

# ARC HYDRO OVERVIEW DOCUMENT #1

## ARC HYDRO TOOLS OVERVIEW



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# Arc Hydro Tools - Overview

## Arc Hydro Overview Document #1

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## Introduction to Arc Hydro

Arc Hydro is an ArcGIS-based system geared to support water resources applications. It consists of two key components:

- Arc Hydro Data Model
- Arc Hydro Tools

These two components, together with the generic programming framework, provide a basic database design and a set of tools that facilitate the analyses often performed in the water resources area. Arc Hydro is intended to provide the initial functionality that can then be expanded by adding to it database structures and functions required by a specific task or application.

## Introduction to Arc Hydro Tools

The Arc Hydro tools operate in the ArcGIS environment. Some of the functions require the Spatial Analyst extension. The majority of the tools are accessed through the Arc Hydro Tools toolbar, where they are grouped by functionality into six menus and nine tools. Additional tools have been developed in the geoprocessing environment and are available in the Arc Hydro Tools toolbox that can be used both in ArcMap and in ArcCatalog.

Name	Tool bar	Tool box	Description
Terrain Preprocessing	x	x	Functions preprocessing a Digital Elevation Model (DEM). These functions are mostly used once in order to prepare spatial information for later use.
Terrain Morphology	x	x	Functions performing an analysis of a non-dendritic terrain (e.g. terrains with sinks).
Watershed Processing	x	x	Functions performing watershed and subwatershed delineation and basin characteristic determination. These functions operate on top of the spatial data prepared in the terrain preprocessing stage.
Attribute Tools	x	x	Functions computing and populating attributes such as identifiers and characteristics.
Network tools	x	x	Functions generating or manipulating properties of geometric (hydro) network.
ApUtilities	x		Functions managing the properties of the Arc Hydro project. These functions will be seldom used and are not detailed in this document.
Buttons and Tools	x		<ul style="list-style-type: none"> <li>▪ Flow Path Tracing</li> <li>▪ Interactive Flow Path Tracing</li> <li>▪ Point Delineation</li> <li>▪ Delineate using EPA Web Service</li> <li>▪ Batch Point Generation</li> <li>▪ Assign Related Identifier</li> <li>▪ Global Delineation</li> <li>▪ Trace By NextDownID Attribute</li> <li>▪ Main Flow Path Tracing</li> </ul>
Arc Hydro Setup		x	Functions setting up the Arc Hydro geoprocessing environment.

Name	Tool bar	Tool box	Description
GIS Data Exchange		x	Functions allowing exchanging GIS data between a geodatabase and an XML file.
H&H Modeling		x	Functions performing Time Series and Green and Ampt calculations.
Point Characterization		x	Functions characterizing input points.
Terrain Preprocessing Workflows		x	Model performing basic terrain preprocessing workflow.
Utility		x	Various utilities working in the Arc Hydro geoprocessing environment.

The Arc Hydro tools have two key purposes. The first purpose is to manipulate (assign) key attributes in the Arc Hydro data model. These attributes form the basis for further analyses. They include the key identifiers (such as HydroID, DrainID, NextDownID, etc.) and the measure attributes (such as LengthDown). The second purpose for the tools is to provide some core functionality often used in water resources applications. This includes DEM-based watershed delineation, network generation, and attribute-based tracing.

The functionality of Arc Hydro tools is expected to grow over time. They have been implemented in a way that allows easy addition to their functionality, either internally (by adding additional code) or externally, by providing additional functionality through the use of key Arc Hydro data structures.

## Arc Hydro Tools User Interface

### Toolbar



### Toolbox

- [-] Arc Hydro Tools.tbx
  - [+] Arc Hydro Setup
  - [+] Attribute Tools
  - [+] GIS Data Exchange
  - [+] H & H Modeling
  - [+] Network Tools
  - [+] Point Characterization
  - [+] Terrain Morphology
  - [+] Terrain Preprocessing
  - [+] Terrain Preprocessing Workflows
  - [+] Utility
  - [+] Watershed Processing

“\*” after a function name indicates a new function.

## Tools list – Toolbar

The tools are presented by their grouping in the user interface (menus and toolbox). The ApUtilities tools are not addressed here, as they are general-purpose utilities not related to the functionality of Arc Hydro tools.

### Terrain Preprocessing

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Create Drainage Line Structures	Generate DEM-compliant drainage line elements associated to the input Stream line features.	x	Standard	x
Create Sink Structures	Generate DEM-compliant sink elements	x		x
Level DEM	Fill the selected polygons (e.g. lakes) up to the FillElev value.	x		x
DEM Reconditioning	Enforce linear drainage pattern (vector) onto a DEM (grid). Implements AGREE methodology.	x		x
Assign Stream Slope	Assign relative elevation to from nodes and to nodes of input streams. Elevations decrease with the digitized direction.	x		
Burn Stream Slope	Burn linear stream slope into a DEM to force the direction of the flow in the stream.	x		x
Build Walls	Build walls in a DEM (grid) at the boundary of selected input polygons.	x		x
Sink Prescreening	Prescreen the input DEM by filling in the pits that do not match the criterion defining a potential sink.	x		x
Sink Evaluation	Generate and characterize the potential sinks for a DEM.	x		x
Depression Evaluation	Generate and characterize the potential depressions for a DEM.			x
Sink Selection	Select the potential sinks that should be considered as real sinks.	x		
Fill Sinks	Fill sinks for an entire DEM (grid).	x		x
Flow Direction	Create flow direction grid for a DEM grid.	x		x
Adjust Flow Direction in Sinks	Modify the flow direction within the input sink polygons so that all traces in a sink polygon end at the input sink point grid located within the sink polygon.	x		x
Adjust Flow Direction in Streams	Modify the values of the input Flow Direction grid cells within the streams and replaces these values with the flow directions from the input Stream Flow Direction grid created by the tool Create Drainage Line Structures.	x		x

