Arc Hydro Geoprocessing Tools - Tutorial

Version 1.4 – July 2010

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Introduction

The purpose of this tutorial is to illustrate, step-by-step, how to access and use the Arc Hydro Geoprocessing (GP) tools that are installed by the standard Arc Hydro setup. The installation process is described in the document “Arc Hydro Tools 1.4 – Tutorial”. This document is targeted to an experienced water resources ArcGIS user who wants to learn how to use the new geoprocessing tools in Arc Hydro.

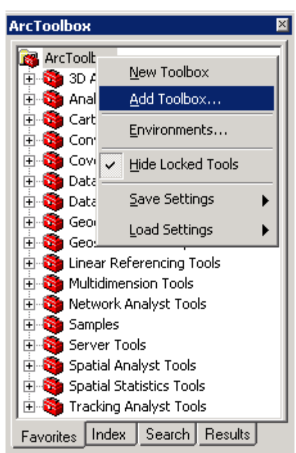
Objective

In this tutorial, the user will perform drainage analysis on a terrain model using the geoprocessing tools instead of the standard Arc Hydro tools. The utility of the Arc Hydro geoprocessing tools is demonstrated by building models allowing running workflows in batch mode.

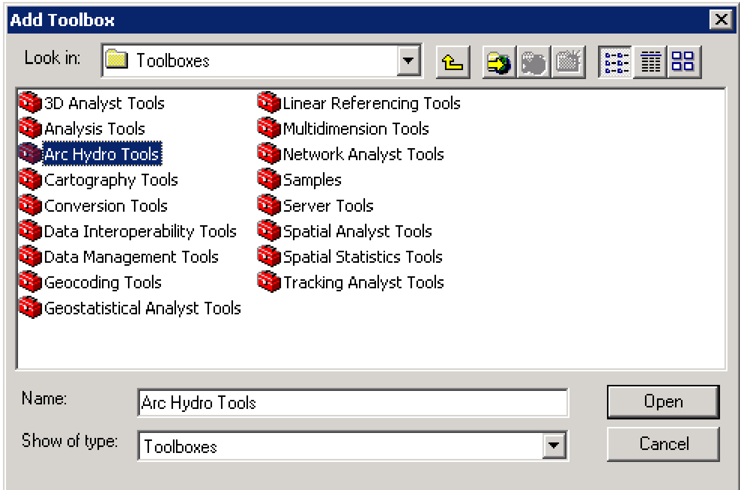
Loading Arc Hydro Tools Toolbox

The Arc Hydro Tools toolbox is installed in the ArcGIS\ArcToolbox\Toolboxes directory as Arc Hydro Tools.tbx. Refer to the document Arc Hydro Tools 1.4 – Tutorial.pdf for detailed information on how to install the Arc Hydro tools if it is not already installed. The toolbox can be added in the ArcToolbox window that is available either in ArcMap or ArcCatalog in not already there.

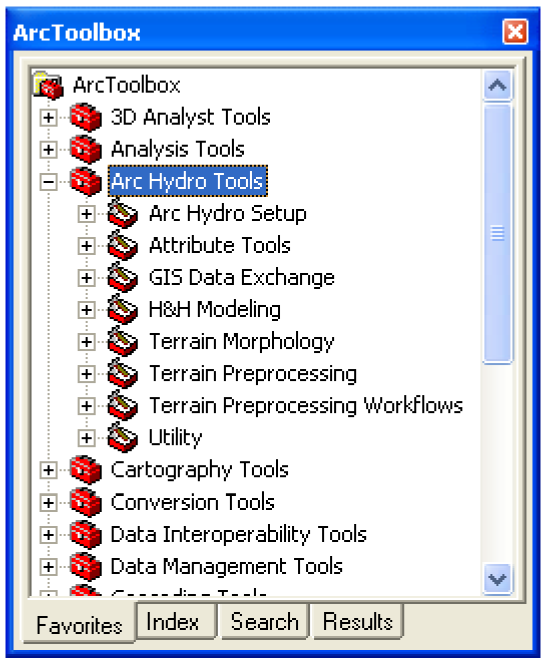
- Open a new map document in ArcMap or open ArcCatalog.
- Click the Show/Hide ArcToolbox window icon () on the Standard toolbar to open the ArcToolbox window if it is not visible.
- If the Arc Hydro Tools toolbox is not visible, add it by following the steps below:
- Right-click ArcToolbox and select Add Toolbox.



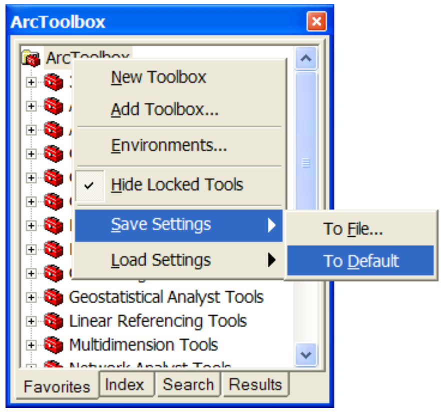
- Browse to the ArcGIS toolboxes location (e.g. C:\Program Files\ArcGIS\ArcToolbox\Toolboxes), select Arc Hydro Tools and click Open.



The Arc Hydro Tools toolbox is added to the list of available toolboxes.



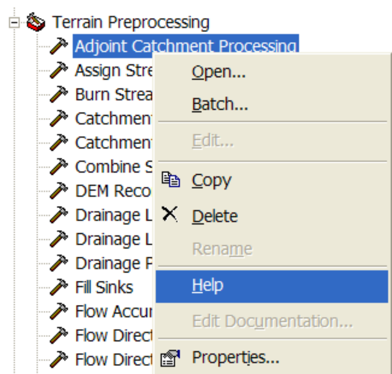
- Right-click ArcToolbox and select Save Settings > To Default.



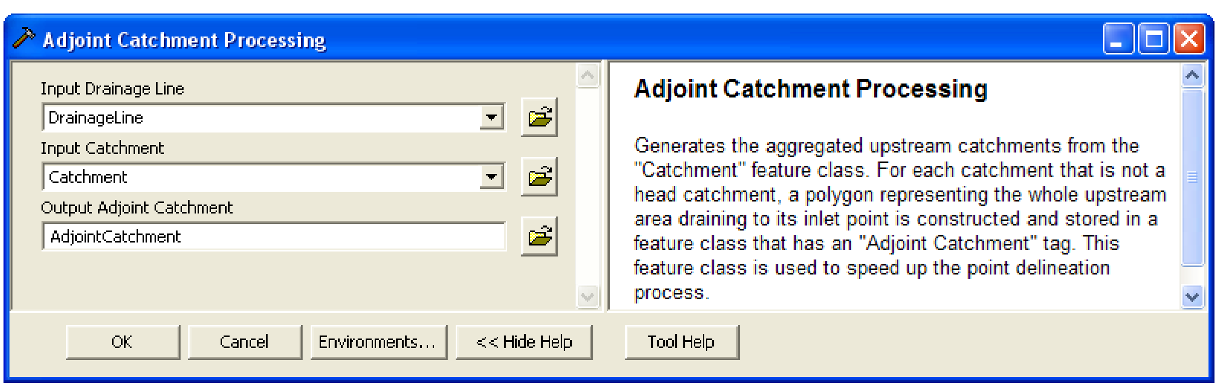
Accessing the Arc Hydro Geoprocessing Tools Help

The online help for the Arc Hydro Geoprocessing tools is accessed in the same way as the standard ArcGIS Geoprocessing tools:

- By right-clicking the tool/model of interest and selecting Help in the context menu.



- By opening the tool user interface and clicking the Tool Help button at the bottom of the right panel.



The first page accessed after clicking on Tool Help describes the parameters used by the tool. The link Learn more about how… on the page allows accessing a page describing in more details what the tool does.

Arc Hydro Tools Configuration

The standard Arc Hydro tools available in the Arc Hydro toolbar read their configuration from a XML file associated to the map document. This configuration is loaded from the template ArcHydroTools.xml configuration file stored in the ArcHydro9\bin folder.

Note

The raster and vector locations are not explicitly set in a new unsaved map document and in ArcCatalog. The geoprocessing tools will use in that case the standard Current Workspace for both those locations. This workspace may be set by right-clicking ArcToolbox and selecting Environments > General Settings.

Arc Hydro Setup

This section describes how to setup non default Arc Hydro target locations used by the Arc Hydro tools. By default, the tools will create the default target vector and raster locations if they do not already exist and the user will not need to use this toolset.

1. Set Target Locations

This tool allows setting the target vector and raster locations in the XML in ArcMap as well as creating these workspaces if they do not already exist in both ArcMap and ArcCatalog.

- The vector location may be set to a personal (existing or not) geodatabase or to a remote geodatabase. The tool will generate the unique ID table in that database if they do not already exist.

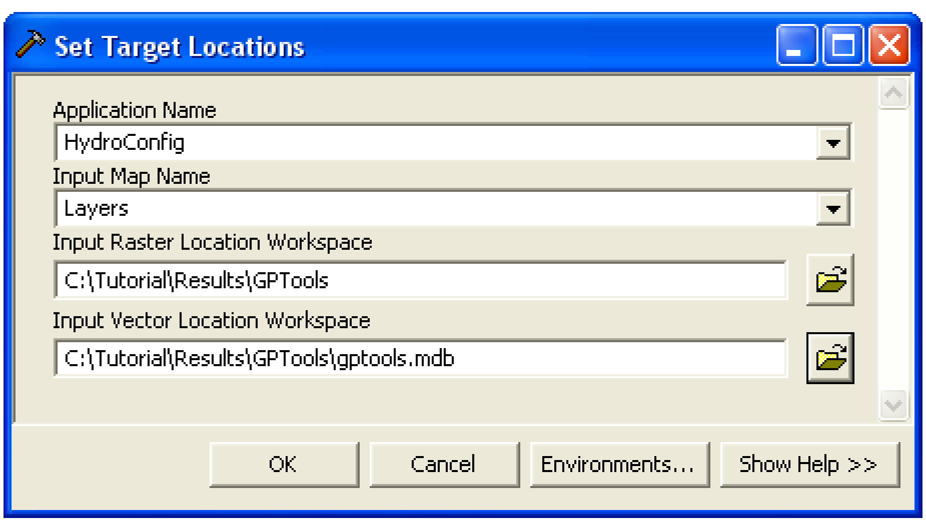
- The raster location must be set to a file geodatabase (existing or not) or to a directory.

In ArcMap, the tool can work with multiple applications (Arc Hydro, GeoHMS, etc.). The Application Name input allows specifying the application to update ("HydroConfig" for Arc Hydro).

- Double click **Arc Hydro Setup > Set Target Locations**.

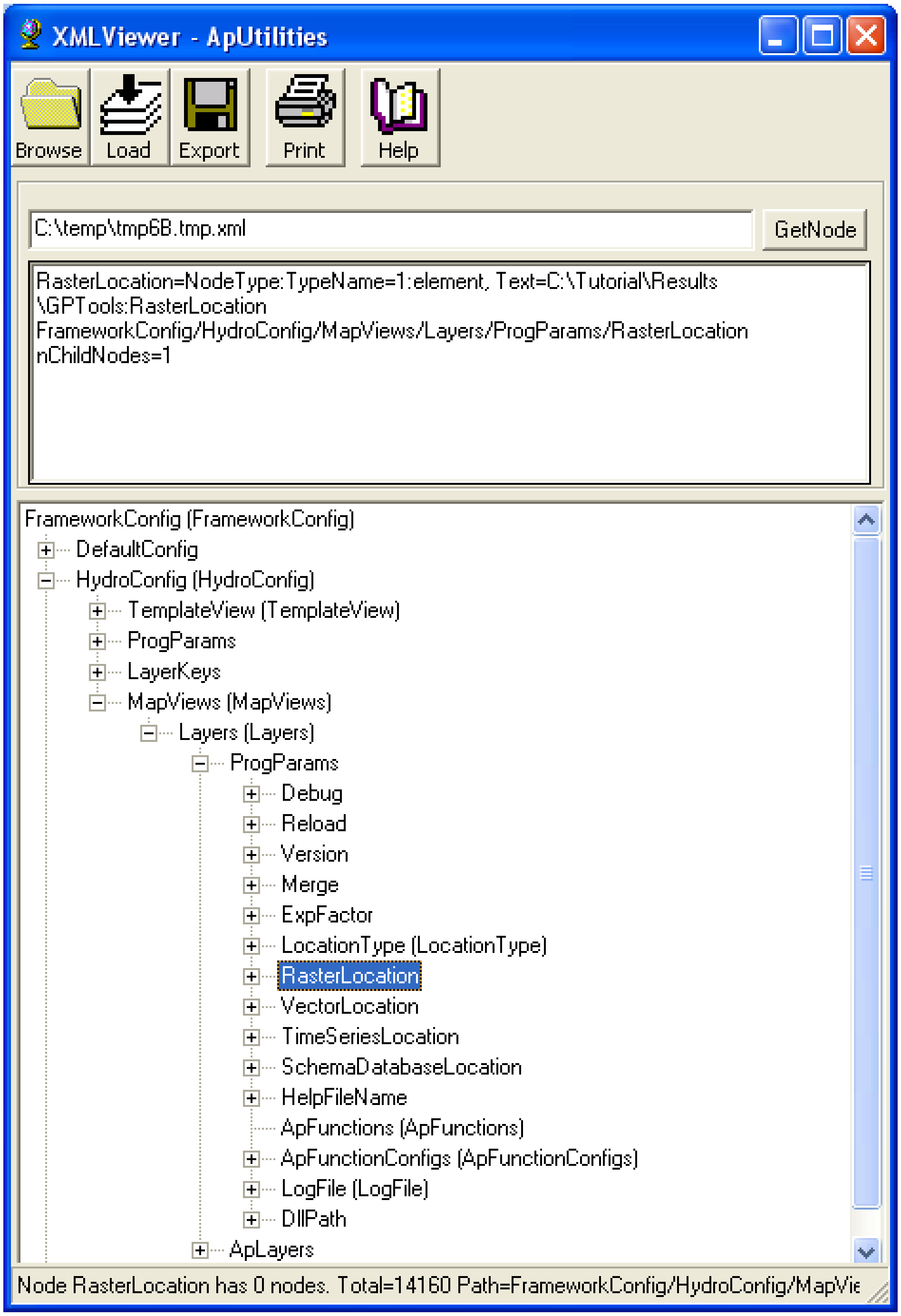
- Select HydroConfig as Application Name and select the active dataframe name (e.g. "Layers") as input Map Name.

- Specify the Raster Location Workspace and the Vector Location Workspace. Click OK.



The tool creates the target locations if they do not already exist. When run from ArcMap, the tool updates as well the Arc Hydro configuration loaded in memory with these locations.

The RasterLocation and VectorLocation have been set to the specified values under a new MapView associated to the active dataframe (Layers).

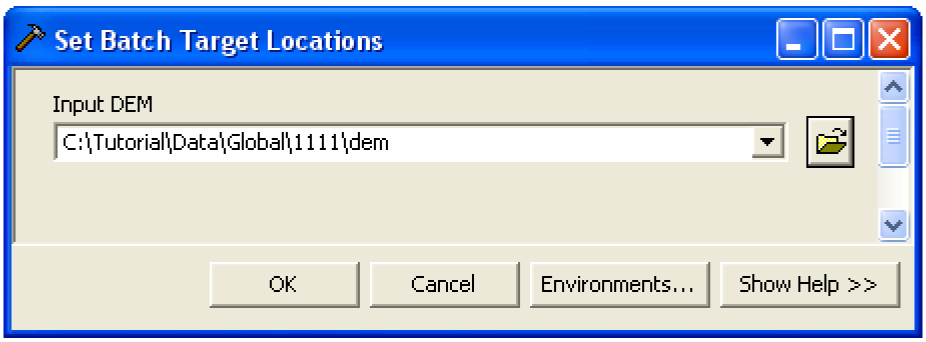


2. Set Batch Target Locations

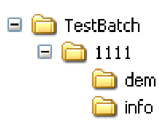
The Set Batch Target Locations tool allows creating the target vector location if it does not already exist as well as setting up and switching to the corresponding Arc Hydro configuration. The tool takes as input a DEM (grid) that is used to determine the raster location as well as the extent of the feature dataset created within the vector location.
You are going to use the data with the global tools to test this tool.

- Create a new directory called TestBatch and create the subdirectory 1111. Copy the grid DataGP\Global\1111\dem into that subdirectory.

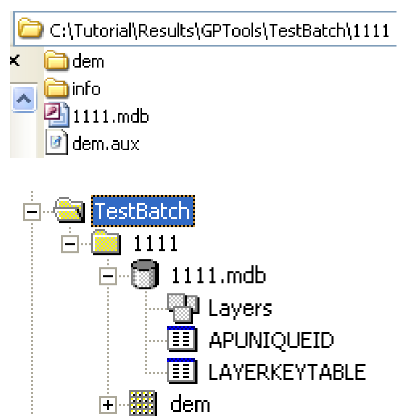
- Double-click **Arc Hydro Setup > Set Batch Target Locations**.



The tool will set the raster location to the directory containing the input DEM and create the target vector geodatabase in that directory as well as the feature dataset “Layers”. The geodatabase will have the same name as the directory in which the DEM is located. The tool will update the target location and vector location in the Arc Hydro configuration loaded in memory in ArcMap so that these locations are used by default when running the Arc Hydro tools.

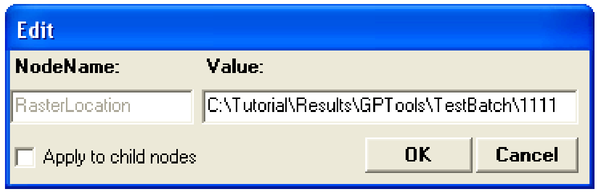


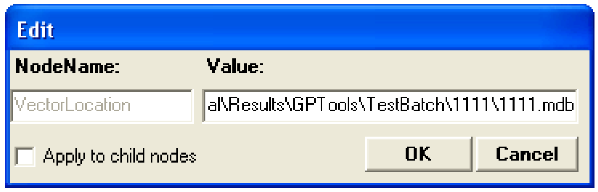
1111 directory before processing



1111 directory after processing

The active environment is set to the newly created Arc Hydro configuration.



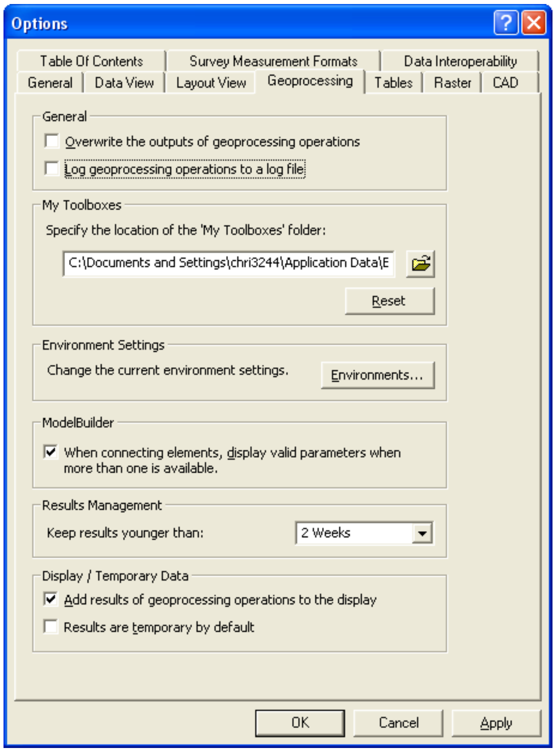


- Reset the configuration to its default by using the function ApUtilities > Additional Utilities > Reset Target Locations on the Arc Hydro Tools toolbar.

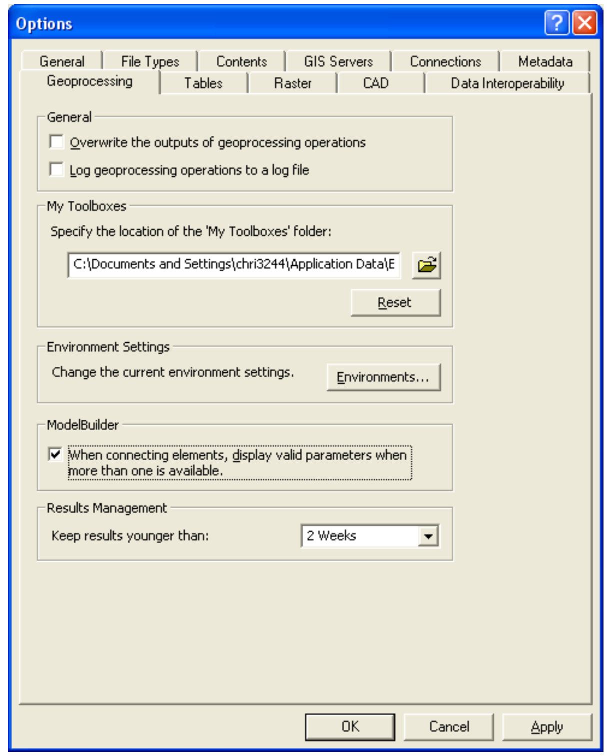
3. Standard Geoprocessing Configuration

In addition to the specific Arc Hydro configuration, the standard Geoprocessing configuration also applies (e.g. overwrite outputs, add output to map, etc.) and can be set in ArcMap or ArcCatalog by using Tools > Options and switching to the Geoprocessing tab. Note that the Display/Temporary data parameters apply to ArcMap only.

- In your map document, select Tools > Options and switch to the Geoprocessing tab.
- Uncheck “Overwrite the outputs of geoprocessing operations”.
- Check “Add results of geoprocessing operations to the display” and click OK.



Geoprocessing options in ArcMap (9.3)



Geoprocessing options in ArcCatalog (9.3)

Terrain Preprocessing

This section walks you through the Terrain Preprocessing tools in the geoprocessing environment. Note that each tool has a corresponding function in the standard Arc Hydro tools toolbar. If you are already familiar with the Arc Hydro tools, and comfortable with the ArcGIS geoprocessing tools, you may want to read through the first 2 tools (Level DEM and DEM Reconditioning) as an example of the Arc Hydro implementation of the geoprocessing tools and then jump to the next section, Terrain Preprocessing Workflows, to learn more on how building models and performing batch processing with the tools.

Note

The preprocessing steps to use when preprocessing a terrain depend on the type of the terrain (dendritic, deranged, i.e. with sinks, combined) and on the type of analysis you want to perform. The objective of the section below is to step through all the tools, not to describe possible workflows. If you are interested in learning more about the terrain preprocessing workflows, refer to the document “Comprehensive terrain preprocessing using Arc Hydro tools”.

You can use the Tutorial data from the DataGP\SanMarcos directory.

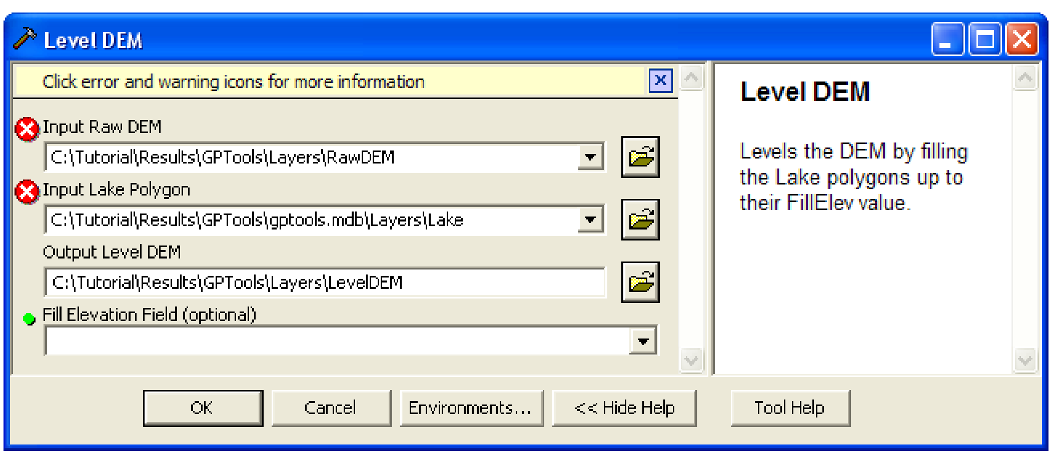
1. Level DEM

This tool levels the input Raw DEM by filling the cells covered by each lake up to the Fill Elevation value defined for that lake polygon.

If you went through the steps in the previous section, you should already have a map called GPTools.mxd that contains the elevation grid elev_cm from the tutorial data. If you do not, add this grid into a new map and save this map as GPTools.mxd.

- Add the lakes feature class DataGP\SanMarcos\SanMarcos.gdb\Hydrography\NHDWaterbody into the Table of Contents of ArcMap.

- Double-click Terrain **Preprocessing** > **Level DEM**.



The default name of the input Raw DEM is constructed by appending to the raster location the name of the active dataframe in the map as well as the default name associated to the RawDEM tag read from the configuration.

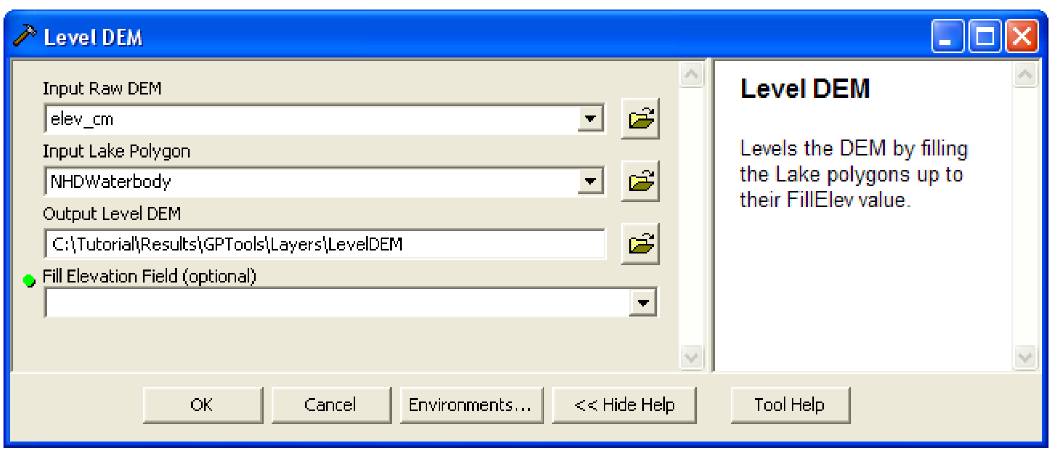
The default name of the input Lake Polygon is constructed by appending to the vector location the name of the active dataframe as well as the name associated to the Lake tag read from the configuration.

The default name of the output Level DEM is constructed by appending to the raster location the name of the active dataframe as well as the name associated to the LevelDEM tag in the configuration.

The red crosses next to the inputs indicate that these inputs do not exist. You have the option to browse to locate each input or to use the dropdown list to select one of the available input in the map. Only the type of data that may be used as input may be selected in the dropdown list (i.e. raster for Raw DEM, polygon layer for Lake Polygon).

- Select the DEM and Lake Polygon that you have added to the map. Keep the default output name.

- If the Lake Polygon layer contains a field storing the Fill Elevation for each lake, select this field as Fill Elevation Field. If this field is not provided, leave the parameter blank. You need to first select one of the existing fields and then delete it to validate the blank field. Selecting a blank field will trigger the recomputation of the Fill Elevation value that will be stored in the LevelElev field. Click OK.



The tool performs the Level DEM step and adds the resulting LevelDEM to the map.

2. DEM Reconditioning

This tool performs the DEM Reconditioning step – it requires as input a DEM and stream feature class, as well as 4 parameters, and generates as output an AgreeDEM grid.

- Add the stream feature class DataGP\SanMarcos.gdb\Hydrography\NHDFlowline into the map.

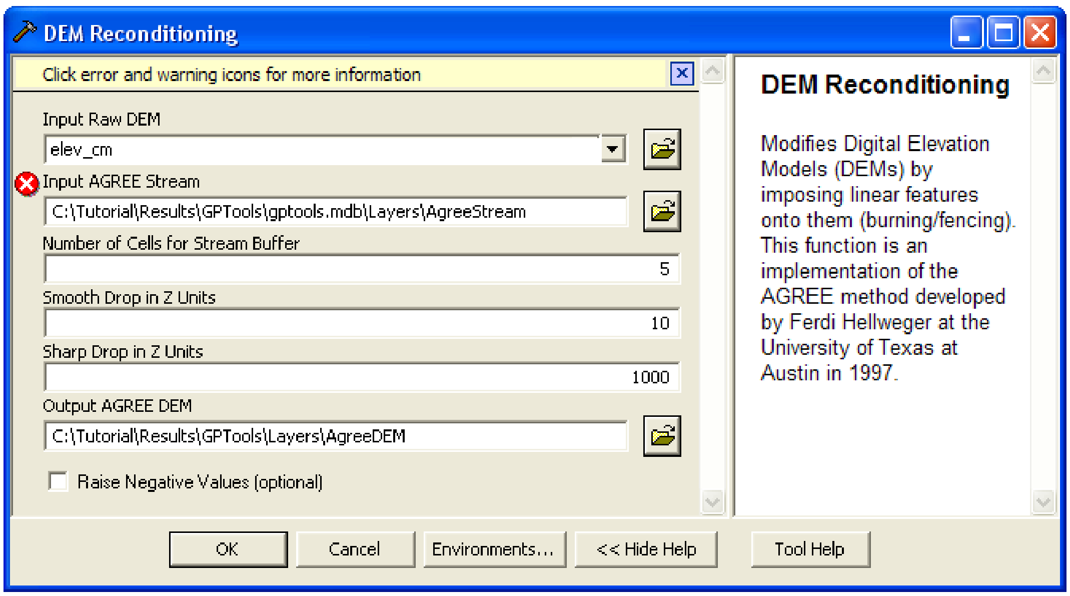
- Double-click **Terrain Preprocessing > DEM Reconditioning**.

The default name of the input Raw DEM is set to the grid that was tagged as RawDEM when running the function Level DEM.

The default name of the input AGREE Stream is constructed by appending to the vector location the name of the active dataframe as well as the name associated to the AgreeStream tag read from the configuration.

The default name of the output AGREE DEM is constructed by appending to the raster location the name of the active dataframe as well as the name associated to the AgreeDEM tag in the configuration.

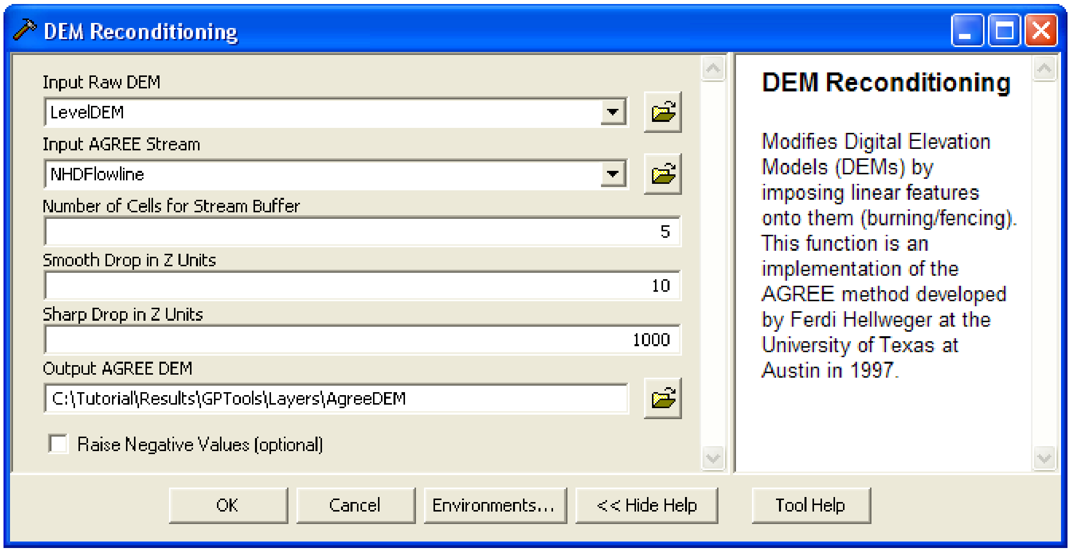
The red cross next to the input indicates that this input does not exist. You have the option to browse to locate the input or to use the dropdown list to select one of the available input in the map. Only the type of data that may be used as input may be selected in the dropdown list (i.e. raster for Raw DEM, line layer for AGREE Stream).



