

Using HMS-PrePro

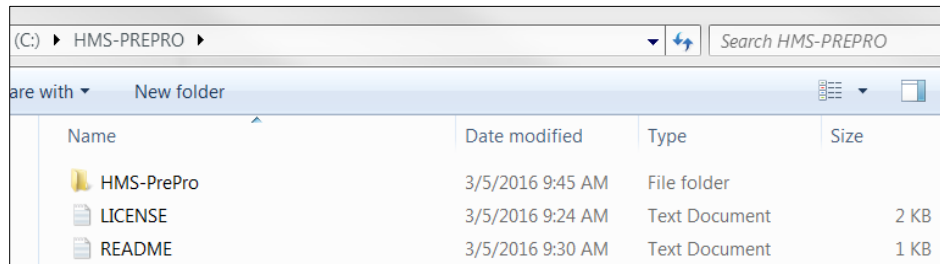
Prepared By: Cynthia V. Castro

HMS-PrePro contains ArcGIS geoprocessing script tools for extracting data from Esri's Living Atlas, deriving a watershed network, estimating hydrological parameters, and storing results in a .BASIN output ASCII file that may be used as input for the HEC-HMS watershed modeling software.

Download: <https://github.com/cvcastro/HMSPrePro>

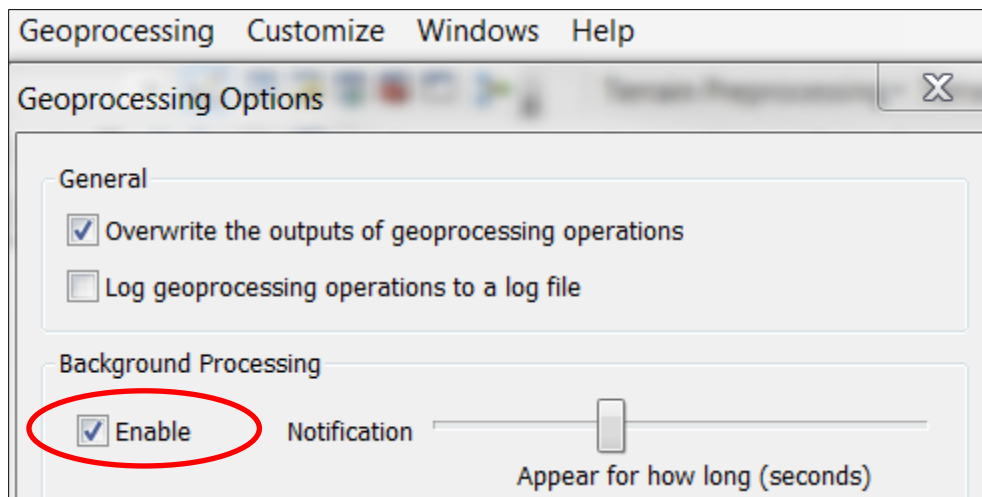
Installation / Set-Up

- 1) Copy or unzip the HMS-PREPRO folder to any location on your hard drive



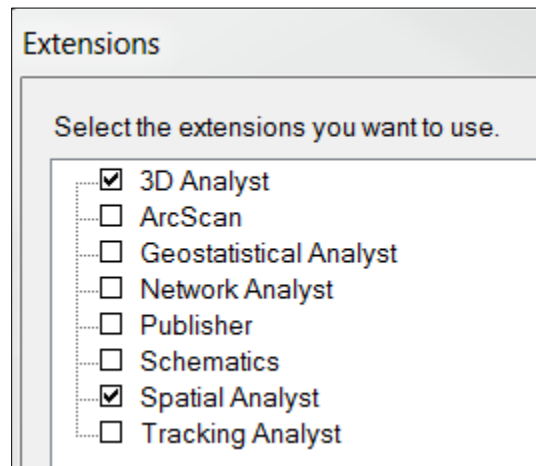
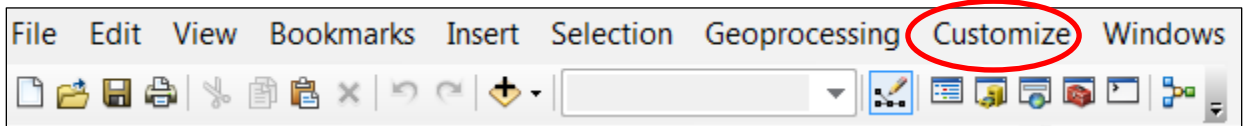
- 2) Ensure you have 64-bit geoprocessing capabilities by looking for a folder containing **ArcGISx64** in C:\Python27. If you do not see this folder, contact your system administrator for installation. Running HMS-PrePro without the 64-bit background geoprocessing may cause failures or a notably longer execution time.