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Adjust Flow Direction in Lakes	Modify input flow direction grid within the input lakes with streams to ensure that each cell within a lake flows toward the closest stream within the lake.	x		x
Flow Accumulation	Create flow accumulation grid from a flow direction grid.	x		x
Stream Definition	Create stream grid with cells from a flow accumulation grid that exceed user-defined threshold.	x		x
Stream Segmentation	Create a stream link grid from the stream grid (every link between two stream junctions gets a unique identifier).	x		x
Combine Stream Link and Sink Link	Create a link grid combining the stream link grid representing dendritic areas and the sink link grid representing deranged areas (i.e. areas with sinks).	x		x
Catchment Grid Delineation	Create a catchment grid for segments in the stream link grid or sinks in the sink link grid. It identifies areas draining into each link.	x		x
Catchment Polygon Processing	Create catchment polygon feature class out of the catchment grid.	x		x
Drainage Line Processing	Create streamline line feature class out of the stream link grid.	x		x
Adjoint Catchment Processing	Create adjoint catchment polygon for each catchment in the catchment polygon feature class. An adjoint catchment is the total upstream area (if any) draining into a single catchment.	x		
Drainage Point Processing	Create a drainage point at the most downstream point in the catchment (center of a grid cell with the largest value in the flow accumulation grid for that catchment).	x		x
Longest Flow Path for Catchments	Create longest flow path segments for each catchment and populates field LengthDown with the length to the most downstream point.	x		x
Longest Flow Path for Adjoint Catchments	Create longest flow path for each adjoint catchment.	x		x
Accumulate Shapes	Generate for each polygon feature in the input feature class the aggregated polygon features consisting of the polygon itself and all of its upstream polygon features.			
Slope	Generates surface slope grid in percent or degree.	x		x

### Terrain Morphology

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Drainage Area Characterization	Generate elevation, area, and volume curves for a set of selected drainage areas.	x		x
Drainage Boundary Definition	Generate 3D boundary lines for selected drainage areas.	x	Advanced	
Drainage Boundary Characterization	Compute width, perimeter, and cross-section area associated with slices of 3D boundary lines. Named Elevation-Width-Area Characterization in toolbox.	x		
Drainage Connectivity Characterization	Generate information about the connectivity between drainage areas.	x	x	x

### Watershed Processing

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Batch Watershed Delineation	Create a watershed for every point in the batch point feature class. Results are stored in a watershed polygon feature class. Watersheds are overlapping if points are on the same stream.	x		x
Batch Subwatershed Delineation	Create a subwatershed for every point in the batch point feature class. Results are stored in a subwatershed polygon feature class. Subwatersheds are non-overlapping if points are on the same stream.	x		x
Batch Global Watershed Delineation	Create a global watershed and compute selected characteristics for each point in the batch point feature class.	x		x
Batch Watershed Delineation for Polygons	Create a watershed for every selected polygon feature in the batch polygon feature class. Results are stored in a watershed (polygon) feature class	x		x
Delineate from Multiple Inlets and Outlets	Create a watershed for input inlet and outlet points. Result is stored in a watershed (polygon) feature class and source points in a watershed point feature class.	x		x

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Drainage Area Centroid	Create a point at the centroid of each polygon in a drainage area feature class and store it in a point feature class.	x		
Longest Flow Path	Create a line following the longest flow path in a drainage area based on steepest descent as defined by the flow direction grid.	x		x
Longest Flow Path for Watersheds	Create a line following the longest flow path in a watershed based on steepest descent. More efficient implementation of Longest Flow Path based on preprocessed data.	x		x
Longest Flow Path for Subwatersheds	Create a line following the longest flow path in a subwatershed based on steepest descent. More efficient implementation of Longest Flow Path based on preprocessed data.	x		x
Main Flow Path	Create the main flow path line for a watershed by “walking” up the drainage lines with the biggest drainage area and extending to the boundary to minimize curvature-weighted flow length.	x		x
Construct 3D Line	Build 3D lines from a selected set of 2D lines by extracting elevations from a DEM.	x		
Smooth 3D Line	Smooth 3D lines linearly along the downstream direction of the line.	x		
Flow Path Parameters from 2D Line	Compute the length, slope and 10-85 slope of a longest flow path by extracting elevations from a DEM.	x		
Flow Path Parameters from 3D Line	Compute the length, slope and 10-85 slope of a 3D longest flow path by extracting elevations from the line.	x		
Basin Length Points	Generate inlet and outlet points for a drainage area based on associated longest flow path. Used as input by Basin Length.			x
Basin Length	Create a cost path line from the inlet point to the outlet point of a basin traveling through a cost surface that has minimum values toward the center and maximum values at the boundary.			x