- Select LevelDEM as input RawDEM and NHDFlowline as input AGREE Stream.

The option to Raise Negative Value allows ensuring that the output DEM only contains positive value. It used to be a requirement for the flow direction function but is not the case anymore – the flow direction function also works with DEMs having negative elevation values.

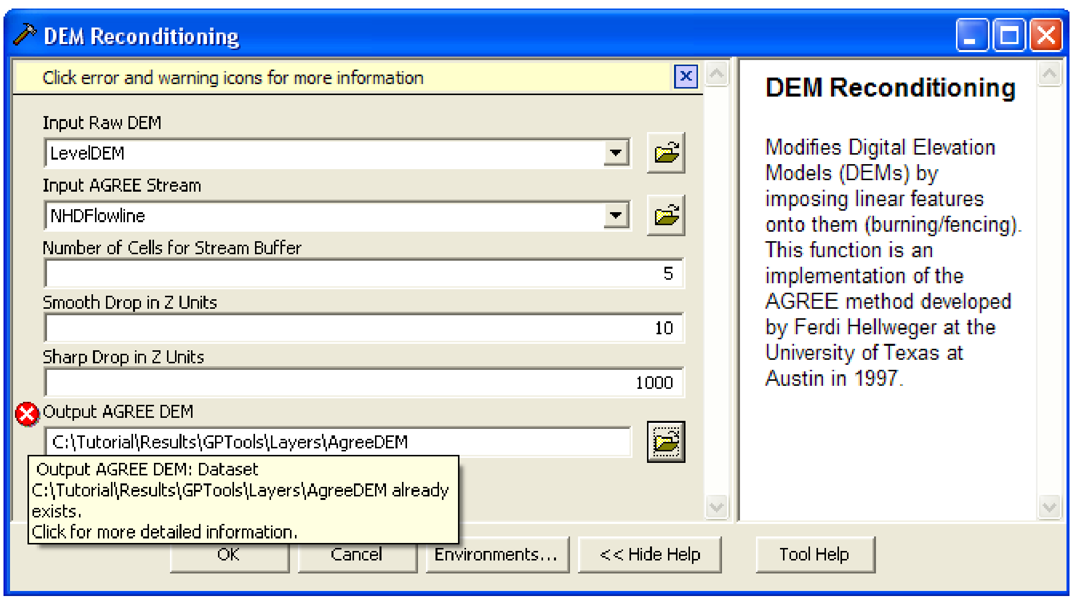
- Uncheck “Raise Negative Values” and Click OK.



The tool performs the DEM Reconditioning step and adds the resulting AgreeDEM to the map.

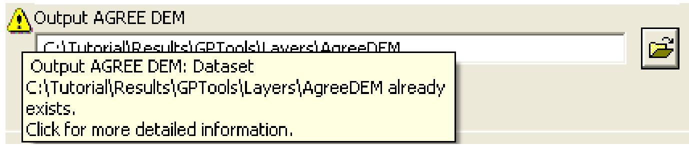
- Double-click **Terrain Preprocessing > DEM Reconditioning** again.

The default output still uses the default setting. The red cross indicates that the output already exists and cannot be overwritten because of the geoprocessing setting of not allowing overwriting output.



Note

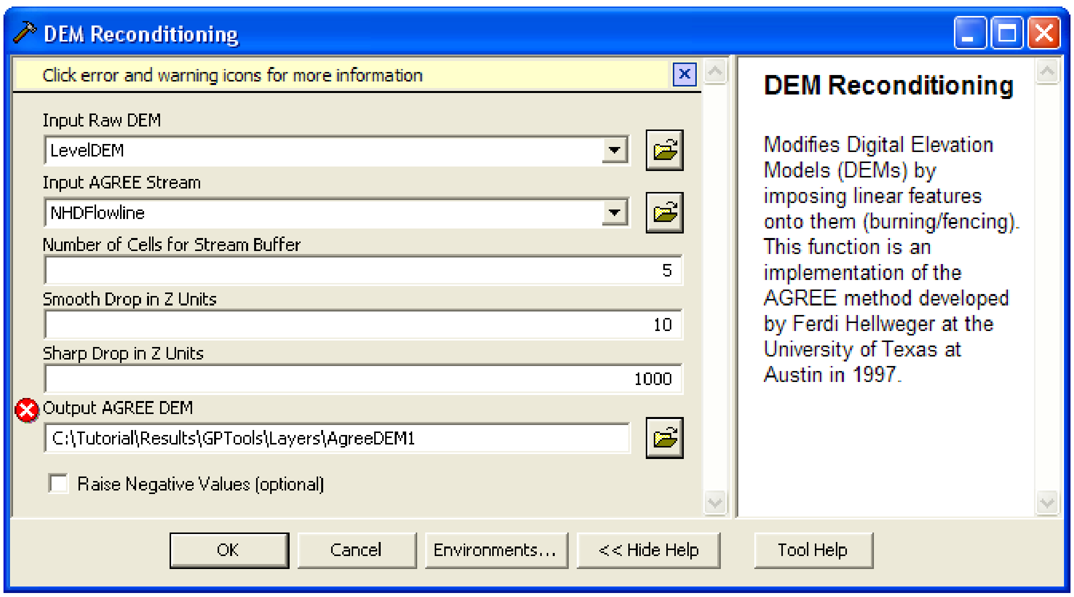
If the geoprocessing setting was set to “allow overwrite”, then there would be a yellow warning triangle instead of a red cross indicating that the output already exists but may be overwritten.



- Modify the name of the output to AgreeDEM1 and click OK to generate the new Agree DEM.

- Double-click **Terrain Preprocessing > DEM Reconditioning** again.

The default output name read from the configuration has been updated to the last value used for the output tag.

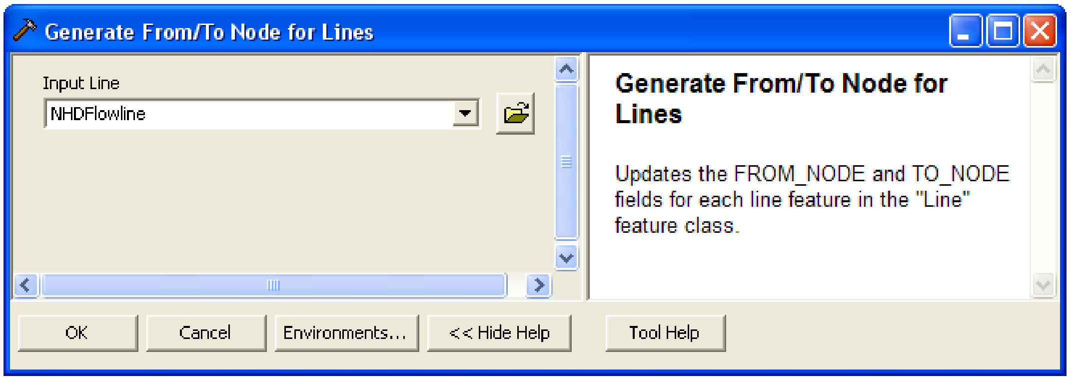


- Click Cancel to close the form.

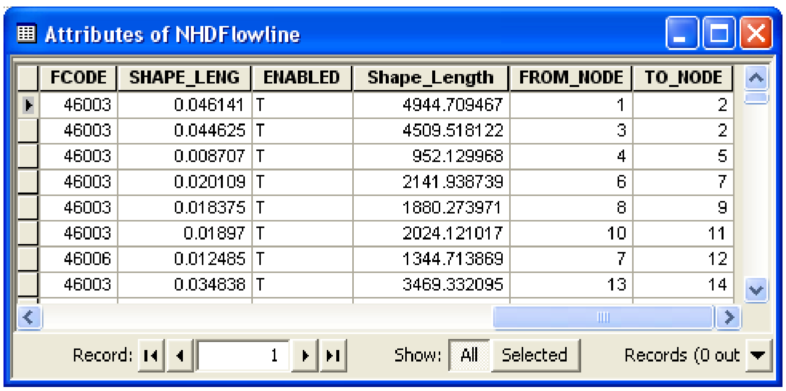
3. Assign Stream Slope

This tool allows assigning From and To Elevations to an input stream (line) feature class. The stream feature class must contain the fields FROM_NODE and TO_NODE that may be populated using the Generate From/To Node for Lines tool from the Attribute Tools toolset.

- Click **Attribute Tools > Generate From/To Node for Lines** and select NHDFlowline as Input Line. Click OK.

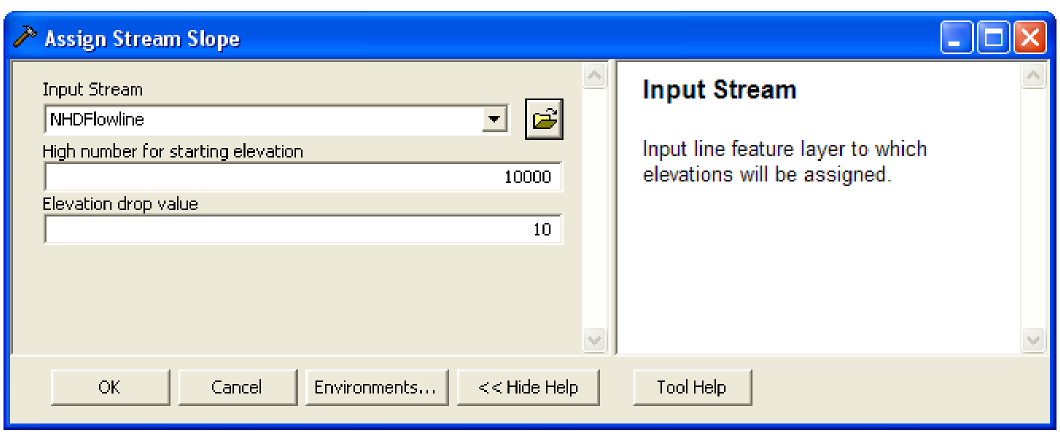


The tool creates the fields From_Node and To_Node in the attributes table of NHDFlowline.



FCODE	SHAPE_LENG	ENABLED	Shape_Length	FROM_NODE	TO_NODE
46003	0.046141	T	4944.709467	1	2
46003	0.044625	T	4509.518122	3	2
46003	0.008707	T	952.129968	4	5
46003	0.020109	T	2141.938739	6	7
46003	0.018375	T	1880.273971	8	9
46003	0.01897	T	2024.121017	10	11
46006	0.012485	T	1344.713869	7	12
46003	0.034838	T	3469.332095	13	14

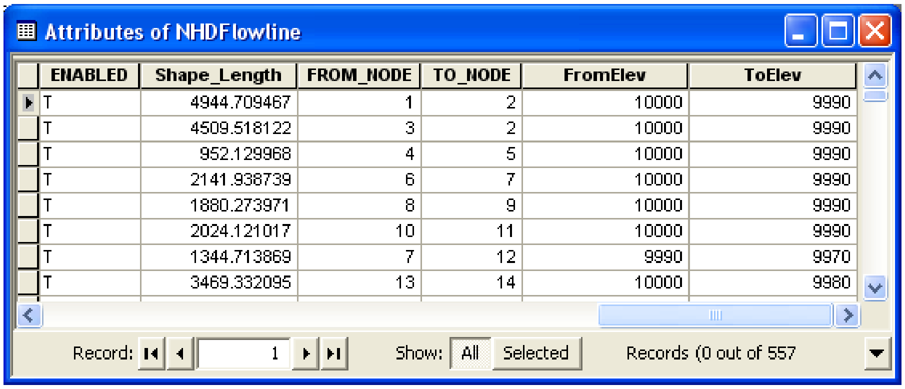
- Click Terrain Preprocessing > Assign Stream Slope.



The parameter "High number for starting elevation" is an arbitrary number that will be used as highest elevation – elevations along the feature will be decremented by the "elevation drop value".

- Keep the defaults and click OK to run the tool.

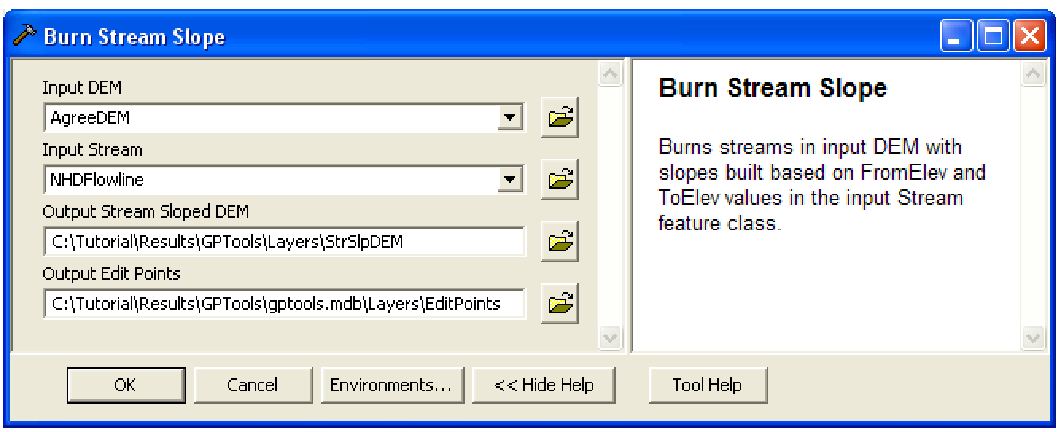
The tool populates the fields FromElev and ToElev in the input stream feature class.



4. Burn Stream Slope

This tool allows burning in a stream slope to force the water to flow in the digitized direction within the streams. The input steam feature must have the fields FromElev and ToElev populated.

- Double-click **Terrain Preprocessing** > **Burn Stream Slope**.
- Select as input DEM the DEM onto which you want to enforce the stream slope (e.g. AgreeDEM) and as input Stream a line feature class with populated FromElev and ToElev fields (e.g. NHDFlowline). Click OK.



The tool burns in the stream slope and generates an output "Stream Sloped DEM". The output EditPoints feature class is an intermediate layer used in the burn in process.

5. Build Walls

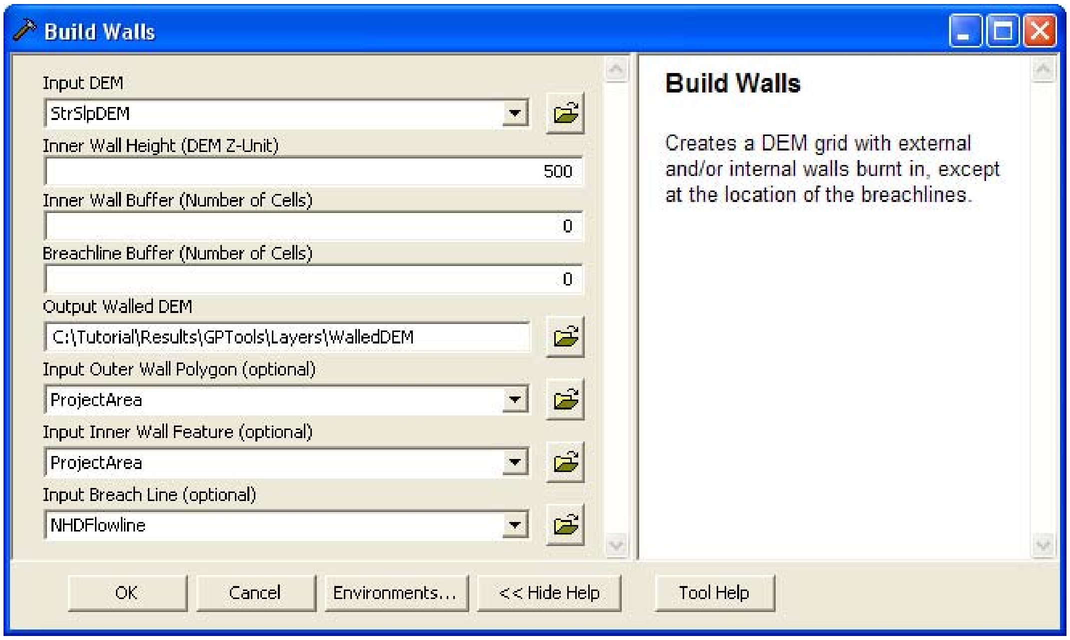
This tool allows building walls onto an input DEM. Two types of walls may be created:

- Outer walls – based on an input polygon feature class (Outer Wall Polygon)
- Inner walls – based on an input polygon, line or point feature class (Inner Wall Feature)

Both types may be built at the same time, but at least one must be selected.

In addition, a Breach Line feature class may be provided as input, to ensure that they are "breaches" in the walls allowing the water to flow out.

- Add DataGP\SanMarcos\SanMarcos.gdb\Hydrography\ProjectArea into the Table of Contents of ArcMap.
- Double-click Terrain Preprocessing > Build Walls.



- Select as input DEM the elevation grid onto which you want to enforce walls slope (e.g. StrSlpDEM) and click OK.
- Enter the Inner Wall Height. The Outer Wall Height is twice this height.
- Enter a buffer (number of cells) for the Inner Walls. Default to 0, i.e. no buffer.
- Enter a buffer for the Breach Line. Default to 0, i.e. no buffer.
- Specify the name of the output Walled DEM.
- Select the Outer Wall Polygon layer (optional, e.g. ProjectArea) to ensure that the outer boundary of the Catchment feature class matches a specific boundary.
- Select the Inner Wall Feature class (optional, e.g. ProjectArea) to ensure internal watersheds/catchments boundary match specific input data.
- Select a Breach Line feature class (optional, e.g. NHDFlowline) that contains features crossing the walls so that the water can flow out.
- Click OK.

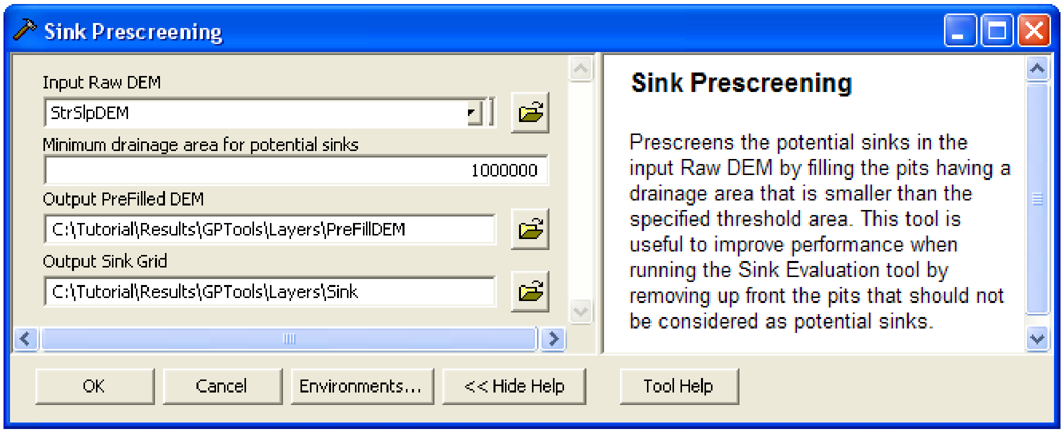
Upon successful completion of the process, the "WalledDEM" layer is added to the map.

6. Sink Prescreening

This tool allows prescreening potentials sinks by filling the pits having a drainage area that is smaller than the specified area threshold and should not be considered as sinks. Prescreening will speed up the Sink Evaluation because fewer potential sinks will need to be processed.

- Double-click **Terrain Preprocessing > Sink Prescreening**.
- Select as input Raw DEM the elevation grid (e.g. StrSlpDEM) you want to prescreen for sinks by filling the potential sinks having a drainage area smaller than the specified

threshold. Enter a threshold value and specify the names of the output Prefilled DEM and Sink Grid and click OK.



The tool generates the output Prefilled DEM where all sinks having a drainage area smaller than the specified threshold have been filled. It also creates the Sink Grid containing all the remaining sinks in the Prefilled DEM.

7. Sink Evaluation

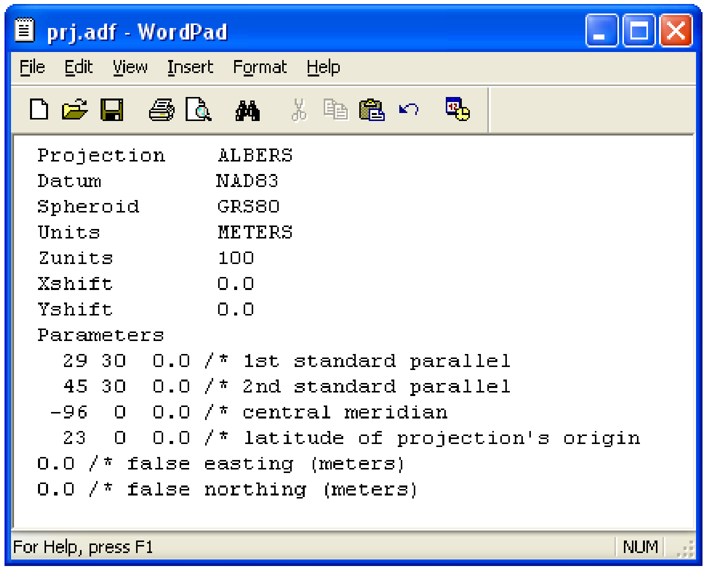
This tool allows characterizing the sinks and depressions to provide more selection criteria to decide whether to use the sinks in the analysis.

Note

You may see a warning message when running the tool indicating that the spatial reference of the input grid does not have a z unit specified and that the tool assumes that the z unit is the same as the linear unit (`Spatial reference does not have z unit. Assuming ZUnit is the same as linear unit and zfactor = 1`).

If the elevations are not in the linear unit of the grid, you need to make sure the projection file associated to the grid is correct. This file is named prj.adf is located in the grid directory.

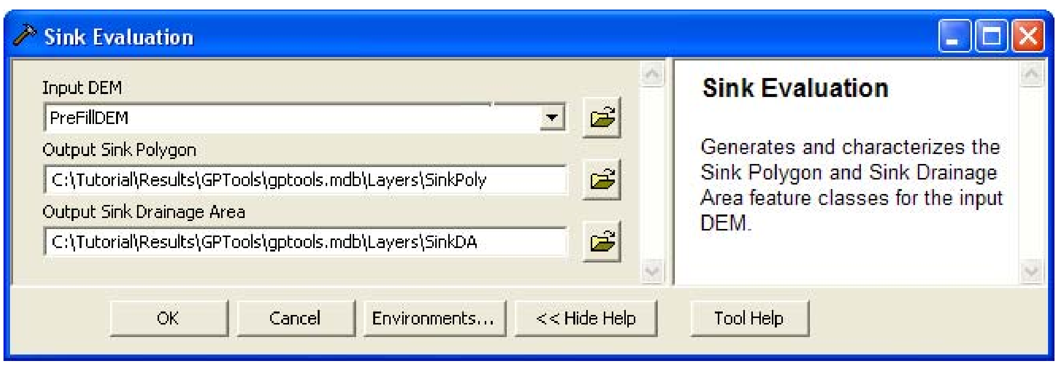
- Set Zunits to 100 in the projection file of the PreFillDem if you are using the tutorial data to indicate that the elevations are in centimeters. Zunits represents the number of elevation unit in one meter (100 centimeters in 1 meter).



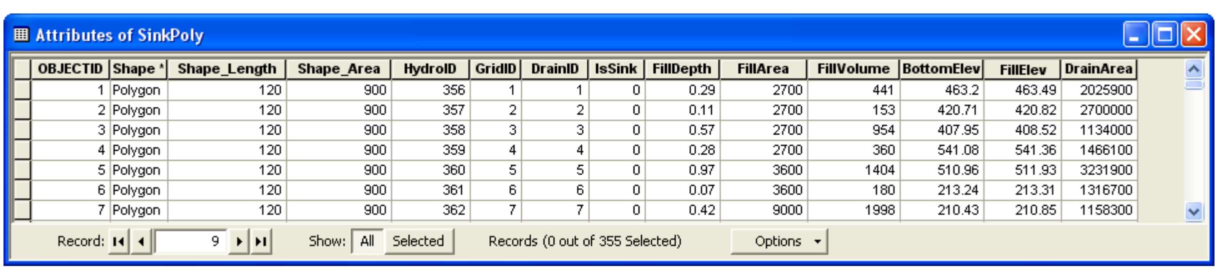

```
Projection    ALBERS
Datum         NAD83
Spheroid      GRS80
Units         METERS
Zunits        100
Xshift        0.0
Yshift        0.0
Parameters
  29 30  0.0 /* 1st standard parallel
  45 30  0.0 /* 2nd standard parallel
 -96  0  0.0 /* central meridian
  23  0  0.0 /* latitude of projection's origin
0.0 /* false easting (meters)
0.0 /* false northing (meters)
```

- Double-click **Terrain Preprocessing > Sink Evaluation**.

- Select as input DEM the Prefilled DEM created by the tool Sink Prescreening. Specify the name of the output Sink Polygon and Sink Drainage Area feature classes and click OK.



The tool generates the Sink Polygon and Sink Drainage Area feature classes, and characterizes these features by populating area, depth, etc. so that the user can decide which sinks to retain for the analysis.

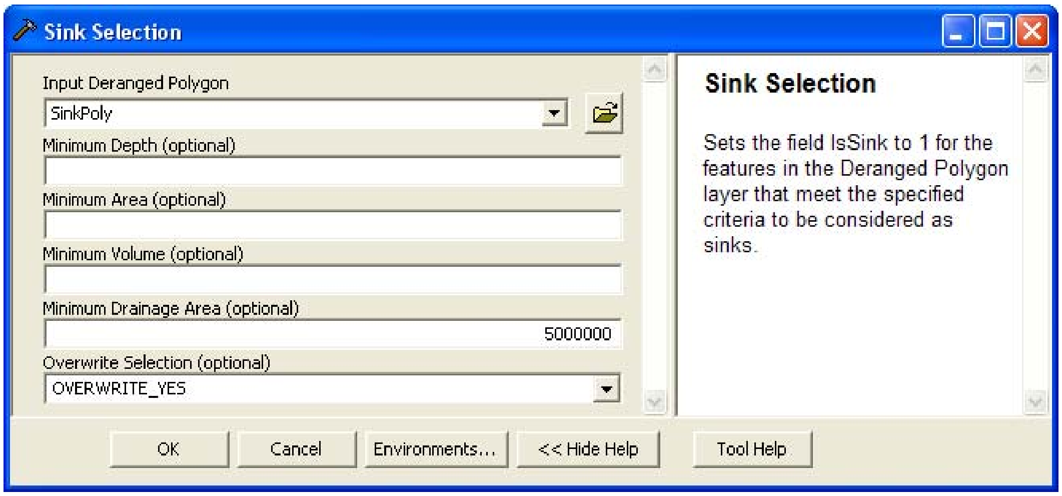


OBJECTID	Shape *	Shape_Length	Shape_Area	HydroID	GridID	DrainID	IsSink	FillDepth	FillArea	FillVolume	BottomElev	FillElev	DrainArea
1	Polygon	120	900	356	1	1	0	0.29	2700	441	463.2	463.49	2025900
2	Polygon	120	900	357	2	2	0	0.11	2700	153	420.71	420.82	2700000
3	Polygon	120	900	358	3	3	0	0.57	2700	954	407.95	408.52	1134000
4	Polygon	120	900	359	4	4	0	0.28	2700	360	541.08	541.36	1466100
5	Polygon	120	900	360	5	5	0	0.97	3600	1404	510.96	511.93	3231900
6	Polygon	120	900	361	6	6	0	0.07	3600	180	213.24	213.31	1316700
7	Polygon	120	900	362	7	7	0	0.42	9000	1998	210.43	210.85	1158300

8. Sink Selection

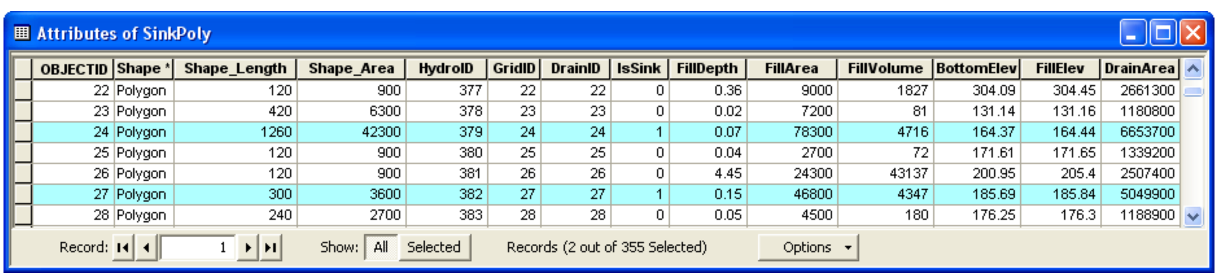
This tool allows selecting sinks based on various criteria. The sinks meeting the criteria will have their field IsSink populated with 1.

- Open the Attributes table of SinkPoly and look at the values of the attributes.
- Double-click Terrain **Preprocessing > Sink Selection**.



- Select as input Deranged Polygon the SinkPoly feature class generated by the Sink Evaluation tool. Specify one or several selection criteria for the input polygons to be populated with IsSink=1, i.e. to be considered as real sinks in the following analyses.
- Select whether to overwrite the existing records having IsSink set to 1 and click OK.

The tool populates the field IsSink with 1 for the polygons meeting the specified criteria.


Attributes of SinkPoly

OBJECTID	Shape *	Shape_Length	Shape_Area	HydroID	GridID	DrainID	IsSink	FillDepth	FillArea	FillVolume	BottomElev	FillElev	DrainArea
22	Polygon	120	900	377	22	22	0	0.36	9000	1827	304.09	304.45	2661300
23	Polygon	420	6300	378	23	23	0	0.02	7200	81	131.14	131.16	1180800
24	Polygon	1260	42300	379	24	24	1	0.07	78300	4716	164.37	164.44	6653700
25	Polygon	120	900	380	25	25	0	0.04	2700	72	171.61	171.65	1339200
26	Polygon	120	900	381	26	26	0	4.45	24300	43137	200.95	205.4	2507400
27	Polygon	300	3600	382	27	27	1	0.15	46800	4347	185.69	185.84	5049900
28	Polygon	240	2700	383	28	28	0	0.05	4500	180	176.25	176.3	1188900

Record: 1 Show: All Selected Records (2 out of 355 Selected) Options

9. Fill Sinks

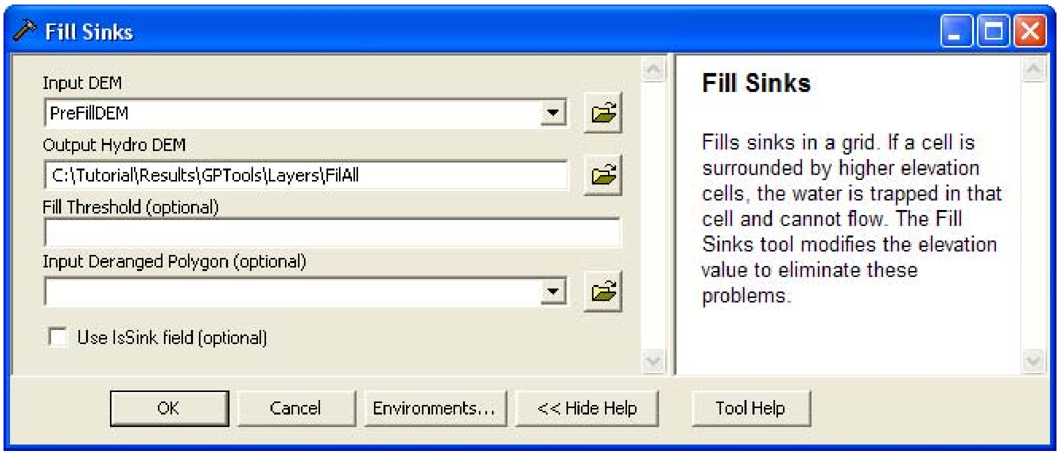
This tool fills in the sinks in the input DEM and generates the output Fil grid. The Deranged Polygon is an optional input that will be ignored if left blank. If it is specified, it will be used to locate the areas that should not be filled (i.e. real sinks).

You are going to run the tool twice. The first time you will fill all sinks and create a filled grid called FillAll. The second time you will not fill the real sinks, i.e. the Sink Poly features having IsSink = 1.

