MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

WATER RESOURCES DIVISION
Municipal Separate Storm Sewer System (MS4) Program

Stormwater Runoff Calculator Manual

Contents

Acronyms

AOI – Area of Interest

BMP – Best Management Practice

EGLE – Michigan Department of Environment, Great Lakes, and Energy

MS4 – Municipal Separate Storm Sewer System

NOAA – National Oceanic and Atmospheric Administration

USDA - United States Department of Agriculture

WRD – Water Resources Division

WSS – Web Soil Survey

1.0 Instructions

Using the MS4 Stormwater Calculator

1. At the top of the spreadsheet, enter the site name and the total drainage area of the site in acres. Total drainage area refers to the area of earth disturbance for a given project.
2. Enter the design rainfall event in inches in the space provided. For the Water Quality Rainfall Event, insert 1 in OR the 90% annual non-exceedance storm for the region or locality. Follow the guidance on the 90% non-exceedance tab or Section 2.0 of the "MS4 Calculator Manual" for determining local amounts. For the Channel Protection Rainfall Event, follow the guidance on the Rainfall tab or in Section 2.0 of the "MS4 Calculator Manual" for determining local rainfall amounts (often the 2-year 24-hour storm), or use approved equivalent rainfall included in the MS4 permit. It is important to note that this is the total amount of rainfall and not the runoff for the site in the pre-development table, enter the area of each applicable land cover and soil combination and the amount of impervious area for the pre-development condition in acres. The total area must add up to the total drainage area recorded at the top of the spreadsheet. Note, here the runoff volume for each land use cover and soil type must be calculated separately and then summed for the entire site. A composite Curve Number (CN) cannot be used. Consult with MS4 technical staff or visit the "Common Curve Numbers Tab" if a land cover at the site is not represented to determine an appropriate CN. For guidance on identifying soil types, please see the "Soils" tabs of the spreadsheet or Sections 3.0 of the "MS4 Stormwater Calculator Manual."
3. In the post-development table enter the proposed cover type and soil type. The total area at the bottom of the table must match the total drainage area recorded at the top of the spreadsheet. Similarly, the total area for each soil group should be equal to or less (depending on the amount of impervious surface added) to the values reported in the pre-development table, unless new soils are being brought to the site. Cover and soil type can be copied from the pre-development table and pasted to the post-development table if applicable. A CN for each new cover type must be selected but composite CNs cannot be used. Consult with MS4 technical staff if a land cover at the site is not represented to determine an appropriate CN.
4. The spreadsheet automatically calculates the Runoff Volume Increase in cubic feet shown in the light blue cell near the bottom of the table. This is the volume of stormwater runoff that must be controlled.
5. For additional guidance on how to use this spreadsheet please see the "New Development Example Scenario," the "Redevelopment Example Scenario" tab or Sections 4.0 and 5.0 of this manual for a completed examples of how to use this spreadsheet.

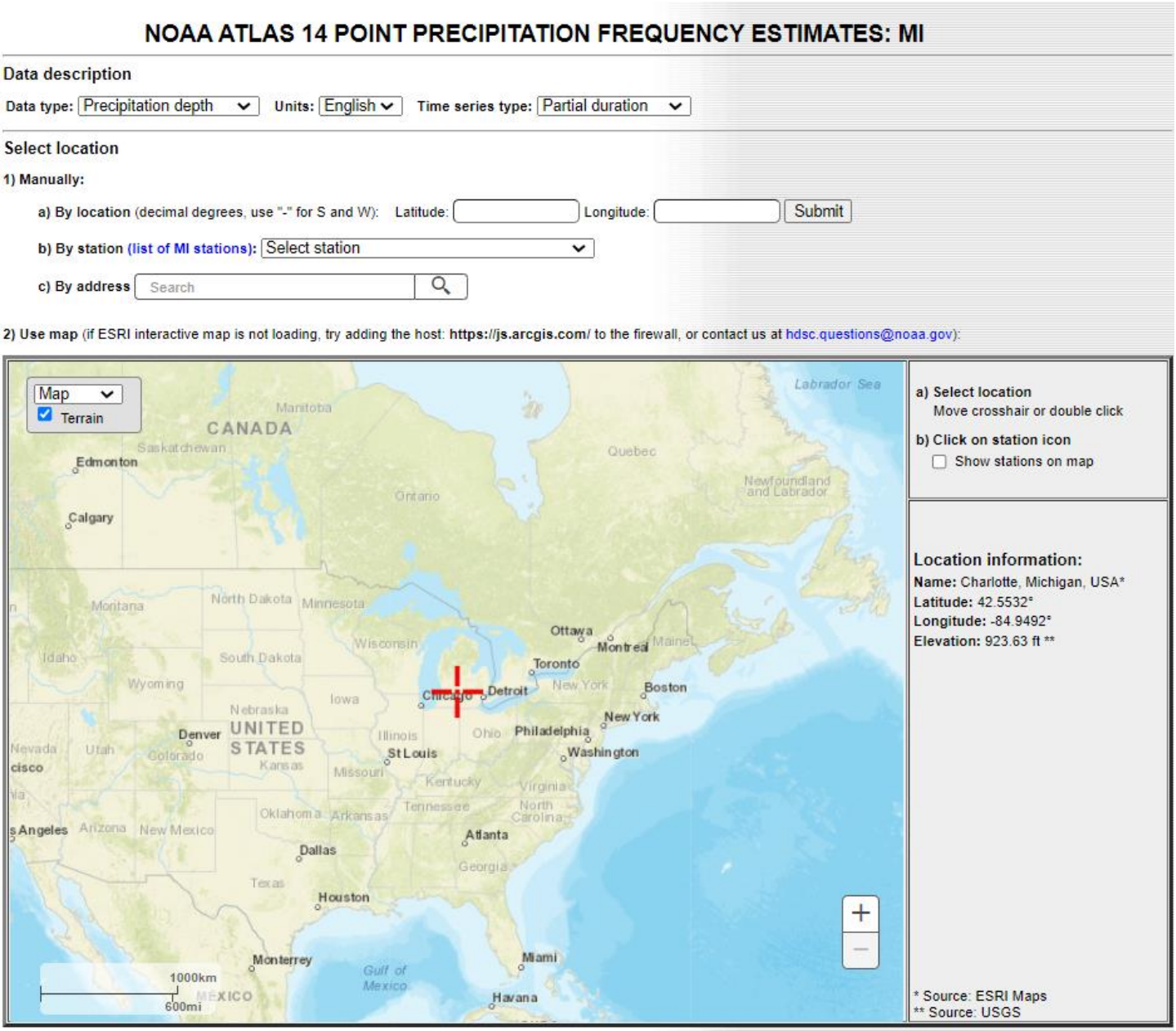
Note: If the goal for the site is to treat the Water Quality Volume generated by one (1) inch of runoff over the entire site the spreadsheet automatically performs that calculation, and the volume is shown in cubic feet in the light blue cell on the bottom right-hand corner of the sheet. This calculation is based on the value provided for the "Total Drainage Area" at the top of this sheet.

2.0 Rainfall

Obtaining Rainfall Data from NOAA ATLAS 14

Go to the [NOAA ATLAS 14 Website](#).

The image below shows the load page. Follow the instructions on the website to select the site location, this can be done by entering latitude/longitude, address, or selecting the desired location on the interactive map.