## Attribute Tools

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Assign HydroID	Assign a unique identifier (HydroID) to a feature. HydroID is unique across an Arc Hydro geodatabase.	x		
Generate From/To Node for Lines	Generate from-node/to-node topology based on physical line connectivity for a line feature class. Nodes are defined as ends of lines. They are not created as a separate feature class, but rather just identified and accounted for internally. This tool does not require a hydro network.	x		
Find Next Downstream Line	Find the HydroID of the next downstream linear feature and store it in the NextDownID field of the feature. The directionality is based on the digitized direction. Connectivity is established by the physical connection of the linear features (does not require hydro network).	x		
Populate DrainArea for Drainage Line	Populate the contributing drainage area for each drainage line as the sum of the areas of the associated catchment and adjoint catchment features.			
Calculate Length Downstream for Edges	Calculate length from the downstream end of a hydro edge to the outlet of the hydro network (requires hydro network). The length is stored in the LengthDown field.	x	x	
Calculate Length Downstream for Junctions	Calculate the length from a hydro junction to the outlet of the hydro network. The length is stored in the LengthDown field. This tool requires a hydro network.	x	x	
Find Next Downstream Junction	Find the HydroID of the next downstream junction and store it in the NextDownID field of the junction feature. This tool requires a hydro network.	x	x	
Store Area Outlets – Junction Intersect Method	Identify the most likely hydro junction that drains an area. The HydroID of that junction is stored in the JunctionID field for the area feature class.	x		
Store Area Outlets – Drainage Point ProximityMethod	Identify the most likely hydro junction that drains an area. The HydroID of that junction is stored in the JunctionID field for the area feature class.	x		
Store Area Outlets – Next Downstream Area Method	Identify the most likely hydro junction that drains an area. The HydroID of that junction is stored in the JunctionID field for the area feature class.	x		

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Consolidate Attributes	Summarize the values of a numerical attribute of a feature class and store them in a field in another (or same) feature class. Relationship between the from and the to feature class is established through related IDs. Operators include sum, min, max, average, median, mode, standard deviation, and count. User specifies the from and the to feature classes, what field to summarize and in what field to store the summarized values. The tool can use the same feature class as both from and to objects to operate on.			
Accumulate Attributes	Summarize the values of a numerical attribute of a feature class and store them in a field in another (or same) feature class. The tool selects the upstream objects by tracing either using the geometric network or a NextDownID relationship, and summarizes the selected objects. Operators include sum, min, max, average, median, mode, standard deviation, and count. The selectable objects are either the traceable objects, or can be in an ID-related feature class (using existing relationship classes). User specifies the from and the to feature classes, what field to summarize, and in what field to store the summarized values.	x		
Display Time Series	Display the values of the selected parameter as a function of time.			
Transfer ID	Establish relationship between a source feature class with an existing Time Series table and a target feature class that needs to be linked to Time Series data.			
Transfer Value	Generate a Time Series table for a polygon feature class based on an existing polygon feature class and its associated Time Series table.			
Scale Design SCurve	Scale a unit hydrograph SCurve using design values stored in the selected Design Value Field in the attributes table of the Drainage feature class.			
Accumulate SCurve	Add up values of input time series to create accumulated time series.			
Export SCurve to RAI	Export SCurve time series into RAI files.			
Master Interpolator	Interpolate time series surfaces based on point time series data.			x

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Compute Local Parameters	Compute parameters for local watersheds (e.g. area, average elevation, maximum elevation, minimum elevation, relief, slope, land cover, precipitation, etc.). All data needed to compute the parameters need to be available in the map. User can configure additional parameters in the XML.			x
Compute Global Parameters	Compute parameters for global watersheds.	x		x
Compute Point Parameters	Compute parameters for selected points (e.g. latitude, longitude, attribute in underlying feature, etc.). The parameters are stored in the Attributes table of the input Point layer.			
Compute Line Parameters	Compute parameters for selected lines.	x		
Compute Subwatershed Parameters	Compute parameters for selected subwatersheds. Process all features at the same time.	x		x
Generate Report	Generate a preconfigured report for the selected feature of interest.			
Export Data	Export predefined data related to the selected feature of interest.			