Enable background geoprocessing (64-bit) by clicking the **Geoprocessing** tab from the ArcMap toolbar and selecting the **Enable** box under Background Processing. Click **OK**.

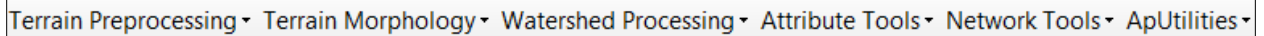


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- 3) Enable the 3D Analyst and Spatial Analyst extensions by selecting the **Customize** tab from the ArcMap toolbar and choosing **Extensions**. Select the box next to 3D Analyst and Spatial Analyst.



- 4) Ensure **ArcHydro** is installed. In ArcMap you will see this toolbar:



- a. If not, download and install the appropriate version of Arc Hydro tools here:
<http://downloads.esri.com/archydro/ArcHydro/Setup/>
 - b. If you have a 64-bit computer, use the “x64” version for faster background processing.
- 5) The use of Esri Living Atlas landscape layers requires an ArcGIS Online **organizational account**. This is different than an ArcGIS Online personal or global account. You may have been invited to become a member of an ArcGIS organizational account through your university or workplace. If so, it is recommended to use the login credentials registered with that organization when using HMS-PrePro. Contact your organization’s administrator for access.

If you have not been invited to join an existing organizational account, you may create a temporary one by signing up for the developer trial here:

- c. <https://developers.arcgis.com/sign-up/>
- d. NOTE: Access to the landscape layers within the Living Atlas is free and does not consume any of your organizational credits/tokens.

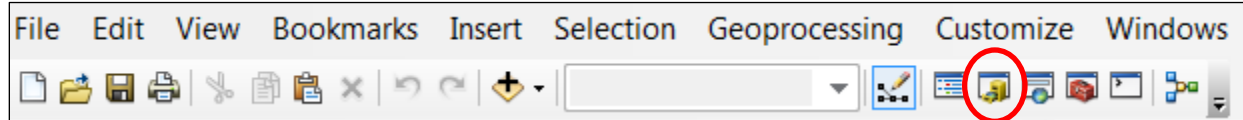
**** Prior to running HMS-PrePro, ensure that you are logged into your organizational account in ArcMap by selecting File >> Sign In...**

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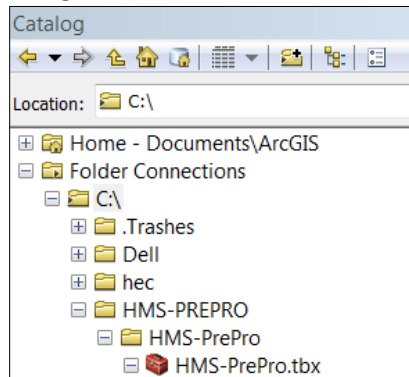
Open HMS-PrePro

Using ArcCatalog:

Open ArcCatalog within ArcMap



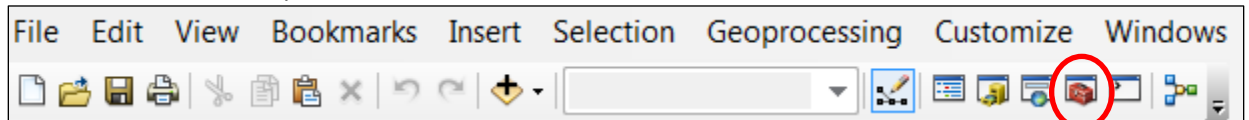
Navigate to the installation directory in ArcCatalog and expand the HMS-PrePro folder.