After selecting the site location, scroll down the web page below the map to the POINT PRECIPITATION FREQUENCY (PF) ESTIMATES and select the “PF tabular” option. It should look like the image below:

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 8, Version 2

PF tabular | PF graphical | Supplementary information

Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.296 (0.233-0.381)	0.346 (0.272-0.445)	0.431 (0.339-0.556)	0.506 (0.396-0.654)	0.616 (0.468-0.819)	0.705 (0.524-0.943)	0.799 (0.574-1.08)	0.898 (0.620-1.24)	1.04 (0.688-1.45)	1.15 (0.740-1.61)
10-min	0.433 (0.342-0.557)	0.506 (0.399-0.651)	0.631 (0.496-0.814)	0.741 (0.579-0.958)	0.902 (0.686-1.20)	1.03 (0.767-1.38)	1.17 (0.840-1.59)	1.32 (0.908-1.81)	1.52 (1.01-2.12)	1.68 (1.08-2.36)
15-min	0.528 (0.417-0.680)	0.617 (0.486-0.794)	0.770 (0.605-0.993)	0.904 (0.706-1.17)	1.10 (0.837-1.46)	1.26 (0.935-1.68)	1.43 (1.02-1.94)	1.60 (1.11-2.21)	1.85 (1.23-2.59)	2.05 (1.32-2.88)
30-min	0.755 (0.596-0.972)	0.881 (0.694-1.13)	1.10 (0.863-1.42)	1.29 (1.01-1.67)	1.57 (1.20-2.09)	1.80 (1.34-2.41)	2.05 (1.47-2.78)	2.31 (1.59-3.18)	2.67 (1.77-3.74)	2.96 (1.91-4.16)
60-min	0.953 (0.752-1.23)	1.13 (0.893-1.46)	1.44 (1.13-1.86)	1.71 (1.34-2.22)	2.11 (1.61-2.81)	2.43 (1.81-3.26)	2.77 (1.99-3.76)	3.13 (2.16-4.32)	3.63 (2.41-5.09)	4.03 (2.60-5.67)
2-hr	1.15 (0.920-1.46)	1.39 (1.11-1.76)	1.79 (1.42-2.27)	2.14 (1.69-2.72)	2.65 (2.04-3.48)	3.06 (2.30-4.04)	3.50 (2.55-4.68)	3.96 (2.77-5.38)	4.59 (3.10-6.36)	5.10 (3.34-7.09)
3-hr	1.26 (1.01-1.59)	1.53 (1.23-1.92)	1.99 (1.59-2.51)	2.39 (1.91-3.02)	2.98 (2.31-3.88)	3.46 (2.62-4.52)	3.95 (2.90-5.26)	4.48 (3.16-6.06)	5.21 (3.54-7.16)	5.79 (3.83-8.00)
6-hr	1.51 (1.23-1.87)	1.80 (1.46-2.23)	2.30 (1.87-2.86)	2.76 (2.22-3.43)	3.43 (2.70-4.41)	3.98 (3.06-5.15)	4.57 (3.40-6.01)	5.20 (3.73-6.95)	6.08 (4.20-8.27)	6.79 (4.56-9.27)
12-hr	1.84 (1.52-2.25)	2.10 (1.73-2.56)	2.58 (2.12-3.15)	3.02 (2.47-3.71)	3.71 (2.98-4.73)	4.30 (3.37-5.51)	4.94 (3.74-6.43)	5.64 (4.11-7.47)	6.65 (4.67-8.95)	7.48 (5.10-10.1)
24-hr	2.17 (1.82-2.62)	2.44 (2.04-2.94)	2.95 (2.45-3.55)	3.42 (2.83-4.13)	4.15 (3.38-5.21)	4.78 (3.79-6.03)	5.46 (4.20-7.01)	6.21 (4.60-8.11)	7.30 (5.20-9.70)	8.18 (5.67-10.9)
2-day	2.48 (2.10-2.93)	2.84 (2.40-3.36)	3.48 (2.93-4.12)	4.05 (3.40-4.82)	4.89 (4.02-6.02)	5.60 (4.49-6.94)	6.35 (4.93-8.00)	7.15 (5.35-9.17)	8.27 (5.98-10.8)	9.18 (6.45-12.1)
3-day	2.73 (2.33-3.20)	3.10 (2.65-3.64)	3.77 (3.20-4.43)	4.37 (3.69-5.15)	5.25 (4.34-6.40)	5.98 (4.84-7.35)	6.76 (5.30-8.45)	7.60 (5.74-9.68)	8.78 (6.40-11.4)	9.72 (6.90-12.7)
4-day	2.94 (2.52-3.43)	3.32 (2.85-3.87)	3.99 (3.41-4.66)	4.60 (3.91-5.39)	5.50 (4.58-6.67)	6.25 (5.09-7.63)	7.06 (5.57-8.76)	7.92 (6.02-10.0)	9.14 (6.71-11.8)	10.1 (7.23-13.1)
7-day	3.46 (3.00-3.98)	3.87 (3.35-4.45)	4.58 (3.96-5.28)	5.22 (4.49-6.04)	6.18 (5.20-7.39)	6.98 (5.74-8.41)	7.83 (6.25-9.61)	8.75 (6.73-11.0)	10.0 (7.46-12.8)	11.1 (8.02-14.2)
10-day	3.92 (3.42-4.47)	4.36 (3.80-4.97)	5.12 (4.46-5.86)	5.81 (5.03-6.66)	6.82 (5.77-8.07)	7.65 (6.34-9.14)	8.54 (6.86-10.4)	9.48 (7.35-11.8)	10.8 (8.10-13.7)	11.9 (8.66-15.2)
20-day	5.28 (4.68-5.93)	5.83 (5.16-6.55)	6.76 (5.96-7.61)	7.56 (6.63-8.53)	8.70 (7.44-10.1)	9.61 (8.05-11.3)	10.5 (8.59-12.6)	11.5 (9.06-14.1)	12.9 (9.78-16.0)	13.9 (10.3-17.5)
30-day	6.49 (5.79-7.21)	7.14 (6.36-7.94)	8.21 (7.30-9.15)	9.10 (8.05-10.2)	10.3 (8.90-11.8)	11.3 (9.53-13.1)	12.3 (10.1-14.5)	13.2 (10.5-16.0)	14.6 (11.1-17.9)	15.5 (11.6-19.4)
45-day	8.08 (7.27-8.89)	8.87 (7.97-9.77)	10.1 (9.07-11.2)	11.1 (9.94-12.3)	12.5 (10.8-14.1)	13.5 (11.5-15.4)	14.5 (12.0-16.9)	15.4 (12.3-18.4)	16.7 (12.9-20.3)	17.6 (13.3-21.8)
60-day	9.48 (8.58-10.4)	10.4 (9.39-11.4)	11.8 (10.7-13.0)	12.9 (11.6-14.2)	14.4 (12.5-16.1)	15.4 (13.2-17.5)	16.4 (13.8-19.0)	17.3 (13.9-20.5)	18.5 (14.3-22.3)	19.2 (14.7-23.7)

