AECOM

New Jersey Probable Maximum Precipitation Tool

Instructions and Application in ArcGIS Pro

New Jersey Department of Environmental Protection

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Distribution List

# Hard Copies	PDF Required	Association / Company Name

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Introduction

This document summarizes the step-by-step instruction to use the New Jersey Probable Maximum Precipitation Tool (NJPMP Tool) in the ESRI's ArcGIS Pro® interface. The tool has been developed by Applied Weather Associates (AWA) in association with AECOM for New Jersey Department of Environmental Protection (NJDEP). This tool will help engineers, hydrologist, and dam safety professional to determine the watershed specific probable maximum precipitation estimates to use for watershed hydrologic studies for New Jersey watersheds. The tool is a Python based script compatible with ArcMap, Arc Catalog or ArcGISPro software from ESRI. The tool provides precipitation estimates on grided and tabular format for user provided watershed or area of interest. The standard output includes the average PMP depths over the provided area with temporary distributed accumulations.

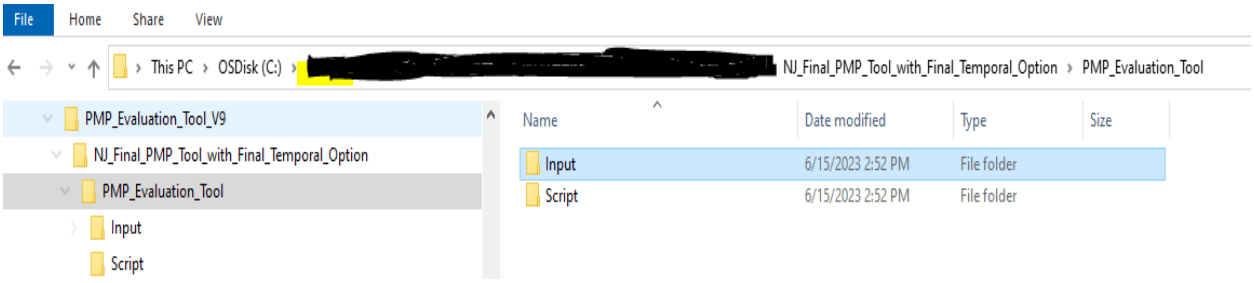
Step 1: Download NJPMP Tool.

Go to NJDEP's Dam Safety website https://dep.nj.gov/wlm/drec/dam-safety/ and click on the NJPMP Tool Download link and save the zip file to your local computer. (Must be save on Local Drive)

NJ_Final_PMP_Tool_with_Final_Temporal_Option

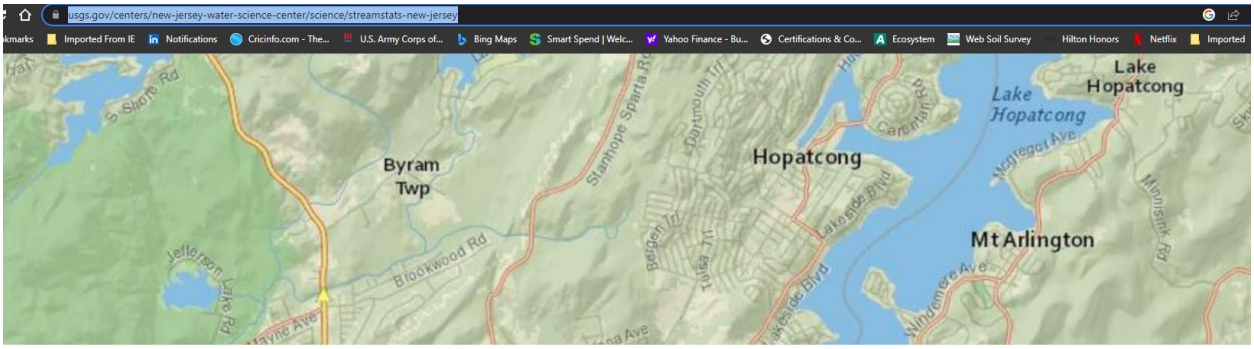
Step 2: Extract the Tool Files

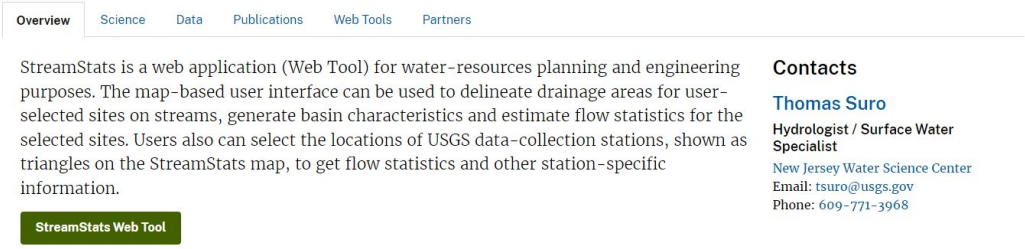
Right Click on the downloaded NJPMP tool zip file & click extract all. The resulting folder would be named as PMP_Evaluation_Tool with default contents of two folders named Input & Script. View the contents of the extracted folder below:



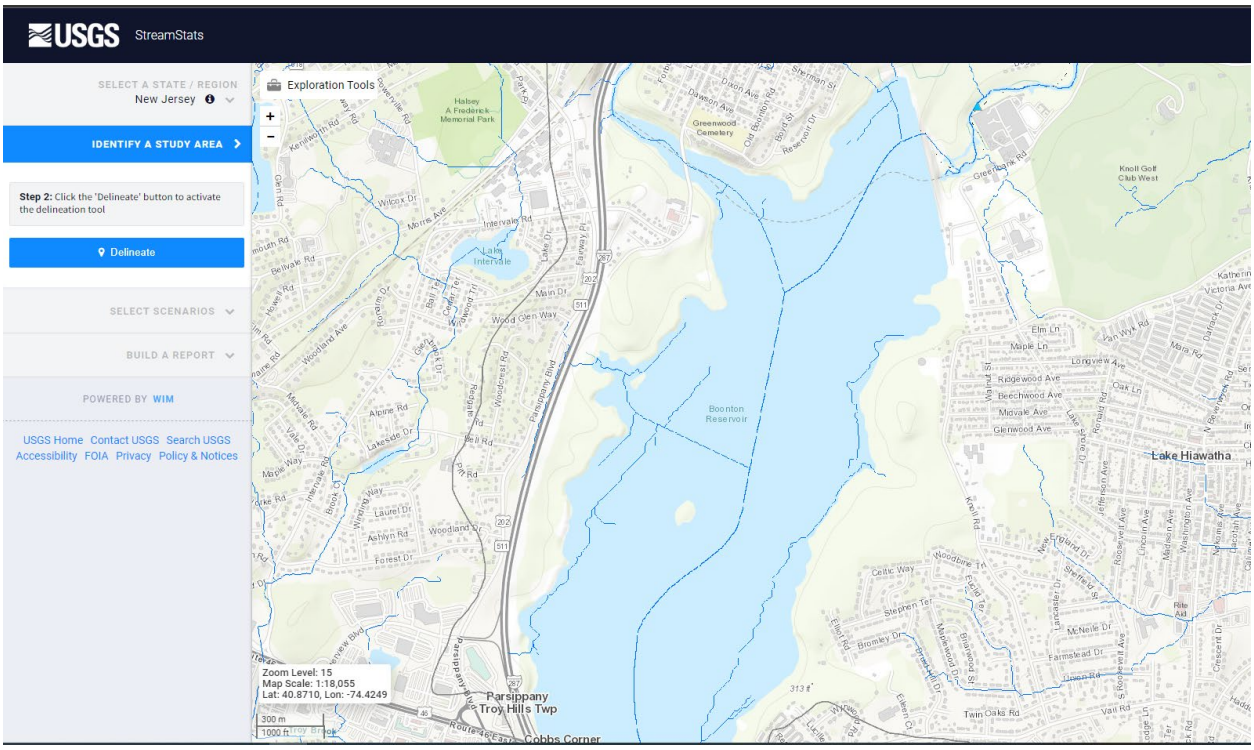
Step 3: Obtain Area of Interest

The NJPMP Tool support the PMP calculations for a distinct watershed (Dams, Rivers at selected Points of interest) or geographic regions (Town, County, or district level boundaries) based on input area of the interest. For watershed boundaries, user can provide their own delineations, one available from prior studies or use service generated watershed such as USGS StreamStats. This document will use StreamStats generated watershed as an example. In order to get a watershed for your area of interest please go to New Jersey StreamStats website at https://www.usgs.gov/centers/new-jersey-water-science-center/science/streamstats-new-jersey and click on the StreamStats Web tool.

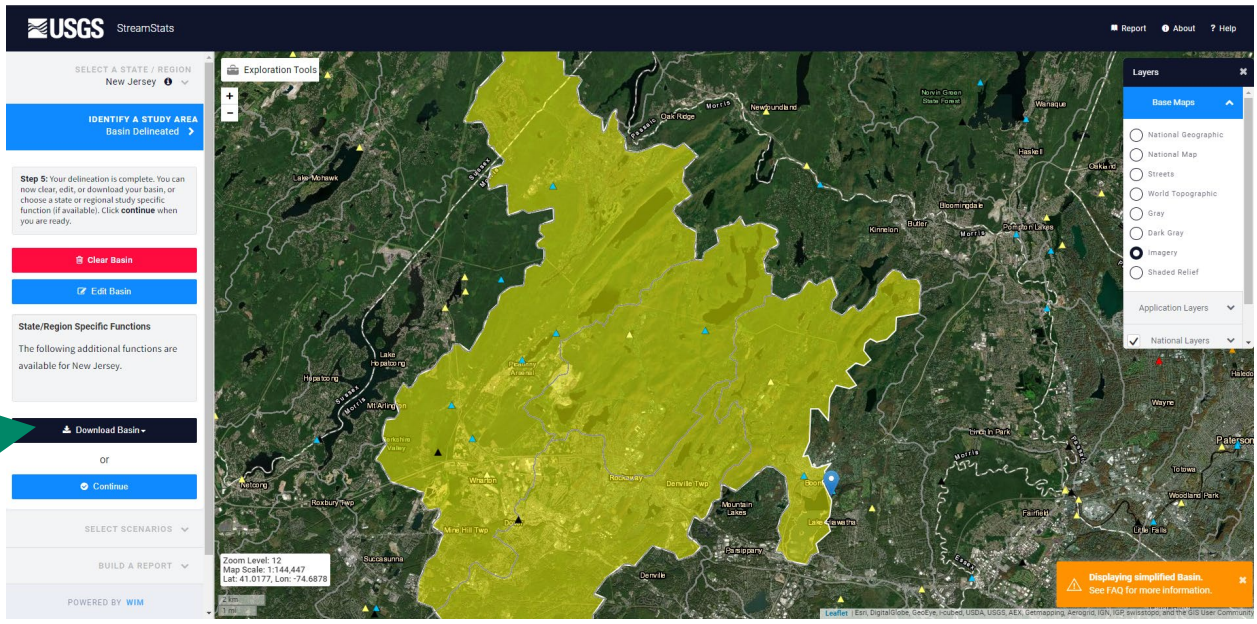




For example, Boonton Reservoir in Morris County, NJ is selected at Point of Interest below:



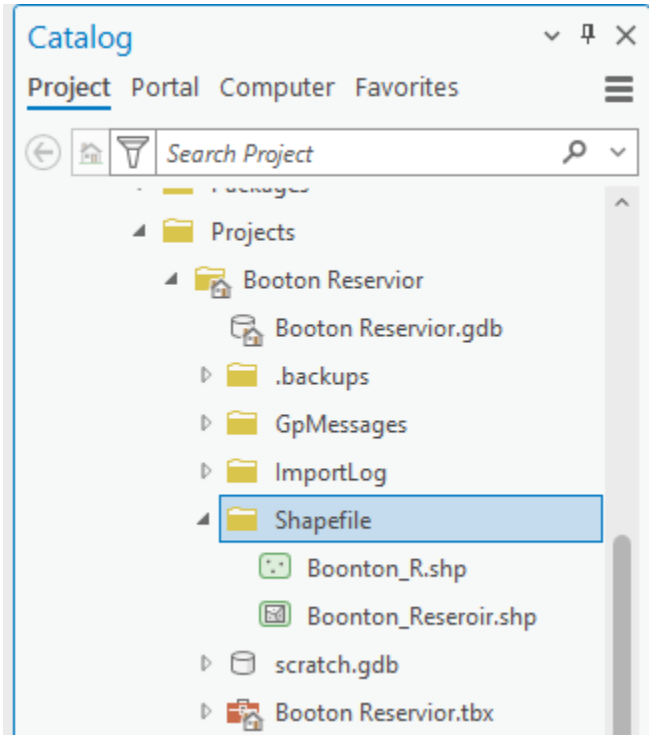
Using StreamStats Delineation option the watershed for this Dam can be delineated as shown below:



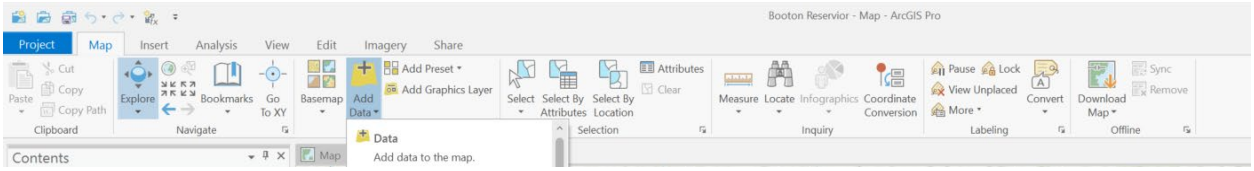
The delineated basin can be downloaded as the shapefile for use for NJPMP Tool input data for PMP depth determination for this watershed.

Step 4: Setting Up ArcGISPro

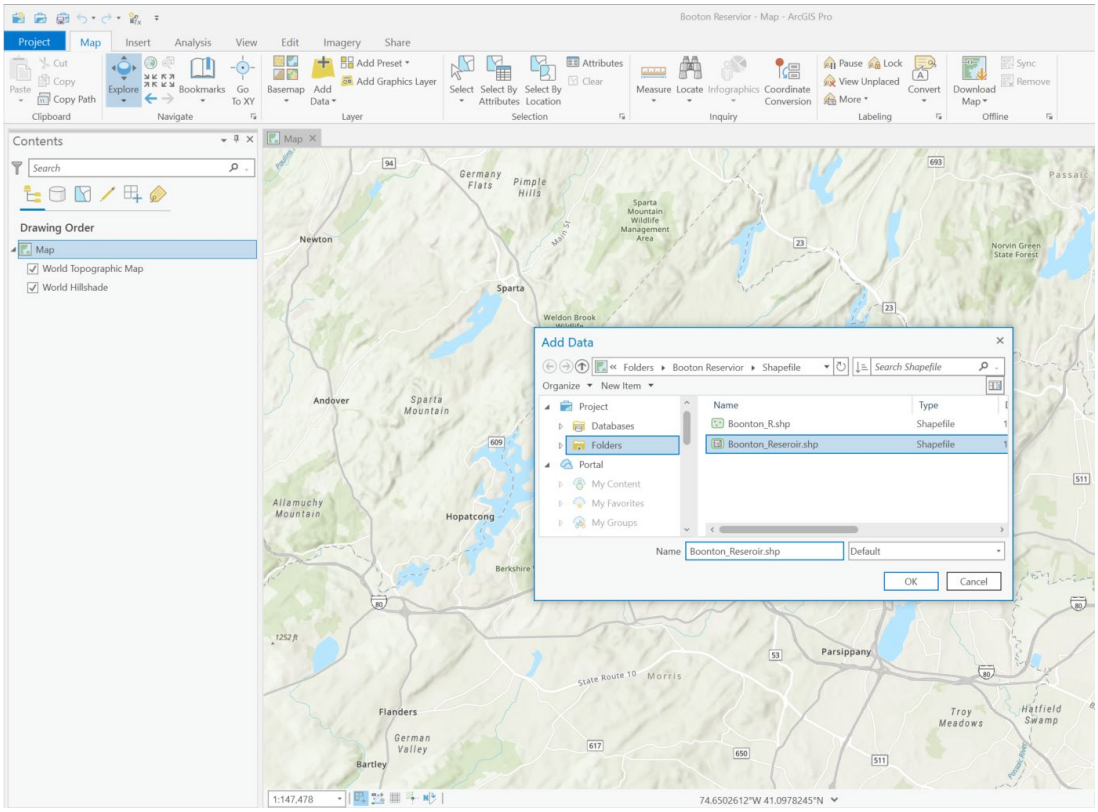
After the watershed delineation shapefile was downloaded it can be renamed in ArcCatalog® from its default name globalwatershed.shp from USGS Download site to the name of the watershed or POI you are analyzing.



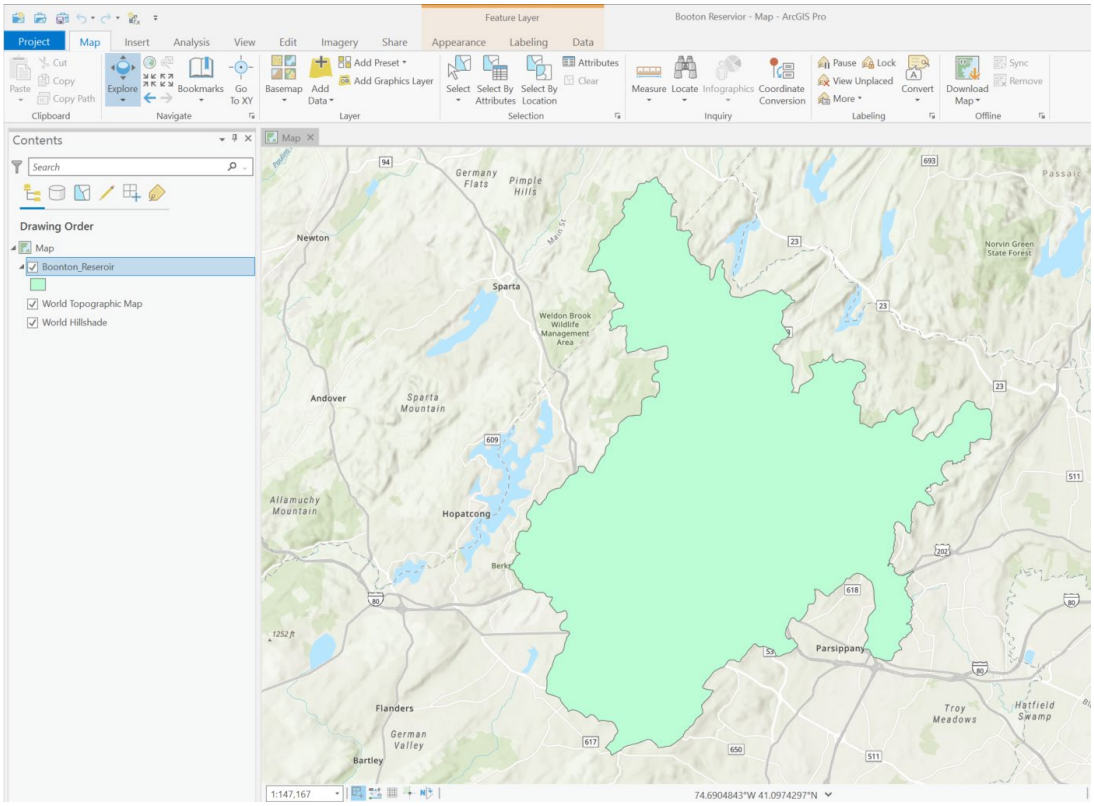
Use Add data to add watershed:



Navigate to the location where the watershed boundary file is located and add the shapefile:

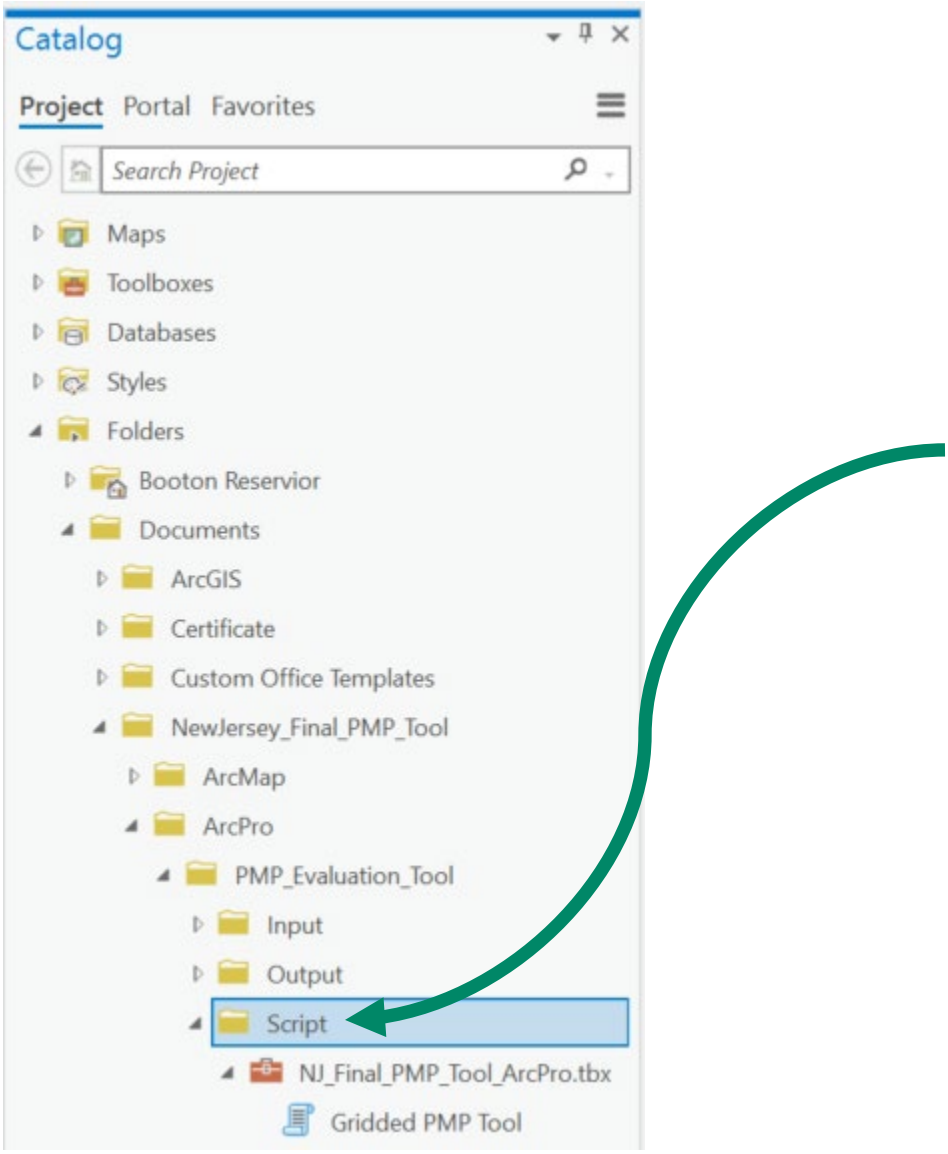


The watershed boundary shall look similar to below in your map.:



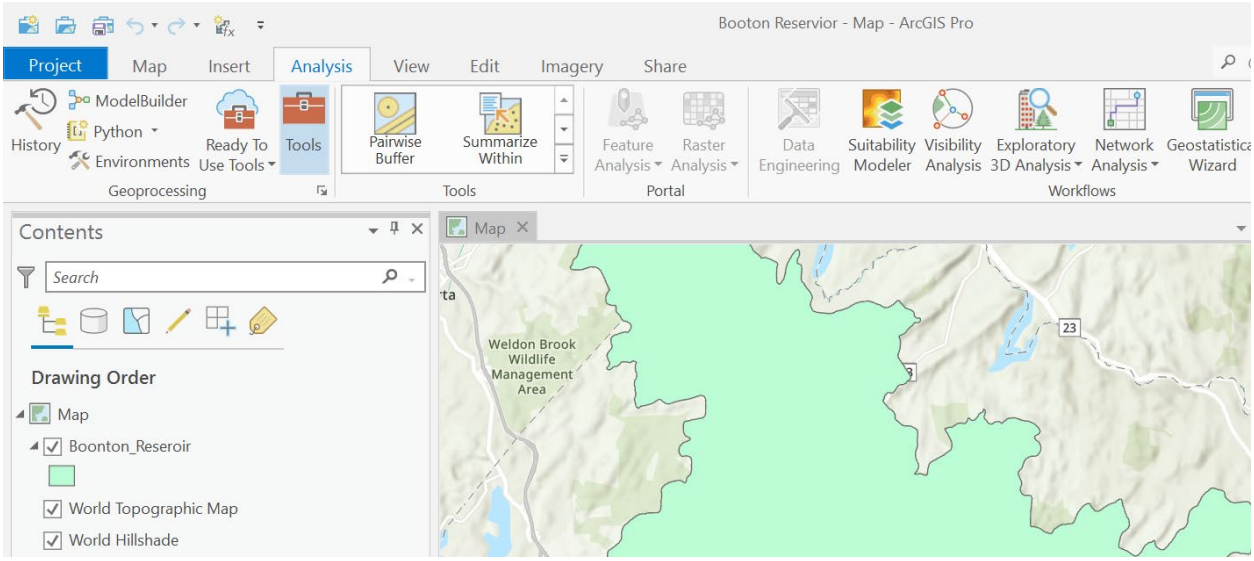
Step 5: Locating & Calling the NJPMP Tool from ArcMap Interface

Use the ArcCatalog® window in the ArcMap *.mxd to navigate to the Python Script for the NJPMP Tool (Gridded PMP Tool) on your local drive:

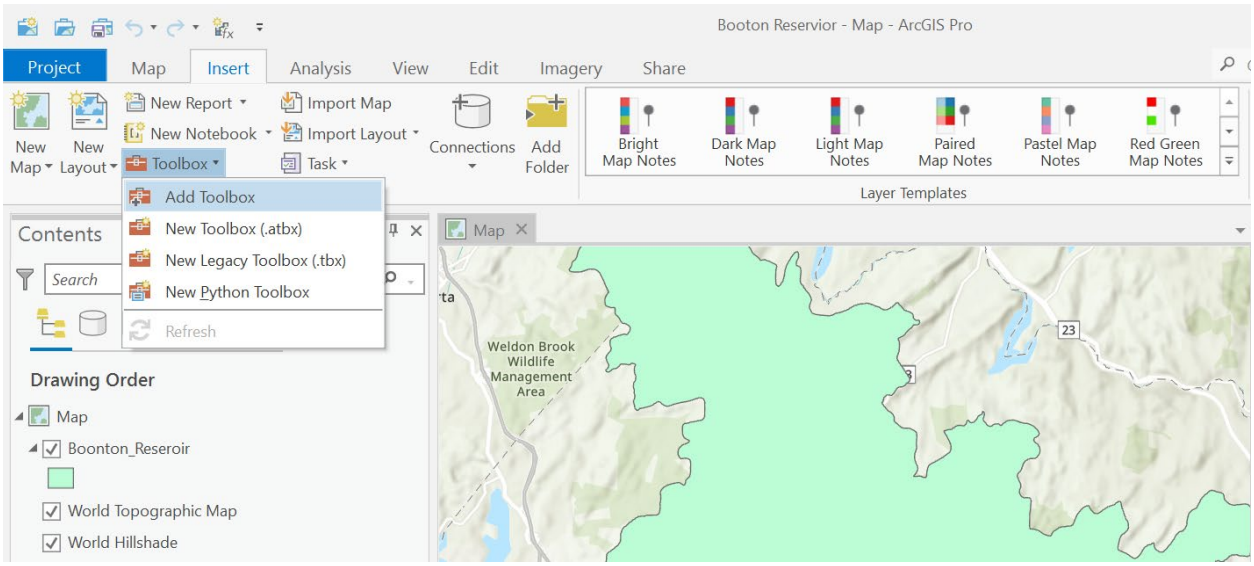


OR

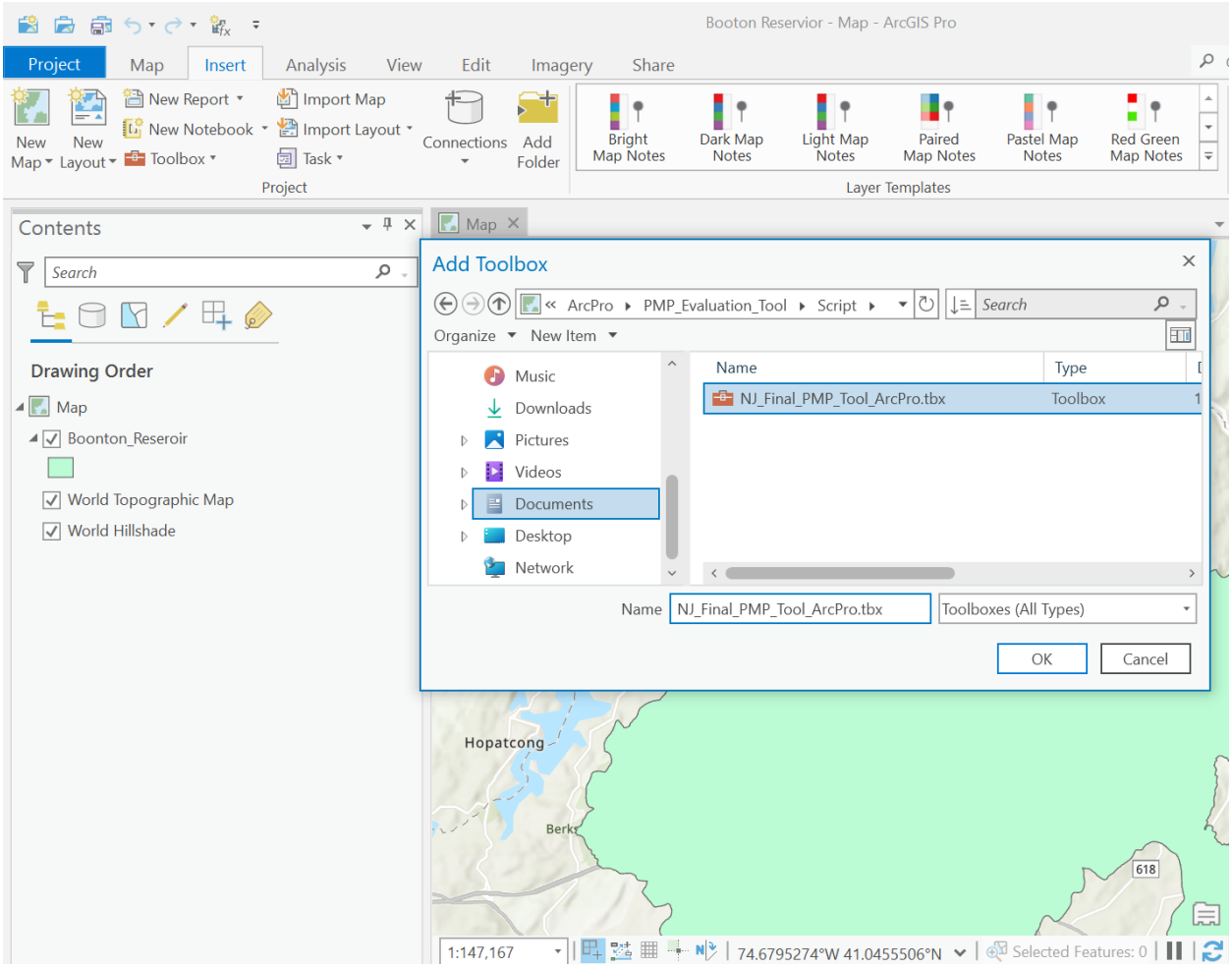
Alternatively, you can add NJPMP Tool to the Arctoolbox® tool library for your ArcGIS Pro by clicking on Tools icon on your ArcGIS Pro.