First run

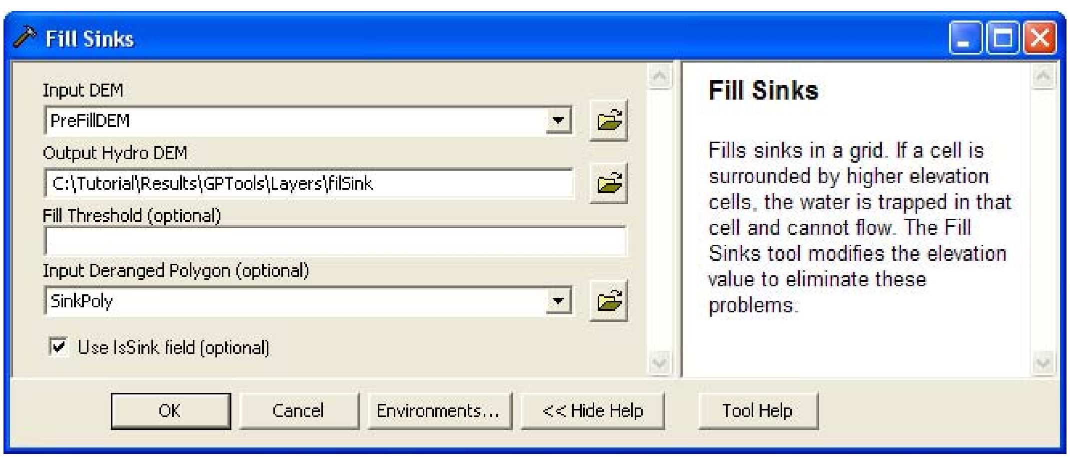
- Double-click **Terrain Preprocessing > Fill Sinks**.
- Select PreFillDEM as input DEM and rename the output Hydro DEM FilAll.
- Leave Fill Threshold and Input Deranged Polygon blank and click OK.

Note that “Use IsSink field” is used only when a Deranged Polygon is set, to indicate whether to use only the features having IsSink set to 1.



The function fills all the sinks in the input DEM.

- Double-click **Terrain Preprocessing > Fill Sinks**.
- Select PreFillDEM as input DEM and rename the output Hydro DEM FilSink.
- Select SinkPoly as Input Deranged Polygon and check “Use IsSink field”. Click OK.

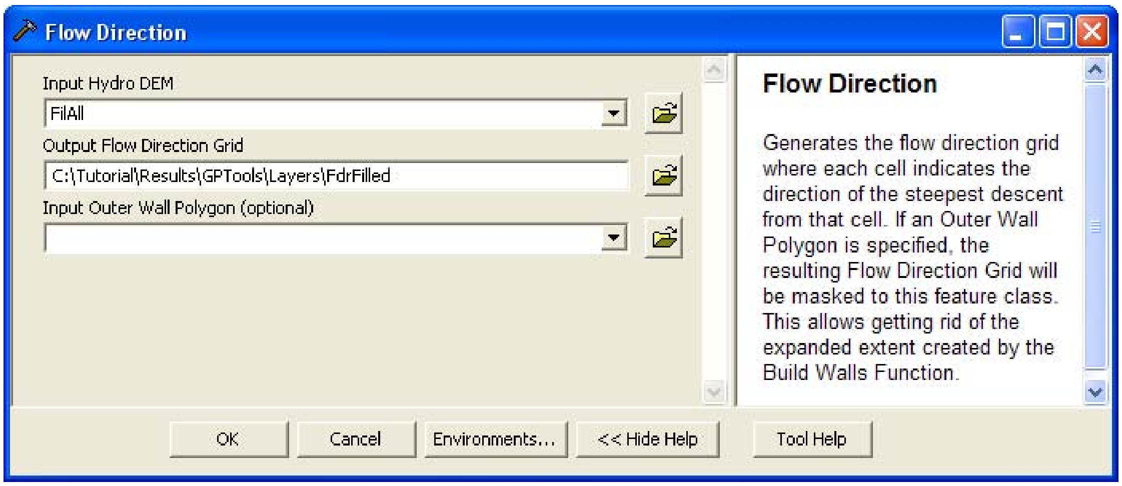


The tool fills only the sinks having IsSink <> 1, i.e. it does not fill the sink polygons identified as real sinks that have IsSink = 1.

10. Flow Direction

This tool computes the flow direction grid for an input Hydro DEM, a DEM that may have modified by reconditioning, walls building, filling, etc.

- Double-click **Terrain Preprocessing > Flow Direction**.
- Specify FillAll as input HydroDEM and rename the output flow direction grid FdrFilled.
- Leave the optional input Outer Wall Polygon blank and click OK.



- The tool generates the Flow Direction Grid associated to the input Hydro DEM and adds it to the Table of Contents of ArcMap.

11. Flow Direction with Sinks

This tool generates the Flow Direction Grid for DEMs with sinks and ensures that the water from each cell within a given sink drainage area flows towards the same location in the sink polygon represented by a sink point.

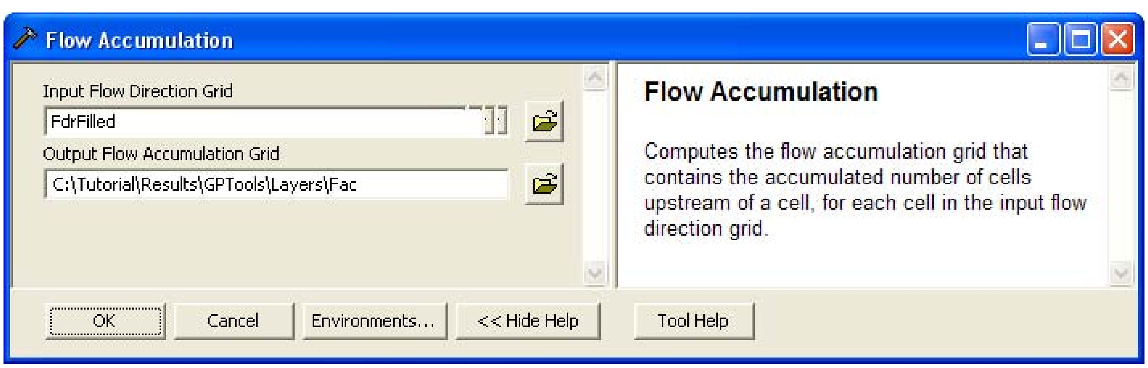
- Double-click **Terrain Preprocessing > Flow Direction with Sinks**.
- Select FilSink as input Hydro DEM, i.e. a filled elevation grid with sinks. Set SinkPoly as the input Deranged Polygon feature class representing the sinks. Only the sink features having IsSink set to 1 will be considered as sinks. Set the optional Outer Wall Polygon to blank.
- Rename the output Flow Direction Grid FdrSink and click OK.

The tool generates the output Flow Direction Grid as well as the output Sink Point feature class, Sink Link Grid and Sink Watershed Grid. The Sink Point feature class stores the point toward which each cell within a sink will flow. The Sink Link Grid is a grid where each sink has a unique identifier. Sink Watershed Grid is a grid representing the drainage areas for each sink. It may be used later in the analysis to define the areas where the drainage lines should not be created.

12. Flow Accumulation

This tool generates the Flow Accumulation grid associated to the input flow direction grid: each cell in the flow accumulation grid stores the number of cells located upstream of that cell.

- Double-click **Terrain Preprocessing > Flow Accumulation**.
- Select FdrFilled as input Flow Direction Grid. Click OK.
- The tool generates the output flow accumulation grid and adds it to the map.

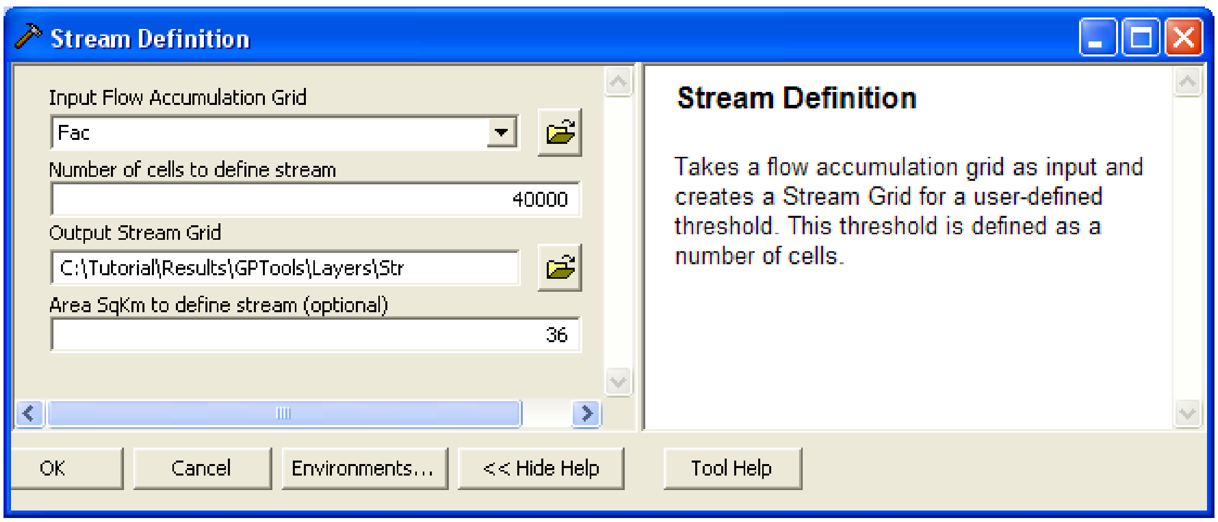


13. Stream Definition

This tool generates the stream grid for an input flow accumulation grid and a threshold. Unlike the related function in the standard Arc Hydro tools, you need to specify the threshold in number of cells defining where a stream should start without any feedback from the function. The recommended value is usually around 1% of the maximum flow accumulation value.

- Double-click **Terrain Preprocessing** > **Stream Definition**.

- Select Fac as input Flow Accumulation Grid and specify a threshold that is approximately 1% of the maximum value of the Flow Accumulation grid (i.e. 40,000 for the tutorial data). Click OK.



The tool generates the output stream grid and adds it to the map.

14. Stream Segmentation

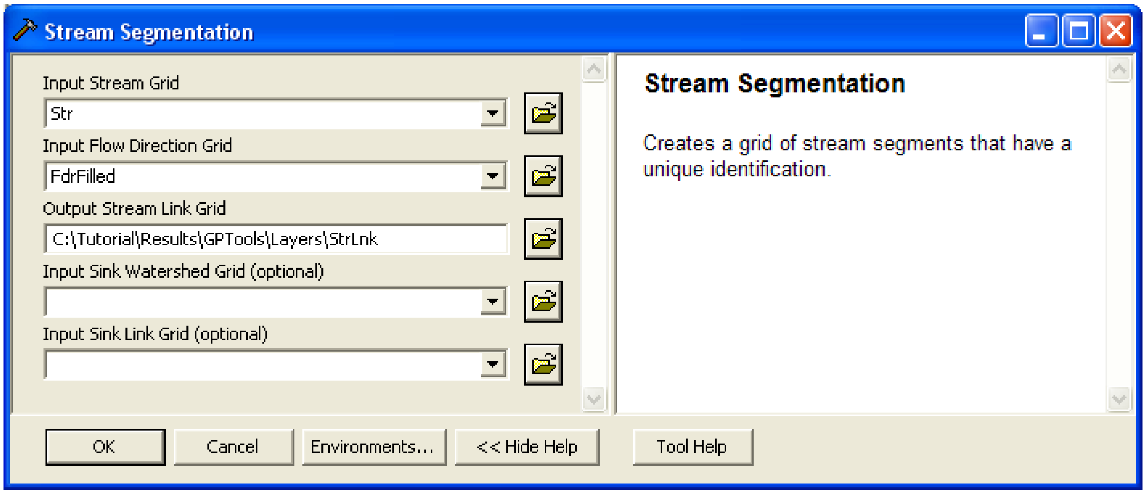
This tool generates the stream link grid for an input stream grid and flow direction grid. All cells in a given link segment have the same value that uniquely identify the segment.

- Double-click **Terrain Preprocessing** > **Stream Segmentation**.

- Specify the input stream grid and flow direction grid and the output stream link grid, and keep the optional Sink Watershed Grid and Sink Link Grid inputs blank.

Notes

- If you do not want to create stream links (and hence drainage lines later on) within the sinks, specify an input Sink Link Grid.
- If you do not want to create stream links within the drainage areas of the sinks, specify an input Sink Watershed Grid.



The tool generates the output stream link grid StrLnk and adds it to the map.

15. Flow Direction with Streams

This tool generates the Drainage Line feature class first based on the input Flow Direction Grid. It subsequently uses the input Stream feature class to add any existing flow splits. This tool may be used instead of the Stream Definition tool that uses a threshold to generate the Drainage Line. It does not use a threshold but tries to match as closely as possible the geometry of the input digitized streams. Another reason to use it instead of the Stream Definition tool is that it allows maintaining flows splits.

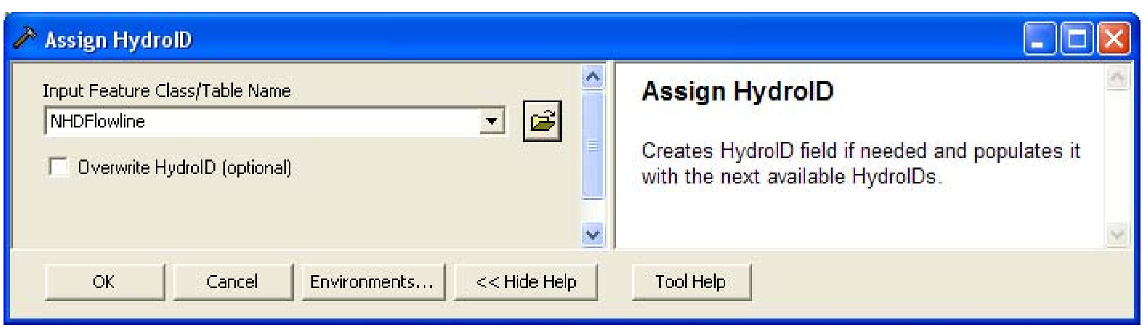
This tool edits the input Flow Direction grid to generate an output Stream Sloped Flow Direction grid that ensures that the water remains within a given stream and does not jump between streams near confluences. It also generates the output Stream Link Grid required to generate Catchments.

The output Edit Points and HydroRiverPoints feature classes are used in the grid editing process.

Note

The input Stream feature class must contain a populated HydroID field.

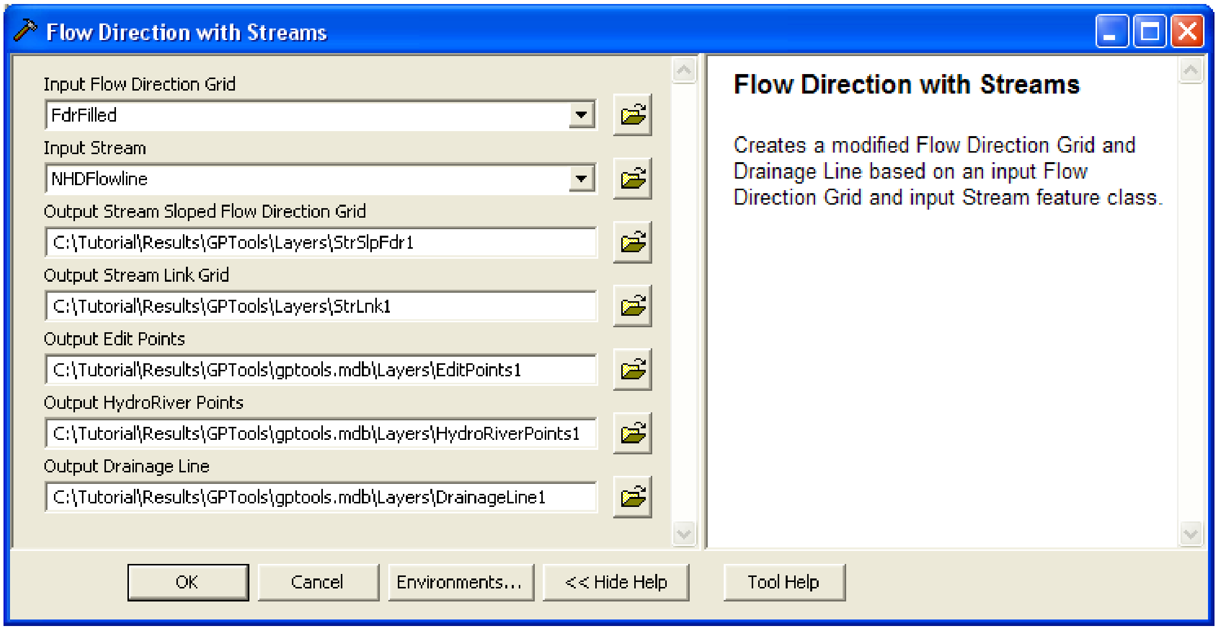
- Double-click **Attribute Tools > Assign HydroID**.
- Select NHDFlowline as input feature class and click OK.



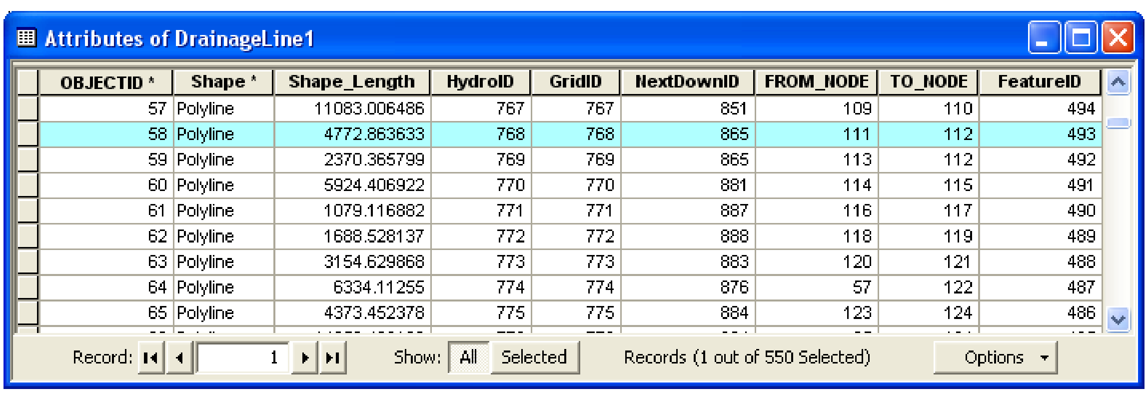
The tool creates and populates the HydroID field in the attributed table of NHDFlowline.

- Double-click **Terrain Preprocessing > Flow Direction with Streams**.

- Specify FdrFilled as input Flow Direction Grid and NHDFlowline as input Stream.
- Rename the output StrSlpFdr1, StrLnk1, EditPoints1, HydroRiverPoints1 and DrainageLine1 and click OK.



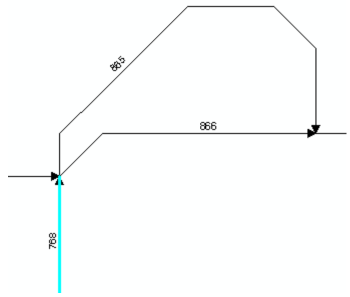
The 4 outputs are added into the Table of Contents of ArcMap.

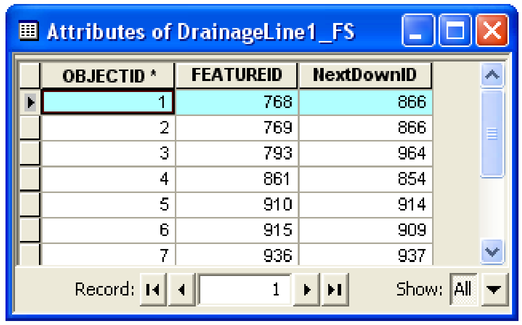

Attributes of DrainageLine1

OBJECTID *	Shape *	Shape_Length	HydroID	GridID	NextDownID	FROM_NODE	TO_NODE	FeatureID
57	Polyline	11083.006486	767	767	851	109	110	494
58	Polyline	4772.863633	768	768	865	111	112	493
59	Polyline	2370.365799	769	769	865	113	112	492
60	Polyline	5924.406922	770	770	881	114	115	491
61	Polyline	1079.116882	771	771	887	116	117	490
62	Polyline	1688.528137	772	772	888	118	119	489
63	Polyline	3154.629868	773	773	883	120	121	488
64	Polyline	6334.11255	774	774	876	57	122	487
65	Polyline	4373.452378	775	775	884	123	124	486

Record: 1 Show: All Selected Records (1 out of 550 Selected) Options

The tool also generates the flow split table DrainageLine1_FS that stores additional downstream connectivity.

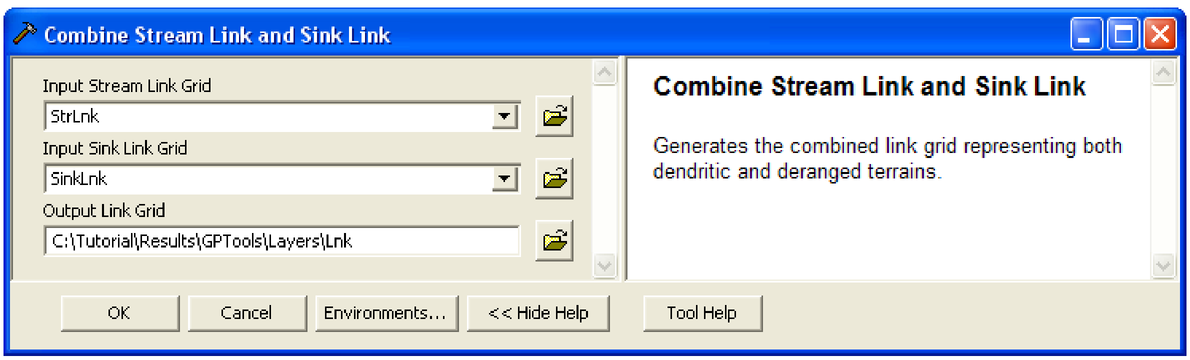




16. Combine Stream Link and Sink Link

This tool generates the link grid by combining links for dendritic (stream link) and deranged (sink link) terrains.

- Double-click **Terrain Preprocessing** > **Combine Stream Link and Sink Link**.



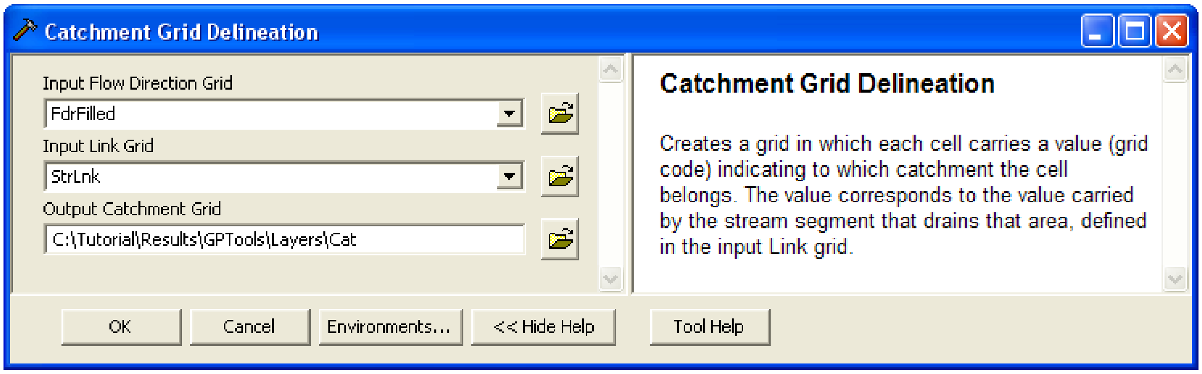
- Specify the input Stream Link Grid and Sink Link Grid, as well as the output Link Grid. Click OK.

The tool creates the Sink Link Grid and adds it into the Table of Contents of ArcMap.

17. Catchment Grid Delineation

This tool generates the catchment grid associated to an input flow direction grid and link grid.

- Double-click **Terrain Preprocessing** > **Catchment Grid Delineation**.
- Select FdrFilled as input Flow Direction grid and StrLink as input Link Grid. Click OK.

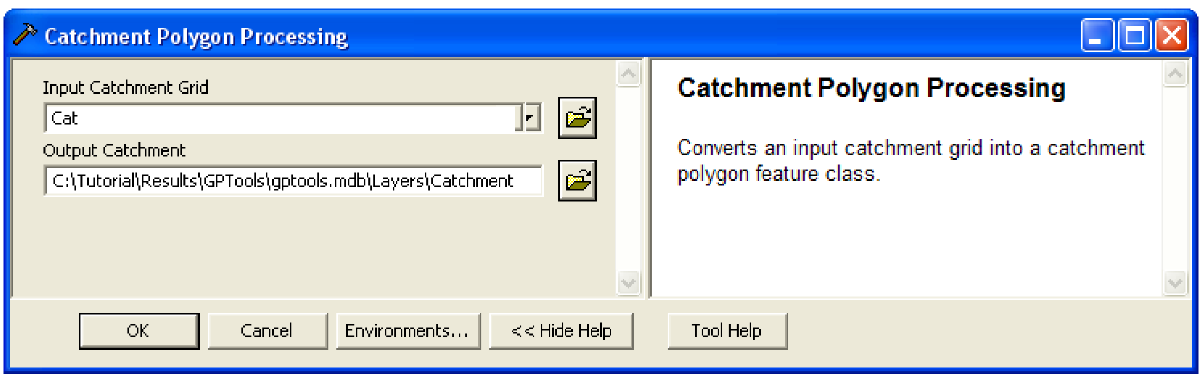


The tool generates the output catchment grid and adds it to the map.

18. Catchment Polygon Processing

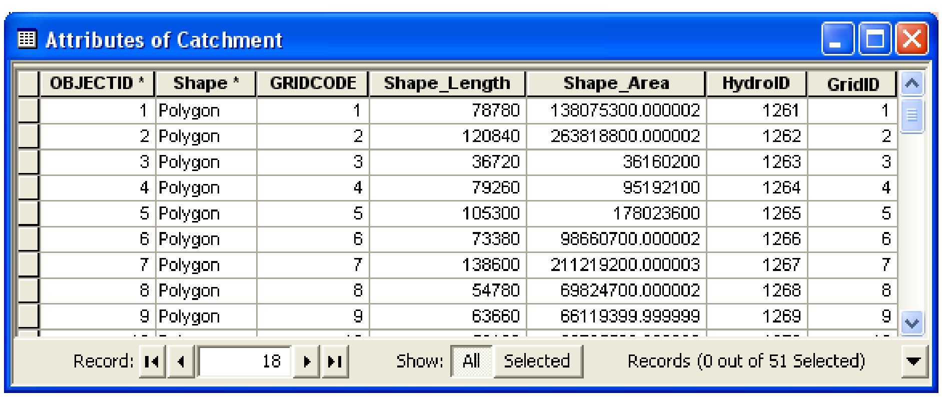
This tool generates the catchment polygon feature classes corresponding to the input catchment grid.

- Double-click **Terrain Preprocessing > Catchment Polygon Processing**.



- Specify the input catchment grid and output catchment polygon feature class. Click OK.

The tool generates the output catchment polygon feature class and adds it to the map.



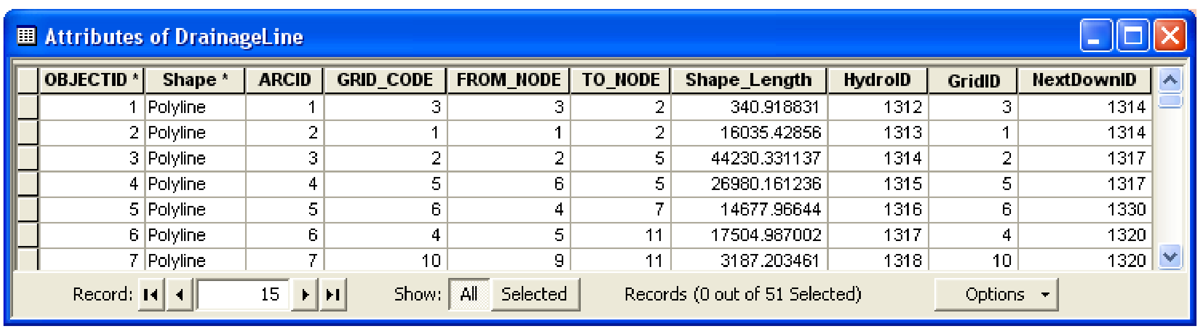
OBJECTID *	Shape *	GRIDCODE	Shape_Length	Shape_Area	HydroID	GridID
1	Polygon	1	78780	138075300.000002	1261	1
2	Polygon	2	120840	263818800.000002	1262	2
3	Polygon	3	36720	36160200	1263	3
4	Polygon	4	79260	95192100	1264	4
5	Polygon	5	105300	178023600	1265	5
6	Polygon	6	73380	98660700.000002	1266	6
7	Polygon	7	138600	211219200.000003	1267	7
8	Polygon	8	54780	69824700.000002	1268	8
9	Polygon	9	63660	66119399.999999	1269	9

19. Drainage Line Processing

This tool generates the drainage line feature class associated to an input stream link grid and flow direction grid.

- Double-click **Terrain Preprocessing > Drainage Line Processing**.
- Select StrLnk as input Stream Link Grid and FdrFilled as input Flow Direction Grid. Rename the output DrainageLine and click OK.

The tool generates the output drainage line feature class and adds it to the map.


Attributes of DrainageLine

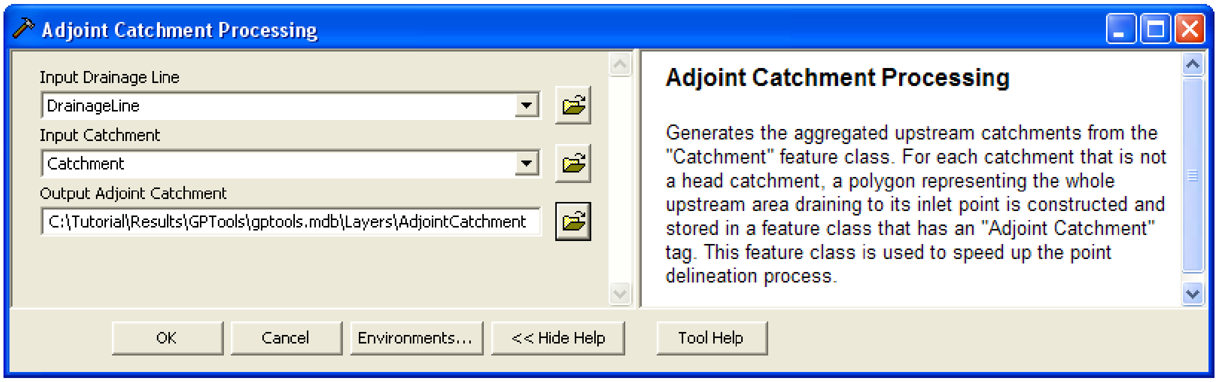
OBJECTID *	Shape *	ARCID	GRID_CODE	FROM_NODE	TO_NODE	Shape_Length	HydroID	GridID	NextDownID
1	Polyline	1	3	3	2	340.918831	1312	3	1314
2	Polyline	2	1	1	2	16035.42856	1313	1	1314
3	Polyline	3	2	2	5	44230.331137	1314	2	1317
4	Polyline	4	5	6	5	26980.161236	1315	5	1317
5	Polyline	5	6	4	7	14677.96644	1316	6	1330
6	Polyline	6	4	5	11	17504.987002	1317	4	1320
7	Polyline	7	10	9	11	3187.203461	1318	10	1320

Record: 15 Show: All Selected Records (0 out of 51 Selected) Options

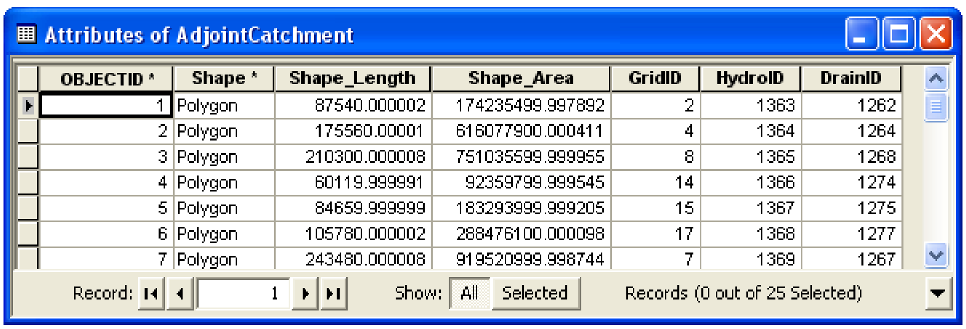
20. Adjoint Catchment Processing

This tool generates the adjoint catchment polygon feature class associated to an input catchment and drainage line feature classes.