Double-click on the script tool to run.

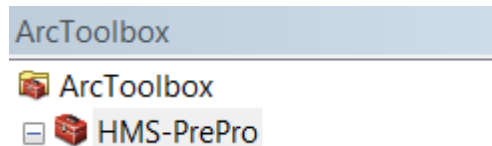
Or, using ArcToolbox:

Open ArcToolbox within ArcMap



Right-click the **ArcToolbox** folder and select **Add Toolbox**.

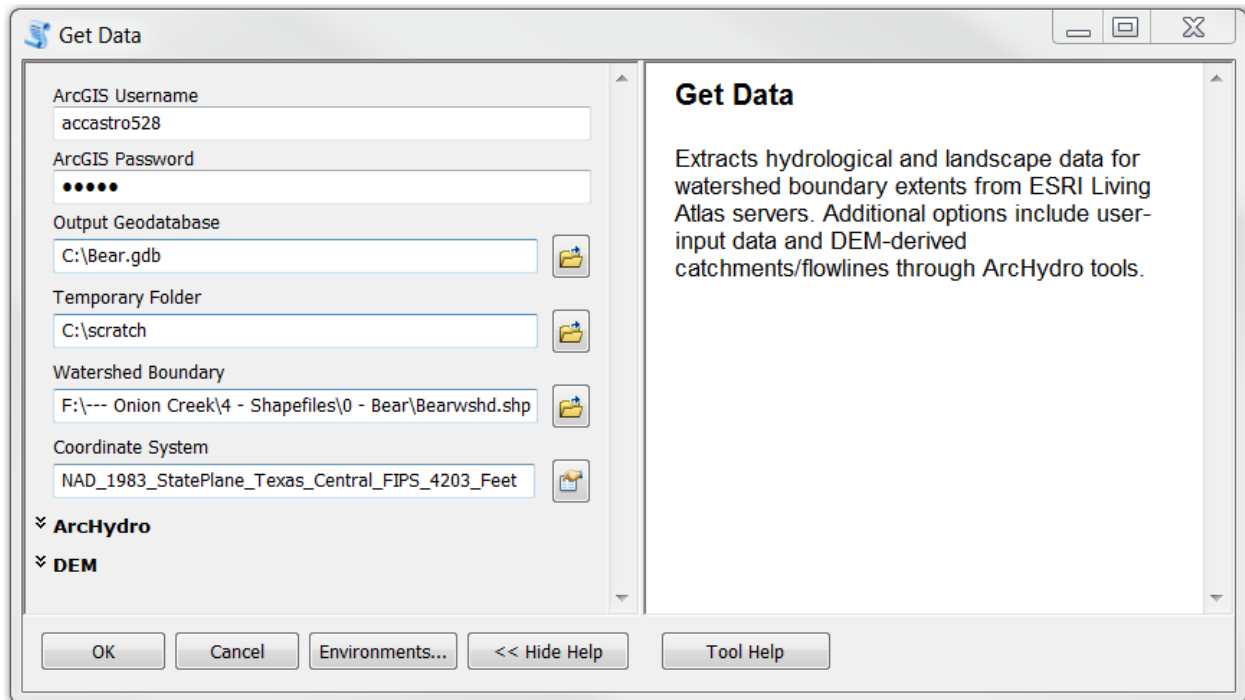
Navigate to the HMS-PREPRO directory and select the **HMS-PrePro.tbx**. Click **Open**.