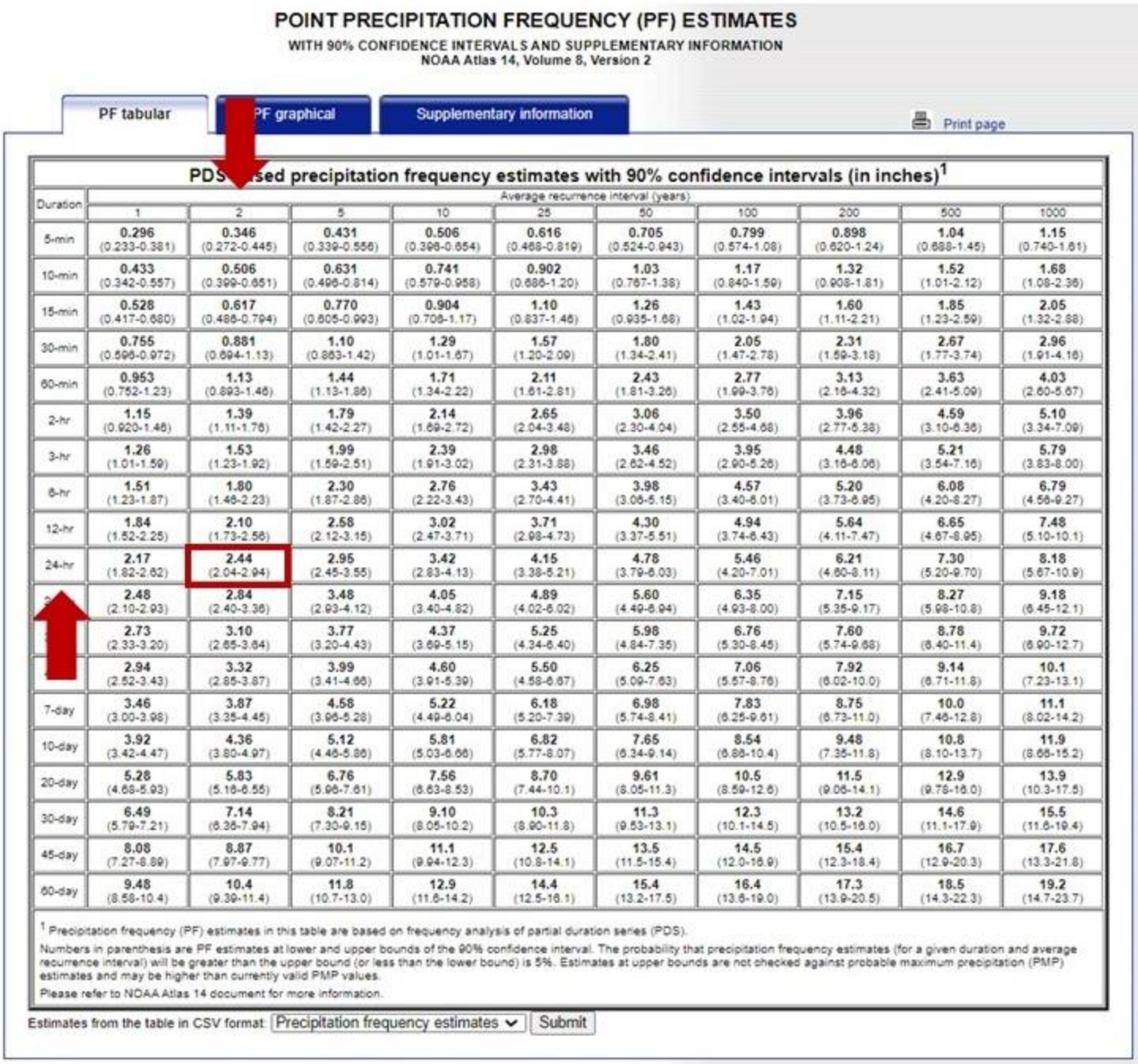
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates | Submit

From the PF Estimates table, identify the recurrence (column) and duration (row) of the design storm (e.g., 2-year 24-hour) and find where they meet. This is the rainfall generated by the design storm and should be used on the “Runoff Volume” tab as the “Design Rainfall Event.”



POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 8, Version 2

PF tabular | PF graphical | Supplementary information | Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

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10-min	0.433 (0.342-0.557)	0.506 (0.399-0.651)	0.631 (0.496-0.814)	0.741 (0.579-0.958)	0.902 (0.686-1.20)	1.03 (0.767-1.38)	1.17 (0.840-1.59)	1.32 (0.908-1.81)	1.52 (1.01-2.12)	1.68 (1.08-2.36)
15-min	0.528 (0.417-0.680)	0.617 (0.486-0.794)	0.770 (0.605-0.993)	0.904 (0.708-1.17)	1.10 (0.837-1.46)	1.26 (0.935-1.68)	1.43 (1.02-1.94)	1.60 (1.11-2.21)	1.85 (1.23-2.59)	2.05 (1.32-2.88)
30-min	0.755 (0.596-0.972)	0.881 (0.694-1.13)	1.10 (0.863-1.42)	1.29 (1.01-1.67)	1.57 (1.20-2.09)	1.80 (1.34-2.41)	2.05 (1.47-2.78)	2.31 (1.59-3.18)	2.67 (1.77-3.74)	2.96 (1.91-4.16)
60-min	0.953 (0.752-1.23)	1.13 (0.893-1.46)	1.44 (1.13-1.86)	1.71 (1.34-2.22)	2.11 (1.61-2.81)	2.43 (1.81-3.26)	2.77 (1.99-3.76)	3.13 (2.16-4.32)	3.63 (2.41-5.09)	4.03 (2.60-5.67)
2-hr	1.15 (0.920-1.46)	1.39 (1.11-1.76)	1.79 (1.42-2.27)	2.14 (1.69-2.72)	2.65 (2.04-3.48)	3.06 (2.30-4.04)	3.50 (2.55-4.68)	3.96 (2.77-5.38)	4.59 (3.10-6.36)	5.10 (3.34-7.09)
3-hr	1.26 (1.01-1.59)	1.53 (1.23-1.92)	1.99 (1.59-2.51)	2.39 (1.91-3.02)	2.98 (2.31-3.88)	3.46 (2.62-4.52)	3.95 (2.90-5.26)	4.48 (3.16-6.06)	5.21 (3.54-7.16)	5.79 (3.83-8.00)
6-hr	1.51 (1.23-1.87)	1.80 (1.46-2.23)	2.30 (1.87-2.86)	2.76 (2.22-3.43)	3.43 (2.70-4.41)	3.98 (3.06-5.15)	4.57 (3.40-6.01)	5.20 (3.73-6.95)	6.08 (4.20-8.27)	6.79 (4.56-9.27)
12-hr	1.84 (1.52-2.25)	2.10 (1.73-2.56)	2.58 (2.12-3.15)	3.02 (2.47-3.71)	3.71 (2.98-4.73)	4.30 (3.37-5.51)	4.94 (3.74-6.43)	5.64 (4.11-7.47)	6.65 (4.67-8.95)	7.48 (5.10-10.1)
24-hr	2.17 (1.82-2.62)	2.44 (2.04-2.94)	2.95 (2.45-3.55)	3.42 (2.83-4.13)	4.15 (3.38-5.21)	4.78 (3.79-6.03)	5.46 (4.20-7.01)	6.21 (4.60-8.11)	7.30 (5.20-9.70)	8.18 (5.67-10.9)
[illegible]	2.48 (2.10-2.93)	2.84 (2.40-3.36)	3.48 (2.93-4.12)	4.05 (3.40-4.82)	4.89 (4.02-6.02)	5.60 (4.49-6.94)	6.35 (4.93-8.00)	7.15 (5.35-9.17)	8.27 (5.98-10.8)	9.18 (6.45-12.1)
[illegible]	2.73 (2.33-3.20)	3.10 (2.65-3.64)	3.77 (3.20-4.43)	4.37 (3.69-5.15)	5.25 (4.34-6.40)	5.98 (4.84-7.35)	6.76 (5.30-8.45)	7.60 (5.74-9.68)	8.78 (6.40-11.4)	9.72 (6.90-12.7)
[illegible]	2.94 (2.52-3.43)	3.32 (2.85-3.87)	3.99 (3.41-4.66)	4.60 (3.91-5.39)	5.50 (4.58-6.67)	6.25 (5.09-7.63)	7.06 (5.57-8.76)	7.92 (6.02-10.0)	9.14 (6.71-11.8)	10.1 (7.23-13.1)
7-day	3.46 (3.00-3.98)	3.87 (3.35-4.45)	4.58 (3.96-5.28)	5.22 (4.49-6.04)	6.18 (5.20-7.39)	6.98 (5.74-8.41)	7.83 (6.25-9.61)	8.75 (6.73-11.0)	10.0 (7.46-12.8)	11.1 (8.02-14.2)
10-day	3.92 (3.42-4.47)	4.36 (3.80-4.97)	5.12 (4.46-5.86)	5.81 (5.03-6.66)	6.82 (5.77-8.07)	7.65 (6.34-9.14)	8.54 (6.86-10.4)	9.48 (7.35-11.8)	10.8 (8.10-13.7)	11.9 (8.66-15.2)
20-day	5.28 (4.68-5.93)	5.83 (5.16-6.55)	6.76 (5.96-7.61)	7.56 (6.63-8.53)	8.70 (7.44-10.1)	9.61 (8.05-11.3)	10.5 (8.59-12.6)	11.5 (9.06-14.1)	12.9 (9.78-16.0)	13.9 (10.3-17.5)
30-day	6.49 (5.79-7.21)	7.14 (6.36-7.94)	8.21 (7.30-9.15)	9.10 (8.05-10.2)	10.3 (8.90-11.8)	11.3 (9.53-13.1)	12.3 (10.1-14.5)	13.2 (10.5-16.0)	14.6 (11.1-17.9)	15.5 (11.6-19.4)
45-day	8.08 (7.27-8.89)	8.87 (7.97-9.77)	10.1 (9.07-11.2)	11.1 (9.94-12.3)	12.5 (10.8-14.1)	13.5 (11.5-15.4)	14.5 (12.0-16.9)	15.4 (12.3-18.4)	16.7 (12.9-20.3)	17.6 (13.3-21.8)
60-day	9.48 (8.58-10.4)	10.4 (9.39-11.4)	11.8 (10.7-13.0)	12.9 (11.6-14.2)	14.4 (12.5-16.1)	15.4 (13.2-17.5)	16.4 (13.6-19.0)	17.3 (13.9-20.5)	18.5 (14.3-22.3)	19.2 (14.7-23.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