- Double-click **Terrain Preprocessing > Adjoint Catchment Processing** and click OK.



The tool generates the output adjoint catchment polygon feature class and adds it to the map. The field DrainID stores the HydroID of the associated Catchment.


Attributes of AdjointCatchment

OBJECTID *	Shape *	Shape_Length	Shape_Area	GridID	HydroID	DrainID
1	Polygon	87540.000002	174235499.997892	2	1363	1262
2	Polygon	175560.00001	616077900.000411	4	1364	1264
3	Polygon	210300.000008	751035599.999955	8	1365	1268
4	Polygon	60119.999991	92359799.999545	14	1366	1274
5	Polygon	84659.999999	183293999.999205	15	1367	1275
6	Polygon	105780.000002	288476100.000098	17	1368	1277
7	Polygon	243480.000008	919520999.998744	7	1369	1267

Record: 1 Show: All Selected Records (0 out of 25 Selected)

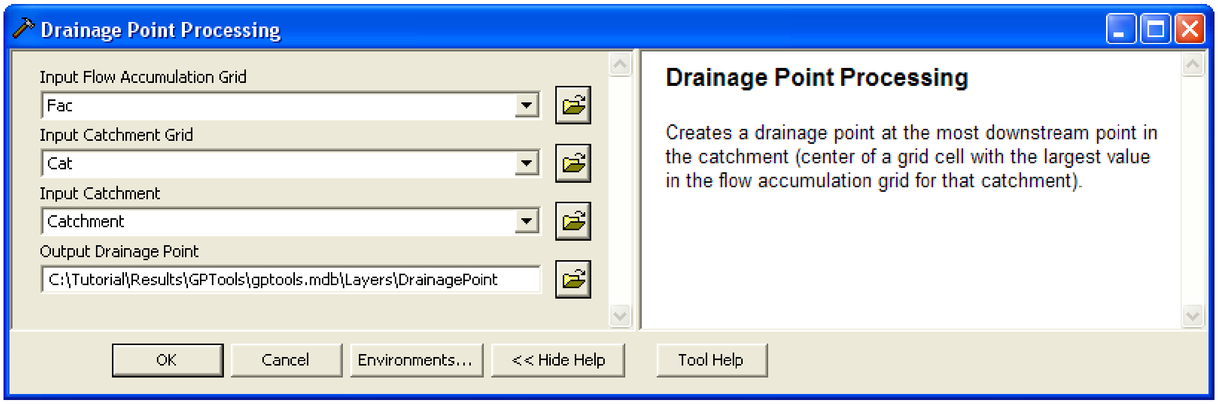
The tool also creates and populates the field NextDownID in the Catchment feature class with the HydroID of the next downstream Catchment. It also creates the flow split table Catchment_FS that stores the additional connectivity. This table is created empty as there is no flow split in the input Drainage Line feature class.

The tool populates the field DrainID in the Drainage Line feature class with the HydroID of its associated Catchment.

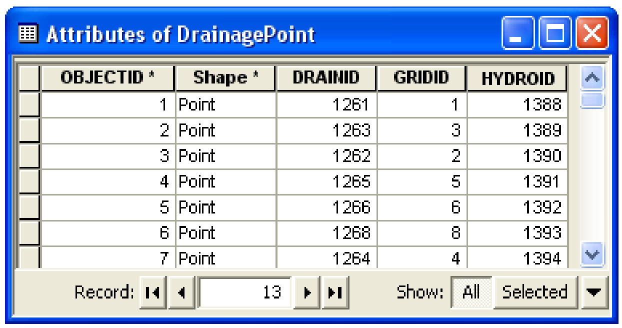
21. Drainage Point Processing

This tool generates the drainage point feature class associated to an input catchment feature class and flow accumulation grid. Drainage Point features represent the location of the cell with the maximum flow accumulation value within each catchment.

- Double-click **Terrain Preprocessing > Drainage Point Processing** and click OK.



The tool generates the output Drainage Point feature class and adds it to the map. The DrainID field stores the HydroID of the associated Catchment.



OBJECTID *	Shape *	DRAINID	GRIDID	HYDROID
1	Point	1261	1	1388
2	Point	1263	3	1389
3	Point	1262	2	1390
4	Point	1265	5	1391
5	Point	1266	6	1392
6	Point	1268	8	1393
7	Point	1264	4	1394

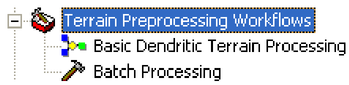
- Save your map and close your map document.

Note

After closing the map, you may want to cleanup your windows temp location from the temporary grids and vectors created by the tools. This location defaults to C:\Documents and Settings\username\Local Settings\Temp

Terrain Preprocessing Workflows

The Terrain Preprocessing Workflows toolset contains one model named Basic Dendritic Terrain Processing as an example of a model that strings together some of the Terrain Preprocessing tools and allows performing a dendritic terrain preprocessing workflow.



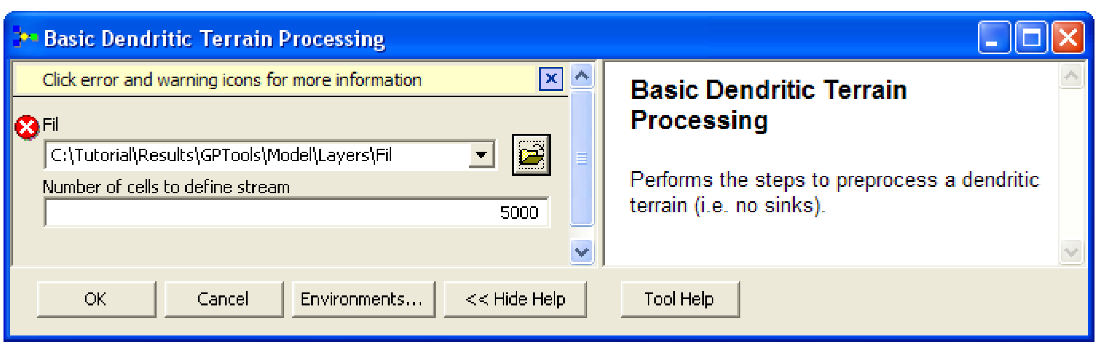
Note

Additional examples of workflows that apply to diverse types of terrains are provided in the document "Comprehensive terrain preprocessing using Arc Hydro tools".

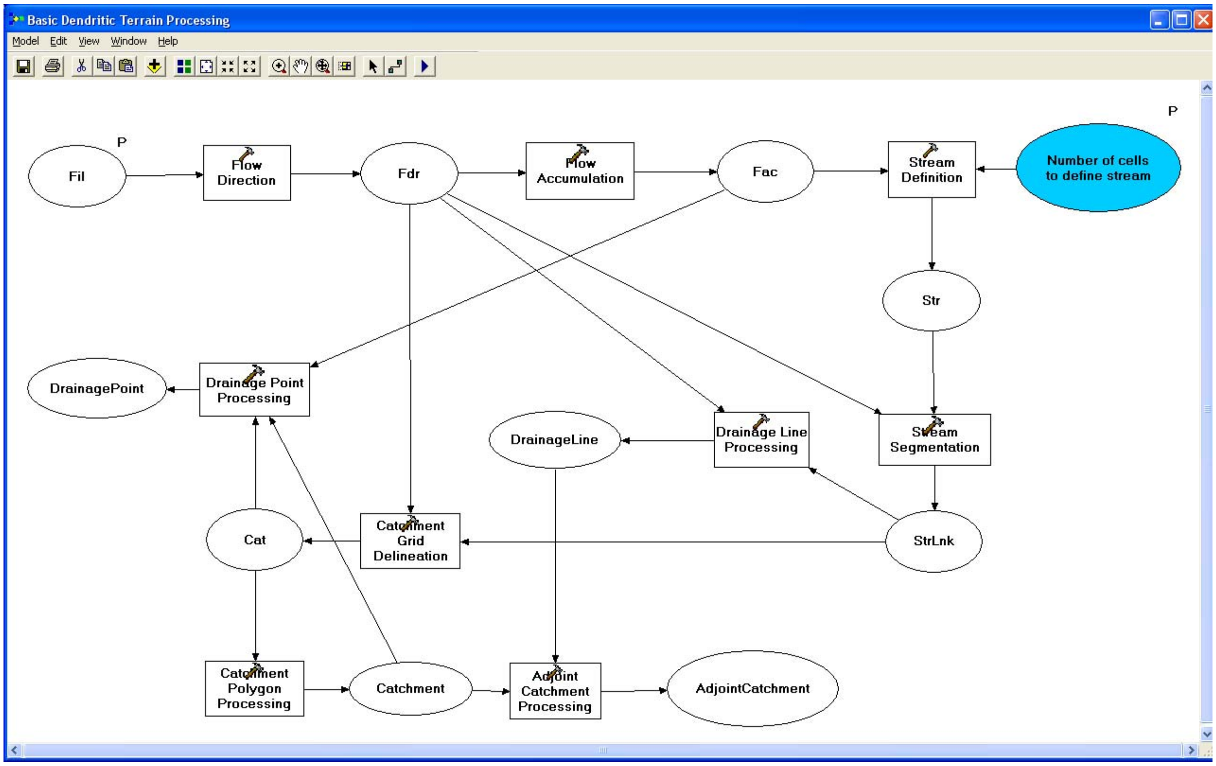
1. Basic Dendritic Terrain Processing

- Open a new map and add the filled DEM grid "filall"grid from the DataGP\Model folder. Add the Arc Hydro Tools toolbox if needed and save the map as Model.mxd for example.
- Right-click **Terrain Preprocessing Workflows > Basic Dendritic Terrain Processing** and select Open.

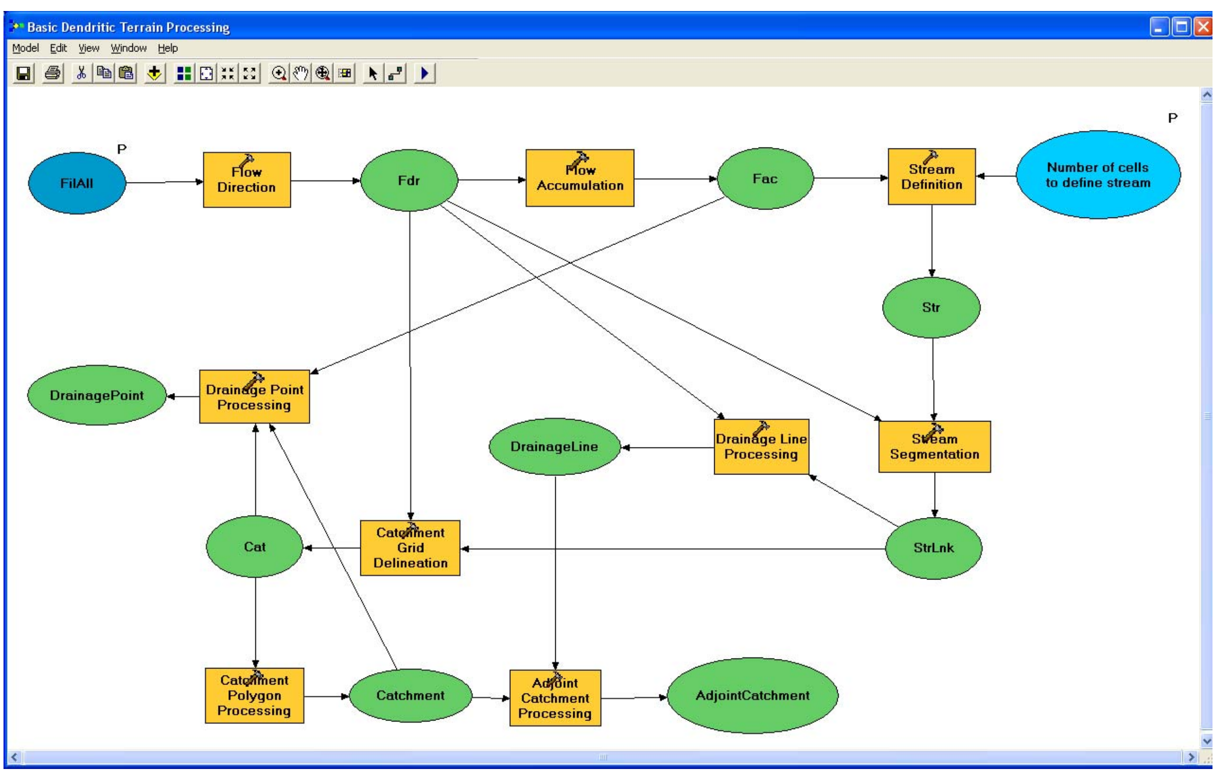
The model requires 2 input parameters: a filled DEM and the number of cells defining a stream. This threshold is used in the model to define the stream grid from the flow accumulation grid.



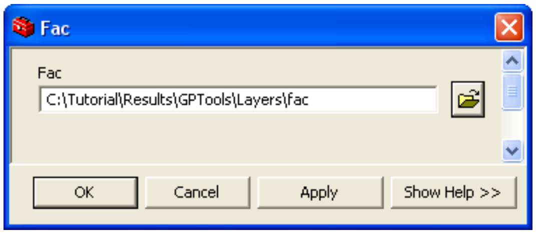
- Click Cancel to close the form and right-click **Batch Terrain Preprocessing > Basic Dendritic Terrain Processing** and select Edit to display the model.

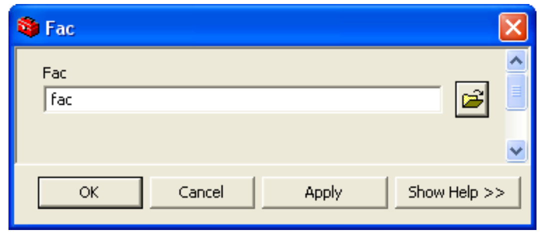


- Right-click Fil and select Open. Browse to an input Filled DEM grid FilAll and click OK. Select Model > Validate Entire Model.



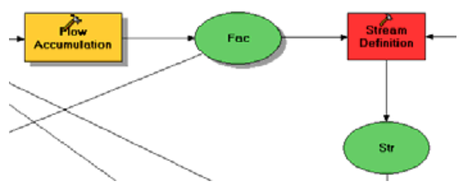
- Right-click Number of cells and select an appropriate threshold for the input filled DEM (e.g. 40,000 if you are using the tutorial data). Click OK.
- Right-click and open each data in the green circles. Remove the full path and keep only the name of the output data. If the full path is set, the tool will generate the data in that location. If it is not set, it will use the default target vector/raster location set in the environment.





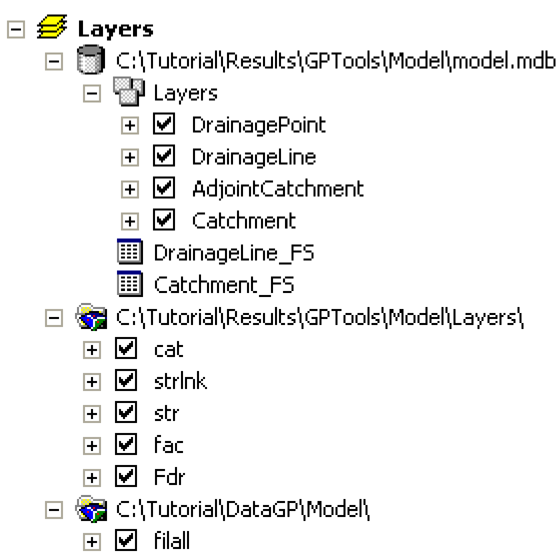
- After resetting the data paths, select Model > Run or click the arrow on the toolbar to run the model.

- The execution processes through each step – the tool currently being run is displayed in red.



- Close the model without saving the changes after completion of the run.

The following data is generated and added into the Table of Contents of ArcMap:



Note

You may need to add the table Catchment_FS manually.

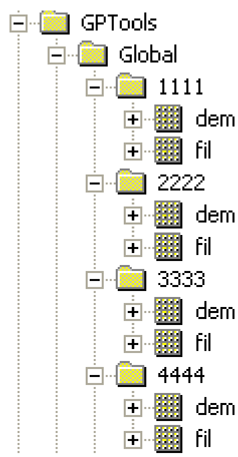
- Save your map and close ArcMap.

2. Batch Processing

The Batch Processing tool allows running a model in batch mode. It will run the model for each subdirectory within the global location specified as input parameter by the user. The batch tool is configured by default to run with the Basic Dendritic Terrain Processing model.
You are going to use the tutorial data from the DataGP\Global directory.

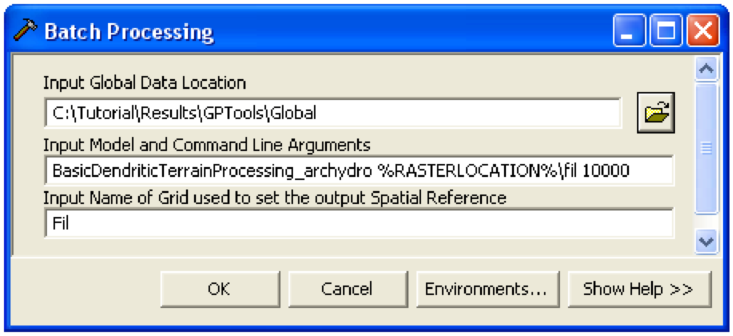
- Copy the DataGP\Global directory into the location where you want to create your data (e.g. Results\GPTools).

- This directory contains 4 subdirectories (1111, 2222, 3333 and 4444) that each contains an elevation grid (dem) and a filled elevation grid (fil).



The dem is the original elevation grid for each area considered and the fil grid the corresponding filled elevation grid. The fil elevation is the input grid used by the previous workflow. The batch process allows applying the workflow to each fil grid and generating the preprocessed data for each subdirectory in batch mode. Note that the same threshold will be used to generate the stream grid for each study area (e.g. 10000 cells).

- Open a new map document. You do not need to save the map.
- Right-click the model Basin Dendritic Terrain Processing and make sure that none of the data in green is set using a full path. Remove the path if needed. Close and save the model if you edited it.
- Double-click Terrain Preprocessing Workflows > Batch Processing.



- Browse to the global location containing the subdirectories to process. Each subdirectory must contain the inputs required to run the model (fil) as well as the grid used to create the output Spatial Reference for the vector location (fil).
- Specify the name of the model and its arguments. By default, this parameter is set to:

BasicDendriticTerrainProcessing_archydro %RASTERLOCATION%\fil 5000

Where:

- BasicDendriticTerrainProcessing_archydro is the name of the model to run
- %RASTERLOCATION%\fil 5000 are the input parameters required by the model:
- %RASTERLOCATION% is the raster target location that will be replaced on runtime with the raster location corresponding to the subdirectory being processed.
- 5000 is the threshold in number of cells defining the start of a stream. Replace this value with 10000.

Note

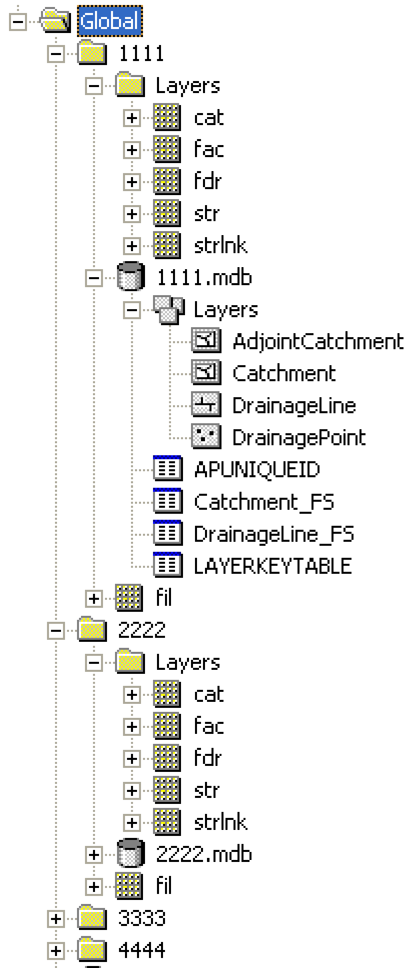
- Input vector data would be defined using the variable %VECTORLOCATION% that would be replaced on run time with the vector target location for each subdirectory.
- Specify the name of the grid used to set the spatial reference for the output vector location (e.g. fil). This grid must exist in each subdirectory.

For each subdirectory under the specified global data location:

1. The batch tool first runs the Set Batchte Target Locations geoprocessing tool using the name of the specified Grid. You need to have a raster with that name (e.g. Fil) in each subdirectory.
2. The batch tool then runs the specified model. It stores its name in the active configuration in memory under HydroConfig/ProgParams/ApFunctions/ApFunction(BatchTerrainProcessing)/BatchProcessingModelName.

Note

The batch tool resets the initial Arc Hydro configuration at the end of the processing.

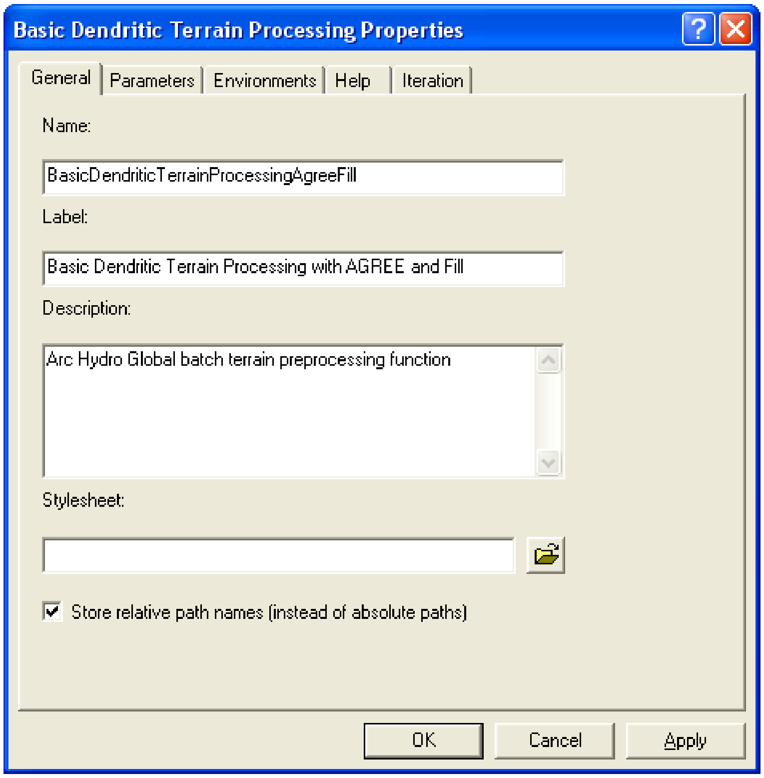


- Close the map without saving it.

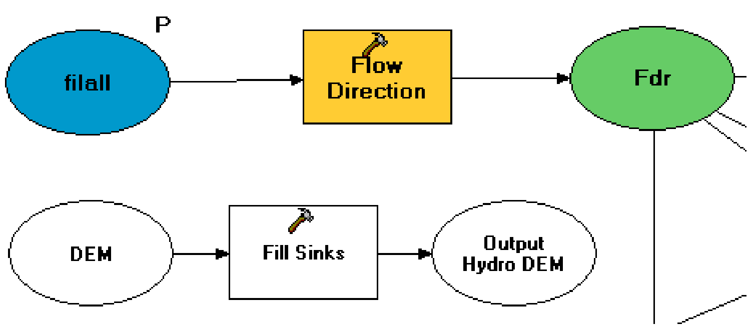
3. How to create your own model

This section describes how to edit the existing model to create a new model that will require as input a Raw DEM (e.g. elev_cm) and a stream feature class (e.g. NHDFlowline).

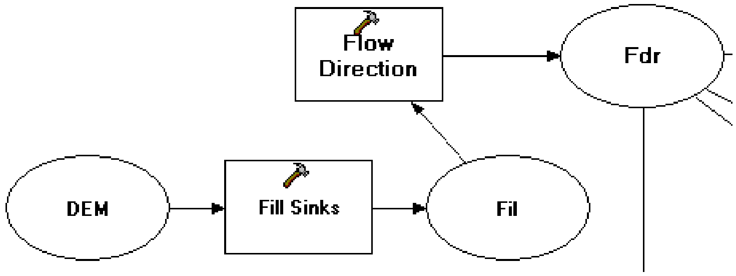
- Open a new map document and add the Arc Hydro toolbox if needed.
- Right-click ArcToolbox and select New Toolbox. Then right-click the new toolbox and select Rename. Enter “My Arc Hydro Tools” and click OK. Right-click the Basic Dendritic Terrain Processing model and select Copy. Navigate to your new toolbox, right-click and select Paste.
- Right-click the model and select Properties. Switch to the General tab. Rename this model BasicDendriticTerrainProcessingAgreeFill and label it “Basic Terrain Preprocessing with Reconditioning and Fill”. Click OK.



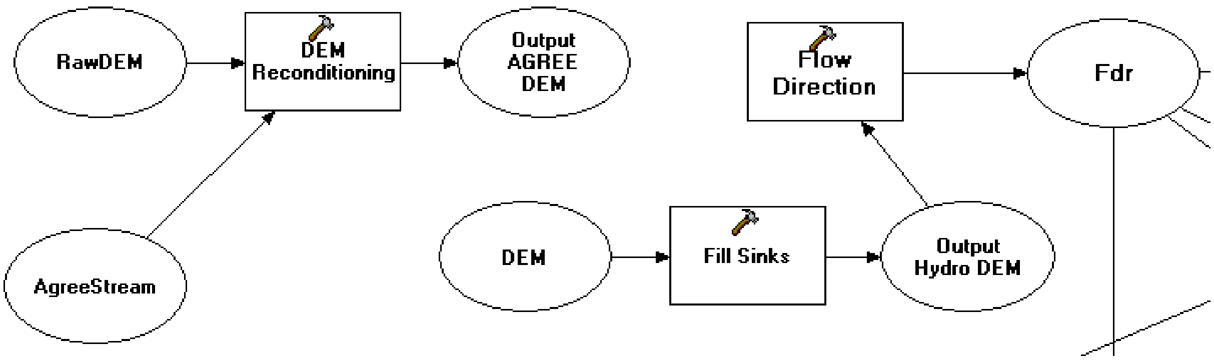
- Right-click the model and select Edit. Drag the Fill Sinks tool from the toolbox into the model.



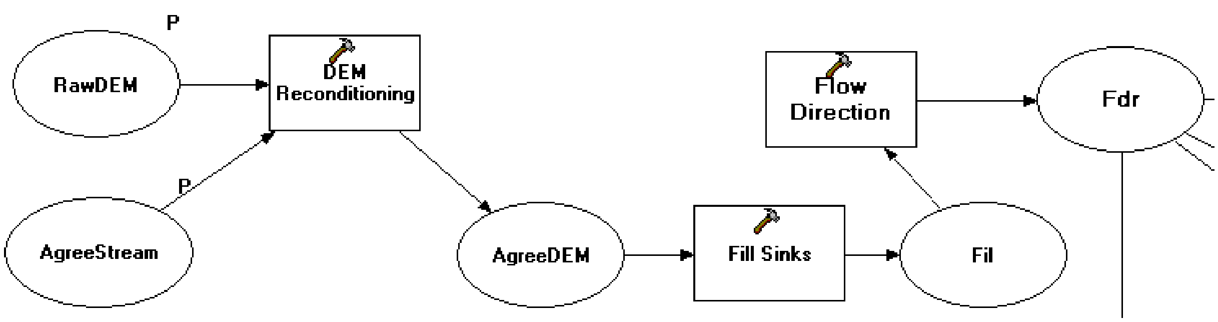
- Select the DerangedPoly box if visible and delete it as this is an optional output that will not be used. Right-click Fill Sinks and select Open. Set the Fill Threshold to blank, the output to Fil and click OK.
- Click to select and delete the input grid to the Flow Direction tool (e.g. filall).
- Right-click Flow Direction, select Open and set the input Hydro DEM to Fil, the output to the Fill Sinks tool.



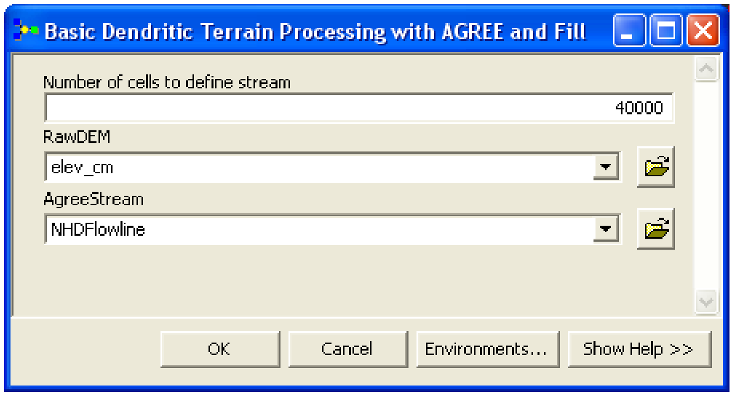
- Save the model, then drag DEM Reconditioning into the model.



- Delete the input to the Fill Sinks tool (e.g. DEM). Right-click Fill Sinks and select Open. Set its input grid to Output AGREE DEM.
- Right-click RawDEM and AgreeStream and make them Model Parameters. Make sure Fill and AGREE DEM are not Intermediate and have Add to Display checked (Right-click each one to see their settings).
- Review the inputs/outputs and make sure they are not using a full path but only the layer tag name.



- Save and close the model. Save the map as MyModel.mxd for example in a MyModel subdirectory.
- Double-click the model. Make sure the inputs are correct and click OK.

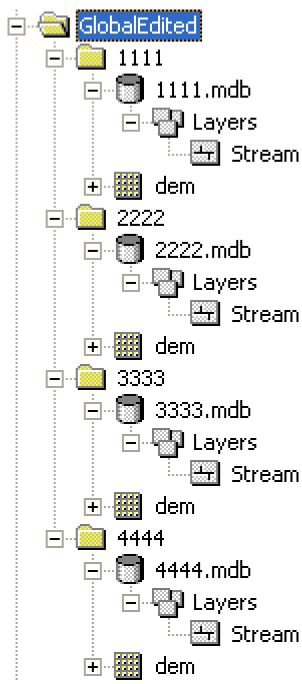


The outputs from the model are generated and added into the Table of Contents of ArcMap.

- Save the map and close ArcMap.

4. How to run your own model in batch mode

- Copy the directory DataGP\GlobalEdited. It contains the input data required to run the model you created in the previous step, i.e. DEM and stream feature class.



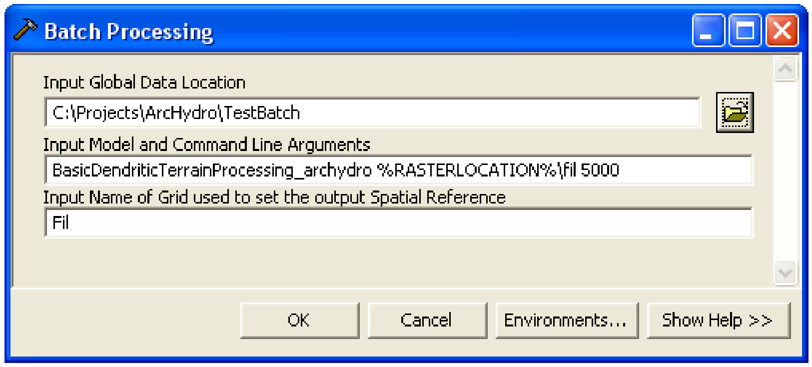
- Open a new map document. You do not need to save the map.

If you do not see the model you previously created, you need to add it to the ArcToolbox window.