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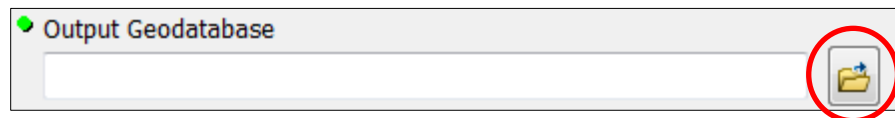
Using the HMS-PrePro *GetData* Tool


- 1) Double-click on the **GetData** script



NOTE: If you encounter an error, first try closing out of ArcMap and re-opening a blank project.

- 2) ArcGIS Username / ArcGIS Password
 - a. Input your ArcGIS organizational username and password.
- 3) Output Geodatabase
 - a. Create an empty geodatabase and navigate to that directory. This is where the output layers will be saved. (NOTE: It is possible to create an empty geodatabase within the tool by selecting the **New File Geodatabase** icon, as shown below.)



After selecting **New File Geodatabase**, rename the *New File Geodatabase.gdb* and select the  icon only once to add the .gdb to the Name field. Select **Add**.

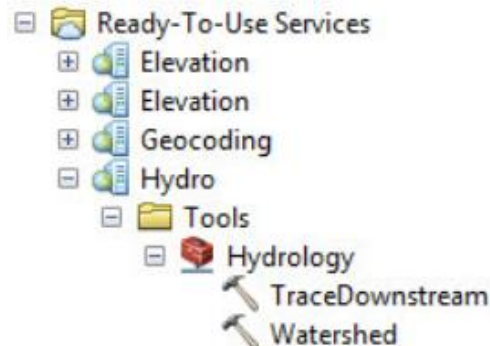
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4) Watershed Boundary

- a. Navigate to the watershed boundary layer. This layer may be a shapefile (.shp) or a feature class within a geodatabase.
- b. If you do not have a watershed boundary layer, you may create one for an area of interest using the ArcGIS Watershed service tool (not part of this tutorial).

For more information about using the Watershed tool, visit:

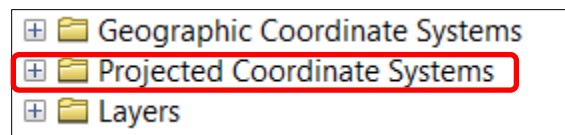
<http://www.arcgis.com/home/item.html?id=8e48f6209d5c4be98ebbf90502f41077>



- c. NOTE: Do not select a watershed that is too large for your computer RAM and/or internet connectivity speeds.
- d. The watershed boundary may not be edited after execution of HMS-PrePro (without having to re-calculate all sub-catchments, reaches, junctions, and catchment parameters). Initial selection of the intended watershed boundary is very important.
- e. Ensure that your watershed contains a projected coordinate system prior to execution.

5) Output Coordinates

- a. Select the desired output coordinate system.
 - i. For hydrological purposes, ensure the output coordinate system preserves spatial area. Examples include the Albers Equal Area Conic projection or the State Plane systems.
 - ii. For use with the HMS-PrePro processing script, a Projected Coordinate System must be selected.
 - iii. NOTE: The projected coordinate system only applies to the Subbasin and Reach layers. The landscape rasters (soils, land use, impervious, and DEM) will remain in the North America Albers Equal Area Conic projection for spatial analysis.

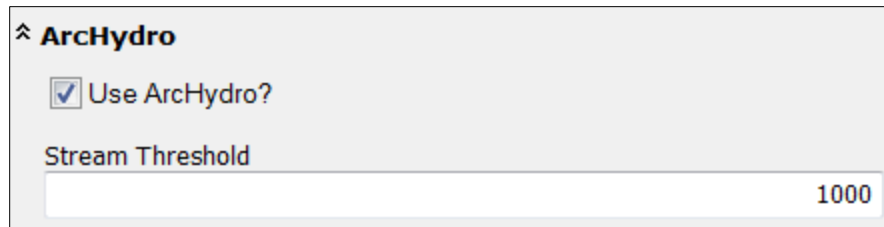


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6) ArchHydro

Select the **Use ArchHydro** option if you wish to derive the stream network (subbasins, reaches, nodes) from a DEM using ArchHydro tools instead of the NHDPlusV2.1 catchments and flowlines. HMS-PrePro will use the stream threshold to delineate the watershed from a DEM.