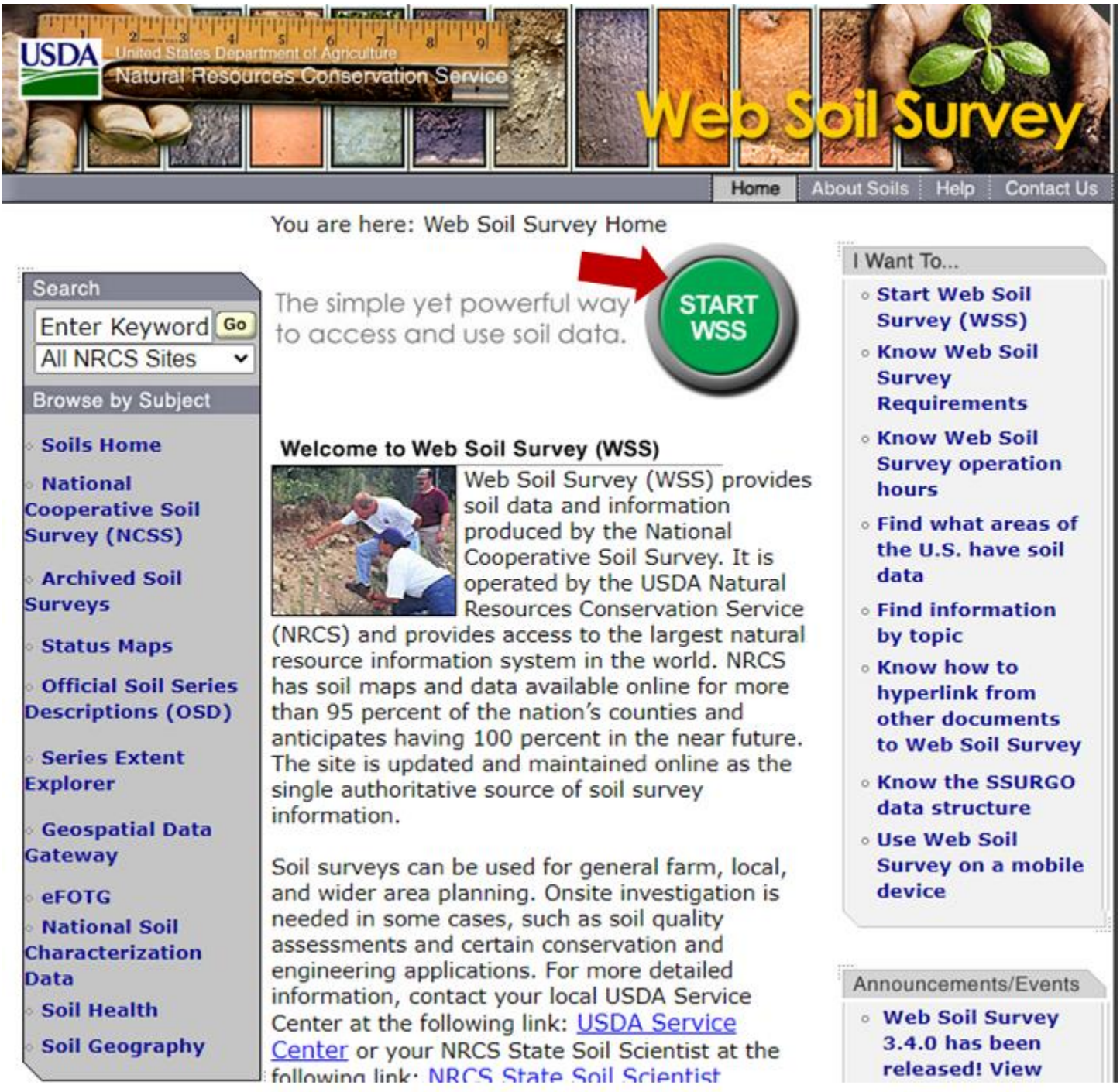
Estimates from the table in CSV format: Precipitation frequency estimates | Submit

3.0 Site Soil Data

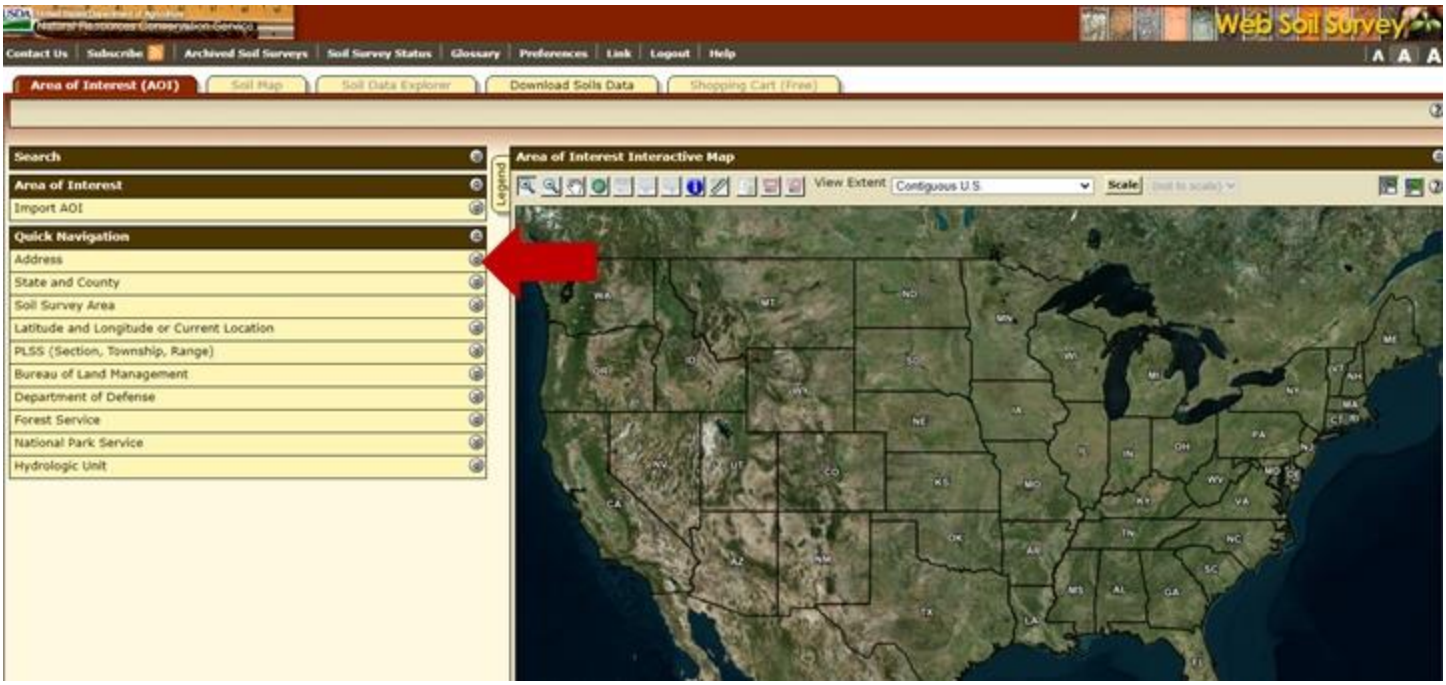
Obtaining Soil Data from the USDA Web Soil Survey