### Network Tools

Tool	Description	Available in Toolbox	Requires Standard or Advanced	Requires Spatial Analyst
Hydro Network Generation	Generate a hydro network (hydro edges and hydro junctions) from drainage lines, catchments, and drainage points. The function updates all the connectivity fields in input feature classes.	x	x	
Node/Link Schema Generation	Generate schematic (node-link) network by connecting centers of catchments/drainage areas and junctions, and connecting junctions and junctions. Connectivity is established through connectivity fields (attributes), not physical connectivity.	x		
Store Flow Direction	Store information about hydro (geometric) network element's directionality into an attribute of the feature matching the element.	x	x	
Set Flow Direction	Define flow direction for a geometric network based on digitized direction or an attribute for the feature.	x	x	

## Buttons and Tools

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Flow Path Tracing	Trace the downstream path, based on the steepest descent, from a user specified point to the edge of the DEM by using a flow direction grid.		x
Interactive Flow Path Tracing	Generate flow path feature, based on the steepest descent, from a user specified point to the boundary of the drainage area by using a flow direction grid.		x
Point Delineation	Interactively delineate a watershed for a user specified point based on the preprocessed DEM.		x
Delineate using EPA Web Service	Generate a watershed by using EPA Delineation Web Services.		
Batch Point Generation	Add user specified point to a batch point feature class. This point feature class can be used as an input to the batch watershed and subwatershed delineation functions.		
Assign Related Identifier	Interactively assign a value of a field in a source feature to a field in the target feature. User specifies both the source and target feature classes and fields.		
Global Point Delineation	Interactively delineate a watershed for a user specified point based on a set of preprocessed geographic units tied together by a geometric network. Compute global parameters.		x
Trace By NextDownID Attribute	Trace upstream, downstream, or in both directions from a selected location using the attribute relationship established through NextDownID field. The final selected features can include the objects selected through the trace, and/or ID-related objects by using the existing relationship classes.		
Main Flow Path Tracing	Trace the upstream path from a specified line feature by finding the path that maximizes the drainage area (i.e. flow) for each line feature.		

## Tools list – Toolbox

The following functions are only available in the Arc Hydro toolbox (i.e. in the geoprocessing environment). The geoprocessing tools that are also available in the toolbar are listed and described in the previous section.

### Arc Hydro Setup

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Set Batch Target Locations	Create the target vector and raster locations based on the location of an input raster and update the Arc Hydro configuration in ArcMap.		
Set Target Locations	Create the target vector and raster locations specified by the user and update the Arc Hydro configuration.		

### Attribute Tools

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Accumulate Local Parameters *	Accumulate user specified parameters in source layer based on HydroID/NextDownID connectivity set in related layer.		
Accumulate Multiple Attributes *	Accumulate user specified attribute(s) based on HydroID/NextDownID connectivity set in related layer.		
Assign River Order	Classify the input features (e.g. Catchment or Drainage Line) using the selected ordering methods and populate the specified RiverOrder field with the calculated order. Does not support flow splits.		
Classify Water Bodies *	Populates the field Type in the input Water Bodies features based on the relationships with the input Stream features. values		
Compute Line Segment Parameters *	Characterize parameters for non-overlapping line segment features.		
Identify Riparian Water Bodies *	Populate the field IsRiparian with 1 for all input Water Bodies of Type 'SinkSolo' that intersect a riparian zone.		

**Attribute Tools/ID Management**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Assign UniqueID	Assign a unique identifier to the specified field.		
Assign WatershedID	Assign a unique watershed identifier based on predefined configuration.		
Compact HydroID	Compact HydroIDs and related IDs (e.g. NextDownID, etc.) in the specified database.		
Copy ApUniqueID Table for Replica	Copy the ApUniqueID table from the geodatabase from which the replica was created into the geodatabase storing the replica.		
Select By WatershedID	Select by WatershedID.		
Sync HydroID	Synchronize HydroIDs and related IDs in the child workspace based on the current last HydroID used in the parent workspace and on the value stored when the child database was checked out.		
Update ApUniqueID Table	Copy LASTID value from replica database into ApUniqueID Table in database from where the replica was created.		
Update HydroID	Update HydroIDs and related IDs in a child workspace based on the maximum HydroID used in the parent workspace. This maximum parent HydroID is added to the original IDs in the child workspaces to generate the new IDs.		

**Attribute Tools/Models**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Features Count *	Model calculating the number of features matching the spatial join match option for each input feature being characterized. Used by the characterization tools.		
Features Density *	Model calculating the density of specified features matching the spatial join match option specified for each input polygon feature. Used by the characterization tools.		
Features Length *	Model calculating the length of linear features intersecting the input polygon features being characterized. Used by the characterization tools.		
Intersect Features *	Model indicating whether the specified input features intersects the input features being characterized. Used by the characterization tools.		

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Percent by Zone	Model computing percentage or rations of categories from an input grid for each input zone. Used by the characterization tools.		x
Stats by Zone *	Model computing statistics from an input grid for each input zone. Used by the characterization tools.		

### GIS Data Exchange/Excel Exchange

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Excel to Map	Execute geoprocessing model in ArcMap using parameters values from Excel and update map data with data from an Excel spreadsheet.		
Export Tool Parameters	Store tool name and parameters into a table.		
Map to Excel	Export data (including geoprocessing model name and parameters) from map into Excel spreadsheet.		
Standard Export to Excel *	Export table to csv or Microsoft Excel.		