Provide a **Stream Threshold** based on the number of DEM cells that you wish to define the stream. The default value is 1000. Smaller stream thresholds will produce more drainage units.

The screenshot shows a configuration window titled "ArchHydro" with a small upward-pointing arrow icon to its left. Inside the window, there is a checkbox labeled "Use ArchHydro?" which is checked. Below this checkbox is a text input field labeled "Stream Threshold" with the value "1000" entered. The input field has a small blue arrow icon on its right side.

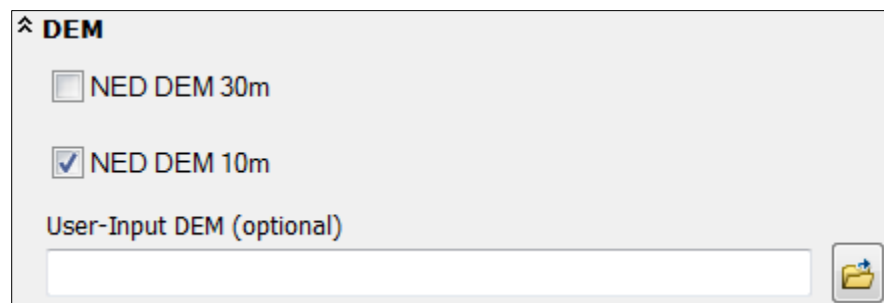
After execution of the *GetData* script, carefully analyze the size of your catchments and reaches. If these are too large or small, re-run the script and adjust the “Stream Threshold” value.

Manual editing of catchments/reaches/junctions prior to running the next script is technically possible, however, if any of the Fields are edited (i.e. Name/HydroID, To_Node, From_Node, NextDownID, NodeID) and the topology does not match perfectly, HMS-PrePro will be unable to run the parameterization script. Manual editing of the basin catchments after running ArchHydro is very typical for land-development projects, because the Node of interest typically lies at a specific location. Care should be executed in updating the Watershed topology connections if manual edits are desired.

7) DEM

The Esri Living Atlas may be used to obtain a 30-meter DEM, which is standard across the United States, or a high-resolution DEM, which is a composite of the best publicly-available DEM in the country. The high-resolution DEM will contain at minimum a 10-meter value from the National Elevation Dataset. More information is available here:

<https://blogs.esri.com/esri/arcgis/2014/07/11/introducing-esris-world-elevation-services/>
<http://www.arcgis.com/home/item.html?id=58a541efc59545e6b7137f961d7de883>