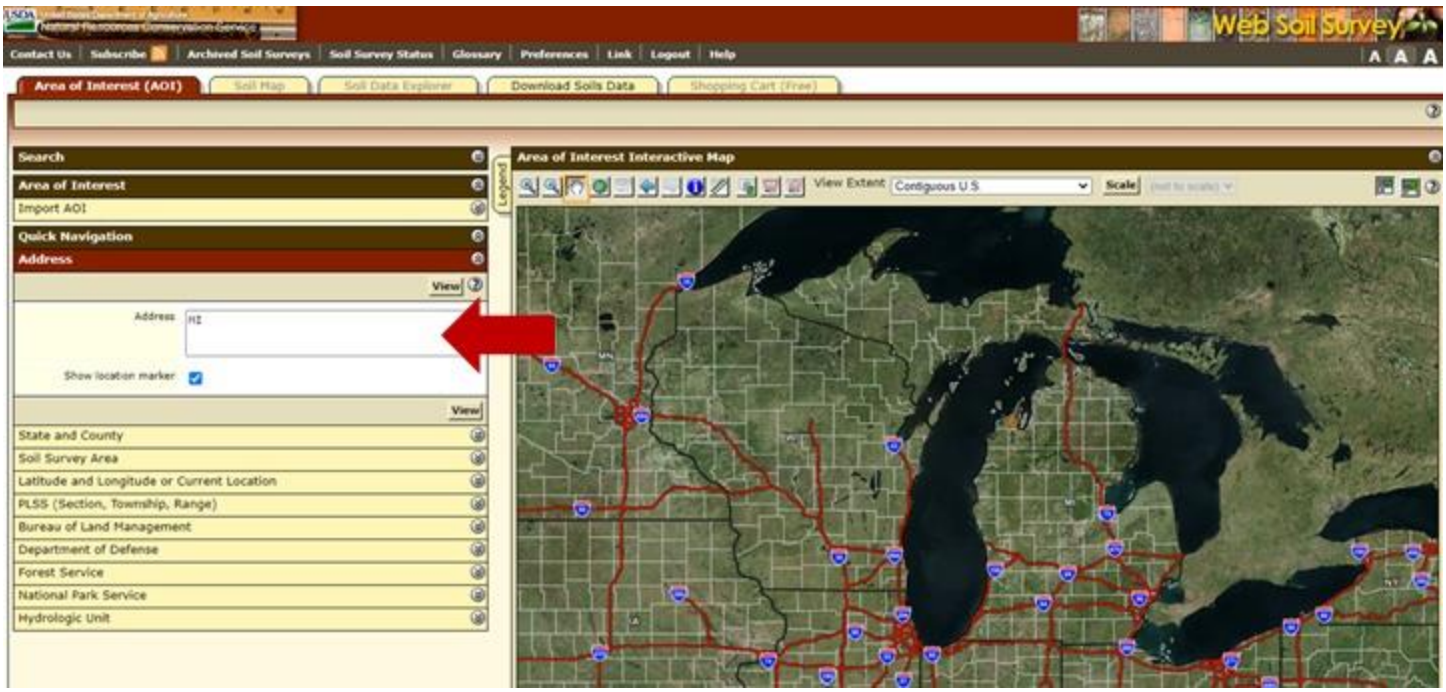
Go to the USDA Web Soil Survey Site.

Launch the site by clicking on the “START WSS” button at the top of the page.

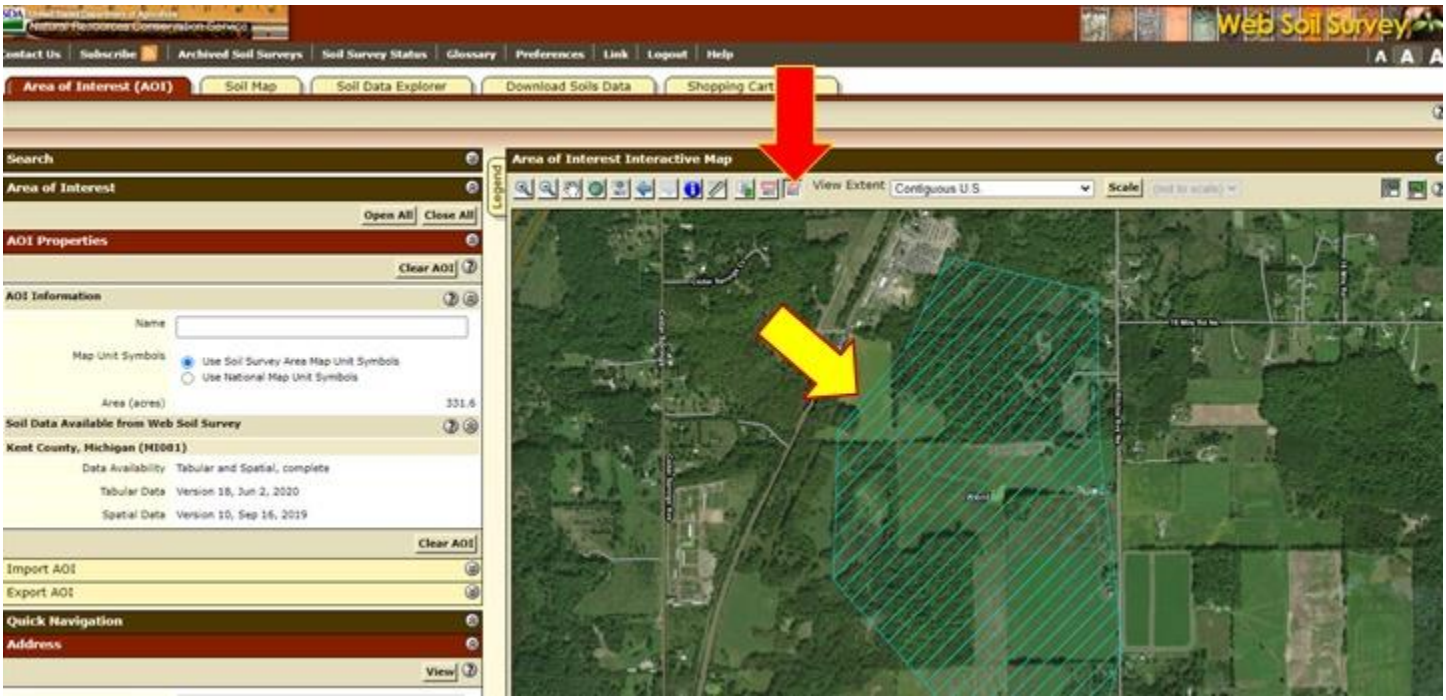


Once launched the Web Soil Survey will open on the Area of Interest (AOI) Tab. Here site locations can either be uploaded or searched using several options. Clicking on the drop-down arrows next to any of the search options expand that search option, which allows you to enter information regarding the site.