### GIS Data Exchange/GWIS to FEMA

Tool	Description	Requires Standard or Advanced	Requires Data Interoperability
GWIS to FEMA DCS Hydraulic	Data operability tool allowing exporting GWIS data (geodatabase) into FEMA DCS Hydraulic data. Data Interoperability Extension must be activated for this tool to be visible.		x
GWIS to FEMA DCS Hydrologic	Data operability tool allowing exporting GWIS data (geodatabase) into FEMA DCS Hydrologic data. Data Interoperability Extension must be activated for this tool to be visible.		x

**GIS Data Exchange/XML Exchange**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Append Coordinate System to XML	Insert information on coordinate system in input XML file by editing the first node ‘./WKT’.		
Export GIS Data to XML	Export preconfigured data from a geodatabase into an XML file.		
Import from XML	Export preconfigured data from an XML file into a geodatabase.		
Transform XML	Transform an XML using an XSL file.		

**H&H Modeling/GeoICPR**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Generate ICPR Basin	Generate ICPR Basin features based ICPR Links and Nodes to prepare for export to ICPR model.		x
Generate ICPR Link	Generate ICPR Link features to prepare for export to ICPR model.		
Generate ICPR Node	Generate ICPR Node features to prepare for export to ICPR model.		
Import from ICPR	Import result of ICPR modeling run into GWIS geodatabase.		
Mosaic Floodplains	Create mosaic datasets for depth and elevation grids corresponding to a fixed return period (frequency) with varying duration or a fixed duration with varying return periods.		

## H&amp;H Modeling/Green and Ampt

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Accumulate Incremental TimeSeries	Accumulate the time series steps from the input incremental times series associated to each input subwatershed feature.		
Compute Green and Ampt Excess Rainfall	Compute the Green and Ampt Excess Rainfall time series for an input subwatershed feature class using an associated Soil Landuse Precipitation polygon feature class (i.e. SLURP) and Soil and Landuse lookup tables.		
Compute Green and Ampt Parameters	Compute the Green and Ampt parameters for an input polygon feature class using the grids generated with the tool Create Green and Ampt Parameter Rasters for example.		x
Create Green and Ampt Parameter Rasters	Create parameter rasters based on an input Soil Landuse polygon created by intersecting a soil feature class with a landuse feature, and the associated Soil and Landuse lookup tables.		x
Export to ICPR Green and Ampt Parameters	Create the ICPR XML file used as input to run ICPR with the Green and Ampt option. Require as input a Basin feature class with Green and Ampt parameters populated. <b>This tool works in ArcMap only, it does not work in ArcCatalog.</b>		
Export to ICPR Green and Ampt Rainfall Excess	Create the ICPR XML file used as input to run ICPR with the Impervious SCS option. <b>This tool works in ArcMap only, it does not work in ArcCatalog.</b>		

## H&amp;H Modeling/Map to Map

Tool	Description	Available in Toolbar	Requires Standard or Advanced	Requires Spatial Analyst
Export to DSS	Export time series data in Arc Hydro format to DSS.	x		
Flood From Stream WSE	Model creating flood plain based on water elevation raster.			x
GeoRAS to Flood	Model generating FloodExtent polygon feature class as well as floodgrid and depthgrid rasters based on input HEC-GeoRAS results geodatabase and the user selected surface water elevation type.			
HMS to GeoRAS	Model generating HEC-GeoRAS results geodatabase based on input HMS files.			

Tool	Description	Available in Toolbar	Requires Standard or Advanced	Requires Spatial Analyst
Import from DSS	Import time series from DSS file into an Arc Hydro time series table.	x		
Run HMS	Run an existing HEC-HMS project using the run parameters specified by the user. HEC-HMS must be installed on the computer. Refer to the US Army Corps of Engineers web page for more information on how to install HEC-HMS.			
Run RAS	Runs an existing HEC-GeoRAS project. HEC-RAS must be installed on the computer. Refer to the US Army Corps of Engineers web page for more information on how to install HEC-RAS ( <a href="http://www.hec.usace.army.mil/software/hec-ras/">http://www.hec.usace.army.mil/software/hec-ras/</a> ).			
SDF to XML	Convert a SDF file into XML.			
Stream WSE From Point WSE Measurements	Model creating water elevation raster along a stream.			x
Update RAS Flow	Update RAS Flow			

### H&H Modeling/Streamstats

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Compute Flows	Compute NSS based flow statistics. Developed to support the USGS Streamstats program.		x
Edit Computed Parameters	Edit parameters and generate flow xml.		
Recompute Flows	Compute flows based on in input flow xml.		
Streamstats Compute Streamgage Flows *	Compute streamgage flows using similar gages.		
Streamstats Edit Parameters and Recompute Flows *	Edit computed parameters and recomputed NSS flows.		
Streamstats Global Parameters	Compute global watersheds. Tool cannot be published as geoprocessing service.		x
Streamstats Global Parameters Server	Compute global watersheds. Tool can be published as geoprocessing service.		x
Streamstats Global Watershed Delineation	Delineate global watersheds. Developed to support the USGS Streamstats program.		x