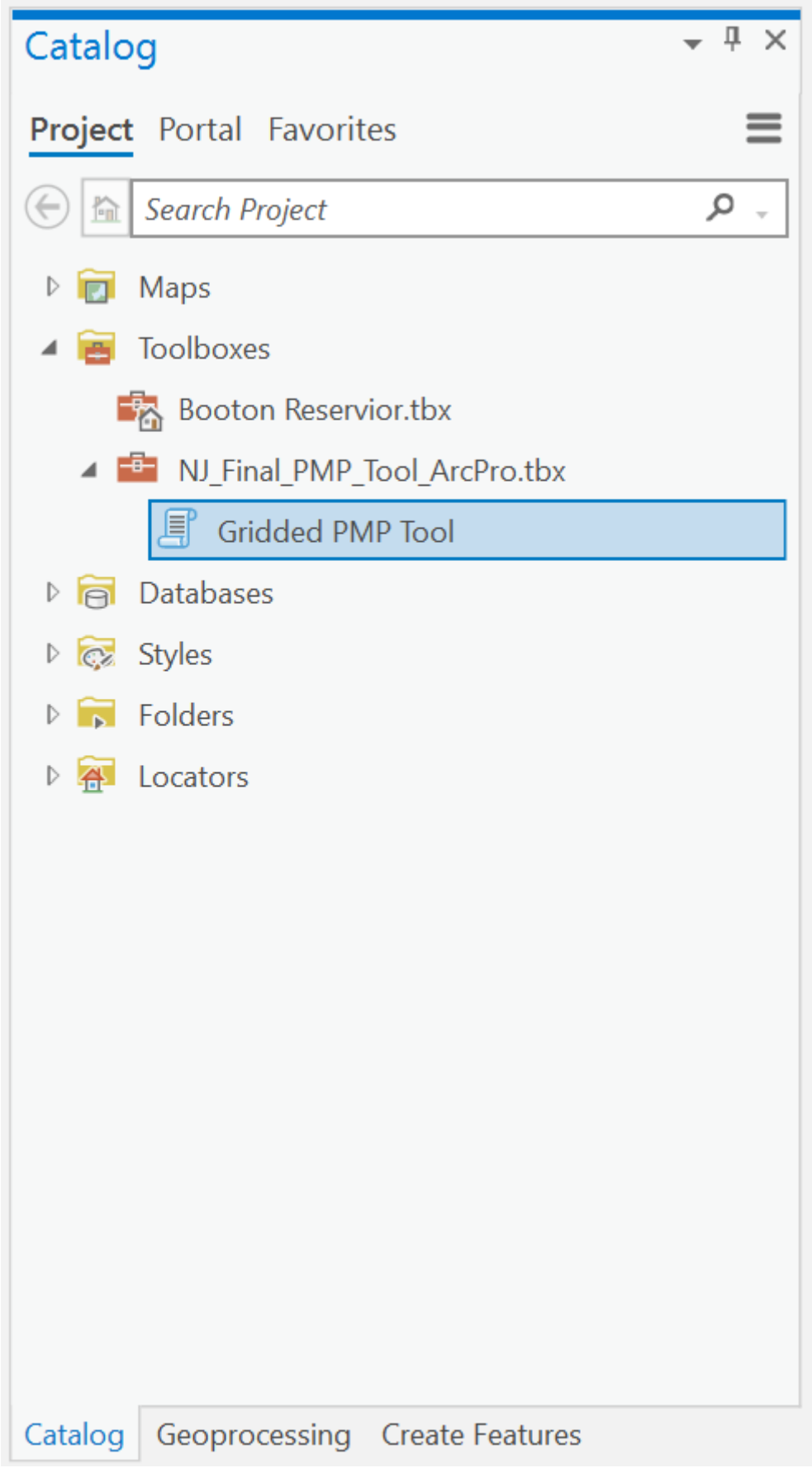
Click on Tools and then click on Add Toolbox as shown below:



Navigate to the location where NJPMP tool is saved on your local drive and click to add NJ_Final_PMP_Tool.tbx



The ArcToolboxes will have NJPMP Tool along with other tools available as below:


Catalog
Project
Portal
Favorites
Search Project
Maps
Toolboxes
Booton Reservior.tbx
NJ_Final_PMP_Tool_ArcPro.tbx
Gridded PMP Tool
Databases
Styles
Folders
Locators
Catalog
Geoprocessing
Create Features

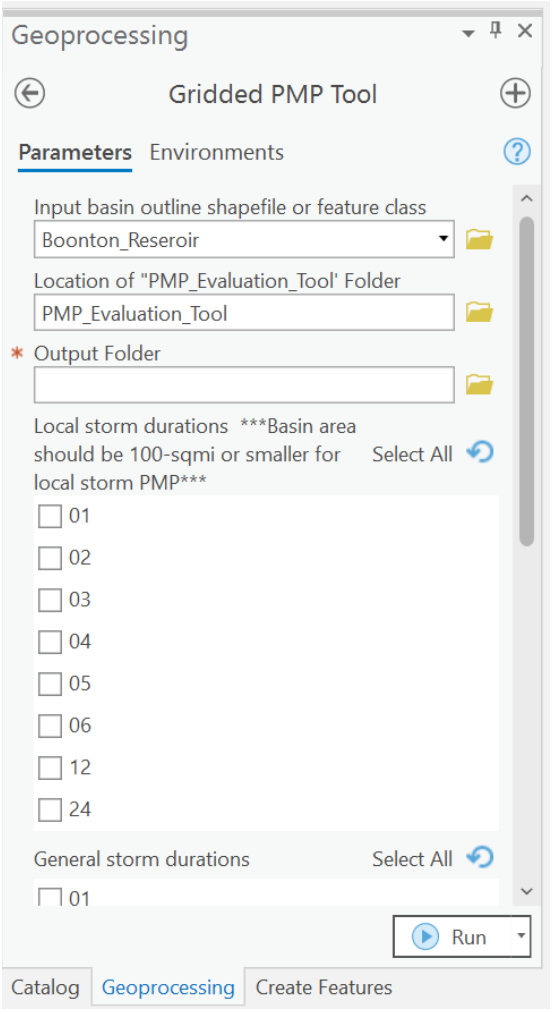
Note: Both methods will provide access to NJPMP Tool script needed to run this analysis. The ArcCatalog will require user to navigate to the file location each time tool intended to be used whereas adding it to ArcGIS Pro tool library on your computer makes it available as toolset without navigating to folder each time use is anticipated.

Reminder: Please **save your map** at this stage as it's ready to process the NJPMP data.

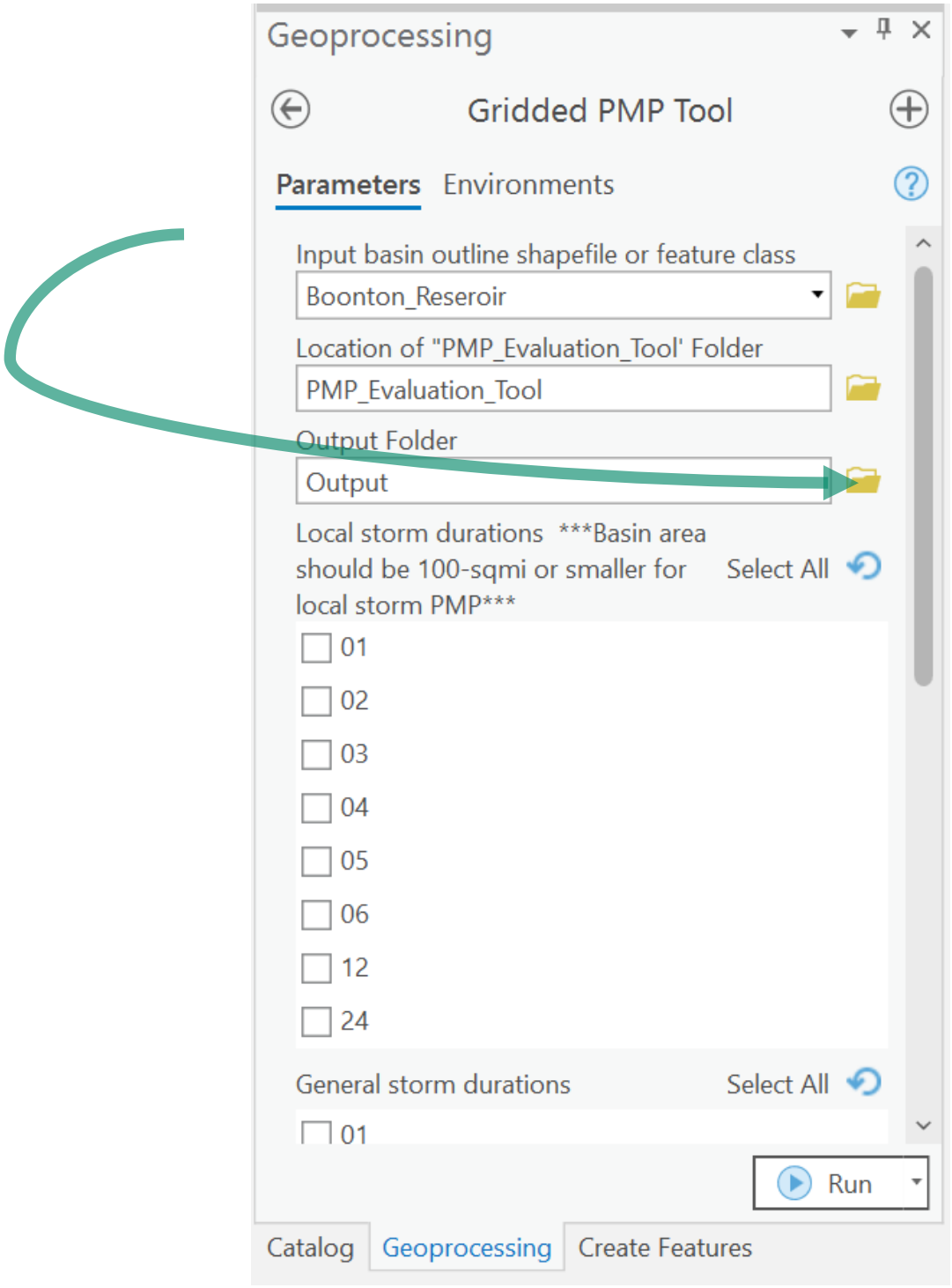
Step 6: Running NJPMP Tool in ArcMap

Navigate to NJPMP Tool location on your map or hard drive and double click on the Gridded PMP Tool Script to start the tool. The processing window will appear as shown below. From the dropdown list for input basin or shape file select the basin shapefile you wish to analyze (For our case selecting Boonton Reservoir)