- Right-click ArcToolbox and select Add Toolbox. Browse to Toolboxes\My Toolboxes and open My Arc Hydro Tools.

The Batch Processing tool requires 3 inputs:

- Input Global Data Location: parent directory containing the subdirectories to process (GlobalEdited)
- Input Model and Command Line Arguments – needs to be updated to reflect the new model/arguments
- Input Name of Grid use to set the output Spatial Reference – same as previously



1. The batch tool first runs the Create Target Locations geoprocessing tools using the input name of the grid specified. You need to have a raster with that name in each subdirectory under your global data location.
2. The batch tool then runs the model specified.

   The batch tool retrieves the name of the grid used to setup the spatial reference in the subdirectories and the name and parameters of the model from the specified parameters. Default values are read from the active configuration in the ArcMap or ArcCatalog session.

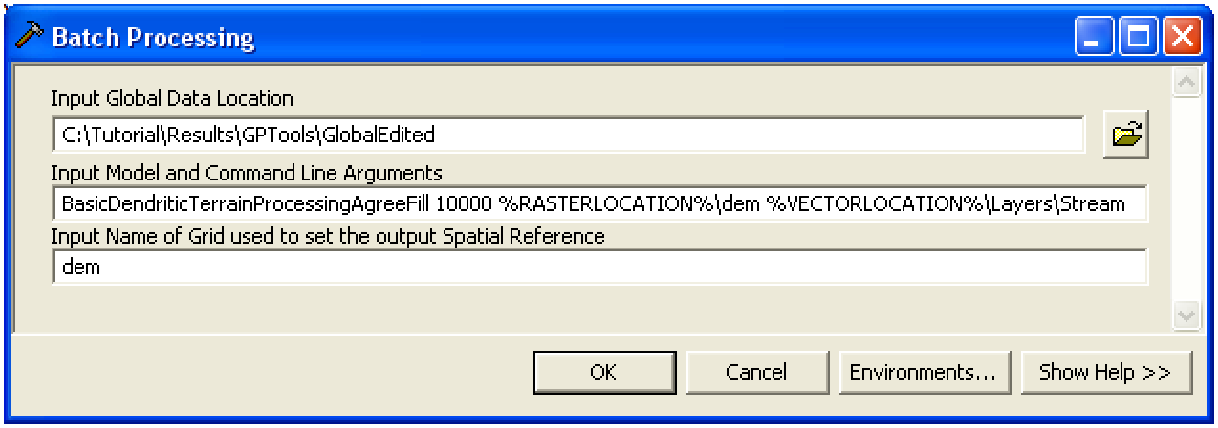
   - The batch tool retrieve the parameters for the tools used in the model based on the active Arc Hydro configuration.
   - The name and parameter(s) of the model run by the Batch Dendritic Terrain Preprocessing tool is defined in the configuration as well. You can modify the configuration so that the batch tool calls your own model.
   - Open the Command Line window in ArcMap or ArcCatalog and drag your new model into it to view its usage:

The default BatchProcessingModelName is set to:

BasicDendriticTerrainProcessing_archydro %RASTERLOCATION%\fil 5000

- Set it to your own model and make sure the parameters are listed in the correct order.

BasicDendriticTerrainProcessingAgreeFill 10000 %RASTERLOCATION%\dem %VECTORLOCATION%\Layers\Stream



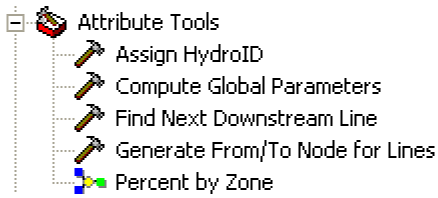
Note that this means that a raster named dem and a feature class called Stream MUST exist in each subdirectory being processed or the model will fail for that directory.

- Browse to the global location containing the subdirectories to process (e.g. GlobalEdited). Each subdirectory must contain the inputs required to run the model as well as the grid used to setup the spatial reference for the vector locations.
- Set dem as input grid used to set the output spatial reference. Note that in this case the output locations already exist.
- Run the Batch Processing tool.

The Batch tool creates the outputs in each subdirectory.

Attribute Tools

These tools allow populating attributes in the specified tables or feature classes.

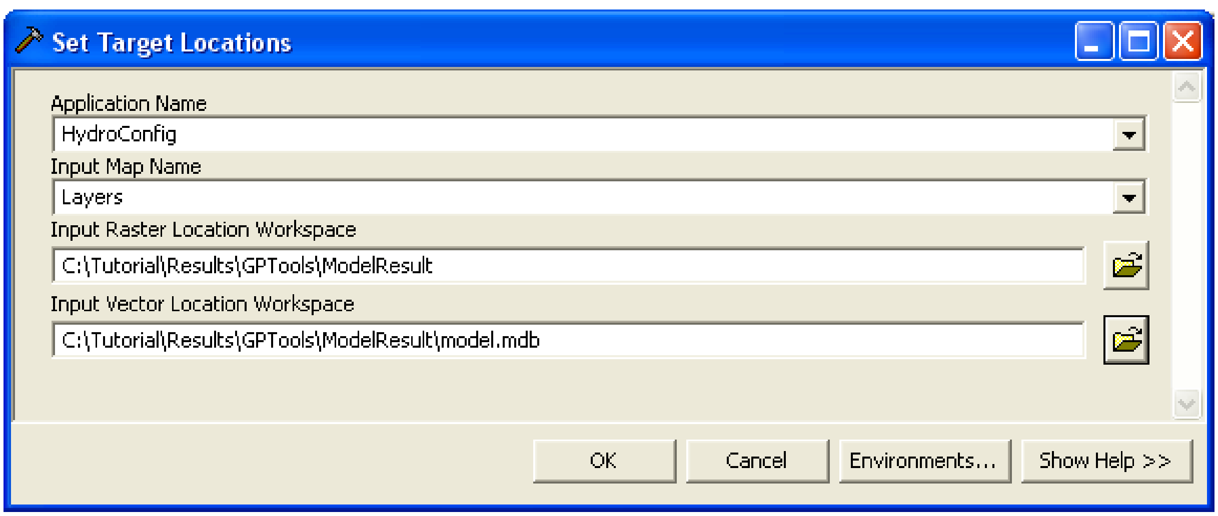


You will use the data from the DataGP\ModelResult folder to test these tools.

- Copy this data directory into a new location since you will be editing the data.
- Open a new map document and add the Drainage Line feature class into the Table of Contents of ArcMap. Save the map as AttributesTools.mxd for example.

In this example you are going to use the existing database (Model.mdb) as vector target location.

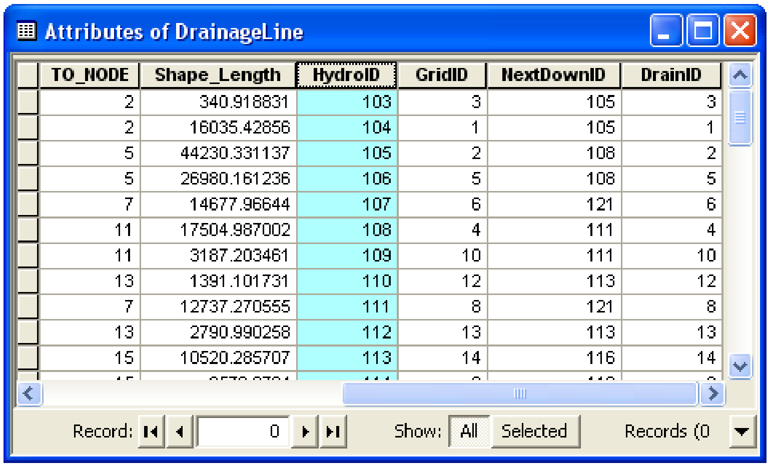
- Double-click the Set Target Locations tool and browse to the existing target locations. Click OK.



1. Assign HydroID

This tool assigns HydroIDs to the records in the specified input feature class or table. It currently works on all features within the feature class. The tool offers the option to overwrite already existing HydroIDs.

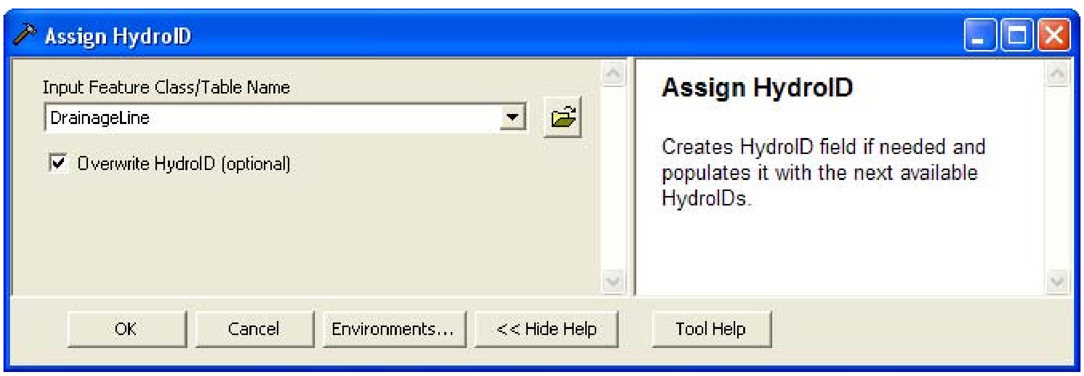
- Open the attributes table of Drainage Line. Check the values in the HydroID field.



Attributes of DrainageLine

TO_NODE	Shape_Length	HydroID	GridID	NextDownID	DrainID
2	340.918831	103	3	105	3
2	16035.42856	104	1	105	1
5	44230.331137	105	2	108	2
5	26980.161236	106	5	108	5
7	14677.96644	107	6	121	6
11	17504.987002	108	4	111	4
11	3187.203461	109	10	111	10
13	1391.101731	110	12	113	12
7	12737.270555	111	8	121	8
13	2790.990258	112	13	113	13
15	10520.285707	113	14	116	14

- Double-click Attribute Tools > Assign HydroID.

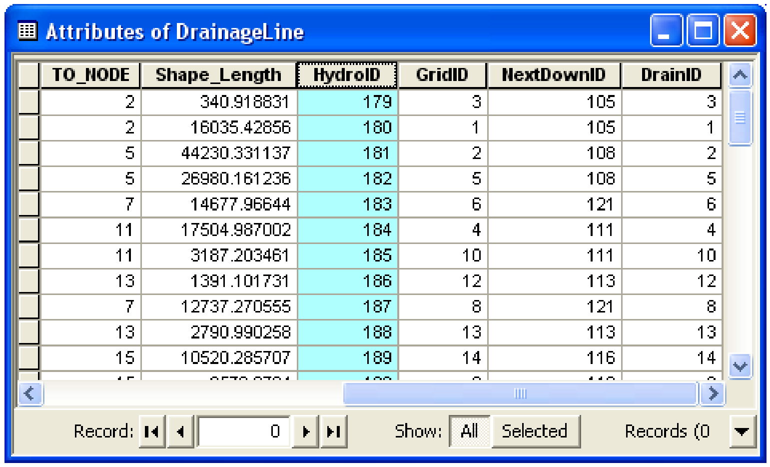


- Specify DrainageLine as the input layer or table and check the Overwrite HydroID checkbox since the HydroID field is already populated. Click OK.

- The tool creates the HydroID field if it does not already exist and updates the HydroIDs as appropriate.

Note

If the HydroIDs are being overwritten while the table is opened in ArcMap, the table needs to be closed and reopened to view the updated HydroIDs.



Attributes of DrainageLine

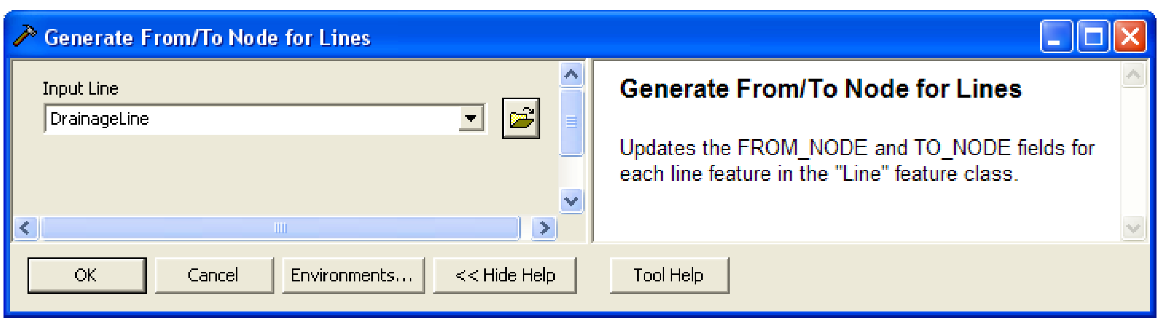
TO_NODE	Shape_Length	HydroID	GridID	NextDownID	DrainID
2	340.918831	179	3	105	3
2	16035.42856	180	1	105	1
5	44230.331137	181	2	108	2
5	26980.161236	182	5	108	5
7	14677.96644	183	6	121	6
11	17504.987002	184	4	111	4
11	3187.203461	185	10	111	10
13	1391.101731	186	12	113	12
7	12737.270555	187	8	121	8
13	2790.990258	188	13	113	13
15	10520.285707	189	14	116	14

Record: 0 Show: All Selected Records (0

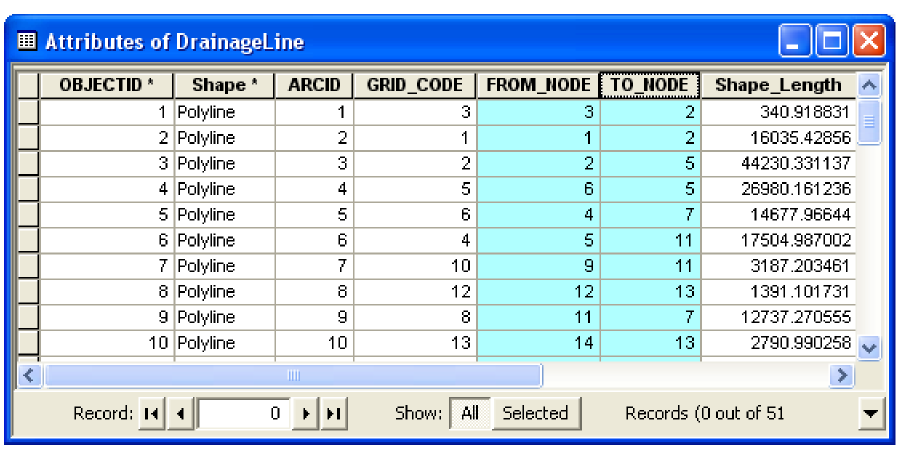
2. Generate From/To Node for Lines

This tool stores the connectivity between line features by creating and populating the fields From_Node and To_Node fields.

- Double-click Attribute Tools > Generate From/To Node for Lines.
- Specify the input Line feature layer for which you want to populate the From_Node/To_Node fields and click OK.



The tool populates the fields FROM_NODE and TO_NODE in the input Line feature class.



Attributes of DrainageLine

OBJECTID *	Shape *	ARCID	GRID_CODE	FROM_NODE	TO_NODE	Shape_Length
1	Polyline	1	3	3	2	340.918831
2	Polyline	2	1	1	2	16035.42856
3	Polyline	3	2	2	5	44230.331137
4	Polyline	4	5	6	5	26980.161236
5	Polyline	5	6	4	7	14677.96644
6	Polyline	6	4	5	11	17504.987002
7	Polyline	7	10	9	11	3187.203461
8	Polyline	8	12	12	13	1391.101731
9	Polyline	9	8	11	7	12737.270555
10	Polyline	10	13	14	13	2790.990258

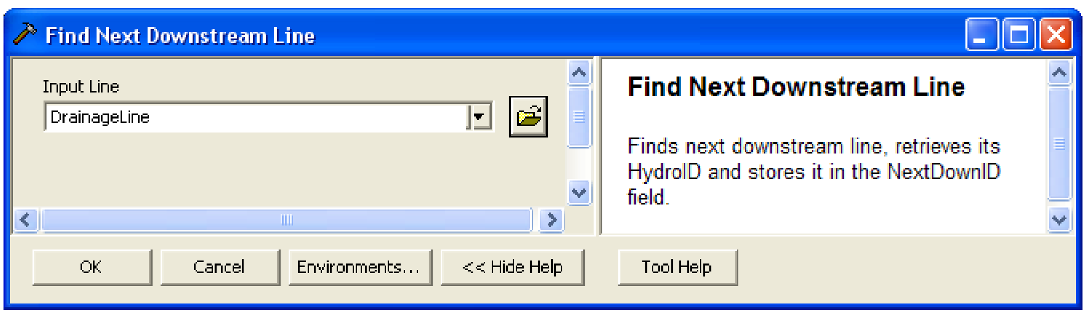
Record: 0 Show: All Selected Records (0 out of 51

3. Find Next Downstream Line

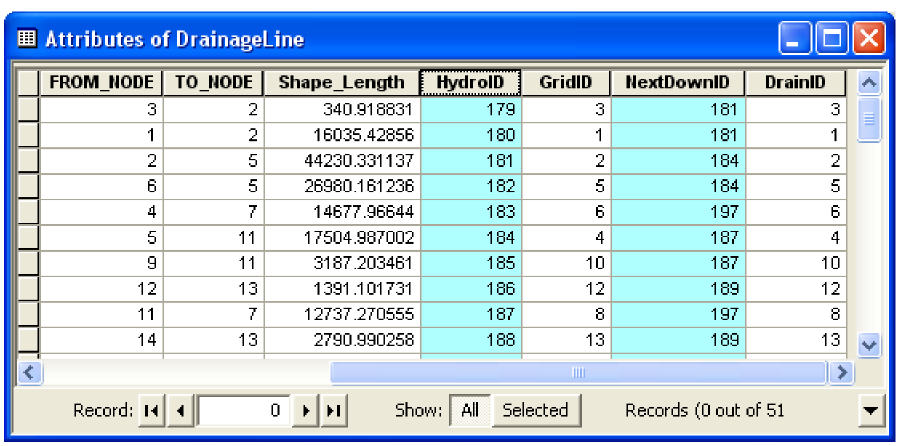
This tool finds the next downstream line based on the From_Node and To_Node fields populated with the previous tool, Generate From/To Node for Lines. It creates the NextDownID field if it does not already exist and populates this field with the HydroID of the next downstream line. The tool also creates a flow split table named by appending _FS to the name of the input Line feature class. This table stores the additional connectivity information for cases when flow splits occur and there is more than one downstream line.

Updating the HydroIDs in Drainage Line with the Assign Hydro tool results in incorrect values bein stored in the NextDownID field. NextDownIDs are supposed to represent the HydroIDs of the next downstream lines. These values need to be updated to match the new HydroIDs by using the Find Next Downstream Line tool.

- Double-click Attribute Tools > Find Next Downstream Line.
- Specify Drainage Line as the input Line feature class for which you want to populate NextDownIDs and click OK.



The tool creates the NextDownID field if it does not already exist and populates it with the HydroID of the next downstream line feature.

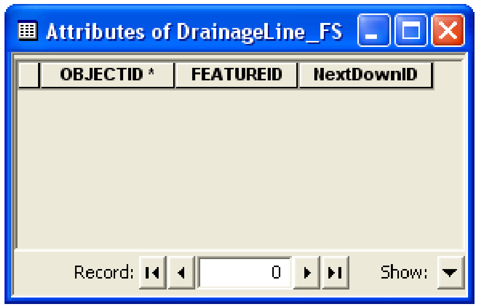

Attributes of DrainageLine

FROM_NODE	TO_NODE	Shape_Length	HydroID	GridID	NextDownID	DrainID
3	2	340.918831	179	3	181	3
1	2	16035.42856	180	1	181	1
2	5	44230.331137	181	2	184	2
6	5	26980.161236	182	5	184	5
4	7	14677.96644	183	6	197	6
5	11	17504.987002	184	4	187	4
9	11	3187.203461	185	10	187	10
12	13	1391.101731	186	12	189	12
11	7	12737.270555	187	8	197	8
14	13	2790.990258	188	13	189	13

Record: 0 Show: All Selected Records (0 out of 51

Note

If the input Line feature class contains flow splits, the additional connectivity information is stored in the flow split table named by appending the suffix "_FS" to the name of the Line feature class (e.g. DrainageLine_FS). The table will be empty if there is no flow splits.

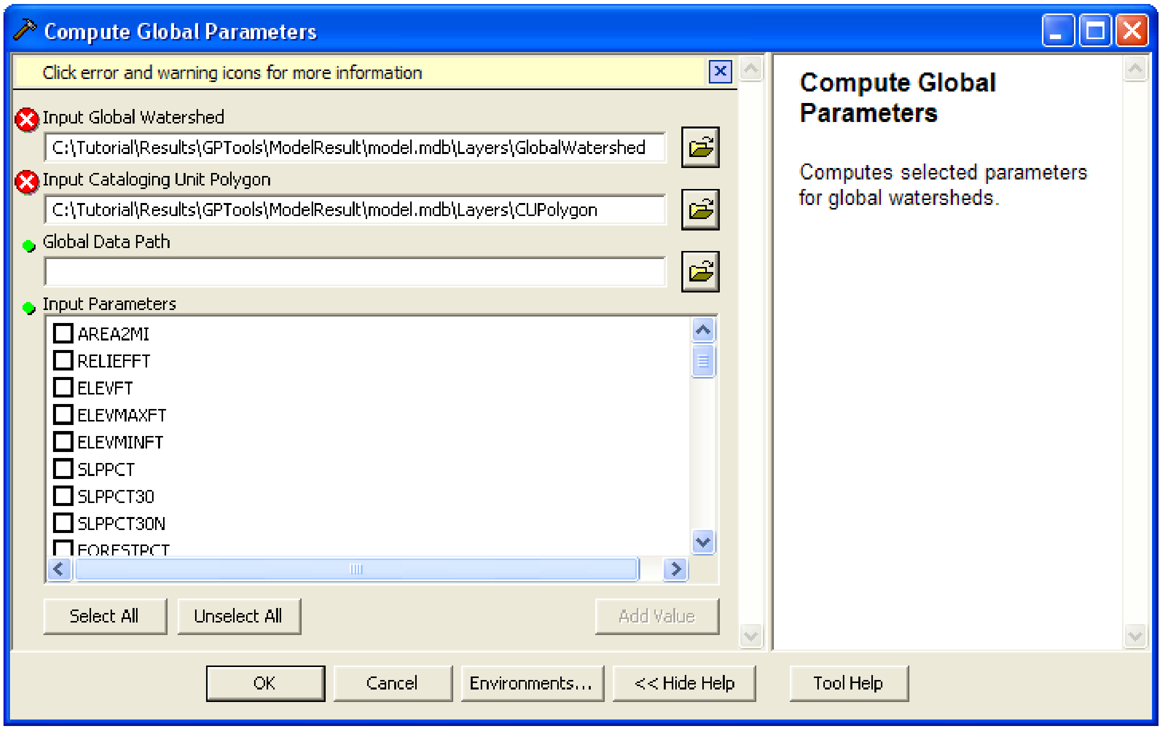


4. Compute Global Parameters

This tool computes the specified characteristics for selected watershed features. It is setup to work for a global environment. The tool identifies the location of the data required to characterize each selected watershed by using a cataloging unit layer with the Name field. This global tool can also be used in a standard "local" environment by setting up a cataloging unit polygon feature class with one feature covering the extent of the data. This allows the data to reside on the disk instead of having to add it into the map (when using the tool in ArcMap) and also allows the tool to be used in ArcCatalog since it does not depend on the map.

You are going to setup the tool to work with your local data.

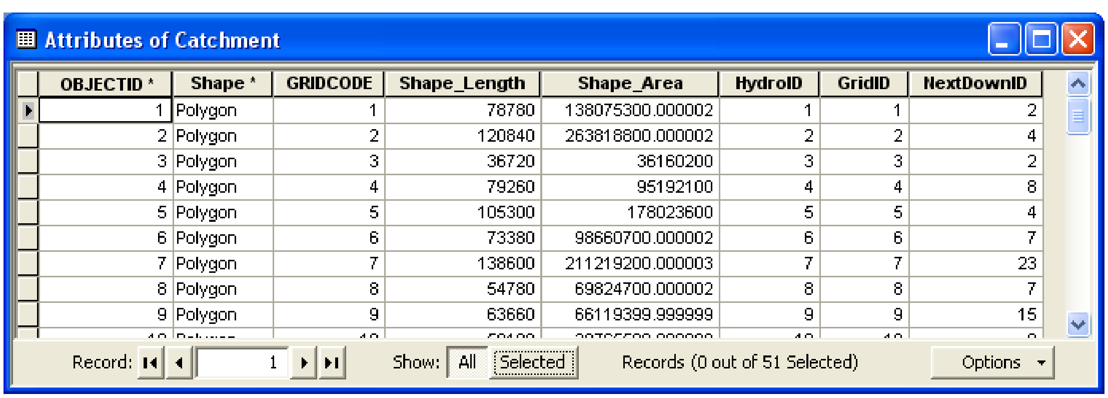
- Double-click Attribute Tools > Compute Global Parameters.



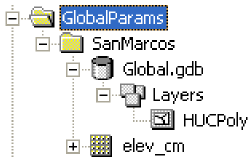
The tool requires as input the Global Watershed feature class that needs to be characterized and the cataloging unit polygon that allows identifying the location of the supporting data on the disk. The Global Data Path must be set to the location of the parent directory under which the supporting data directory is located. The name of the subdirectory is read from the Name field in the Cataloging Unit Polygon feature class.

You are going to characterize the Catchment features corresponding to the Drainage Line features in the map.

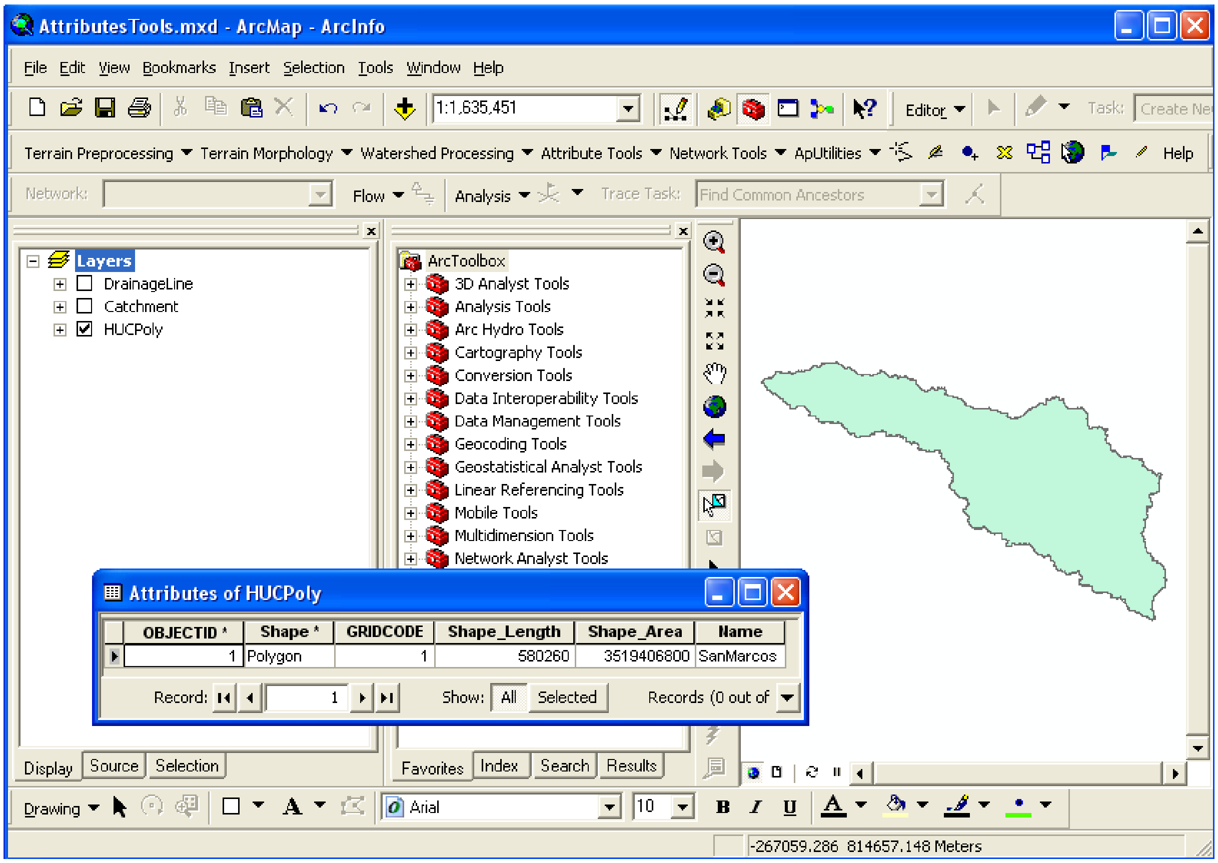
- Click Cancel to close the tool and add the Catchment feature class into the map. It is located in the same geodatabase as Drainage Line. Open its attributes table.



The supporting data for this example is located in the directory DataGP\GlobalParams.

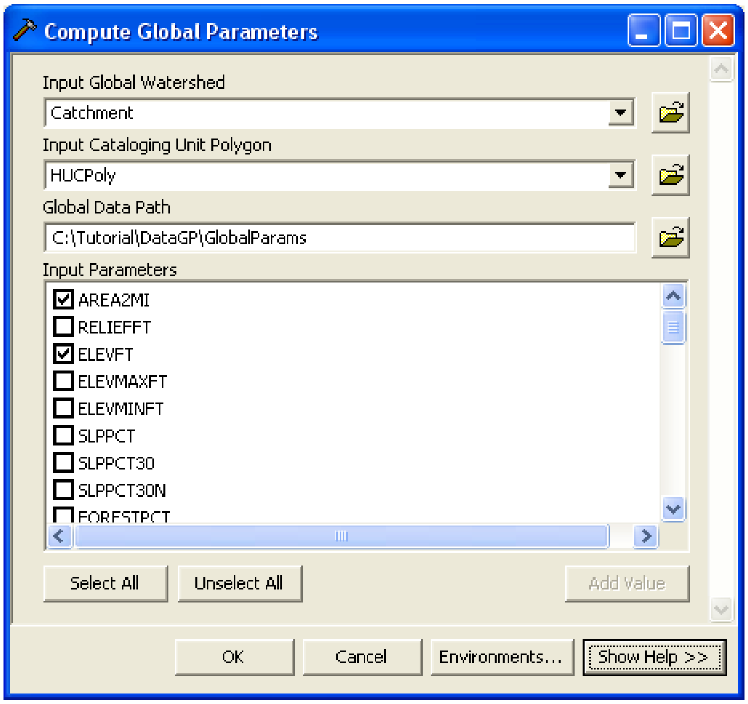


- Browse to the Global.gdb database in this location and add the Cataloging Unit Polygon layer HUCPoly into the Table of Contents of ArcMap.



This polygon layer contains one polygon feature that covers the entire study area (San Marcos). This layer was created by converting the input elevation raster (elev_cm) into a grid of value 1, converting this grid into a polygon feature class and dissolving the resulting polygon features based on the GridID field (all GridIDs were equal to 1). Then the Name field was added and populated with “SanMarcos”, which is the name of the subdirectory under the Global location.

- Select a few features in the Catchment feature class (e.g. the first 4 features in the table) as the tool works on a selected set. It will process all features if there is no selected set.
- Double-click **Attribute Tools** > **Compute Global Parameters**. Select Catchment as Input Global Watershed, HUCPoly as Input Cataloging Unit Polygon and use the DataGP\GlobalParams directory as Global Data Path.