**H&H Modeling/Time of Concentration**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Adjust Slope *	Adjusts slope grid so that each cell having a value that is less than the specified threshold is assigned the threshold value.		x
Compute Time of Concentration	Compute Time of Concentration and associated Longest Flow Path for each input Drainage Area feature. The time of concentration (Tc) is defined as the time for runoff to travel from the hydraulically most distant point of the drainage area to the outlet of the drainage area.		x
Compute Time of Concentration for Group Basin	Compute Time of Concentration and associated Group Longest Flow Path for each input Group Basin feature.		
Compute Time of Concentration for Longest Flow Path *	Compute Time of Concentration for Longest Flow Path.		
Compute Travel Time for Preferential Link	Compute Travel Time for each selected input Preferential Link.		
Define TR55 Zones for Longest Flow Path *	Define TR55 Zones for Longest Flow Path features.		
Generate TR55 Zone Grid	Create a new TR55 Zone grid that identifies 3 TR55 zones within the extent of the Drainage Area feature class. Each zone defines a way for the water to move across that zone.		x

**H&H Modeling/Utility**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Create Fishnet by Cell Height and Width *	Generate fishnet based on user specified cell width and height. Cell height is defined along the height (shorter side) of the outline rectangle, while cell width is defined along the width (longer side) of the outline rectangle.		
Create Fishnet by Number of Rows and Columns *	Generate fishnet based on user specified number of rows and columns. Rows are defined along the height (shorter side) of the outline rectangle, while columns are defined along the width (longer side) of the outline rectangle.		
Densify Fishnet *	Densify fishnet based on the values stored in the nDenRow and nDenColumn required attributes of the input fishnet.		
Thin Cross-Section *	Thin 3D Cross Sections to remove vertices while minimizing the impact on the area defined by the lines.		

**Point Characterization**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Generate Flow Path	Generates flow path associated to each input point.		x

### Terrain Morphology/AH Connectivity Refinement

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Add Linear Structure HydroEdges to Preferential Link	Create a Preferential Path (Link and Node features) representing a Linear Structure link by merging the geometries of Linear Structures HydroEdges with their connected HydroEdges (i.e. Conduit).		
Add Point Structure HydroEdges to Preferential Link	Create a Preferential Path (Link and Node features) representing a Point Structure link by merging the geometries of the HydroEdges connected to the HydroJunction representing the structure (Culvert, bridge or control structure).		
Connect Control Structure Junctions	Connect HydroJunctions of Hydraulic Type Inlet/Outlet and Control Structure associated to a Conduit or Channel edge and defining a Control Structure Sequence to the spider web geometric network by creating new 'Linear Structure' HydroEdge features.	x	x
Connect HydroJunctions	Connect HydroJunctions of Hydraulic Type Culvert, Bridge, Control Structure, Dam and Levee to the spider web geometric network by creating new 'Structure Link' HydroEdge features. Tool is also available in the SWFWMD – Connectivity Tools toolbar installed with Arc Hydro.	x	x
Define Overland Preferential Node Link Schema	Create a Preferential Node/Link schema that defines the “main” overland flow paths associated to Catchment features.	x	
Flip Preferential Path	Flip preferential links, switch directional attributes and updates FlowDir field in associated HydroEdge features.	x	
Set Flow Direction Using Preferential Link	Update the attribute storing the flow direction (e.g. FLOWDIR) for the selected HydroEdge features to match the direction of their associated Preferential Link.	x	
Sink Identification by HEP	Set the field IsSink to 1 in the input Sink Polygon features containing Hydraulic Element Points features.		
Update Preferential Node Link Schema	Generate Overland Preferential Link and Preferential Node feature classes based on the 'IsPreferred' attribute in the input HydroEdge feature class.		

**Terrain Morphology/Drainage Boundary Processing**

Tool	Description	Available in Toolbar	Requires Standard or Advanced	Requires Spatial Analyst
Cross Section Direction	Set the orientation of a cross section from left to right when looking in the digitized direction of the intersecting input Line feature.			
Drainage Area Characterization	Generate elevation, area, and volume curves for a set of selected drainage areas.	x		
Drainage Boundary Definition	Generate 3D boundaries lines for the polygon features in the input Drainage Area feature class.	x	Advanced	
Drainage Boundary Direction	Set the digitized direction of the selected Drainage Boundary lines based on user-provided Preferential Link line features.			
Drainage Boundary Smoothing	Create new Smooth Drainage Boundary features with jaggy removed by applying out-of-the-box smoothing algorithms (PEAK) to the input Drainage Boundary feature class.		x	
Elevation-Width-Area Characterization	Available in toolbar as Drainage Boundary Characterization. Compute width, perimeter, and cross-section area associated with slices of 3D boundary lines.	x	x	
Station-Elevation Characterization	Computes Station (Measure)-Elevation for every vertex in the input 3D line.			

**Terrain Morphology/Grouping**

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Generate Group Basin	Generate Group Basin features by dissolving the input Catchment features based on the field GroupID.		
Generate Group Junction	Create a new Group Junction feature class by reselecting from HydroJunctions that meet one of the grouped junction criteria.	Advanced	
Generate Group Link	Create a new Group Link feature class that establishes the connectivity between the Group Basins based on Group Junctions and Group Flow Direction.		
Group Selected Catchments	Assign a unique 'GroupID' to selected Catchments.		
Modify Terminal Sink in Group Basin *	Update preferential links and nodes, hydro edges as well as sink point and catchments to match the specified terminal sink in each group basin.		

