GIS AEP Tool Documentation

Maryland Statewide PMP Study

1. AEP Tool Description and Usage

The Basin AEP Tool extracts 6-hour and 24-hour basin-average precipitation for Annual Exceedance Probabilities (AEP) and corresponding Average Recurrence Intervals (ARI) estimates, and 5% and 95% confidence interval estimates, for user-defined drainage basin area. The development of the Annual Exceedance Probability is detailed in Section 14 of the Probable Maximum Precipitation Study for Maryland (2024).

The tool calculates an areal-reduction factor (ARF) based on duration and the basin location, east or west of the Appalachian Divide, using a three-parameter log-logistic function. The tool exports Excel spreadsheet tables of basin average precipitation estimates for AEPs of 1 to $1x10^{-10}$. The tool also calculates the AEP of PMP for the basin using user-input PMP datasets. The resulting precipitation frequency estimates and AEP of PMP are plotted on charts as .png images.

The tool is compatible with ArcGIS Pro. It is recommended that the most current version of the software is used. The tool is accessed from the Maryland_Final_PMP_Tool.tbx toolbox within the ArcGIS desktop environment.

1.1 File Structure

The Basin AEP Tool, and the gridded precipitation frequency datasets it utilizes are contained within the 'PMP_Evaluation_Tool' folder. The 'AEP.gdb' file geodatabase contains the precipitation frequency gridded datasets for each duration for every available return period. The AEP.gdb is located within the 'Input' sub folder. The script tool is located within the 'Script' subfolder, along with the PMP tool. See the PMP tool documentation for more information on the PMP tool and the overall file structure.

1.2 Usage

As a prerequisite to the AEP tool usage, the user should have downloaded the 'PMP_Evaluation_Tool' to a location on their local file system. A polygon feature class or basin shapefile is needed for input. Running the PMP tool with the basin is not required unless the user chooses the option to calculate the AEP of PMP.

1.3 Input Parameters

The tool accepts the following input parameters.

Table 1 - AEP Tool input parameters

Parameter # (in script)	Display Name	Data Type	Type	Direction	MultiValue
0	Input basin outline shapefile or feature class	Feature Layer	Required	Input	No
1	AEP Durations	String	Required	Input	Yes
2	Output Folder Path	Folder	Required	Input	No
3	Estimate AEP of PMP	Boolean	Optional	Input	No
4	"PMP Points" feature class for each storm type	Feature Layer	Optional	Input	Yes

Figure 1 shows the tool dialogue window with each of the input parameters. The first parameter required by the tool dialogue is a feature layer, such as a basin shapefile or feature class, designed to outline the area of interest (AOI) for the precipitation frequency estimates. The tool will calculate the basin area size in square miles. If the feature layer has multiple features (or polygons), the tool will use the combined area as the analysis region. Only the selected polygons will be used if the tool is run from the ArcMap environment with selected features highlighted. If the AOI shapefile extends beyond the project analysis domain, AEP will only be evaluated for grid cells inside the project domain. The AOI shapefile or feature class should not have any spaces or symbol characters in the filename or the file path.

The user then selects the precipitation durations to be evaluated. At least one duration is needed.

The user will need to set the 'Output Folder' path which provides the tool with the location to create the output AEP files. The user must have read/write privileges for this folder location.

Finally, the user has the option to calculate the AEP of PMP for the basin. If the user selects this option, they will need to provide the "PMP_Point" feature class(es) produced by the Basin PMP Tool. The tool can accept a separate feature class for each storm type (see example in Figure 1).