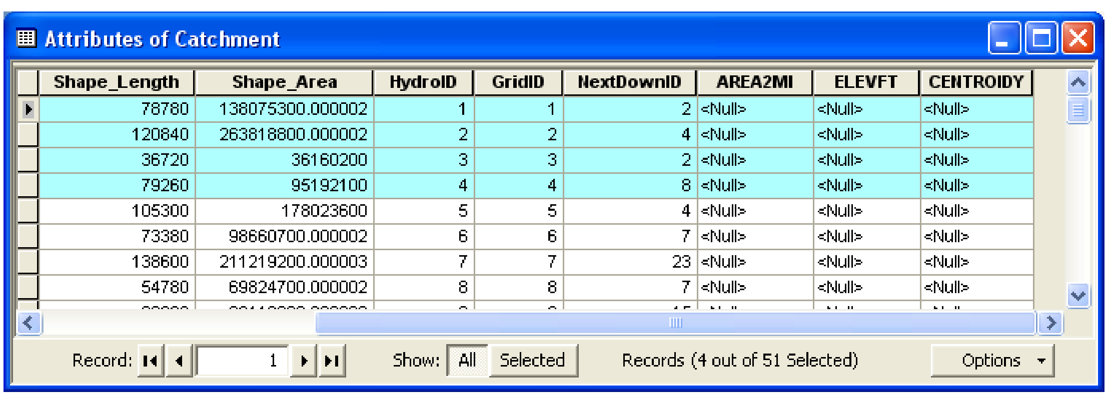


- Select AREA2MI, ELEVFT and CENTROIDY as Input Parameters and click OK.

The tool fails with the following messages:

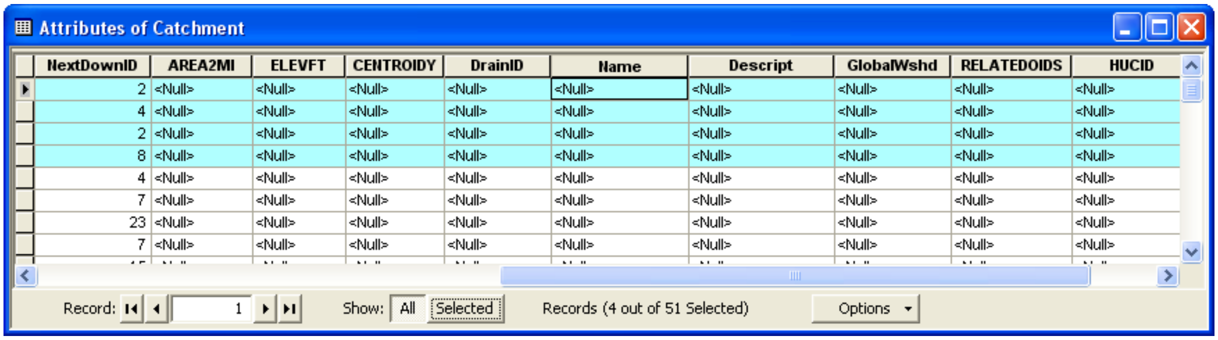
DRAINID does not exist for GlobalWatershed!
NAME does not exist for GlobalWatershed!
DESCRIPTION does not exist for GlobalWatershed!
GLOBALWSHD does not exist for GlobalWatershed!
RELATEDOIDS does not exist for GlobalWatershed!

You need to create these fields that are required in the Global Watershed feature class. Note that new fields corresponding to the selected parameters have been created in the attributes table of Catchment.



- On the Arc Hydro toolbar, select Watershed Processing > Data Management Watershed Delineation. Double-check that the Catchment feature class is tagged as Global Watershed and click OK.

The required missing fields are created in the Catchment feature class.

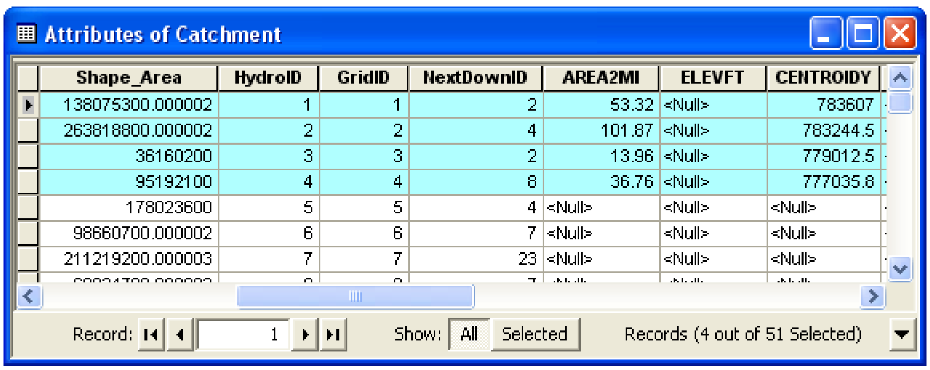


Attributes of Catchment

NextDownID	AREA2MI	ELEVFT	CENTROIDY	DrainID	Name	Descript	GlobalWshd	RELATEDOIDS	HUCID
2	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
4	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
2	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
8	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
4	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
7	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
23	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
7	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>

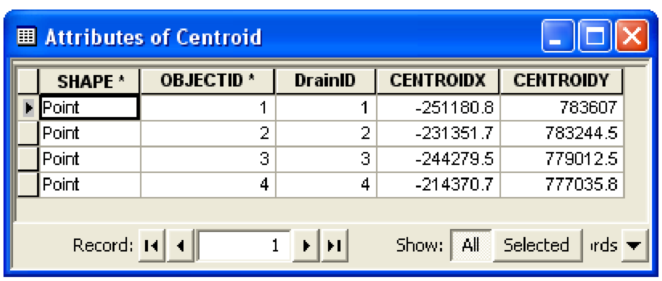
- Double Click Compute Global Parameters and compute AREA2MI, ELEVFT and CENTROIDY.

The function successfully computes and populates the parameters AREA2MI and CENTROIDY. It also generates the centroid point features and stores them in the new CENTROID feature class.



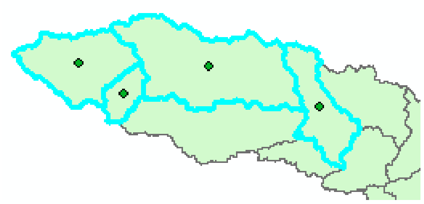
Attributes of Catchment

Shape_Area	HydroID	GridID	NextDownID	AREA2MI	ELEVFT	CENTROIDY
138075300.000002	1	1	2	53.32	<Null>	783607
263818800.000002	2	2	4	101.87	<Null>	783244.5
36160200	3	3	2	13.96	<Null>	779012.5
95192100	4	4	8	36.76	<Null>	777035.8
178023600	5	5	4	<Null>	<Null>	<Null>
98660700.000002	6	6	7	<Null>	<Null>	<Null>
211219200.000003	7	7	23	<Null>	<Null>	<Null>



Attributes of Centroid

SHAPE *	OBJECTID *	DrainID	CENTROIDX	CENTROIDY
Point	1	1	-251180.8	783607
Point	2	2	-231351.7	783244.5
Point	3	3	-244279.5	779012.5
Point	4	4	-214370.7	777035.8



The parameter ELEVFT is not computed. The following message is displayed for each feature:

OID: 1

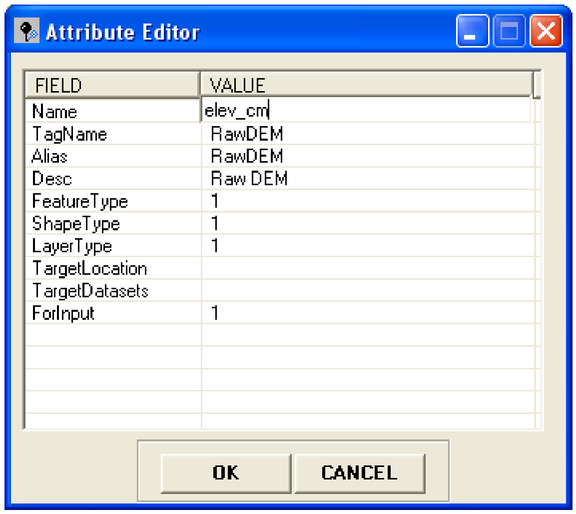
Raster dataset DEM not found. Checking corresponding ApLayer.

Raster not found for ApLayer RawDEM. Parameter ELEVFT cannot be computed.

The computation failed because the function could not find the input elevation grid DEM in the input directory. The name of the elevation grid needs to be set to elev_cm instead of DEM in the XML configuration associated to the map.

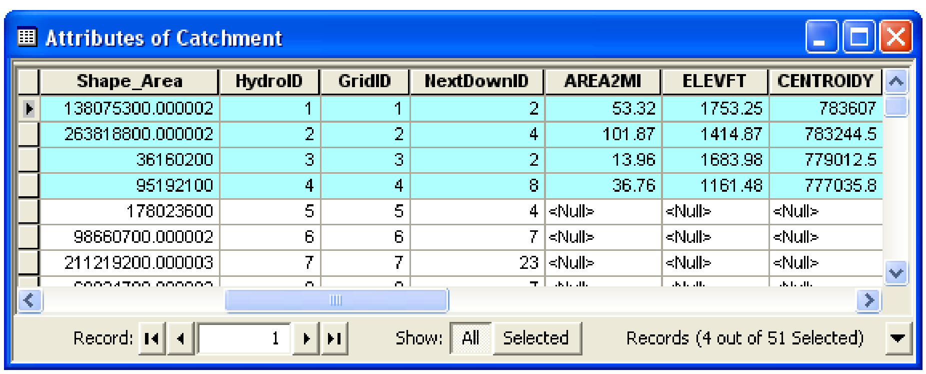
- Select ApUtilities > XML Manager to open the active configuration.

- Browse to the node *HydroConfig\ProgParams\ApFunctions\ApFunction(WshParams)\ApFields\ApField(ELEVFT)\ApLayers\ApLayer(RawDEM,DEM).* Right-click this node and select EditAttributes. Change Name from DEM to elev_cm and click OK. Close the form and save the map.



- Double-click Compute Global Parameters and compute ELEVFT.

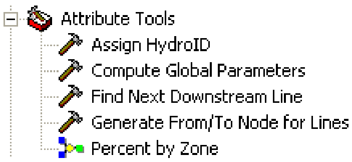
The tool computes the ELEVFT parameter using the elev_cm grid and populates the corresponding field in the attributes table of Catchment.



Detailed information on how to setup additional parameters that can be computed with this tool can be found in the document "Local Parameters Configuration". In particular, you can configure the tool to work with your models. The model Percent by Zone is an example of model connected to the tool – it allows computing the percent of the area in the input watershed falling into each classification of the grid (E.g. percent landuse).

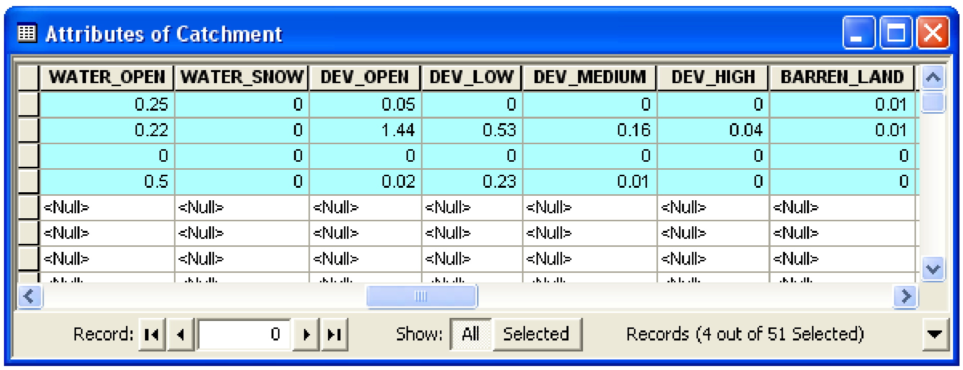
Note

You need to allow overwriting of the outputs of the geoprocessing functions to use this model (Tools > Options>Geoprocessing tab).



- Double-click Compute Global Parameters and compute the parameter LUSE_NLCD.

The function computes predefined landuse percentages and store their values in new fields created in the attributes table of Catchment.

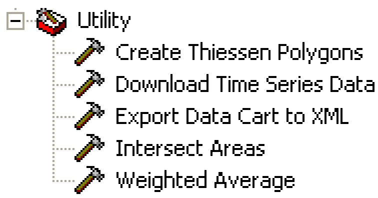


WATER_OPEN	WATER_SNOW	DEV_OPEN	DEV_LOW	DEV_MEDIUM	DEV_HIGH	BARREN_LAND
0.25	0	0.05	0	0	0	0.01
0.22	0	1.44	0.53	0.16	0.04	0.01
0	0	0	0	0	0	0
0.5	0	0.02	0.23	0.01	0	0
<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>

- Save and close the map.

Utility

There are currently 5 tools in the Utility toolset.



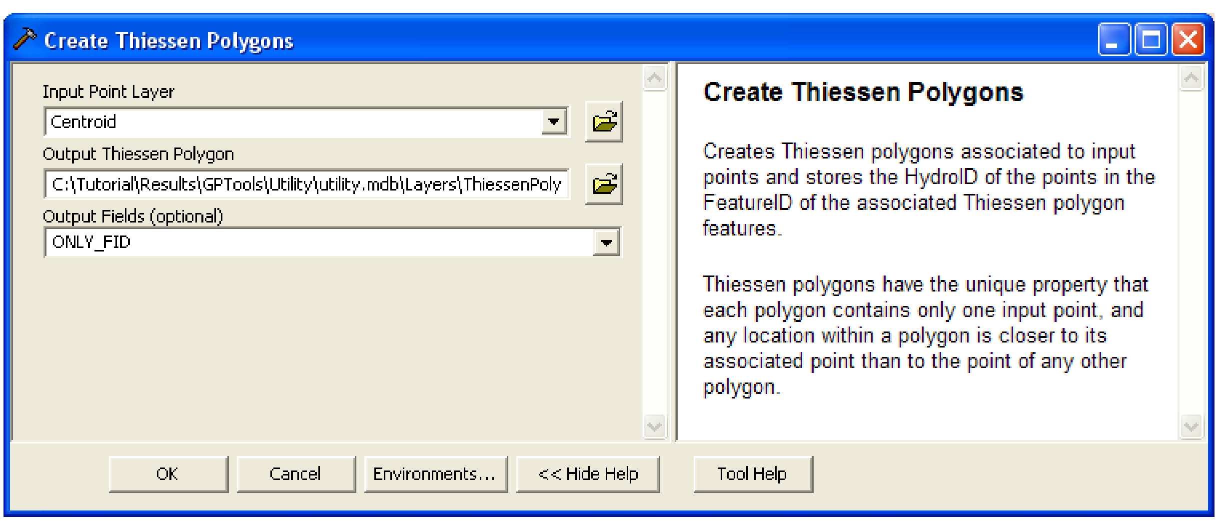
You will use the data from the DataGP\ModelResult folder and from the DataGp\TimeSeries folder to test these tools.

- Open a new map document and add the Catchment feature class from the DataGP\ModelResult\Model.mdb geodatabase. Save the map as Utility.mxd in the Utility directory for example.
- On the Arc Hydro Tools toolbar, select Watershed Processing > Drainage Area Centroid and create the centroid features associated to the catchments (e.g. Centroid).

1. Create Thiessen Polygons

This tool creates the Thiessen polygons associated to input points. The input point feature class must contain the field HydroID that will be transferred into the FeatureID field in the associated Thiessen polygon feature.

- Double-click Utility > Create Thiessen Polygons.
- Select Centroid as the input Point Layer for which you want to create Thiessen Polygon features. Keep the default name ThiessenPoly for the output polygon feature class. Specify whether to transfer all fields from the input point layer or only the feature ids and click OK.



The tool creates the output ThiessenPoly feature class. The FeatureID field stores the HydroID of the associated input point feature.

Attributes of ThiessenPoly

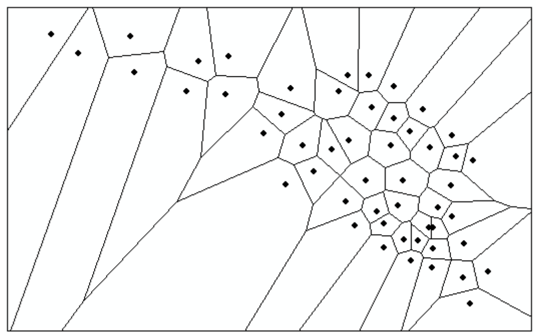
OBJECTID *	Shape *	Shape_Length	Shape_Area	Input_FID	FeatureID
45	Polygon	87669.981335	311241950.064847	1	1
44	Polygon	59961.265306	204880737.508156	2	2
7	Polygon	174118.392937	869120940.929108	3	3
8	Polygon	52750.922265	174489122.797304	4	4
43	Polygon	174174.005741	1046804285.36574	5	5
48	Polygon	68429.191598	273952791.963251	6	6
9	Polygon	66282.649461	237091688.028499	7	7
47	Polygon	57656.956927	168913485.382929	8	8

Record: 0 Show: All Selected Records (0 out of 51 Selected)

Attributes of Centroid

Shape *	OBJECTID *	DrainID	HydroID
Point	1	1	1
Point	2	2	2
Point	3	3	3
Point	4	4	4
Point	5	5	5
Point	6	6	6
Point	7	7	7
Point	8	8	8

Record: 1 Show: All

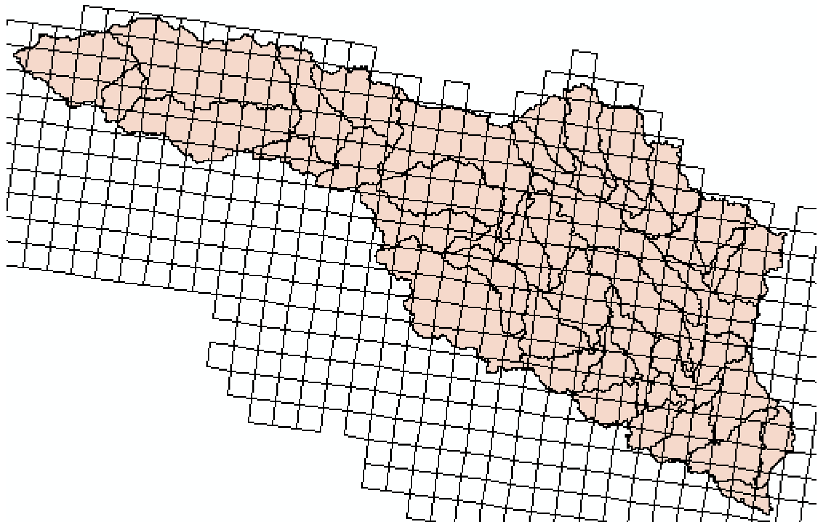


2. Intersect Areas

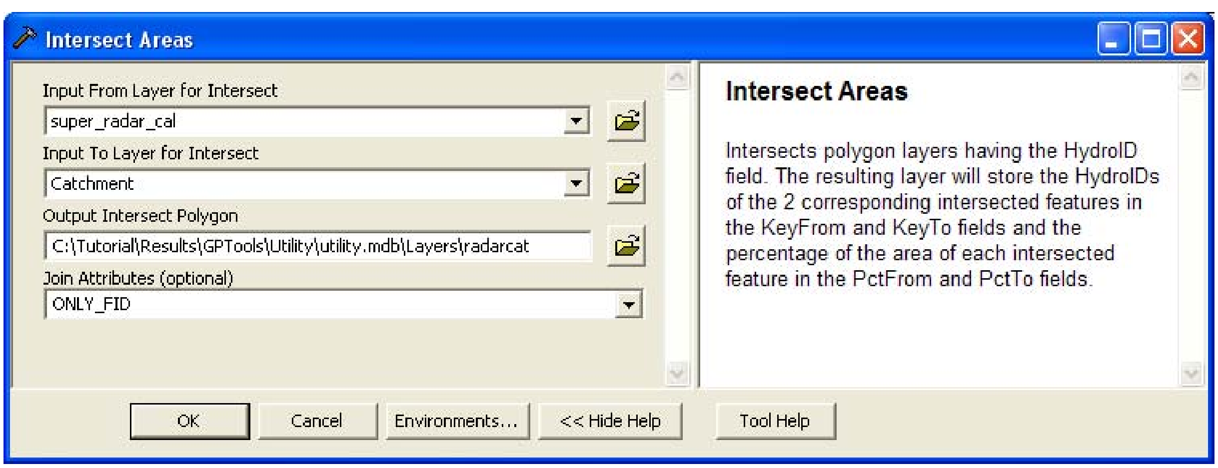
This tool intersects a From Layer polygon feature class with a To Layer polygon class and attributes the resulting intersected features with the HydroIDs of the source intersected features as well as with the percentage of the area of those source features. These fields may later be used by the tool Weighted Average to transfer values from the From Layer to the To Layer by performing a weighted average.

- Add the feature class super_radar_cal from the DataGP\TimeSeries\TimeSeries.mdb geodatabase into the Table of Contents of ArcMap.

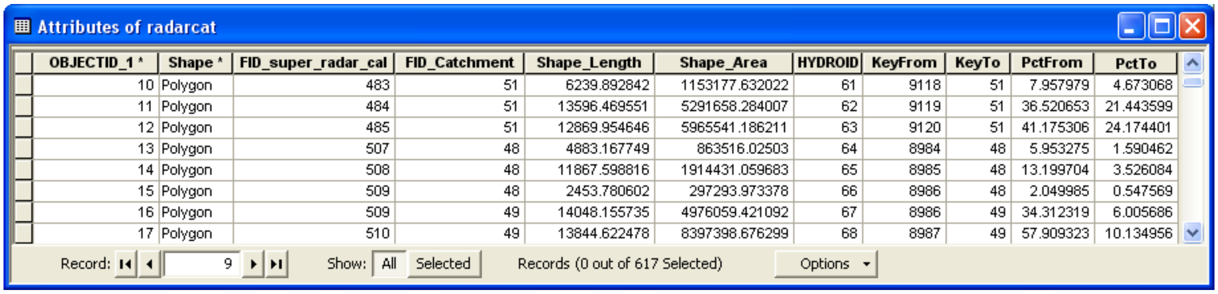
Super_radar_cal is a polygon feature class defining NEXRAD for the study area. You are going to intersect this layer with the Catchment feature class.



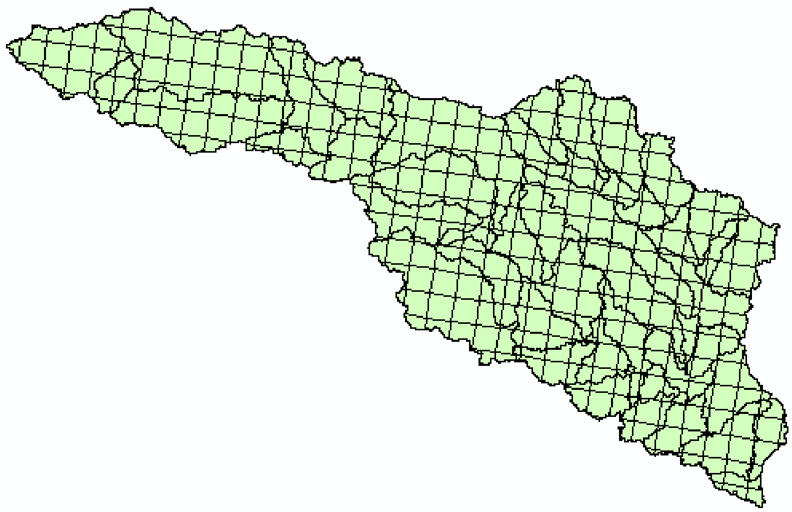
- Double-click Utility > Intersect Areas.
- Select super_radar_cal as From Layer and Catchment as To Layer. Rename the output Intersect Polygon radarcat.
- Specify the attributes from the source layers that should be in the resulting layer. Defaults to ONLY_FID. Note that if you select ALL, the HydroID fields of the source layers will not be exported into HydroID and HydroID_1 fields in the new layer. The HydroID field in the resulting layer will contain new values uniquely identifying each resulting feature in the geodatabase. Click OK.



The tool intersects the 2 source polygon feature classes and for each feature in the resulting intersected feature class, it stores the HydroID of the source features in the KeyFrom and KeyTo fields and the percentage of the areas in the PctFrom and PctTo fields. The HydroID field uniquely identifies the resulting features in the target geodatabase.



OBJECTID_1 *	Shape *	FID_super_radar_cal	FID_Catchment	Shape_Length	Shape_Area	HYDROID	KeyFrom	KeyTo	PctFrom	PctTo
10	Polygon	483	51	6239.892842	1153177.632022	61	9118	51	7.957979	4.673068
11	Polygon	484	51	13596.469551	5291658.284007	62	9119	51	36.520653	21.443599
12	Polygon	485	51	12869.954646	5965541.186211	63	9120	51	41.175306	24.174401
13	Polygon	507	48	4883.167749	863516.02503	64	8984	48	5.953275	1.590462
14	Polygon	508	48	11867.598816	1914431.059683	65	8985	48	13.199704	3.526084
15	Polygon	509	48	2453.780602	297293.973378	66	8986	48	2.049985	0.547569
16	Polygon	509	49	14048.155735	4976059.421092	67	8986	49	34.312319	6.005686
17	Polygon	510	49	13844.622478	8397398.676299	68	8987	49	57.909323	10.134956

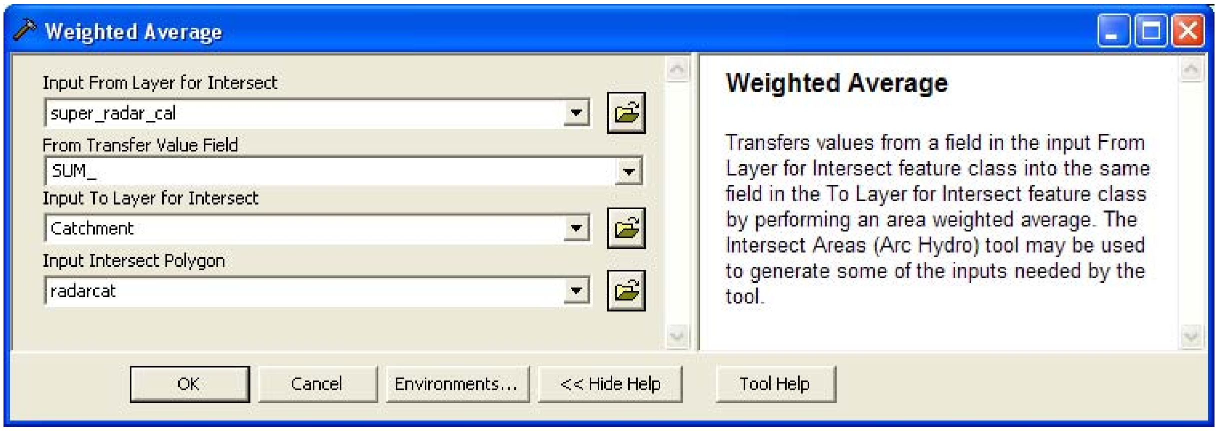


3. Weighted Averages

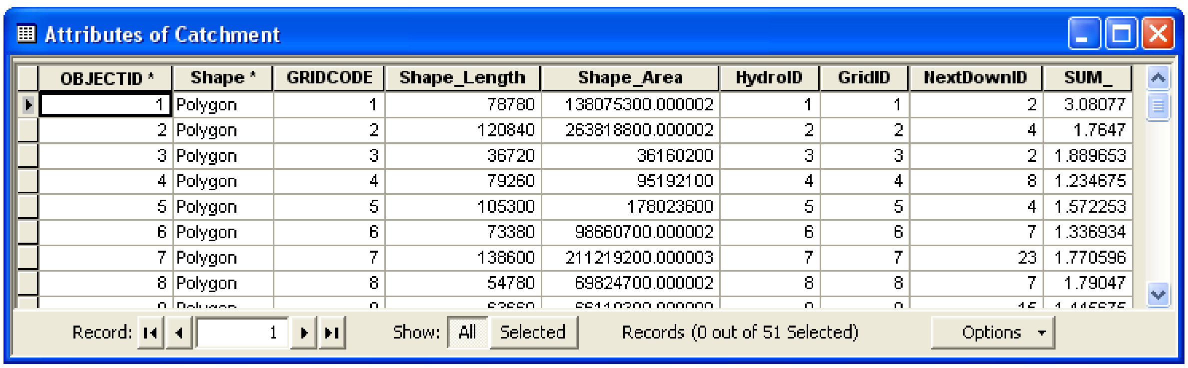
This tool transfers values from a From Layer feature class to a To Layer feature class by computing area weighted average using the intersect layer created by the tool Intersect Areas.

You are going to use this tool to generate the values of precipitation over each catchment based on the values of precipitation associated to the NEXRAD cells.

- Double-click Utility > Weighted Averages.
- Select super_rad_cal as input From Layer for Intersect polygon feature class and SUM_ as Transfer Value Field.
- Select Catchment as input To Layer and radarcat as Input Intersect Polygon. Click OK.



The tool transfers the value from the From Layer into the same field in the To Layer by performing a weighted average using the values stored in the KeyFrom, PctFrom, KeyTo and PctTo fields in the input Intersect Polygon feature class.



OBJECTID *	Shape *	GRIDCODE	Shape_Length	Shape_Area	HydroID	GridID	NextDownID	SUM_
1	Polygon	1	78780	138075300.000002	1	1	2	3.08077
2	Polygon	2	120840	263818800.000002	2	2	4	1.7647
3	Polygon	3	36720	36160200	3	3	2	1.889653
4	Polygon	4	79260	95192100	4	4	8	1.234675
5	Polygon	5	105300	178023600	5	5	4	1.572253
6	Polygon	6	73380	98660700.000002	6	6	7	1.336934
7	Polygon	7	138600	211219200.000003	7	7	23	1.770596
8	Polygon	8	54780	69824700.000002	8	8	7	1.79047

- Save and close the map.

4. Download Time Series Data

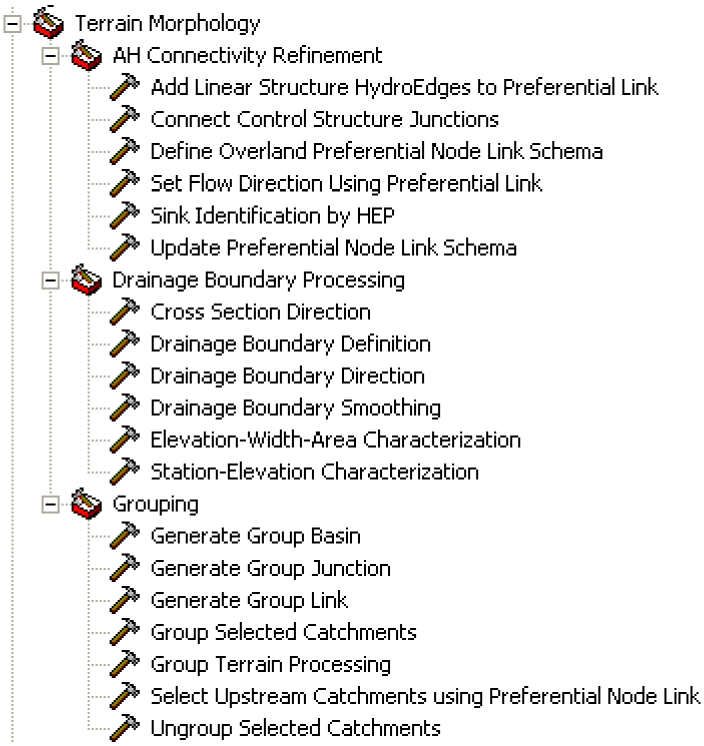
To be developed

5. Export Data Cart to XML

To be developed

Terrain Morphology

The Terrain Morphology toolset contains 3 subtoolsets that are used to process deranged terrains.



The Drainage Boundary Processing toolset allows generating and characterizing 3D drainage boundaries. You are going to use the data from DataGP\Morphology to test these tools.

- Copy the DataGP\Morphology directory (e.g. Results\GPTools\Morphology).

- Switch the type of the default target vector geodatabase from mdb to gdb by changing the value of the parameter HydroConfig/ProgParams/LocationType/Vector from 0 (mdb) to 1 (gdb) in the default configuration file ArcHydroTools.xml located in the ArcHydro9/bin folder.
- Open a new map. Add the Catchment and the DrainagePoint feature classes from the newly copied Morphology.gdb geodatabase, the elevation grid elev_cm and the filled DEM Fil. Save the map as Morphology.mxd.