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Remove Duplicate Terminal Sinks from Group Basin *	Ensure that each Group Basin contains only one terminal sink identified using the junction having the lowest elevation along the catchments' boundaries.		
Select Upstream Catchments using Preferential Node Link	Trace upstream of user selected catchment(s) based on Preferential Node/Link and returns the upstream catchment features as a selection set.		
Ungroup Selected Catchments	Ungroup selected Catchments by assigning 'GroupID=NULL' to selected Catchments.		

### Terrain Preprocessing

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Append Coastal Catchments	Identify all areas that have not yet been assigned to catchments defined by the input catchment grid, create "coastal" catchment polygons out of those areas and append these polygons to the existing set of catchments.		x
Assign CatType Attribute	Set catchment types for the existing set of catchments by populating the CatType attribute (Sink, Drainage, Coast).		
Global Adjoint Catchment Processing	Create the GlobalAdjointCatchment feature class that stores the global upstream polygon (adjointcatchment + upstream cataloging units) associated to each catchment. May be used as input AdjointCatchment feature class by the local watershed delineation tools to produce global watersheds.		x
Extend Lines	Extend input line features using specified direction and distance.		
Flow Direction with Sinks	Create flow direction grid for a DEM with sinks that ensures that each cell within a sink flows toward a sink point. Also create Sink Link grid defining the links for deranged areas. This tool has been replaced by the Create Sink Structures/Adjust Flow Direction in Sinks tools.		x
Global Adjoint Catchment Processing *	Generate Global AdjointCatchments by merging local AdjointCatchments with their upstream cataloging units.		
Sink Watershed Delineation	Delineate areas draining into sinks (sink watersheds) and create both raster and vector representation of sink watersheds.		x

**Terrain Preprocessing\DEM Manipulation**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Create Sinks for Line Structure *	Create Sink Structures for lines of type Structure, i.e. having the field StructType populated.		
DEM Reconditioning from Stream Grid *	Enforce linear drainage pattern (vector) onto a DEM (grid) using Stream Grid as input. Implements AGREE methodology.		

**Terrain Preprocessing\Vector QC**

<b>Tool</b>	<b>Description</b>	<b>Requires Standard or Advanced</b>	<b>Requires Spatial Analyst</b>
Create Initial QC GDB *	Create a QC file geodatabase and a "Layers" feature dataset in it with the same spatial reference as the provided reference DEM.		
Identify Water Body and Stream Intersections *	Identify Water Body and Stream Intersections and populate the fields DistCount, MultiCount and IsRivSplit in the input Water Body features.		
Non Draining Watersheds *	Populate the attribute "NonDraining" with 1 if the watershed polygon does not contain either a stream or a sink (using intersect operation).		
Stream Connectivity Parameters *	Generate required connectivity attributes in the specified input Stream feature class for stream QC (HydroID, FROM_NODE, TO_NODE, NextDownID, FlowSplitCnt). Generate the derived output Stream_AllEndPt point feature class storing the input stream line end points.		
Stream QC *	Generate a rasterized vector version of the input Stream feature class using the input DEM. Potential issues are written in the field QCVALUE in the output feature class.		
Stream Near Processing Area Boundary *	Populate attribute "NearBnd" in the input Stream feature class with 1 for streams located near the processing area boundary (otherwise "null").		
Stream Near Watershed Boundary *	Populate attribute "NearWsh" in the input stream feature class with 1 if the streams are near the watershed boundary (otherwise "null").		

### Terrain Preprocessing Workflows

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Basic Combined Terrain Processing	Model in the geoprocessing environment performing the basic terrain preprocessing steps for a dendritic and deranged terrain.	Advanced	
Basic Dendritic Terrain Processing	Model in the geoprocessing environment performing the basic terrain preprocessing steps for a dendritic terrain.		x
Basic Deranged Terrain Processing	Model in the geoprocessing environment performing the basic terrain preprocessing steps for a deranged terrain, i.e. a terrain with sinks.	Advanced	
Batch Processing	Run a model in batch mode, i.e. for each subdirectory defined under the global directory. Input data for each run must be stored in a subdirectory located in the specified global input location.		x
Dendritic Terrain Processing with Imposed Drainage Line and Wall	Model in the geoprocessing environment performing terrain preprocessing steps for a dendritic terrain including burning in lines and imposing walls.		x

### Utility

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Convert 3D Line to Raster	Create line raster using by using linear interpolation from 3D Line vertices.		x
Convert 3D Line to Raster Py *	Create line raster using by using linear interpolation from 3D Line vertices (python).		
Create Thiessen Polygons	Create the Thiessen polygons associated to input points and populate their FeatureID field with the HydroID of the corresponding point.		
Create Unit Patch by Near Neighbor Method *	Create Unit Patch By Near Neighbor Method.		
Create Zone by Distance *	Create polygon zone based on user provided distance. All input polygons within user specified distance will be grouped into a single "zone".		
Create Zone by Distance From Raster *	Create zone based on user provided distance and input raster layer. Create connection points for the shortest link between the polygons within the zone.		
Download Time Series Data	Download time series data into a new Arc Hydro geodatabase based on an input Data Cart.		
Export Data Cart to XML	Export a Data Cart layer/table into an XML.		