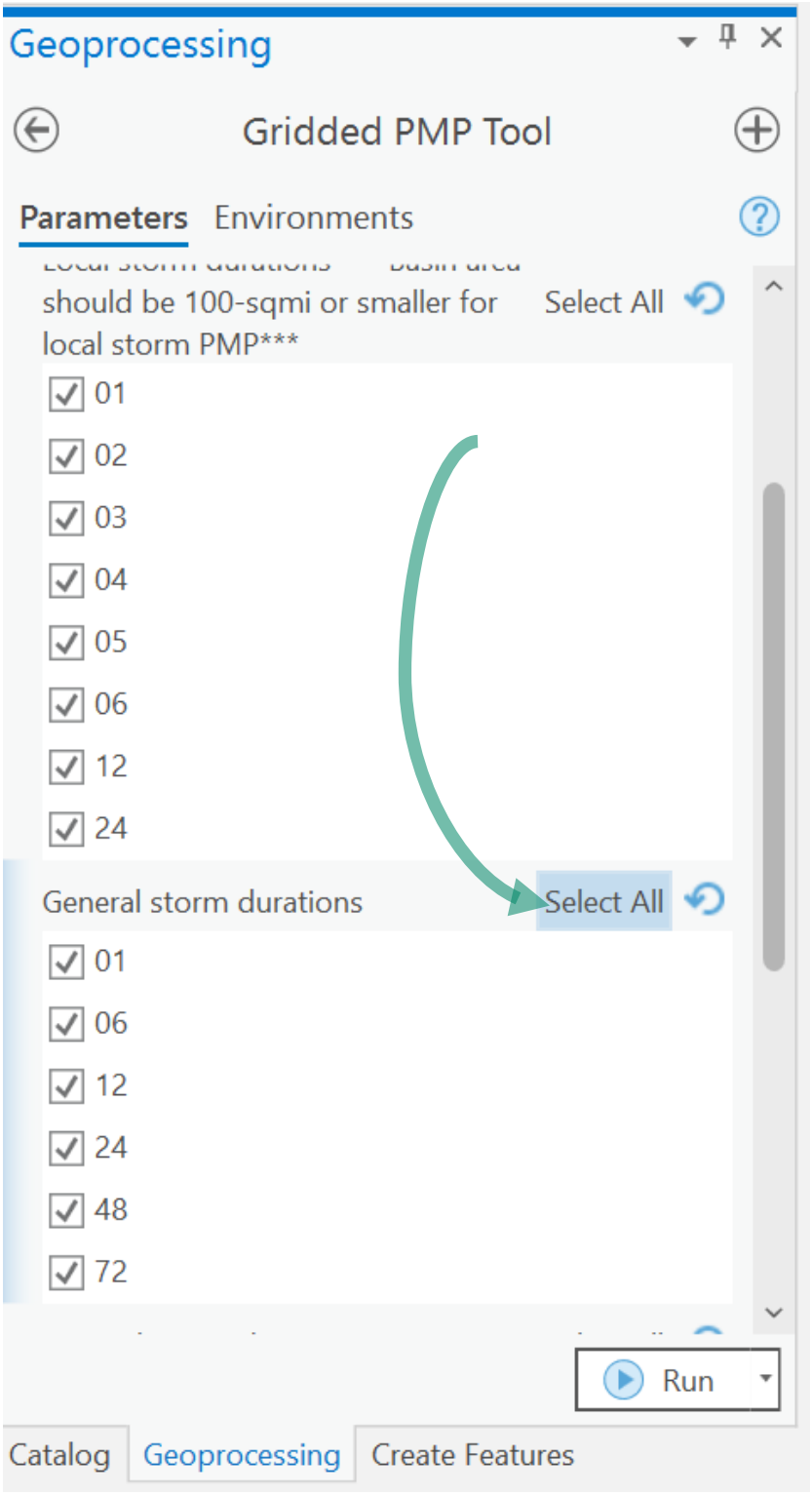
Note: Check the location of "PMP_Evaluation_Tool" Folder, it should be the same location as in Step # 2, where the NJPMP tool files were extracted.



Using the folder icon on the Output Folder Line navigate to the desired location on your drive to save the output data from NJPMP Tool processing, for this example it is navigated to Boonton_Reservoir Folder see below:

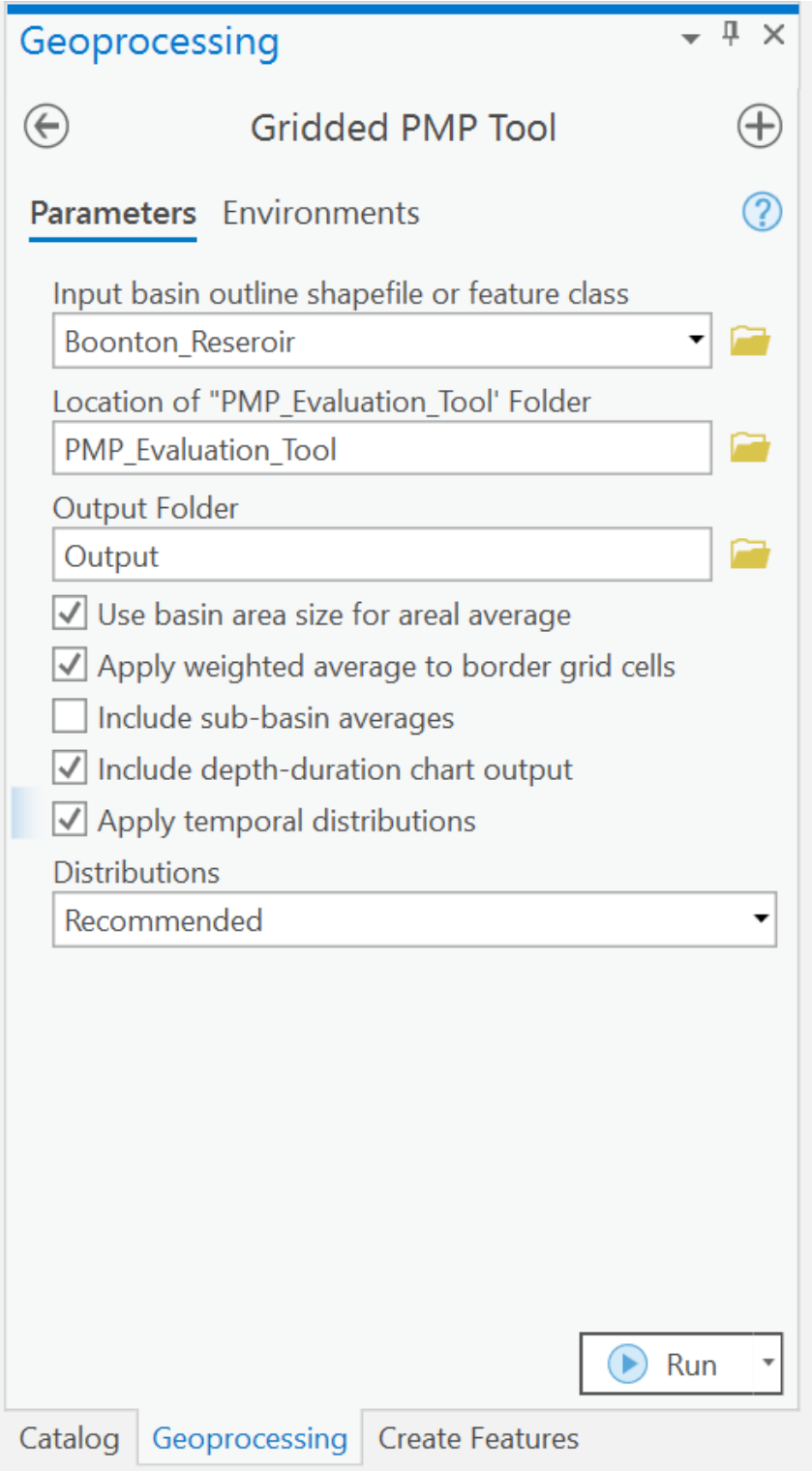


Select all Local, General, and Tropical storm durations, from 1 hour to 24 hours for computations for NJ watershed irrespective of the drainage area of the basin.



Note: The NJPMP distributions are recommended based on the overall contributing watershed size at point of interest e.g., local storm application in hydrologic modeling is limited to drainage areas less than 100 square miles.

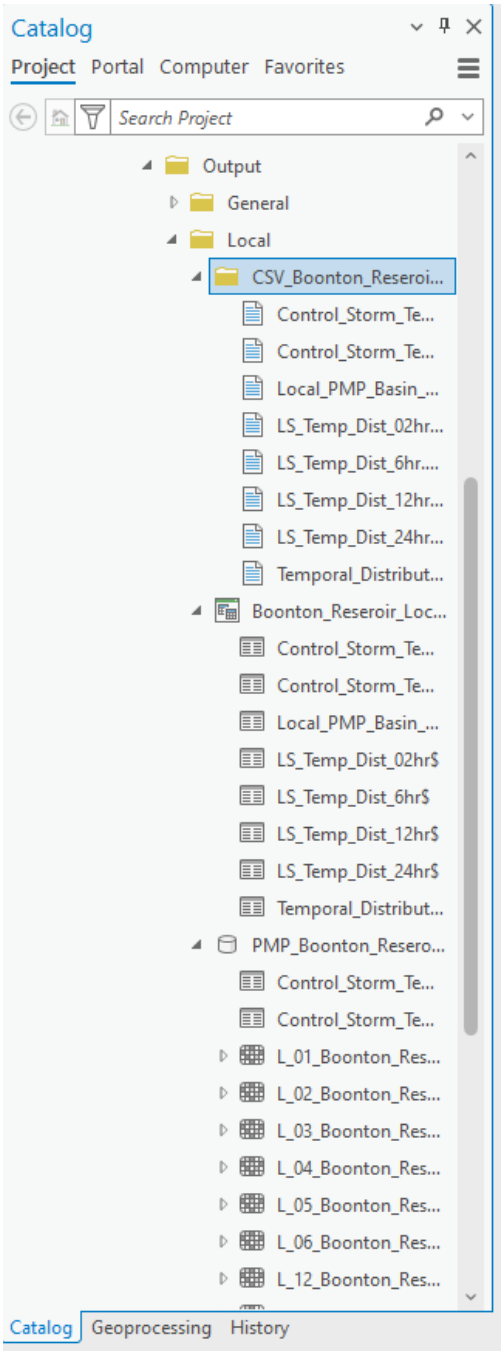
Scroll down within tool interface and check the boxes shown below. (Note that NJDEP requires determination of temporal distribution for development of rainfall/runoff model)