Note

The data was created by using the following tools, starting with the Hillsborough elevation grid (elev_cm):

- Sink Prescreening (threshold: 1,000,000 m2)
- Sink Evaluation

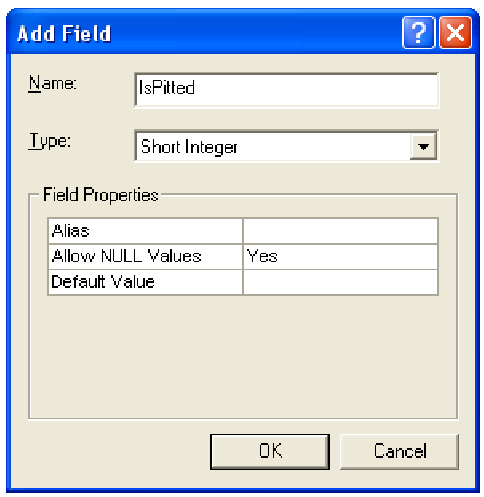
- Sink Selection (Minimum Drainage Area = 15,000,000 m2)
- Fill Sinks (using SinkPoly and IsSink field)
- Set ZUnits to 100 for Fil grid (close ArcMap, edit the prj.adf file and reopen ArcMap)
- Flow Direction with Sinks
- Flow Accumulation
- Catchment Grid Delineation
- Catchment Polygon Processing
- Drainage Point Processing

Drainage Boundary Processing Toolset

1. Drainage Boundary Definition

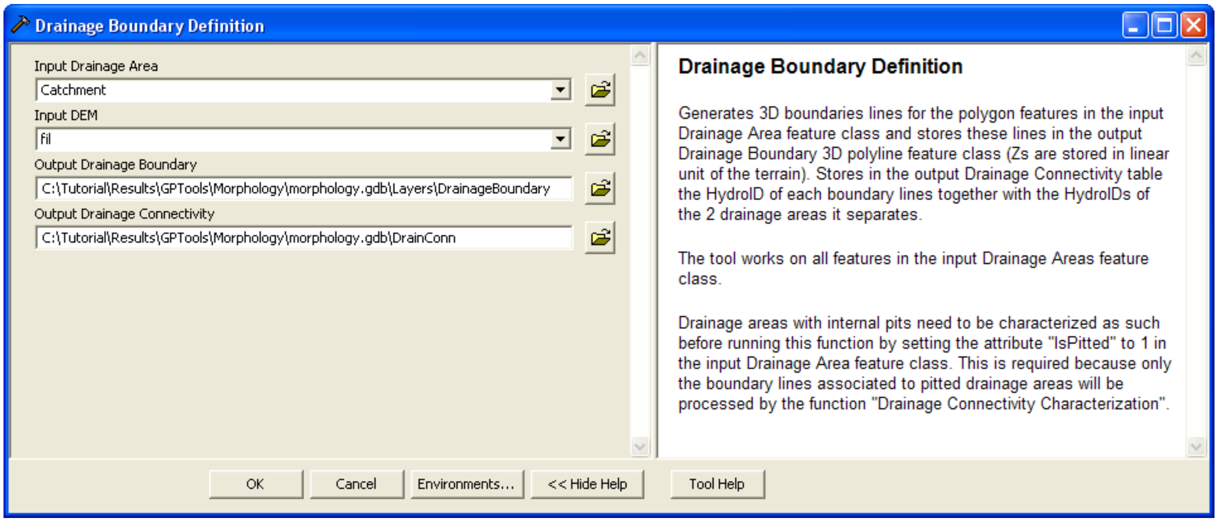
This tool allows generating 3D boundaries lines for the polygon features in the input Drainage Area feature class and storing these lines in the output Drainage Boundary 3D polyline feature class (Zs are stored in linear unit of the terrain). The tool stores in the output Drainage Connectivity table the HydroID of each boundary lines together with the HydroIDs of the 2 drainage areas it separates.
The tool works on all features in the input Drainage Areas feature class.
Drainage areas with internal pits need to be characterized as such before running this function by setting the attribute “IsPitted” to 1 in the input Drainage Area feature class. This is required because only the boundary lines associated to pitted drainage areas will be processed by the function “Drainage Connectivity Characterization”.

- Open the attributes table of Catchment. Select Options > Add Field and add the field IsPitted as short integer.

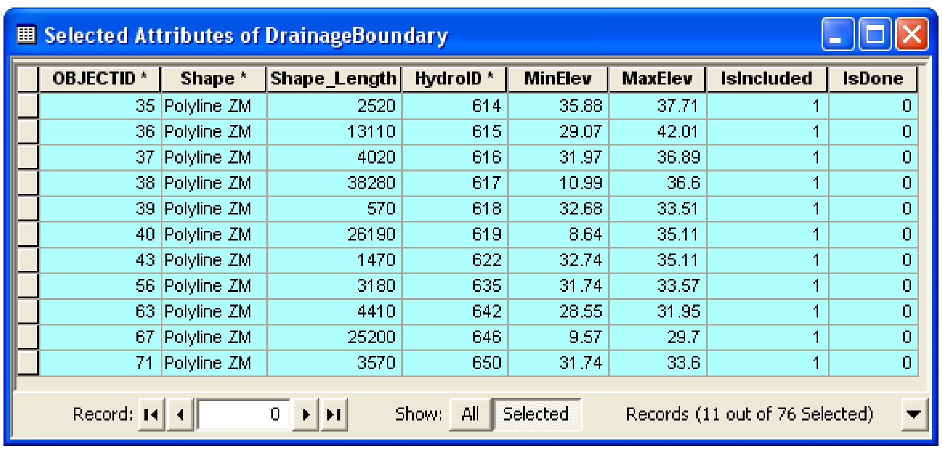


- Right-click the field header (i.e. IsPitted) and select Field Calculator. Enter 1 as value and click OK to assign the value of 1 for each record.

- Double-click **Terrain Morphology > Drainage Boundary Processing > Drainage Boundary Definition**. Select Catchment as input Drainage Area and the filled DEM Fil as input DEM. Keep the defaults for the output and click OK.

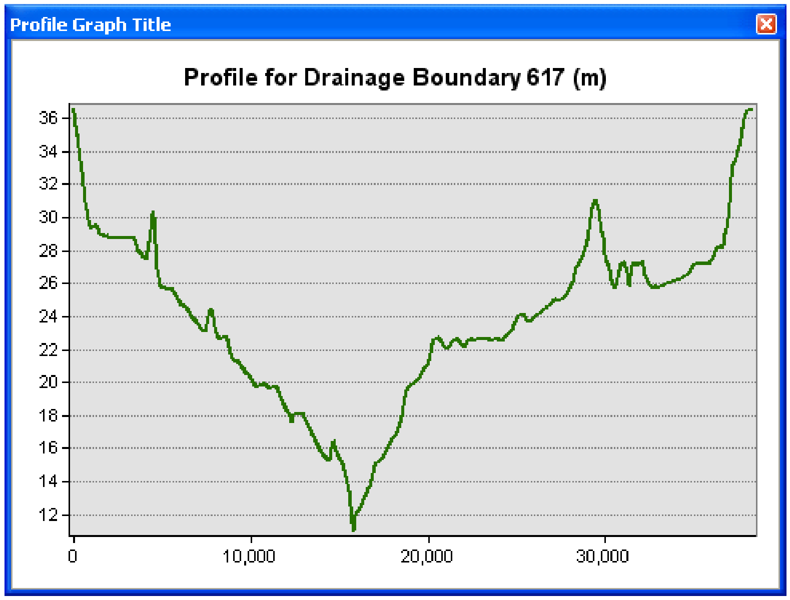


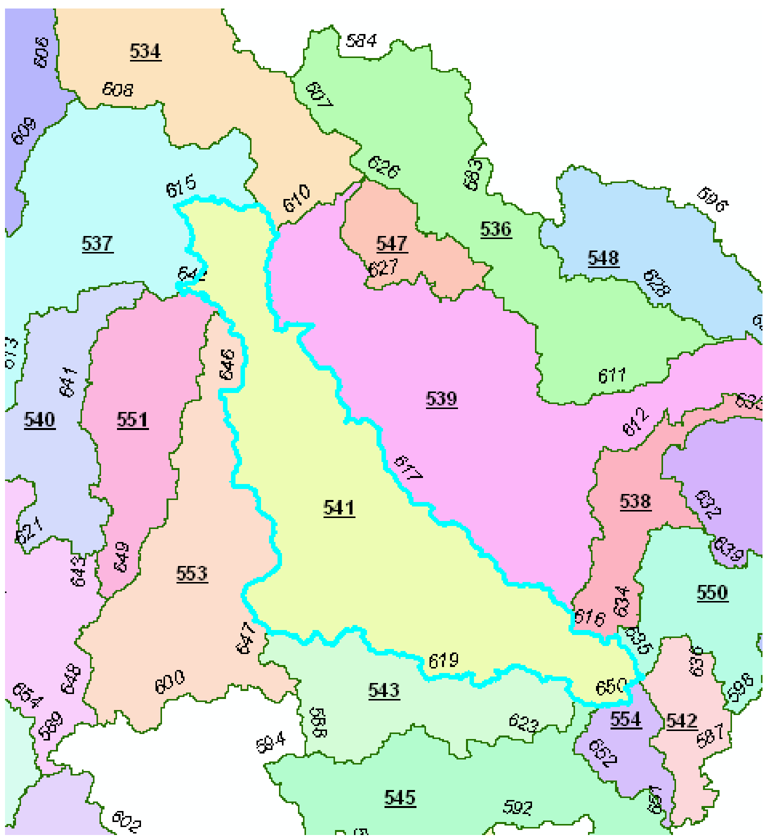
The tool generates the output 3D Drainage Boundary feature class. The field IsIncluded is set to 1 if at least one of the areas separated by the boundary line has the field IsSink set to 1. The field IsDone is populated with 0.


Selected Attributes of DrainageBoundary

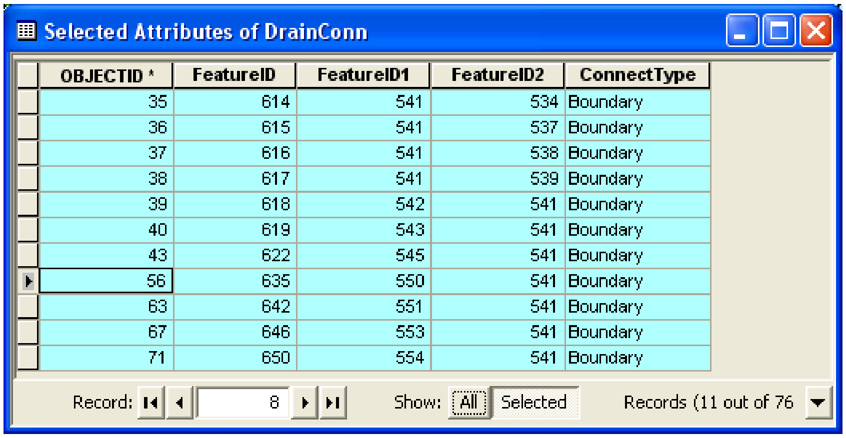
OBJECTID *	Shape *	Shape_Length	HydroID *	MinElev	MaxElev	IsIncluded	IsDone
35	Polyline ZM	2520	614	35.88	37.71	1	0
36	Polyline ZM	13110	615	29.07	42.01	1	0
37	Polyline ZM	4020	616	31.97	36.89	1	0
38	Polyline ZM	38280	617	10.99	36.6	1	0
39	Polyline ZM	570	618	32.68	33.51	1	0
40	Polyline ZM	26190	619	8.64	35.11	1	0
43	Polyline ZM	1470	622	32.74	35.11	1	0
56	Polyline ZM	3180	635	31.74	33.57	1	0
63	Polyline ZM	4410	642	28.55	31.95	1	0
67	Polyline ZM	25200	646	9.57	29.7	1	0
71	Polyline ZM	3570	650	31.74	33.6	1	0

Record: 0 Show: All Selected Records (11 out of 76 Selected)





The tool also generates the Drainage Connectivity table that stores the HydroIDs of the Catchment located to the left (FeatureID1) and to the right (FeatureID2) of the boundary lines, based on the digitized direction of the lines.


Selected Attributes of DrainConn

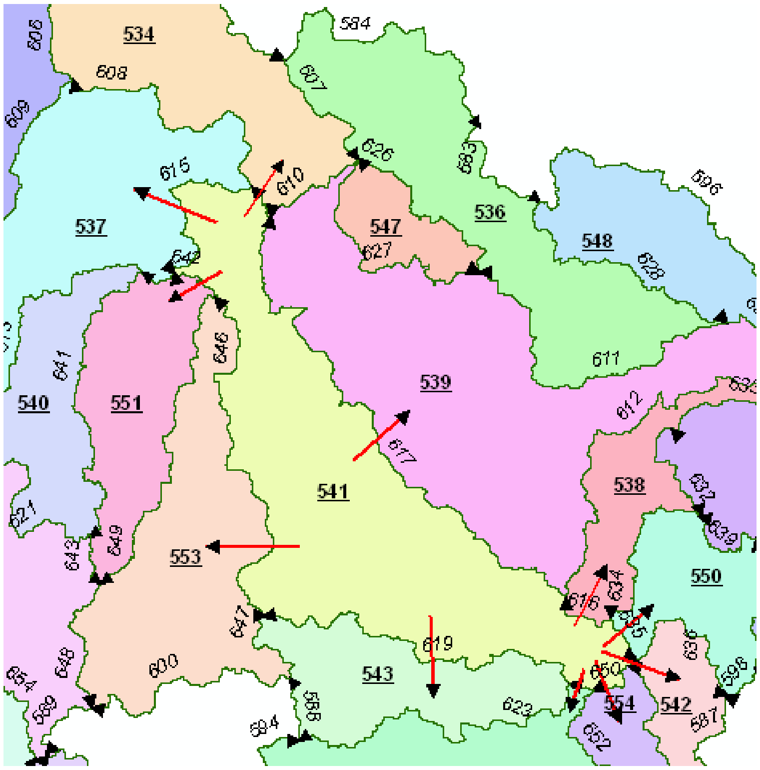
OBJECTID *	FeatureID	FeatureID1	FeatureID2	ConnectType
35	614	541	534	Boundary
36	615	541	537	Boundary
37	616	541	538	Boundary
38	617	541	539	Boundary
39	618	542	541	Boundary
40	619	543	541	Boundary
43	622	545	541	Boundary
56	635	550	541	Boundary
63	642	551	541	Boundary
67	646	553	541	Boundary
71	650	554	541	Boundary

Record: 8 Show: All Selected Records (11 out of 76

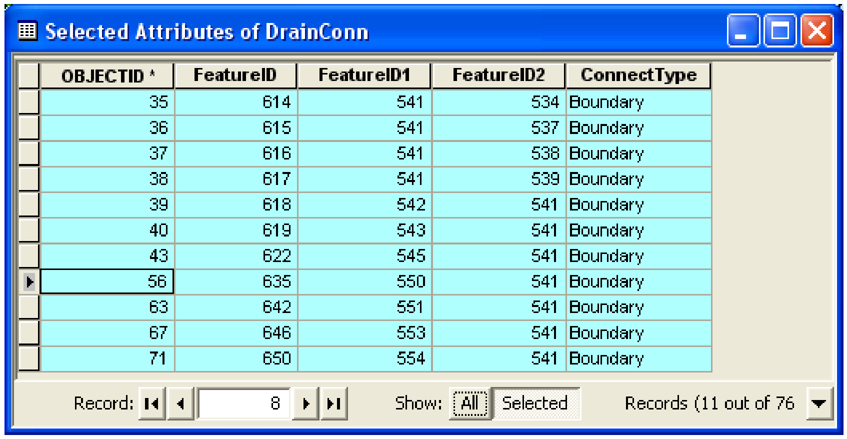
2. Drainage Boundary Direction

This tool allows setting the digitized direction of the selected Drainage Boundary lines based on user-provided Preferential Link line features. A Preferential Link is a line feature that connects 2 Drainage Area features and its direction defines the preferred flowpath between the 2 Drainage Area features. The digitized direction of a Drainage Boundary line is set from left to right when looking in the digitized direction of the intersecting Preferential Link feature.

- Add the PrefLink feature class into the Table of Contents of ArcMap and modify the symbology of PrefLink and DrainageBoundary so that you can see the digitized directions of the lines.



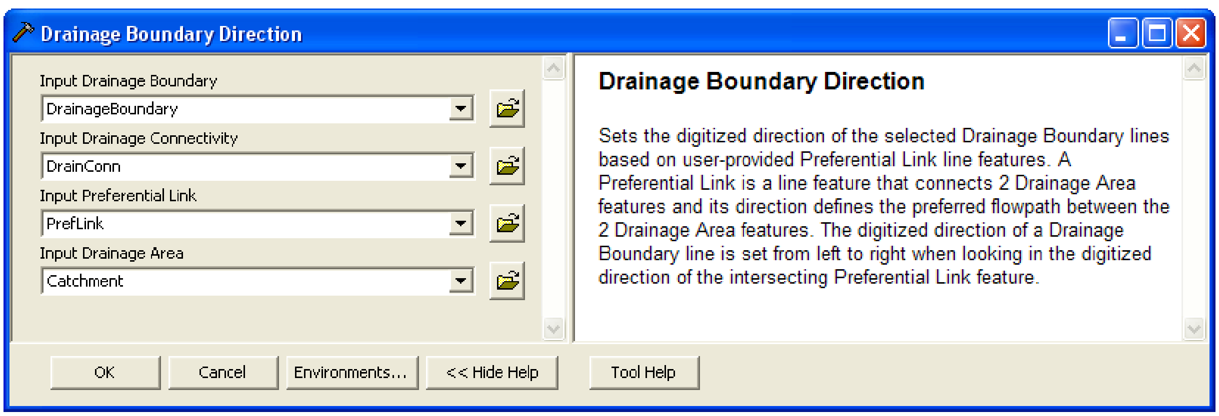
- Open the Drainage Connectivity table and review the connectivity for the Drainage Boundary lines intersected by the Preferential Link features.


Selected Attributes of DrainConn

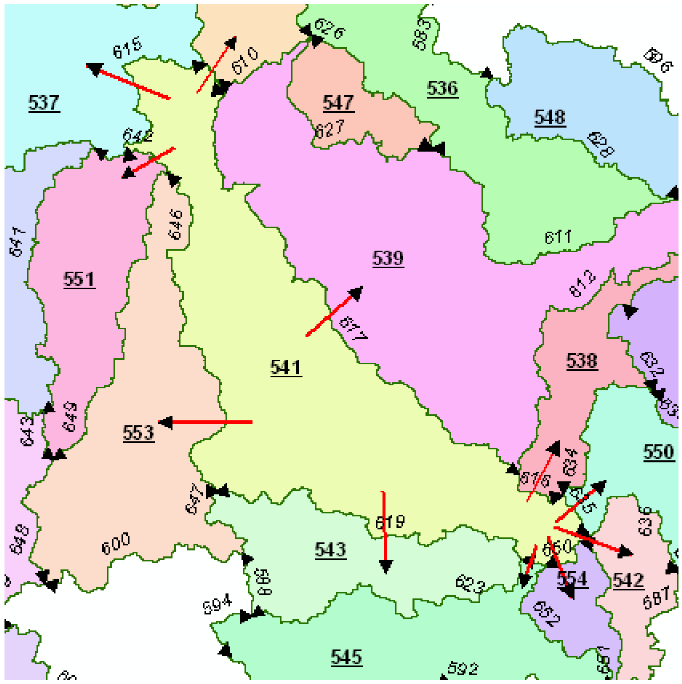
OBJECTID *	FeatureID	FeatureID1	FeatureID2	ConnectType
35	614	541	534	Boundary
36	615	541	537	Boundary
37	616	541	538	Boundary
38	617	541	539	Boundary
39	618	542	541	Boundary
40	619	543	541	Boundary
43	622	545	541	Boundary
56	635	550	541	Boundary
63	642	551	541	Boundary
67	646	553	541	Boundary
71	650	554	541	Boundary

Record: 8 Show: All Selected Records (11 out of 76

- Double-click Terrain Morphology > Drainage Boundary Processing > Drainage Boundary Direction. Select the inputs as shown below and click OK.



- Refresh the map and review the direction of the Drainage Boundary lines as well as the Drainage Connectivity table.



Selected Attributes of DrainConn

OBJECTID *	FeatureID	FeatureID1	FeatureID2	ConnectType
35	614	541	534	Boundary
36	615	541	537	Boundary
37	616	541	538	Boundary
38	617	541	539	Boundary
39	618	541	542	Boundary
40	619	541	543	Boundary
43	622	541	545	Boundary
56	635	541	550	Boundary
63	642	541	551	Boundary
67	646	541	553	Boundary
71	650	541	554	Boundary

Record: 1 Show: All Selected Records (11 out of 76

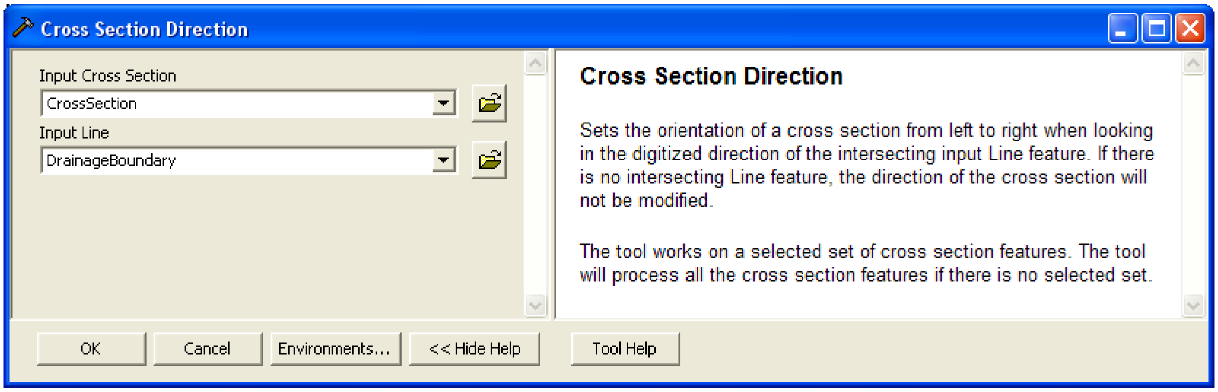
The directions of the lines have been modified using the digitized direction of the intersecting PrefLink features. The fields FeatureID1 and FeatureID2 in the Drainage Connectivity table have been updated to match the new directions.

3. Cross Section Direction

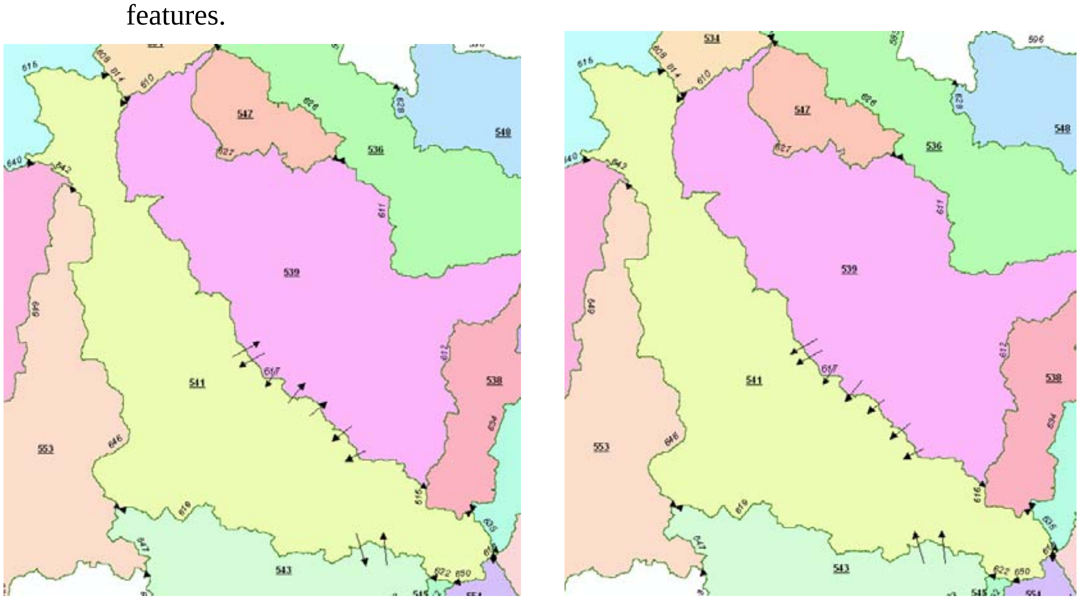
This tool allows setting the orientation of a cross section from left to right when looking in the digitized direction of the intersecting input Line feature. If there is no intersecting Line feature, the direction of the cross section will not be modified.
The tool works on a selected set of cross section features. The tool will process all the cross section features if there is no selected set.

- Add the CrossSection feature class into the Table of Contents of ArcMap. Review the directions of the Cross Section features.

- Double-click **Terrain Morphology > Drainage Boundary Processing > Cross Section Direction**. Select CrossSection as Input Cross Section and DrainageBoundary as Input Line and click OK.



- Refresh the map and review the directions of the Cross Section features. Directions have been modified to match the direction of the intersecting Drainage Boundary features.

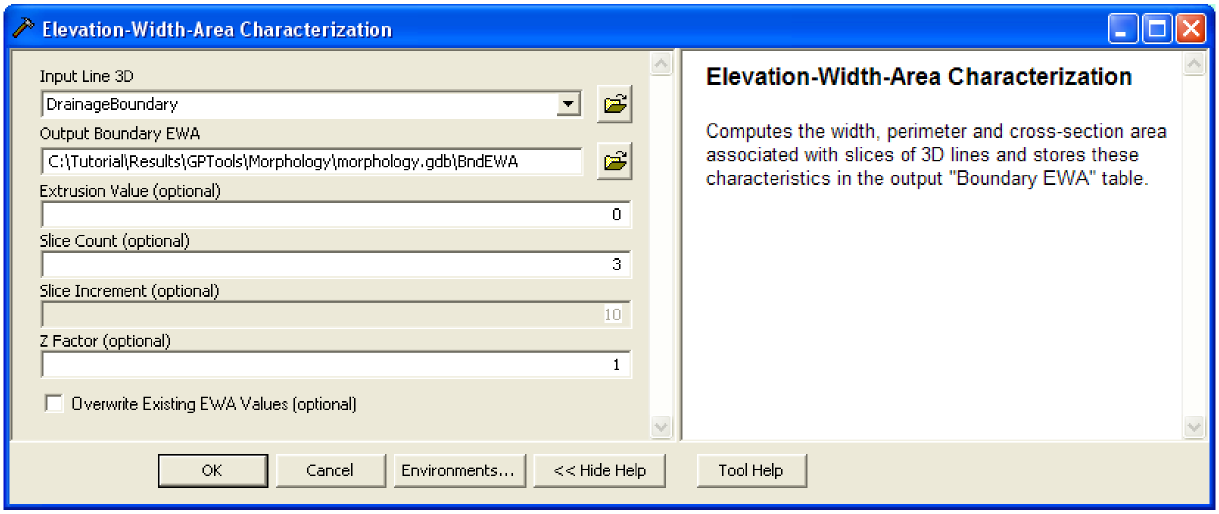


4. Elevation-Width-Area Characterization

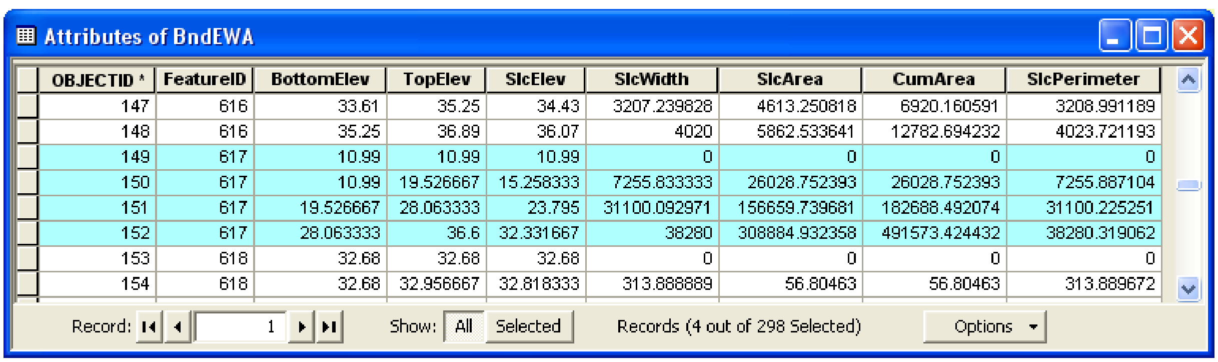
This tool allows computing the width, perimeter and cross-section area associated with slices of 3D lines and stores these characteristics in the output “Boundary EWA” table.

- Double-click Terrain Morphology > Drainage Boundary Processing > Elevation-Width-Area Characterization.

- Select DrainageBoundary as Input Line 3D and Slice Count to 3. Keep the defaults for the other inputs/outputs. Leave Z Factor to 1 as the elevations in the 3D lines already take into account the Z Factor of the elevation DEM elev_cm. Click OK.

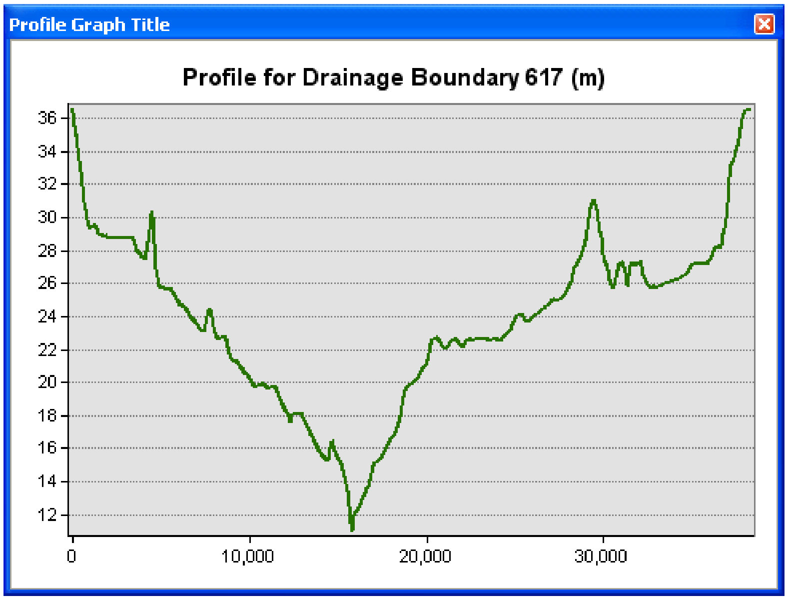


The tool generates the output Boundary EWA table that characterizes slices of the input Drainage Boundary lines. Each input 3D Line is identified in the table by the field FeatureID that stores the HydroID of the line. The table contains 4 records for each line. The first record provides information on the lowest elevation on the boundary line (BottomElev=TopElev=SlcElev=Minimum elevation along the line). The 3 additional records characterize the 3 slices requested when running the tool (Slice Count = 3). If an Extrusion Value had been specified, one additional record would have been added for each 3D Line.


