and acceptable load bar to indicate what reductions are still needed.