Geoprocessing
Gridded PMP Tool
Parameters
Environments
Input basin outline shapefile or feature class
Boonton_Reseroir
Location of "PMP_Evaluation_Tool' Folder
PMP_Evaluation_Tool
Output Folder
Output
Use basin area size for areal average
Apply weighted average to border grid cells
Include sub-basin averages
Include depth-duration chart output
Apply temporal distributions
Distributions
Recommended
Run
Catalog
Geoprocessing
Create Features

Step 7: Geoprocessing of NJPMP Data:

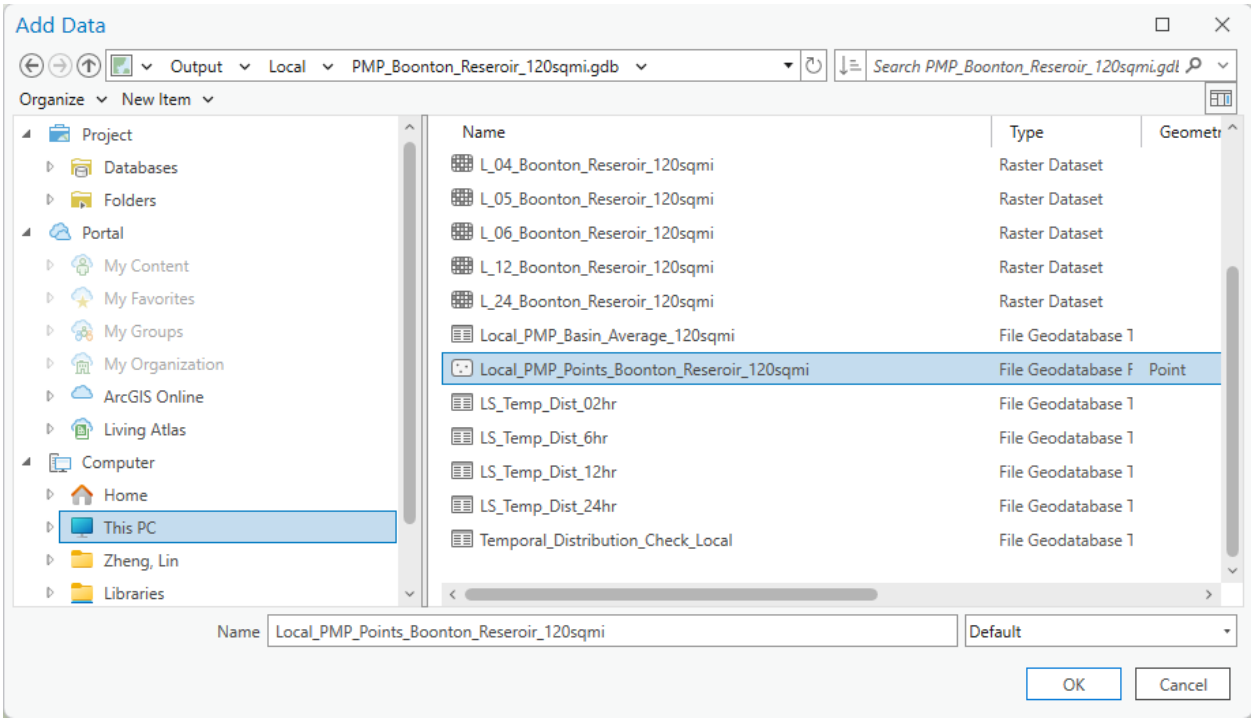
Click Ok on the dialog box and NJPMP Tool will compute the PMP depths and durations applicable to the selected watershed. This process is based on the transposition of the historic storms in the selected watershed based on the location of the watershed and proximity of the storms to selected watershed. The tool then calculate the maximum precipitation depth for the selected storm durations from the dialog box.)

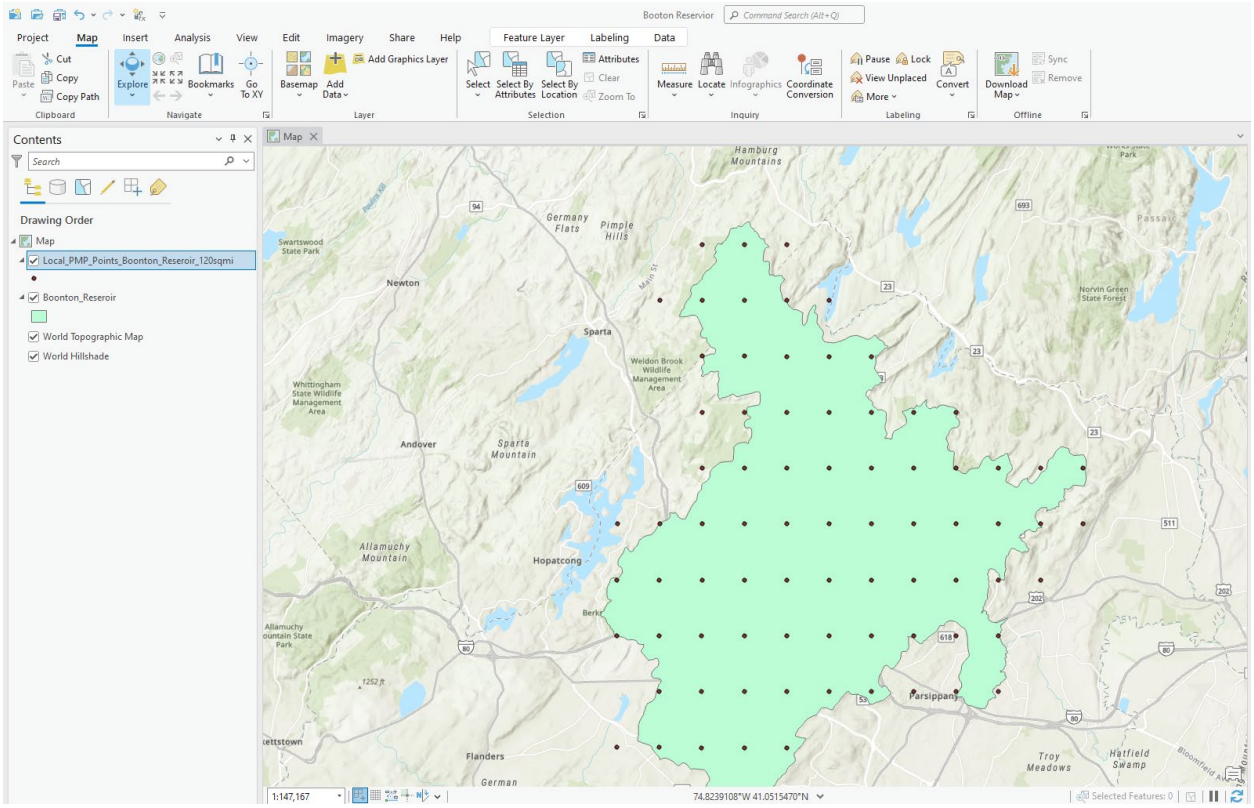
After the NJPMP Tool completes the computations, the results can be viewed from ArcCatalog (GIS Data) and through Windows File Explorer (Non-GIS Data).



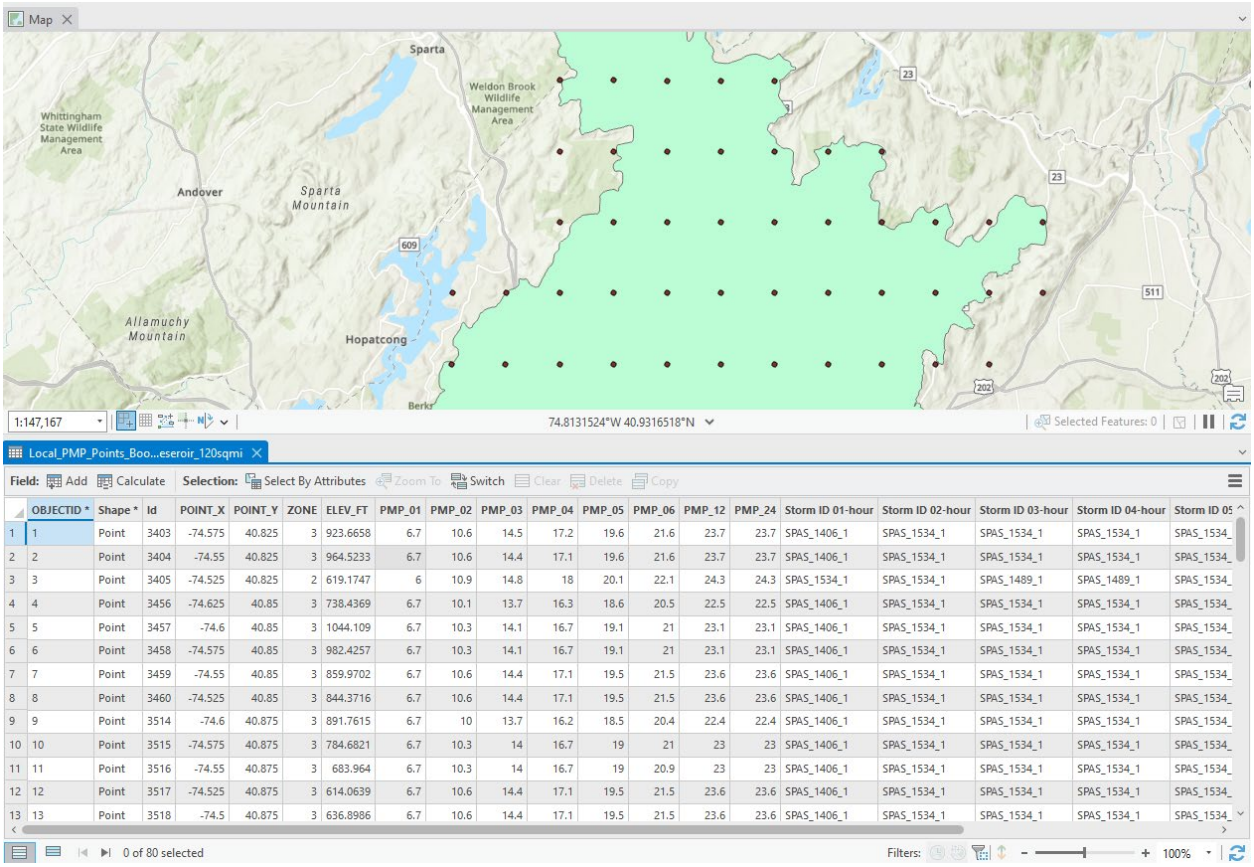
Step 8: Viewing Derived Spatial NJPMP Data for Watershed

Navigate to ArcCatalog or Add Data option on ArcGIS Pro and navigate to the output folders containing results of GeoProcessing data from NJPMP Tool. To view output data points used for the basin add **Local_PMP_Points_Boonton_Reseroir_120sqmi** featureclass from the output Geodatabase as shown below to review the PMP Depth at selected points within the watershed as shown below.