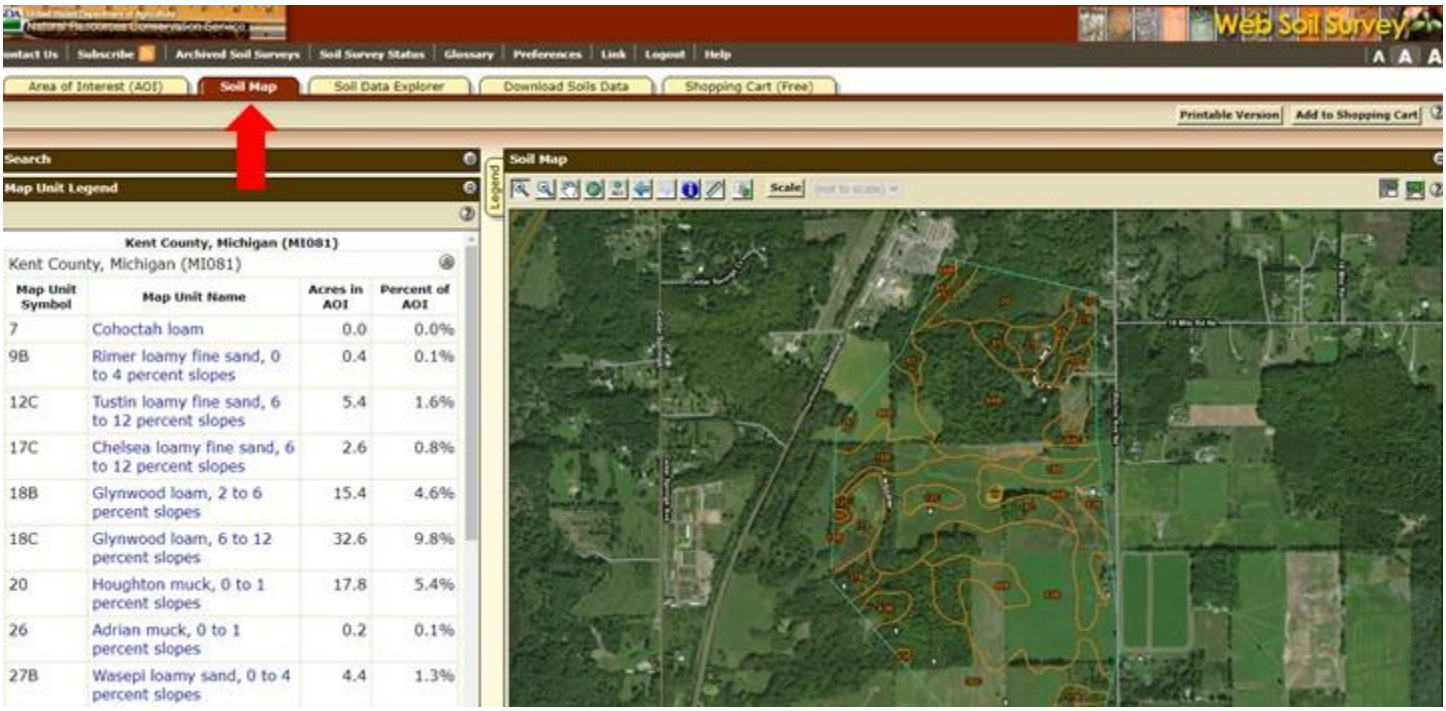




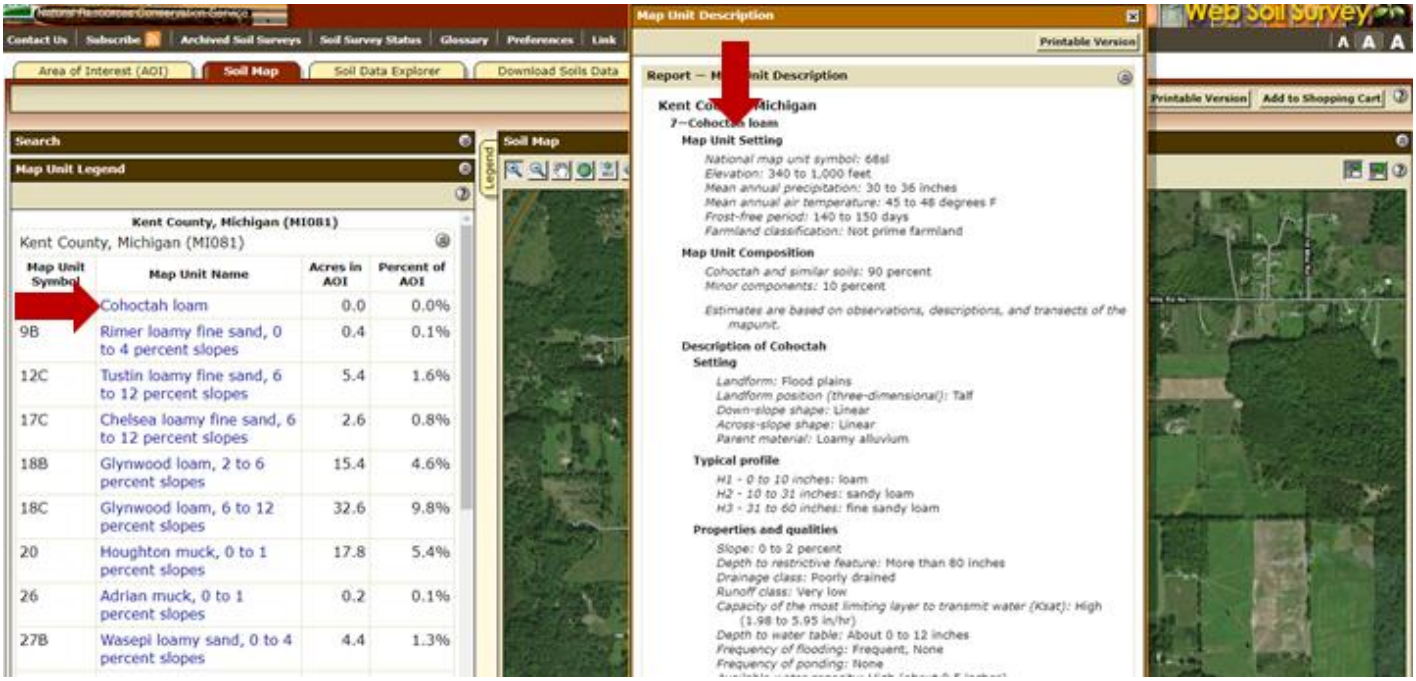
After locating the site, you can use the create AOI toggles above the map to select the entire drainage area for the site. These toggles will allow you to draw the drainage area on the map.



Once you have identified the drainage area within the AOI, click on the “Soil Map” tab. This will load all of the soil types within the drainage area both on the map and in a table on the left hand of the screen. The table will display the acres and percentage of the total area for each soil type.



To determine the soil type (A, B, C, and D) referenced on the “Runoff Volume” tab of this workbook, click on the name of each soil in the table on the left hand of the screen. This will open a pop-up window that displays information about the selected soil.



Scroll down to the section labeled “Interpretive groups” and look for the “Hydrologic Soil Group”. This will list the soil type.

Description of Cohoctah

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 31 inches: sandy loam
H3 - 31 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent, None
Frequency of ponding: None
Available water capacity: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F098XA004MI - Wet Floodplains
Hydric soil rating: Yes

It is important to note that on the “Runoff Volume” tab runoff is calculated based on a combination of land use and soil types. Therefore, the information collected on the Web Soil Survey should be compared to land-use maps and linked to determine the amount of area to put under each category.