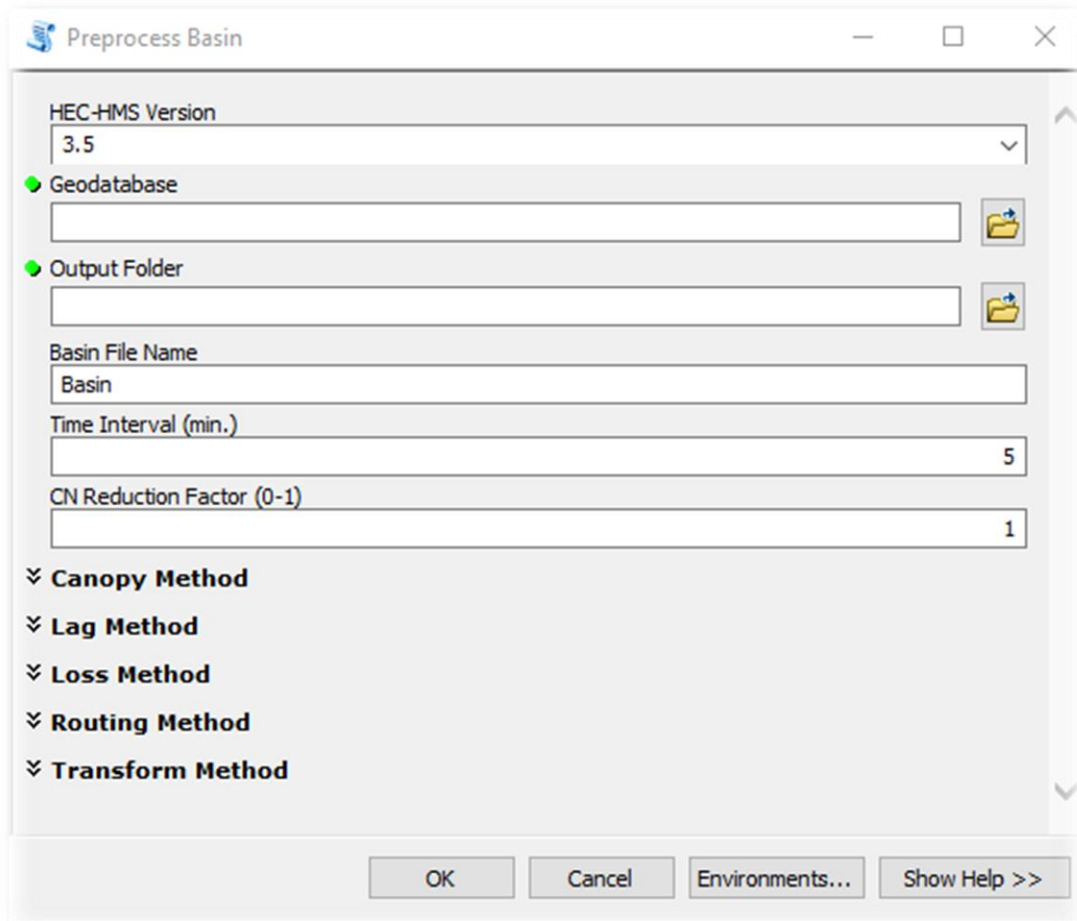
The screenshot shows a configuration window titled "DEM" with a small upward-pointing arrow icon to its left. Inside the window, there are two radio button options: "NED DEM 30m" (which is unselected) and "NED DEM 10m" (which is selected). Below these options is a text input field labeled "User-Input DEM (optional)". To the right of the input field is a small icon of a folder with a plus sign.

By selecting the **NED DEM 10m**, a high-resolution DEM will be extracted that contains elevation values (10-meter to 3-meter resolution) from the National Elevation Dataset. In some locations,

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Using the *Preprocess Basin* Script

Double-click on the **Preprocess Basin** script



NOTE: If you encounter an error, first try closing out of ArcMap and re-opening a blank project. Sometimes, background processing will crash if the layer being processed is open.

- 1) Select version of HEC-HMS.
- 2) Select the geodatabase created with the *Get Data* tool.
- 3) Select an output folder for the .BASIN HEC-HMS file.
- 4) Choose a name for the .BASIN file.
- 5) Select a time interval (whole number) for the HEC-HMS simulation.
- 6) Choose a Curve Number reduction factor (optional) according to observed/calibrated data.
- 7) You may choose to employ various Methodologies for basin losses and routing.
See HEC-HMS User's Manual for more information.
- 8) Read the "Help" dialogue box for information regarding each Methodology and required input.
** This step is particularly important if you wish to execute the TR-55 Lag Time script. Follow the user-steps listed under the "Help" screen, and then run the Optional "TR-55 Method" script after fully executing the "Preprocess Basin" script and updating necessary parameters.
- 9) Select **OK**.