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Generate Processing Units	Aggregate input catchment features covering a big study area into smaller areas that can be processed using one of the Terrain Preprocessing workflows.		
Intersect Areas	Intersect two polygon layers and attributes the intersection layer with the percentage in area from each input polygon layer.		
Point TSValue to 3D Line	Interpolate or extrapolate elevations along a line based on field value in input points.		
Terrain Profile *	Generates 3D line, jpg and xml file showing elevation profile associated to the input line.		
Spatial Reference From Raster	Set spatial reference based on input raster (used in model).		
Update TSValue on Points	Update field in input point based on specified time step and variable.		
Weighted Average	Transfer a value from a source layer into a target layer by computing area weighted average.		

## Utility/Support

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Create Directory	Create directory using user-specified path if the directory does not already exist. The Input Location parameter is a string that can be chained directly in model builder with the output of the Select Path model tool.		
Create TIN	Create TIN. This tool allows the user to specify the inputs using string. It then calls the standard Create TIN tool from the 3D Analyst. It also editing the input parameters in model builder.		3D Analyst
Get Coordinate System from Vector	Retrieve coordinate system from input vector so that it can be used as input in model builder (e.g. to generate a feature dataset).		
Get Feature Layer Path *	Return paths associated to the input feature layer.		
Get Feature Layer Workspace *	Return workspaces associated to the input feature layer.		
Get Field	Retrieve list of fields from input feature class so that the user can select an existing field.		
Get Field Alias	Return alias name of selected input field as string.		
Get Field Alias by Alias	Select the input field based on the fields' alias names and return the selected field alias as string.		
Get Spatial Reference from Raster	Retrieve the spatial reference from an input raster.		
Get Spatial Reference from Vector	Retrieve the spatial reference from an input vector.		
Get Schema Workspace *	Return workspace containing specified schema database.		
TIN to Raster	Call the 3D Analyst TIN to Raster tool by passing all the inputs as string so that they can be parsed and modified in model builder. For example, the cell size input can be read from a variable and passed to the out-of-the-box tool as CELLSIZE %cellsize%.		3D Analyst

### Watershed Processing

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Catchment Delineation for Polygons *	Delineate catchments for input Polygon features (e.g. lakes).		x
Interactive Delineation	Interactive watershed delineation model based on Batch Watershed Delineation tool.		x
Subwatershed from Watershed *	Develops Arc Hydro subwatershed polygon and subwatershed point feature classes from Arc Hydro watershed polygon and watershed point feature classes.	Advanced	

### Watershed Processing/Line Processing

Tool	Description	Requires Standard or Advanced	Requires Spatial Analyst
Create Analysis Line *	Create lines for a specific analysis from an input Line feature class by performing at the location of the input ActionPoint features the action defined in the ActionType field: 1 (Trim), 2 (Extend) or 3 (Split).		x
Identify Threshold Points *	Identify points based on provided flow accumulation threshold.		x
Remove Stream Pseudo Nodes *	Remove pseudo nodes in input stream feature class so that the connectivity can be correctly established.		x

## Additional Toolbars installed with Arc Hydro

### EPA Aggregator



Set of tools developed for the U.S. Environmental Protection Agency to evaluate the impact of mercury deposition.

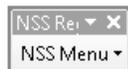
### GeoICPR Tools

Set of tools developed for Southwest Florida Water Management District to support import/export with ICPR model.



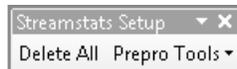
### NSS Regressions

Set of tools developed for Wisconsin Department of Natural Resources.



### Streamstats Setup

Set of tools developed to support the United States Geological Survey Streamstats program.



### SWFWMD - Connectivity Tools

Set of tools developed for Southwest Florida Water Management District to support structure connectivity for deranged terrains.



## Additional Toolboxes installed with Arc Hydro

### Arc Hydro Partial Terrain Update

- [-] Arc Hydro Partial Terrain Update.tbx
  - [-] Add Field Long
  - [-] Basic Deranged Terrain Processing
  - [-] Basic Deranged Terrain Processing for Update
  - [-] Compact HydroID
  - [-] Create DEM for Reprocessing
  - [-] Identify Updated Catchments
  - [-] Update ApUniqueID Table
  - [-] Update Raster Data
  - [-] Update Vector Data

### IDNR Streams

- [-] C:\Program Files (x86)\ESRI\WaterUtils\ArcHydro\ArcToolbox
  - [+] Scripts
  - [-] Toolboxes
    - [-] IDNR Streams.tbx
      - [+] 1. DEM Preparation
      - [+] 2. Terrain Preprocessing
      - [+] 3. Characterization Layers Definition
      - [+] 4. Supporting Data Generation
      - [+] 5. Stream Characterization
      - [+] 6. Local Area Characterization
      - [+] 7. Total Area Characterization
      - [+] 8. Multi Layers Characterization
      - [+] 9. Data Export and Report Generation