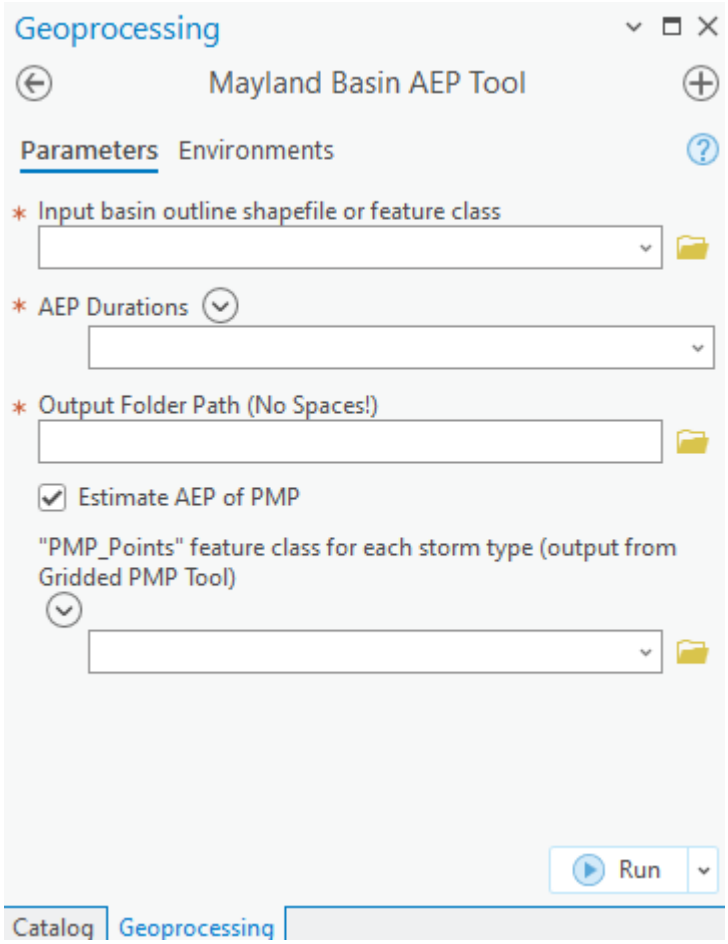

Figure 1 - The Basin AEP Tool input dialogue window

1.4 Tool Output

Once the tool has been run, the output folder will be populated with the results. For each duration the tool will produce an Excel (.xls) spreadsheet containing the basin average precipitation frequency estimates. An example is shown in Table 2. The tool will also produce a logarithmic frequency curve plot showing the basin average precipitation and the 95% confidence bounds. Additionally, if the option to calculate the AEP of PMP was chosen, the PMP depths will be plotted on the chart and a table of the AEP of PMP values will be plotted on the image. An example of this plot is shown in Figure 2.

Table 2 - Example basin AEP table output

OBJECTID	Annual Exceedance Probability	Precip (in) 50% conf.	Precip (in) 5% conf.	Precip (in) 95% conf.
1	1	1.36	1.19	1.52
2	0.5	2.63	2.38	2.92
3	0.2	3.56	3.25	3.93
4	0.1	4.26	3.87	4.69
5	0.04	5.26	4.72	5.76
6	0.02	6.08	5.4	6.72
7	0.01	6.99	6.14	7.79
8	0.005	7.98	6.93	8.98
9	0.002	9.43	8.05	10.7
10	0.001	10.67	8.99	12.22
11	0.0002	14.02	11.43	16.31
12	0.0001	15.7	12.61	18.59
13	0.00001	22.61	17.27	28.47
14	0.000001	32.08	23.15	43.11
15	0.0000001	45.06	30.68	64.62
16	0.00000001	62.87	40.25	96.77
17	0.000000001	87.27	52.41	144.62
18	1E-10	120.74	67.9	215.65

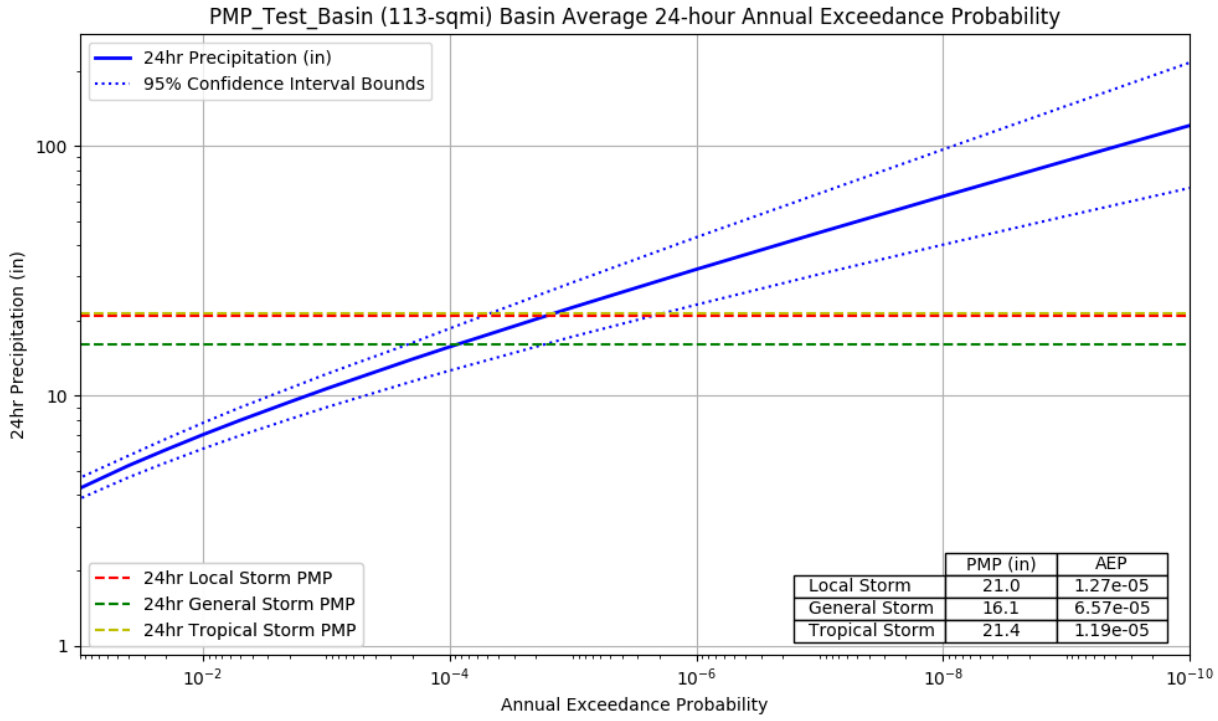

Figure 2 - Example basin precipitation frequency curve and AEP of PMP plot output