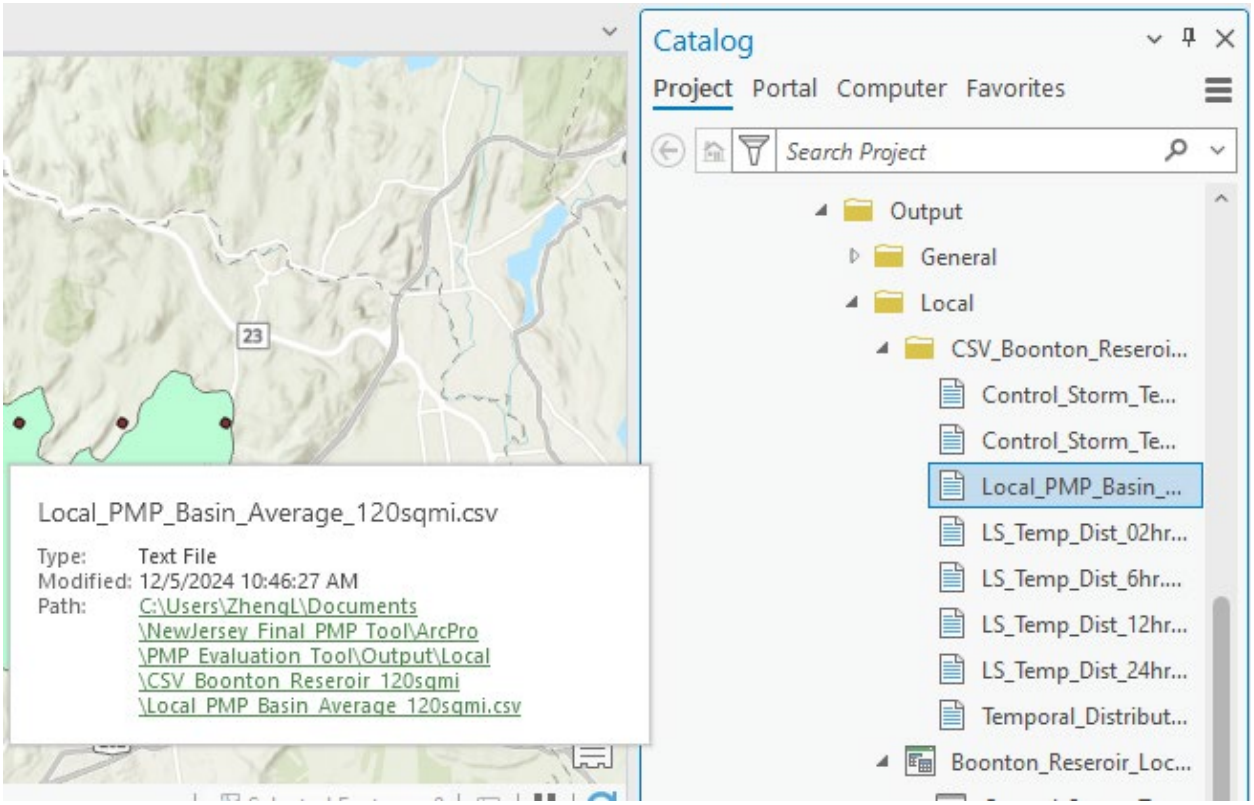


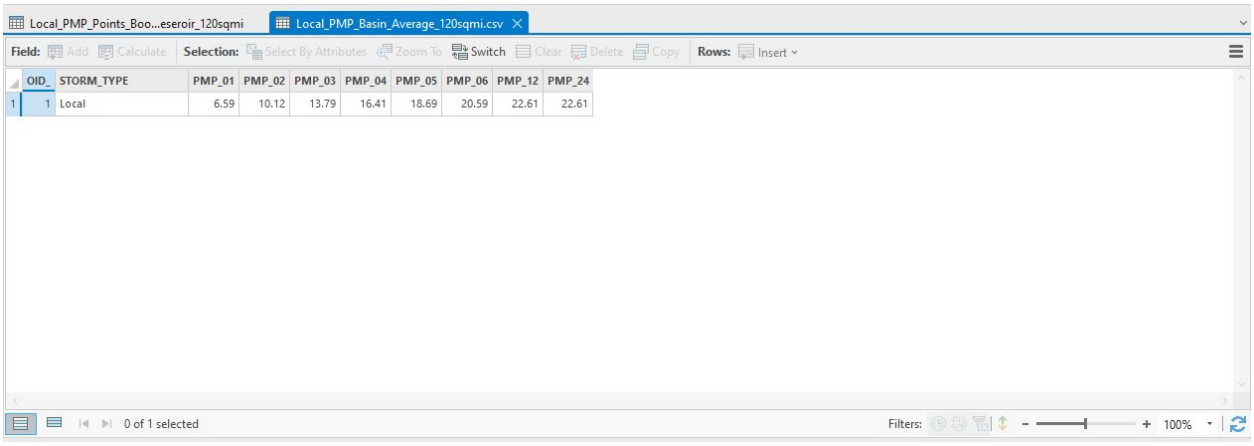
The Attribute table of the database will contain information at each point including lat/long elevation and controlling storm for each recurrence intervals. (Note: at same point different durations may have different control storms.



	OBJECTID *	Shape *	Id	POINT_X	POINT_Y	ZONE	ELEV_FT	PMP_01	PMP_02	PMP_03	PMP_04	PMP_05	PMP_06	PMP_12	PMP_24	Storm ID 01-hour	Storm ID 02-hour	Storm ID 03-hour	Storm ID 04-hour	Storm ID 05
1	1	Point	3403	-74.575	40.825	3	923.6658	6.7	10.6	14.5	17.2	19.6	21.6	23.7	23.7	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
2	2	Point	3404	-74.55	40.825	3	964.5233	6.7	10.6	14.4	17.1	19.6	21.6	23.7	23.7	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
3	3	Point	3405	-74.525	40.825	2	619.1747	6	10.9	14.8	18	20.1	22.1	24.3	24.3	SPAS_1534_1	SPAS_1534_1	SPAS_1489_1	SPAS_1489_1	SPAS_1534_
4	4	Point	3456	-74.625	40.85	3	738.4369	6.7	10.1	13.7	16.3	18.6	20.5	22.5	22.5	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
5	5	Point	3457	-74.6	40.85	3	1044.109	6.7	10.3	14.1	16.7	19.1	21	23.1	23.1	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
6	6	Point	3458	-74.575	40.85	3	982.4257	6.7	10.3	14.1	16.7	19.1	21	23.1	23.1	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
7	7	Point	3459	-74.55	40.85	3	859.9702	6.7	10.6	14.4	17.1	19.5	21.5	23.6	23.6	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
8	8	Point	3460	-74.525	40.85	3	844.3716	6.7	10.6	14.4	17.1	19.5	21.5	23.6	23.6	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
9	9	Point	3514	-74.6	40.875	3	891.7615	6.7	10	13.7	16.2	18.5	20.4	22.4	22.4	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
10	10	Point	3515	-74.575	40.875	3	784.6821	6.7	10.3	14	16.7	19	21	23	23	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
11	11	Point	3516	-74.55	40.875	3	683.964	6.7	10.3	14	16.7	19	20.9	23	23	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
12	12	Point	3517	-74.525	40.875	3	614.0639	6.7	10.6	14.4	17.1	19.5	21.5	23.6	23.6	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_
13	13	Point	3518	-74.5	40.875	3	636.8986	6.7	10.6	14.4	17.1	19.5	21.5	23.6	23.6	SPAS_1406_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_1	SPAS_1534_

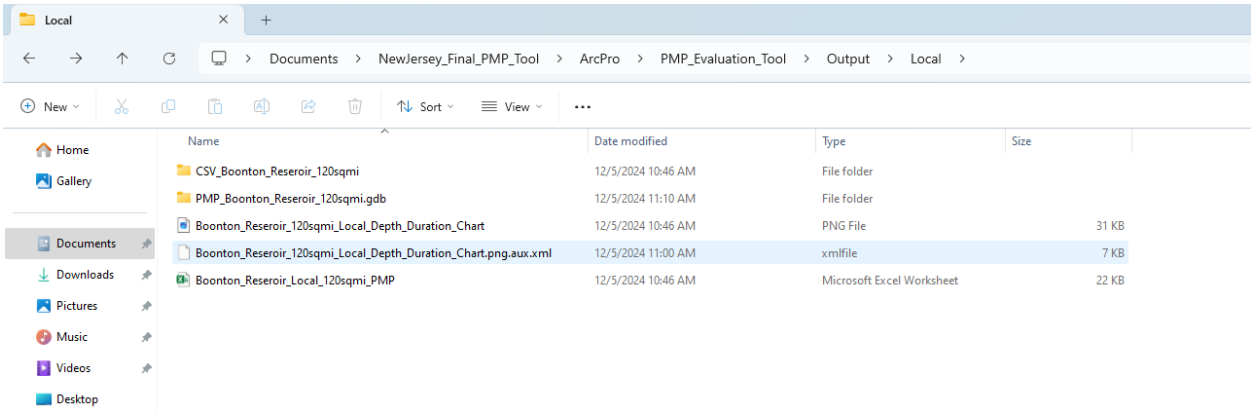
The Average Basin PMP average can be viewed as follows:



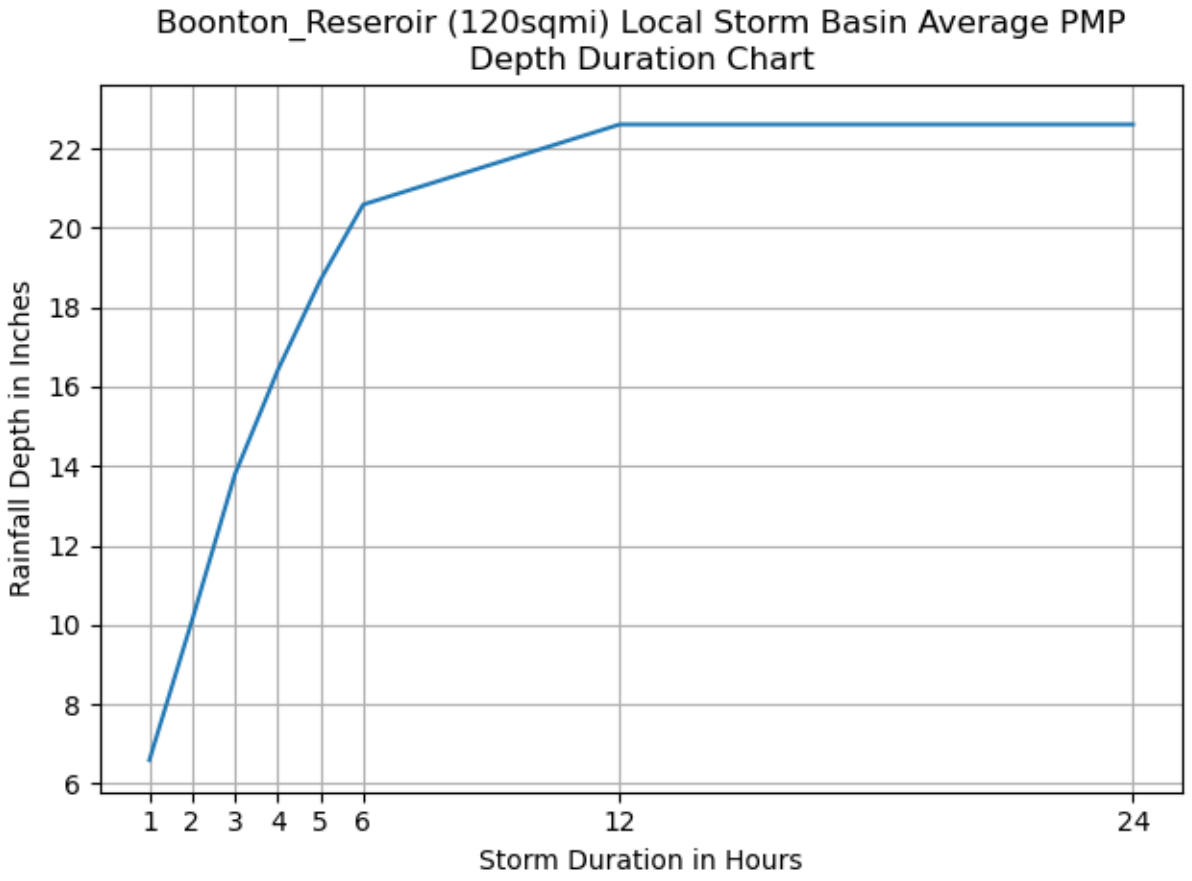


Step 9: Viewing Non-Spatial Data of NJPMP (CSV Files Tables)

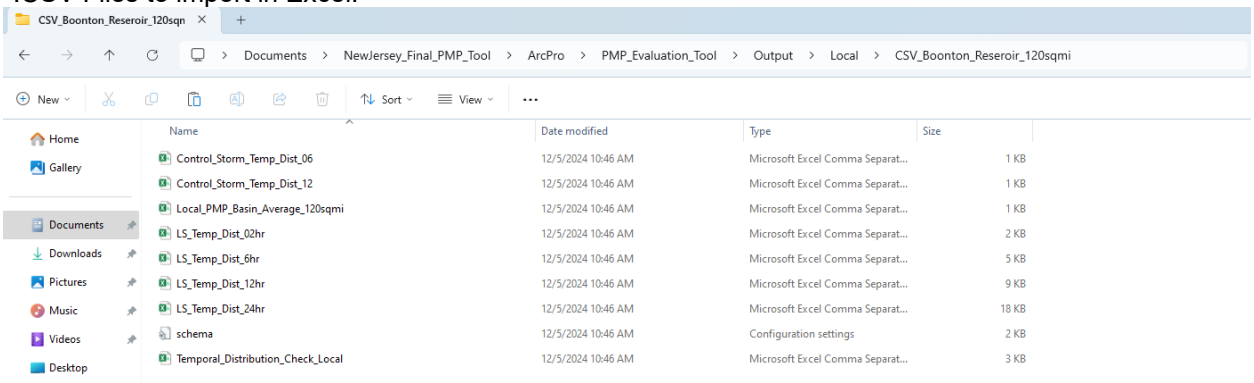
The Non-spatial data for NJPMP Tool can be viewed through windows explorer and Microsoft Excel.



The Depth-Duration Chart:



*.CSV Files to import in Excel:



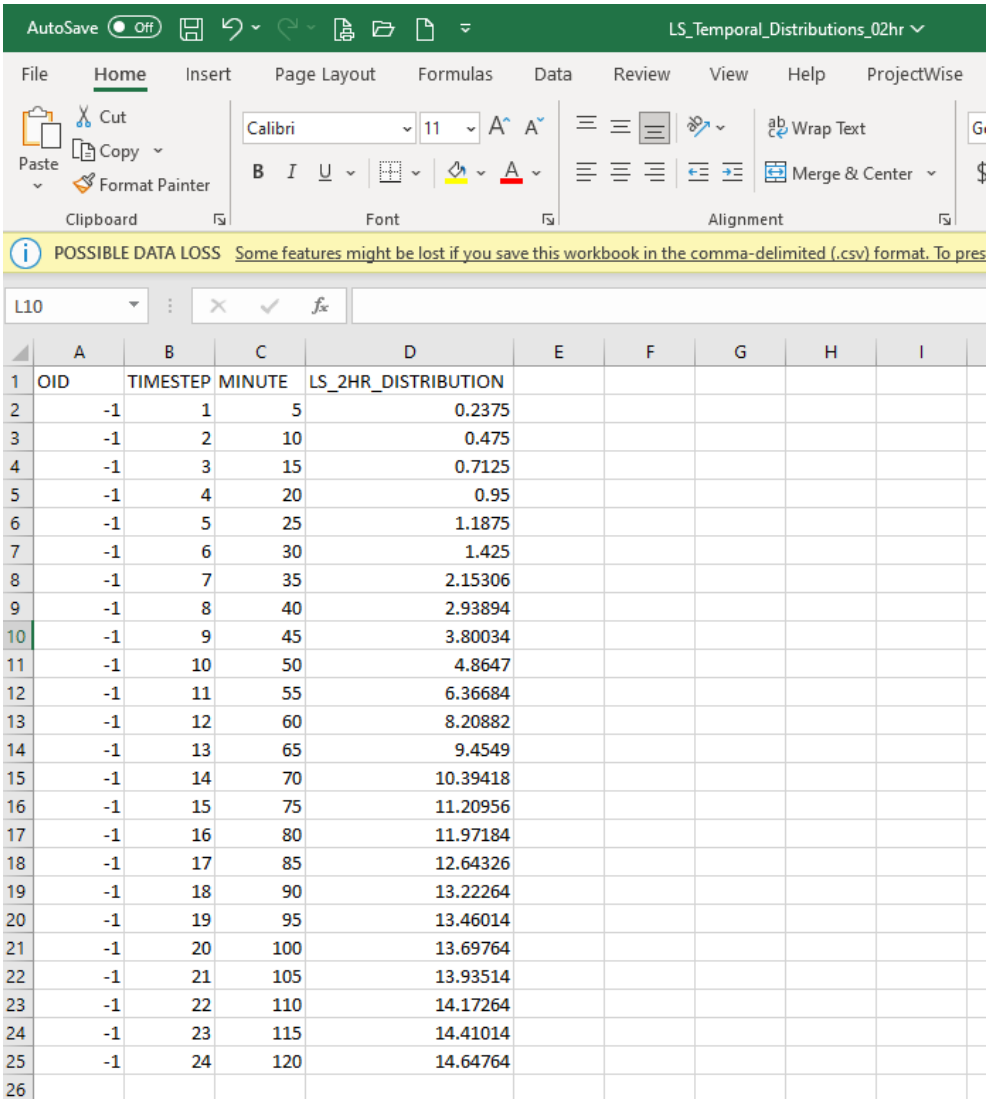
The recommended recommended PMP storms and temporal distributions for NJ PMP Tool are as follows:

Local Storm*	General Storm	Tropical Storm
2-hour local storm synthetic 6-hour local storm 10th-percentile 12-hour local storm 10th-percentile 24-hour local storm 10th-percentile 6-hour local controlling Storm 12-hour local controlling Storm	24-hour general storm 10th-percentile 12-hour general controlling storm	24-hour tropical storm 10th-percentile 12-hour tropical controlling storm

*Local storm application in hydrologic modeling is limited to drainage areas less than 100 square miles.

Step 10: Review & Use Temporal Distribution in Model

Now you can derive the necessary distribution such as LS_Temporal_Distribution_02hr into your HEC-HMS or other hydrologic model's meteorological model for simulations.



	A	B	C	D	E	F	G	H	I
1	OID	TIMESTEP	MINUTE	LS_2HR_DISTRIBUTION					
2	-1	1	5	0.2375					
3	-1	2	10	0.475					
4	-1	3	15	0.7125					
5	-1	4	20	0.95					
6	-1	5	25	1.1875					
7	-1	6	30	1.425					
8	-1	7	35	2.15306					
9	-1	8	40	2.93894					
10	-1	9	45	3.80034					
11	-1	10	50	4.8647					
12	-1	11	55	6.36684					
13	-1	12	60	8.20882					
14	-1	13	65	9.4549					
15	-1	14	70	10.39418					
16	-1	15	75	11.20956					
17	-1	16	80	11.97184					
18	-1	17	85	12.64326					
19	-1	18	90	13.22264					
20	-1	19	95	13.46014					
21	-1	20	100	13.69764					
22	-1	21	105	13.93514					
23	-1	22	110	14.17264					
24	-1	23	115	14.41014					
25	-1	24	120	14.64764					
26									

Reference:

PADEP: INSTRUCTIONS - Using the PA PMP TOOL in ArcGIS_Reference PA.pdf

NJDEP/AWS: Probable Maximum Precipitation Study For New Jersey Final Report

AECOM: NJPMP tool Additional Analyses Memo 07-07-22

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