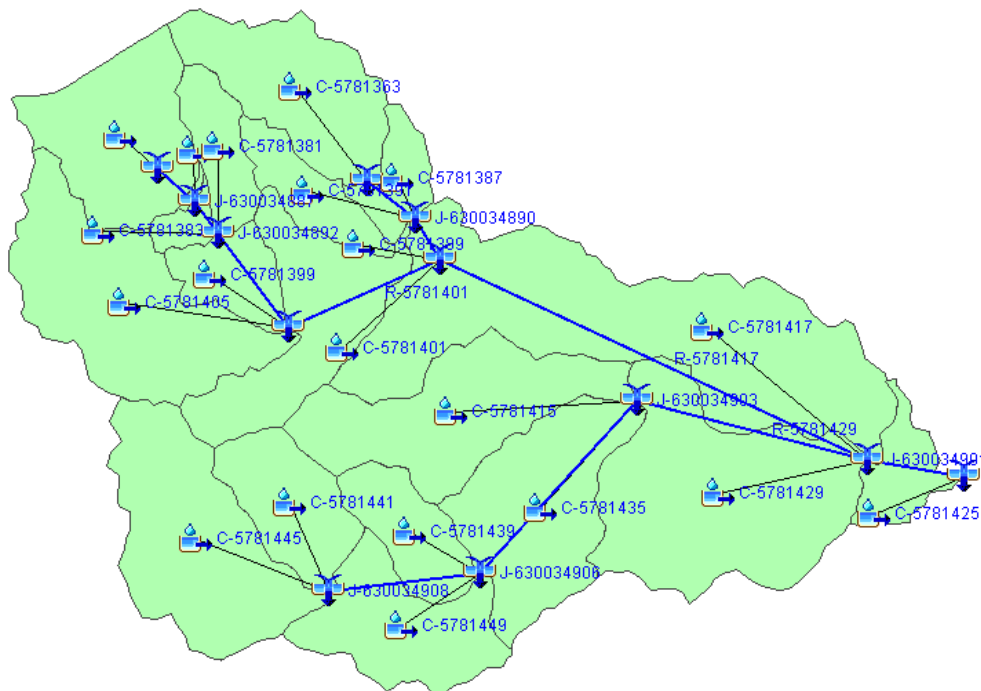
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Opening .BASIN File in HEC-HMS

Now that you have created a .BASIN file from the hydrological geodatabase, you may use this to *initialize* a HEC-HMS model. Further calibration and engineering optimization is necessary to accurately model the watershed response. These results should not be used for design or judgment purposes without further analysis by a professional engineer.

- 1) Open HEC-HMS
Download available: <http://www.hec.usace.army.mil/software/hec-hms/downloads.aspx>
- 2) Create a New Project (File >> New...). Choose the U.S. Customary units.
- 3) Import the .BASIN file (File >> Import >> **Basin Model**).
Navigate to the directory where you saved the .BASIN file in the HMS-PrePro tool.
- 4) In the legend, open the Basin Models folder and select your basin. You may optimize the view by selecting View >> Maximum Extents and changing the percentage value.

You may also import background images (i.e. subbasin, longest flowpath) by selecting View >> Background Maps >> Add. When importing background images to HEC-HMS, the layer cannot be contained in a geodatabase. You will need to export the data as a shapefile first.



- 5) To fully execute a HEC-HMS model, you will need to create a meteorological model, control specifications, and a simulation run. Refer to the HEC-HMS manual for further information.

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Questions

For questions regarding this product, please contact:

Cynthia V. Castro

cynthiavail11@gmail.com

Please note that no requested coding updates will be conducted on this tool by the Author. The current tool is compatible with ArcMap 10.7. If you wish to update the script codes for improved performance or for future versions of ArcGIS/ArcPro/HEC-HMS/additional software, you *must* upload the modified script back into GitHub for public use and contact the Author, per licensing agreement.