4.0 New Development Example

Setting

A developer within an urbanized area under the jurisdiction of an MS4 Permittee is developing on a previously undeveloped lot. The development will include sidewalks, a building, and parking lots. In order to comply with the post-construction requirements of their permit, they will need their discharge to remain at or under the pre-development volume and rate for the design storm.

Drainage Area: The total site area is roughly 20 acres. However, development will only be occurring on 17 Acres.

Design Storm: The 2-year 24-hour storm event will be used. For this area this equates to 2.36 inches of rainfall.

Pre-Development: The area selected for development is approximately 17 acres. The pervious area is woods in good condition with A and B soil types.

Post-Development: The developed area includes new parking, sidewalks, and a new building. The development will result in 10 acres of impervious surface with the remaining area as lawn with A and B soil types.

Maps and Site Data

The maps below show a rough representation (not drawn to scale) of the pre-development and post-development conditions for the region and the Table below each map summarizes land uses and soils for each scenario.

Pre-Development

Pre-Development Land Uses and Soil Types		
Land Use	Acres	Soil Type
Woods (Good Condition)	12	A
Woods (Good Condition)	5	B

Post Development

Post Development Land Use and Soil Types		
Land Use	Acres	Soil Type
Open Space/Grass	4	A
Open Space/Grass	3	B
Impervious	10	NA

MS4 Stormwater Runoff Volume Calculator

Below is an example of how this information would be entered into the MS4 Stormwater Runoff Volume Calculator.

Calculations for Storm Water Runoff Volume Control

Project Name: New Development Example

Total Drainage Area: 17 acres

Design Channel Protection Rainfall Event: 2.36 in
(see Rainfall Tab or Section 2.0 for aid in using ATLAS 14 for determining local or site specific rainfall events)

Pre-Development Conditions

Land Cover Type	Soil Type	Combo	Condition *Condition should be considered Good to Fair	Area (ft^2)	Area (ac)	CN (from TR-55)	S $\frac{1000}{CN} - 10$	Q Runoff[1] (in) $\frac{(P-0.2S)^2}{(P+0.8S)}$	Runoff Volume[2] (ft^3) $Q \times 1/12 \times A$
Woods	A	WoodsGoodA	Good	522720	12.00	30	23.3	0.253045868	11,022.7
Woods	B	WoodsGoodB	Good	217800	5.00	55	8.2	0.058800995	1,067.2
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
Other:							0.0	0	0.0
Other:							0.0	0	0.0
Other:							0.0	0	0.0
Other:							0.0	0	0.0
TOTAL:	N/A		N/A	740520	17.00	N/A	N/A	N/A	12089.92

Post-Development Conditions

Land Cover Type	Soil Type	Combo	Condition Condition should be assumed good or NA	Area (ft^2)	Area (ac)	CN*	S $\frac{1000}{CN} - 10$	Q Runoff[1] (in) $\frac{(P-0.2S)^2}{(P+0.8S)}$	Runoff Volume[2] (ft^3)
Woods	A	WoodsGoodA	Good	174240	4.00	30	23.3	0.253045868	3,674.2
Woods	B	WoodsGoodB	Good	130680	3.00	55	8.2	0.058800995	640.3
Impervious Area	NA	Impervious AreaNANA	NA	435600	10.00	98	0.2	2.131608158	77,377.4
				0			0.0	0	0.0
				0			0.0	0	0.0
				0			0.0	0	0.0
Other:				0			0.0	0	0.0
Other:				0			0.0	0	0.0
Other:				0			0.0	0	0.0
Other:				0			0.0	0	0.0
TOTAL:	N/A			740520	17.00	N/A	N/A	N/A	81,691.9

Runoff Volume Increase (ft^3): 69,602

Water Quality Runoff Volume (ft^3): 61,710

Runoff Volume Increase = (Post-Dev. Runoff Volume) MINUS (Pre-Dev. Runoff Volume)

1. Runoff (in) = Q = (P - Ia)2 / (P- Ia)+ S
Ia =0.2S therefore;
Runoff (in) = Q = (P - 0.2S)^2 / (P+ 0.8S)

2. Runoff Volume (ft^3) = Q x 1/12 x Area

* Runoff Volume must be calculated separately for pervious and impervious areas (without using a weighted CN)

Where: P = 2-Year, 24-Hour Rainfall (in)
S = 1000/ CN - 10
CN = Curve Number
Q = Runoff (in)
Area = Area of specific land cover (ft^2)

Instructions

1. At the top of the spreadsheet, enter a site name and the drainage area in acres. Total drainage area refers to the area of earth disturbance for a given project.

2. Enter the design rainfall event in inches in the space provided. For the Channel Protection Rainfall Event, follow the guidance on the Rainfall tab or in Section 2.0 of the "MS4 Calculator Manual" for determining local rainfall amounts (often the 2-yr 24-hr storm), or use approved equivalent rainfall included in the MS4 permit. It is important to note that this is the total amount of rainfall and not the runoff for the site.

3. In the pre-development table, enter the area of each applicable land cover and soil combination and the amount of impervious area for the pre-development condition in acres. The total area must add up to the total drainage area recorded at the top of the spreadsheet. Note, here the runoff volume for each land use cover and soil type must be calculated separately and then summed for the entire site. A composite Curve Number (CN) cannot be used. Consult with MS4 technical staff or visit the "Common Curve Numbers Tab" if a land cover at the site is not represented to determine an appropriate CN. For guidance on identifying soil types, please see the "Soils" tabs of the spreadsheet or Sections 3.0 of the "MS4 Storm Water Calculator Manual".

4. In the post-development table enter the proposed cover type and soil type. The total area at the bottom of the table must match the total drainage area recorded at the top of the spreadsheet. Similarly, the total area for each soil group should be equal to or less (depending on the amount of impervious surface added) to the values reported in the pre-development table, unless new soils are being brought to the site. Cover and soil type can be copied from the pre-development table and pasted to the post-development table if applicable. A CN for each new cover type must be selected but composite CNs cannot be used. Consult with MS4 technical staff or visit the "Common Curve Numbers Tab" if a land cover at the site is not represented to determine an appropriate CN.

5. The spreadsheet automatically calculates the Runoff Volume Increase in cubic feet shown in the light green cell near the bottom of the table. This is the volume of storm water runoff that must be controlled.

6. For additional guidance on how to use this spreadsheet please see the "New Development Example Scenario", the "Redevelopment Example Scenario" tab or Sections 4.0 and 5.0 of this manual for a completed examples of how to use this spreadsheet.

Note: If the goal for the site is to treat the Water Quality Volume generated by 1 inch of runoff over the entire site the cell below performs that calculation based on the value provided for the "Total Drainage Area" at the top of this sheet.

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Results

The above calculations show that to meet the channel protection criteria, a volume of 69,602 cubic feet of stormwater runoff must be maintained onsite or in accordance with the permittee's approved Post-Construction Program. By maintaining this runoff volume onsite, the Water Quality Runoff Volume would also be treated.

5.0 Redevelopment Example

Setting

A public school district currently covered under an MS4 Permit plans to add a new wing to an existing building and additional parking to their site. In order to comply with the post-construction requirements of their permit they will need their discharge to remain under the pre-development volume and rate for the 2-year, 24-hour event.

Drainage Area: The total site area is roughly 12.4 acres. However, redevelopment will only be occurring on 4.5 Acres.

Design Storm: The 2-year 24-hour storm event will be used. For this area this equates to 2.36 inches of rainfall.

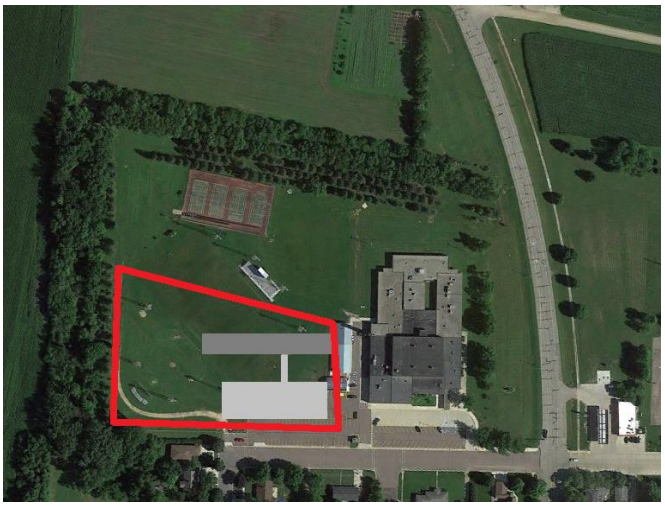
Pre-Redevelopment: The area selected for redevelopment is approximately 4.5 acres and has an impervious percentage of approximately 33%. The pervious area is lawn in good condition with a B soil type.

Post-Development: The redeveloped area includes new parking and building additions. The new impervious percentage is approximately 75% with the remaining area lawn with B soil type.

Maps and Site Data

The maps below show a rough representation (not drawn to scale) of the pre-development and post-development conditions for the region and the Table below each map summarizes land uses and soils for each scenario.

Pre-Development



Post Development

Pre-Development Land Uses and Soil Types		
Land Use	Acres	Soil Type
Lawn	3	B
Inpervious	1.5	NA

Post Development Land Use and Soil Types		
Land Use	Acres	Soil Type
Lawn	1.1	B
Impervious	3.4	NA

MS4 Stormwater Runoff Volume Calculator

Below is an example of how this information would be entered into the MS4 Stormwater Runoff Volume Calculator.

Calculations for Storm Water Runoff Volume Control

Project Name: Redevelopment Example

Total Drainage Area: 4.5 acres

Design Channel Protection Rainfall Event: 2.36 in

(see Rainfall Tab or Section 2.0 for aid in using ATLAS 14 for determining local or site specific rainfall events)

Pre-Development Conditions

Land Cover Type	Soil Type	Combo	Condition *Condition should be considered Good to Fair	Area (ft^2)	Area (ac)	CN (from TR-55)	S $\frac{1000}{CN} - 10$	Q Runoff[1] (in) $\frac{(P-0.2S)^2}{(P+0.8S)}$	Runoff Volume[2] (ft^3) $Q \times 1/12 \times A$
Grass	B	GrassGoodB	Good	130680	3.00	61	6.4	0.156424478	1,703.5
Impervious Area	NA	Impervious AreaNANA	NA	65340	1.50	98	0.2	2.131608158	11,606.6
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
							0.0	0	0.0
Other:							0.0	0	0.0
Other:							0.0	0	0.0
Other:							0.0	0	0.0
Other:							0.0	0	0.0
TOTAL:	N/A		N/A	196020	4.50	N/A	N/A	N/A	13310.07

Post-Development Conditions

Land Cover Type	Soil Type	Combo	Condition Condition should be assumed good or NA	Area (ft^2)	Area (ac)	CN*	S $\frac{1000}{CN} - 10$	Q Runoff[1] (in) $\frac{(P-0.2S)^2}{(P+0.8S)}$	Runoff Volume[2] (ft^3)
Grass	B	GrassGoodB	Good	47916	1.10	61	6.4	0.156424478	624.6
Impervious Area	NA	Impervious AreaNANA	NA	148104	3.40	98	0.2	2.131608158	26,308.3
				0			0.0	0	0.0
				0			0.0	0	0.0
				0			0.0	0	0.0
				0			0.0	0	0.0
Other:				0			0.0	0	0.0
Other:				0			0.0	0	0.0
Other:				0			0.0	0	0.0
Other:				0			0.0	0	0.0
TOTAL:	N/A			196020	4.50	N/A	N/A	N/A	26,932.9

Runoff Volume Increase (ft^3): 13,623

Water Quality Runoff Volume (ft^3): 16,335

Runoff Volume Increase = (Post-Dev. Runoff Volume) MINUS (Pre-Dev. Runoff Volume)

1. Runoff (in) = Q = (P - Ia)2 / (P- Ia)+S
Ia =0.2S therefore;
Runoff (in) = Q = $(P - 0.2S)^2 / (P+ 0.8S)$

2. Runoff Volume (ft^3) = Q x 1/12 x Area

* Runoff Volume must be calculated separately for pervious and impervious areas (without using a weighted CN)

Where: P = 2-Year, 24-Hour Rainfall (in)
S = 1000/ CN - 10
CN = Curve Number
Q = Runoff (in)
Area = Area of specific land cover (ft^2)

Instructions

1. At the top of the spreadsheet, enter a site name and the drainage area in acres. Total drainage area refers to the area of earth disturbance for a given project.

2. Enter the design rainfall event in inches in the space provided. For the Channel Protection Rainfall Event, follow the guidance on the Rainfall tab or in Section 2.0 of the "MS4 Calculator Manual" for determining local rainfall amounts (often the 2-yr 24-hr storm), or use approved equivalent rainfall included in the MS4 permit. It is important to note that this is the total amount of rainfall and not the runoff for the site.

3. In the pre-development table, enter the area of each applicable land cover and soil combination and the amount of impervious area for the pre-development condition in acres. The total area must add up to the total drainage area recorded at the top of the spreadsheet. Note, here the runoff volume for each land use cover and soil type must be calculated separately and then summed for the entire site. A composite Curve Number (CN) cannot be used. Consult with MS4 technical staff or visit the "Common Curve Numbers Tab" if a land cover at the site is not represented to determine an appropriate CN. For guidance on identifying soil types, please see the "Soils" tabs of the spreadsheet or Sections 3.0 of the "MS4 Storm Water Calculator Manual".

4. In the post-development table enter the proposed cover type and soil type. The total area at the bottom of the table must match the total drainage area recorded at the top of the spreadsheet. Similarly, the total area for each soil group should be equal to or less (depending on the amount of impervious surface added) to the values reported in the pre-development table, unless new soils are being brought to the site. Cover and soil type can be copied from the pre-development table and pasted to the post-development table if applicable. A CN for each new cover type must be selected but composite CNs cannot be used. Consult with MS4 technical staff or visit the "Common Curve Numbers Tab" if a land cover at the site is not represented to determine an appropriate CN.

5. The spreadsheet automatically calculates the Runoff Volume Increase in cubic feet shown in the light green cell near the bottom of the table. This is the volume of storm water runoff that must be controlled.

6. For additional guidance on how to use this spreadsheet please see the "New Development Example Scenario", the "Redevelopment Example Scenario" tab or Sections 4.0 and 5.0 of this manual for a completed examples of how to use this spreadsheet.

Note: If the goal for the site is to treat the Water Quality Volume generated by 1 inch of runoff over the entire site the cell below performs that calculation based on the value provided for the "Total Drainage Area" at the top of this sheet.

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Results

The above calculations show that to meet the channel protection criteria, a volume of 13,623 cubic feet of stormwater runoff must be maintained onsite or in accordance with the permittee's approved Post-Construction Program. To also meet the water quality criteria using the same BMP or treatment train, there are two (2) options:

1. The developer may choose to maintain the entire Water Quality Runoff Volume of 16,335 cubic feet of stormwater runoff onsite. In this case, the same BMP or treatment train would address both channel protection criteria and water quality criteria.

2. The developer may choose to maintain only the Runoff Volume Increase of 13,623 cubic feet of stormwater runoff onsite. This BMP or treatment train would address channel protection criteria. Water quality criteria would also be met for 13,623 cubic feet of stormwater runoff. An additional BMP or treatment train would be needed to treat and release the difference between the Water Quality Runoff Volume (16,3335 cubic feet) and the Runoff Volume Increase (13,623 cubic feet). Therefore, 2,712 cubic feet of stormwater runoff would need to be treated using an additional BMP to meet the water quality criteria.

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