Attributes of BndEWA

OBJECTID *	FeatureID	BottomElev	TopElev	SlcElev	SlcWidth	SlcArea	CumArea	SlcPerimeter
147	616	33.61	35.25	34.43	3207.239828	4613.250818	6920.160591	3208.991189
148	616	35.25	36.89	36.07	4020	5862.533641	12782.694232	4023.721193
149	617	10.99	10.99	10.99	0	0	0	0
150	617	10.99	19.526667	15.258333	7255.833333	26028.752393	26028.752393	7255.887104
151	617	19.526667	28.063333	23.795	31100.092971	156659.739681	182688.492074	31100.225251
152	617	28.063333	36.6	32.331667	38280	308884.932358	491573.424432	38280.319062
153	618	32.68	32.68	32.68	0	0	0	0
154	618	32.68	32.956667	32.818333	313.888889	56.80463	56.80463	313.889672

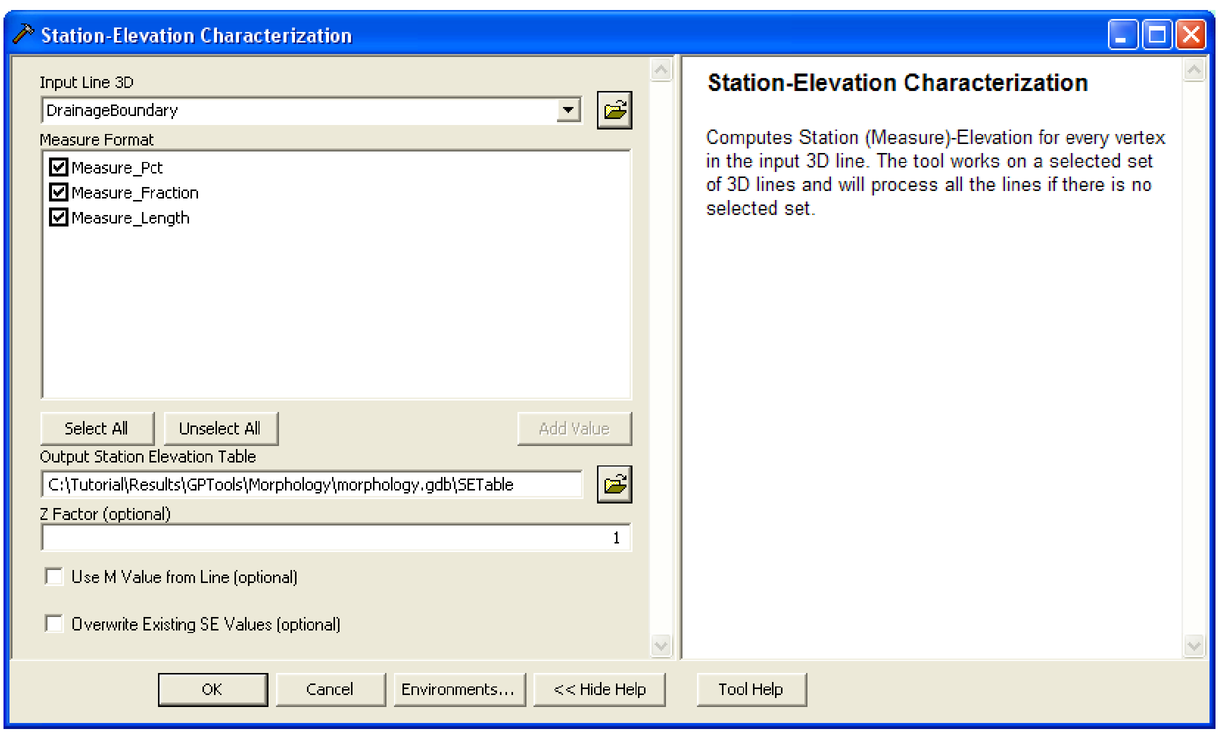
Record: 1 Show: All Selected Records (4 out of 298 Selected) Options



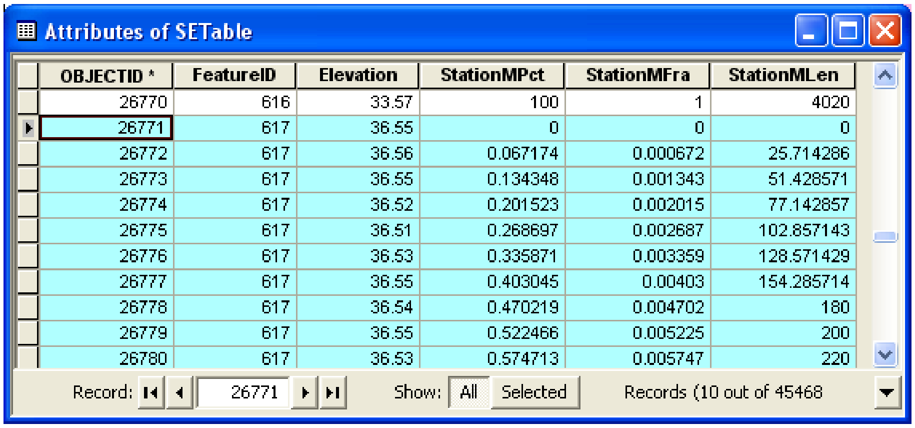
5. Station-Elevation Characterization

This tool allows computing Station (Measure)-Elevation for each vertex in the input 3D line. The tool works on a selected set of 3D lines and will process all the lines if there is no selected set.

- Double-click **Terrain Morphology** > **Drainage Boundary Processing** > **Station-Elevation Characterization**. Select DrainageBoundary as input Line 3D and click Select All to select all measure formats. Do not check "Use M Value from Line" as the measures are not populated in the Drainage Boundary feature class. Click OK.



The tool generates the output Station Elevation table that stores the measure and elevation for each vertex in the input Line 3D feature class.

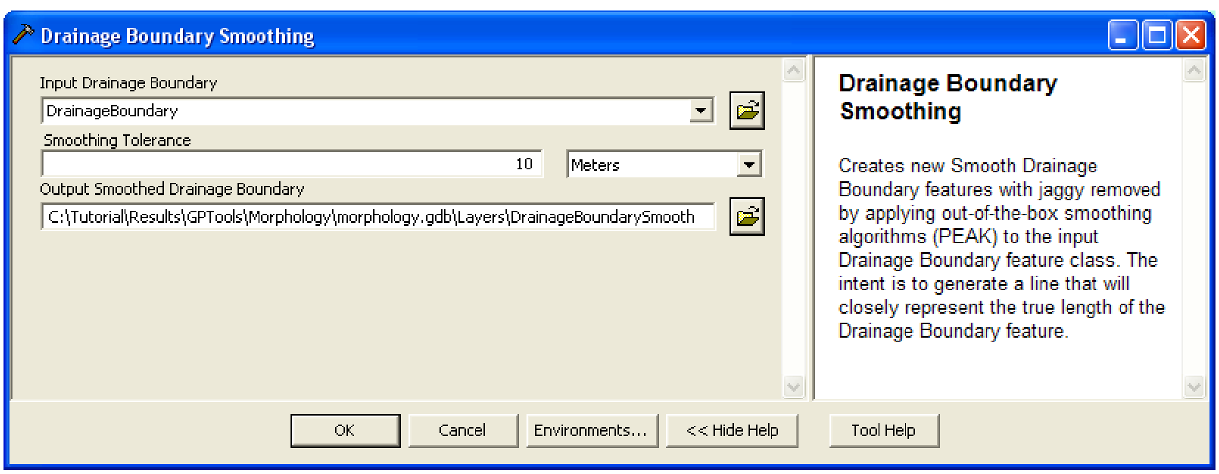


OBJECTID *	FeatureID	Elevation	StationMPct	StationMFra	StationMLen
26770	616	33.57	100	1	4020
26771	617	36.55	0	0	0
26772	617	36.56	0.067174	0.000672	25.714286
26773	617	36.55	0.134348	0.001343	51.428571
26774	617	36.52	0.201523	0.002015	77.142857
26775	617	36.51	0.268697	0.002687	102.857143
26776	617	36.53	0.335871	0.003359	128.571429
26777	617	36.55	0.403045	0.00403	154.285714
26778	617	36.54	0.470219	0.004702	180
26779	617	36.55	0.522466	0.005225	200
26780	617	36.53	0.574713	0.005747	220

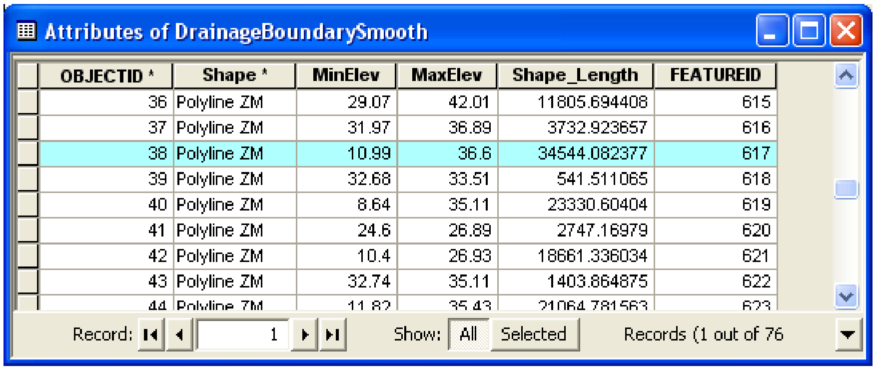
6. Drainage Boundary Smoothing

This tool allows creating new Smooth Drainage Boundary features with jaggy removed by applying out-of-the-box smoothing algorithms (PEAK) to the input Drainage Boundary feature class. The intent is to generate a line that will closely represent the true length of the Drainage Boundary feature.

- Double-click **Terrain Morphology > Drainage Boundary Processing > Drainage Boundary Smoothing**. Select DrainageBoundary as input Drainage Boundary. The Smoothing Tolerance has to be greater than 0. Set it to 10 meters for example and click OK.



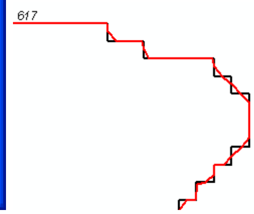
The tool generates the smoothed 3D Drainage Boundary feature class. The FeatureID field in that feature class stores the HydroID of the associated input Drainage Boundary feature.



Attributes of DrainageBoundarySmooth

OBJECTID *	Shape *	MinElev	MaxElev	Shape_Length	FEATUREID
36	Polyline ZM	29.07	42.01	11805.694408	615
37	Polyline ZM	31.97	36.89	3732.923657	616
38	Polyline ZM	10.99	36.6	34544.082377	617
39	Polyline ZM	32.68	33.51	541.511065	618
40	Polyline ZM	8.64	35.11	23330.60404	619
41	Polyline ZM	24.6	26.89	2747.16979	620
42	Polyline ZM	10.4	26.93	18661.336034	621
43	Polyline ZM	32.74	35.11	1403.864875	622
44	Polyline ZM	11.82	35.43	21064.781563	623

Record: 1 Show: All Selected Records (1 out of 76

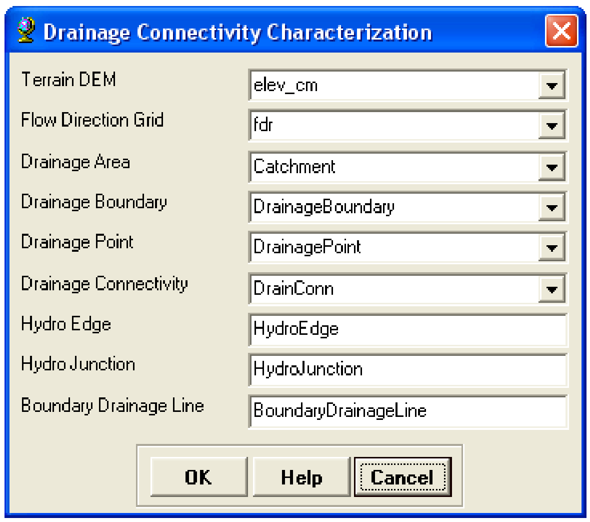


AH Connectivity Refinement Toolset

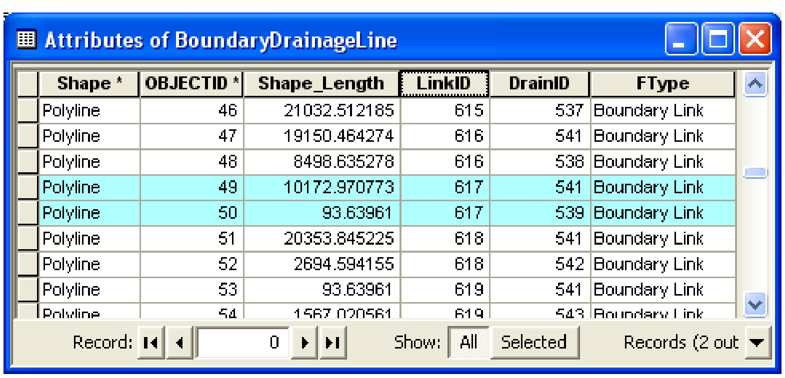
The Arc Hydro Connectivity Refinement Toolset contains a set of tools that allow adding the impact of existing structures to the connectivity established based on the terrain. Before using these tools, you need first to generate the spider web connectivity using the function Drainage Connectivity Characterization available in the Terrain Morphology menu in the Arc Hydro Tools toolbar.

- Add the flow direction grid Fdr into the Table of Contents of ArcMap and select Terrain Morphology > Drainage Connectivity Characterization.

- Specify the inputs and outputs as shown below, click OK and process all the features.



The function generates the output BoundaryDrainageLine feature class that defines the connectivity between the drainage areas.



Attributes of BoundaryDrainageLine

Shape *	OBJECTID *	Shape_Length	LinkID	DrainID	FType
Polyline	46	21032.512185	615	537	Boundary Link
Polyline	47	19150.464274	616	541	Boundary Link
Polyline	48	8498.635278	616	538	Boundary Link
Polyline	49	10172.970773	617	541	Boundary Link
Polyline	50	93.63961	617	539	Boundary Link
Polyline	51	20353.845225	618	541	Boundary Link
Polyline	52	2694.594155	618	542	Boundary Link
Polyline	53	93.63961	619	541	Boundary Link
Polyline	54	1567.020561	619	543	Boundary Link

Record: 0 Show: All Selected Records (2 out

The function also generates the HydroEdge and HydroJunction feature classes but it does not create their associated geometric network.

Attributes of HydroEdge

Shape *	OBJECTID *	Shape_Length	HydroID	DrainID	FType	FlowDir	EdgeType	Enabled
Polyline M	1	3276.320344	656	534	Boundary Link	Uninitialized	Flowline	True
Polyline M	2	5011.173157	659	535	Boundary Link	Uninitialized	Flowline	True
Polyline M	3	15176.423151	662	536	Boundary Link	Uninitialized	Flowline	True
Polyline M	4	8136.100084	665	536	Boundary Link	Uninitialized	Flowline	True
Polyline M	5	23772.444789	667	536	Boundary Link	Uninitialized	Flowline	True
Polyline M	6	4193.010819	669	537	Boundary Link	Uninitialized	Flowline	True
Polyline M	7	16080.214966	672	538	Boundary Link	Uninitialized	Flowline	True
Polyline M	8	8877.274888	675	542	Boundary Link	Uninitialized	Flowline	True
Polyline M	9	8615.102807	678	543	Boundary Link	Uninitialized	Flowline	True

Record: 1 Show: All Selected Records (0 out of 126 Selected) Options

Attributes of HydroJunction

Shape *	OBJECTID *	HydroID	NextDownID	FType	SchemaRole	AncillaryRole	Enabled	JUNCTION_PLACEMENT_DESC	HYDRAULIC_TYPE_DESC
Point	1	657	-1	Sink Node	1	0	1	AH	NONE
Point	2	658	<Null>	Boundary Node	1	0	1	AH	NONE
Point	3	660	-1	Sink Node	1	0	1	AH	NONE
Point	4	661	<Null>	Boundary Node	1	0	1	AH	NONE
Point	5	663	-1	Sink Node	1	0	1	AH	NONE
Point	6	664	<Null>	Boundary Node	1	0	1	AH	NONE
Point	7	666	<Null>	Boundary Node	1	0	1	AH	NONE
Point	8	668	<Null>	Boundary Node	1	0	1	AH	NONE
Point	9	670	-1	Sink Node	1	0	1	AH	NONE

Record: 41 Show: All Selected Records (0 out of 97 Selected) Options

The function updates the field IsDone with 1 in the attributes table of Drainage Boundary.

Attributes of DrainageBoundary

OBJECTID *	Shape *	Shape_Length	HydroID *	MinElev	MaxElev	IsIncluded	IsDone
1	Polyline ZM	33600	580	38.5	76.17	1	1
2	Polyline ZM	39210	581	22.65	48.24	1	1
3	Polyline ZM	120	582	49.85	50.68	1	1
4	Polyline ZM	8760	583	25.81	50.83	1	1
5	Polyline ZM	21090	584	30.91	71.11	1	1
6	Polyline ZM	7500	585	22.63	25.24	1	1
7	Polyline ZM	4620	586	44.23	65.3	1	1

Record: 1 Show: All Selected Records (0 out of 76 Selected)

The HydroJunction feature class you just created is missing the field INCLUDE_CONNECT_DESC required by the connectivity tools. You are going to create this field by using the Data Management function under the Network Tools menu.

- Select Network Tools > Data Management Network Tools. Make sure HydroJunction is tagged as Hydro Junction and click OK.

All the fields defined in the configuration file are appended, including the field INCLUDE_CONNECT_DESC.

You need to create the geometric network based on the HydroJunction and HydroEdge feature classes.

- Save and close the map. Open ArcCatalog and browse to the target dataset. Right click the feature dataset (e.g. Layers in Morphology.gdb) and select New > Geometric Network.

- Select the option to build a network from existing features and select HydroEdge and HydroJunction. Rename the network archydro. Select to create HydroEdge as a complex edge and to snap both feature classes with the tolerance provided. Keep the remaining default options and build the network.

- Close ArcCatalog and reopen your map in ArcMap.

The network you just created had uninitialized flow directions. You need to set the flow direction (e.g. in the digitized direction) before using the tools.

- Select Network Tools > Set Flow Direction in the Arc Hydro Tools toolbar. Select HydroEdge and With Digitized Direction and click OK to set the flow direction in the network.

The connectivity established and represented by the geometric network is based only on the terrain. The tools in the current toolset will add additional information to this connectivity.

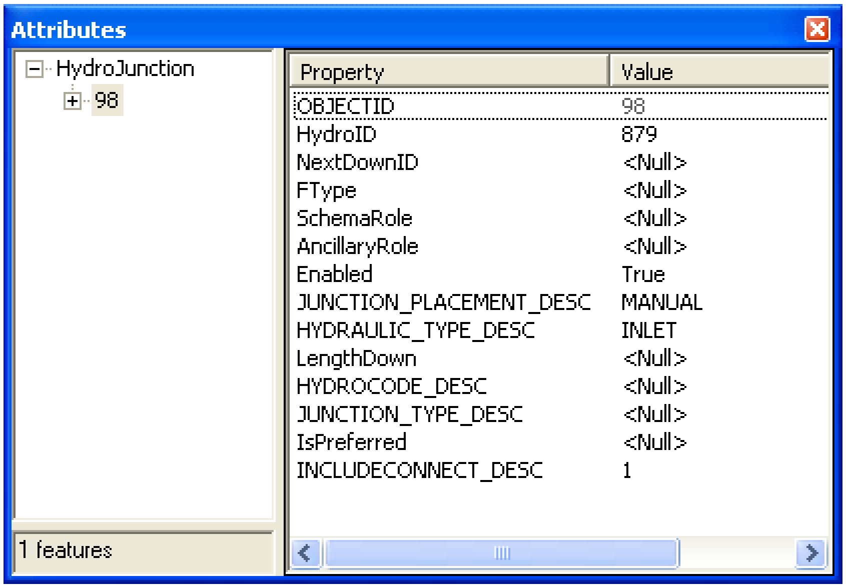
1. Connect Control Structure Junctions

This tool allows connecting HydroJunctions of Hydraulic Type Inlet/Outlet and Control Structure associated to a Control Structure Sequence to the spider web geometric network. A Control Structure Sequence is defined as one or many linear structures and point structures connected together through HydroJunctions and HydroEdges to move water between Catchments.

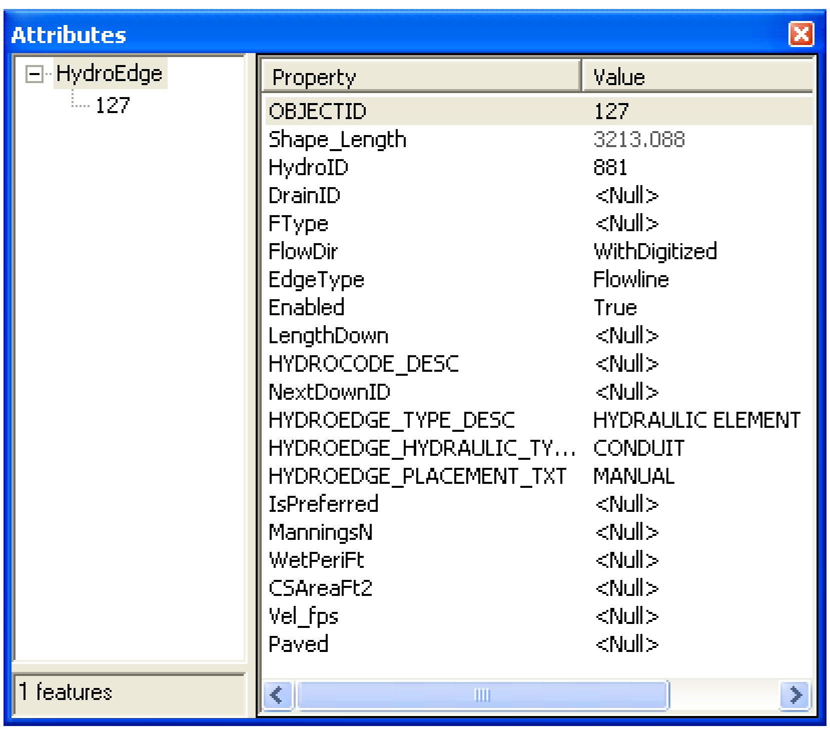
- Add the DrainageLine feature class into the Table of Contents of ArcMap. This feature class is empty because the terrain was processed as deranged but it is required as input by this tool.

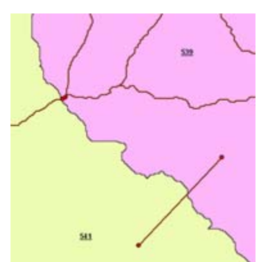
You are going to create a few inlets and connected structure. Only the HydroJunctions having HYDRAULIC_TYPE_DESC=’INLET’ or ‘CONTROL STRUCTURE (‘CS’) and INCLUDE_CONNECT_DESC = 1 will be processed by the function.

- Start editing and add a new Hydro Junction feature in one of the Catchment feature. Set the field HYDRAULIC_TYPE_DESC to INLET and the field INCLUDECONNECT_DESC to 1. Create another Hydro Junction with the same attributes in a neighboring catchment.



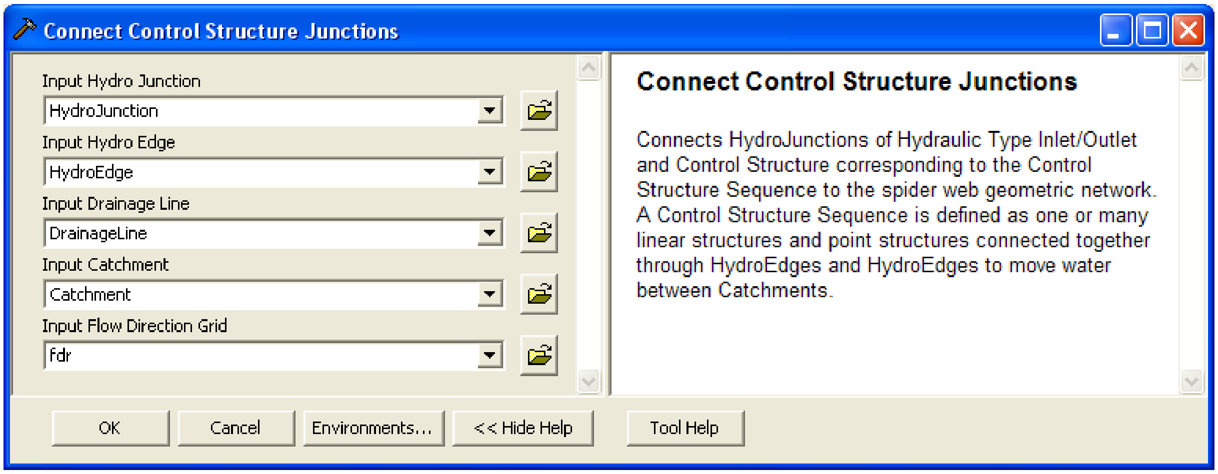
- Set the snapping environment to snap to HydroJunction (Editor > Snapping in on the Editor toolbar) and create a new HydroEdge of type Flowline that connects the 2 new junctions and is digitized from Catchment 539 to Catchment 541. Save your edits and stop editing.





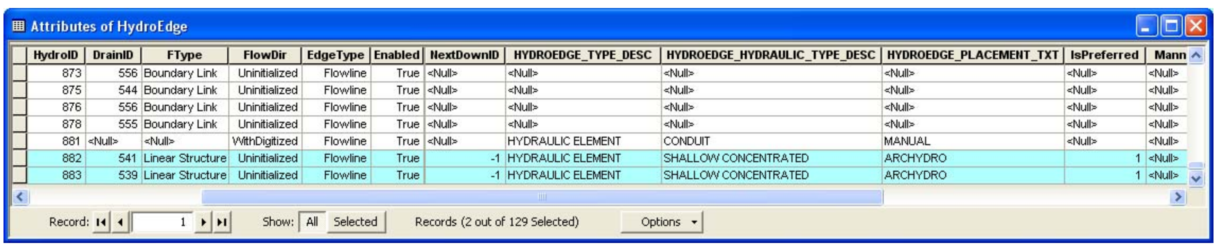
- Set the Flow Direction in the digitized direction using Set Flow Direction.

- Double-click Terrain Morphology > AH Connectivity Refinement Tools > Connect Control Structure Junctions. Specify the inputs as shown below and click OK.



The tool traces from the HydroJunctions (inlet/control structures) using the geometric network and the flow direction grid and connects the HydroJunctions to the closest Drainage Line or Sink. The tool sets the flow direction in the digitized direction for the new Hydro Edge features.

The field HYDROEDGE_HYDRAULIC_TYPE_DESC is populated with SC (SHALLOW CONCENTRATED) for the newly created HydroEdge features.


Attributes of HydroEdge

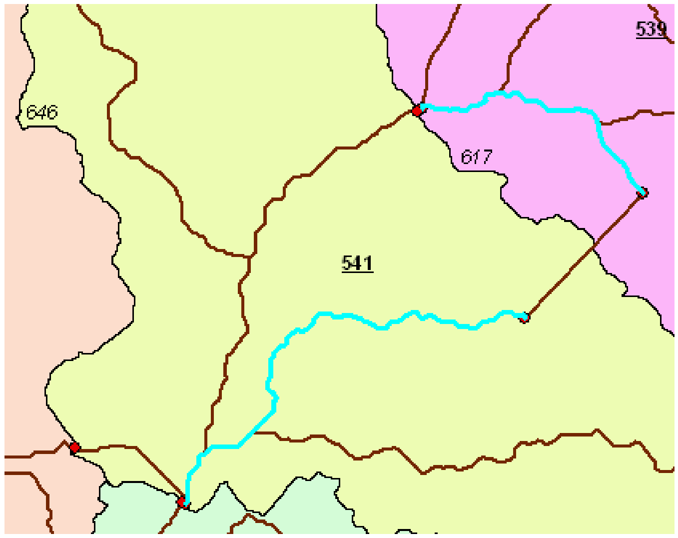
HydroID	DrainID	FType	FlowDir	EdgeType	Enabled	NextDownID	HYDROEDGE_TYPE_DESC	HYDROEDGE_HYDRAULIC_TYPE_DESC	HYDROEDGE_PLACEMENT_TXT	IsPreferred	Mann
873	556	Boundary Link	Uninitialized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
875	544	Boundary Link	Uninitialized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
876	556	Boundary Link	Uninitialized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
878	555	Boundary Link	Uninitialized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
881	<Null>	<Null>	WithDigitized	Flowline	True	<Null>	HYDRAULIC ELEMENT	CONDUIT	MANUAL	<Null>	<Null>
882	541	Linear Structure	Uninitialized	Flowline	True	-1	HYDRAULIC ELEMENT	SHALLOW CONCENTRATED	ARCHYDRO	1	<Null>
883	539	Linear Structure	Uninitialized	Flowline	True	-1	HYDRAULIC ELEMENT	SHALLOW CONCENTRATED	ARCHYDRO	1	<Null>

Record: 1 Show: All Selected Records (2 out of 129 Selected) Options

Note

CHAN (CHANNEL) is reserved for Hydro Edge features that are manually digitized (like Conduit) but are channels.

The field IsPreferred is populated with 1 to indicate a preferred path. If new HydroJunctions are created (when there are no existing junctions at the ends of the new HydroEdges, which is not the case in this example), the field IsPreferred is also populated with 1 for the new HydroJunctions.



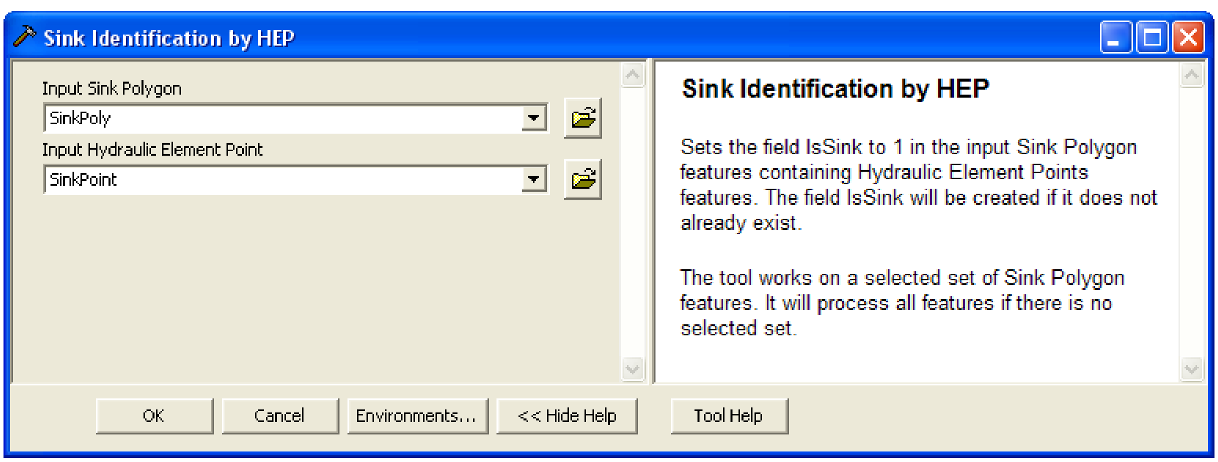
2. Sink Identification by HEP

This tool allows settings the field IsSink to 1 in the input Sink Polygon features containing Hydraulic Element Point features. The field IsSink will be created if it does not already exist.

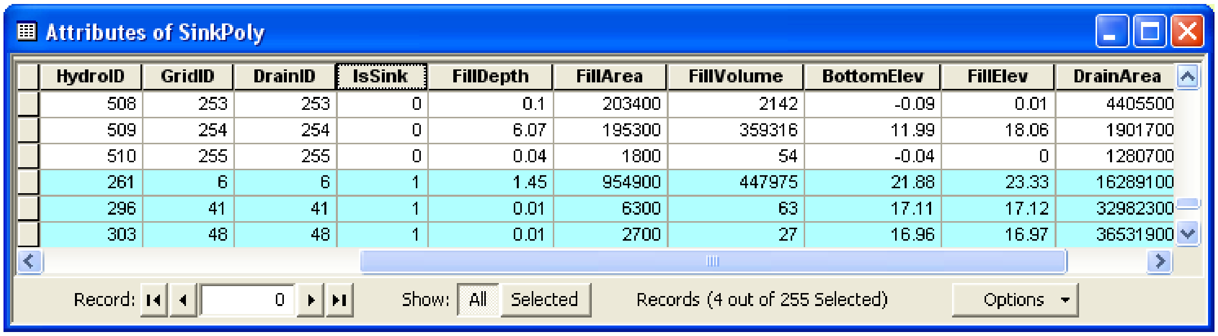
The tool works on a selected set of Sink Polygon features. It will process all features if there is no selected set.

- Add the SinkPoly and SinkPoint feature classes into the Table of Contents of ArcMap. Open the attributes table of SinkPoly and use the Field Calculator to set the field IsSink to 0 for all records.

- Double-click **Terrain Morphology** > **AH Connectivity Refinement Tools** > **Sink Identification by HEP**. Specify SinkPoly and SinkPoint as inputs and click OK.



The tool populates the field IsSink with 1 for all the SinkPoly features containing a SinkPoint feature.


Attributes of SinkPoly

HydroID	GridID	DrainID	IsSink	FillDepth	FillArea	FillVolume	BottomElev	FillElev	DrainArea
508	253	253	0	0.1	203400	2142	-0.09	0.01	4405500
509	254	254	0	6.07	195300	359316	11.99	18.06	1901700
510	255	255	0	0.04	1800	54	-0.04	0	1280700
261	6	6	1	1.45	954900	447975	21.88	23.33	16289100
296	41	41	1	0.01	6300	63	17.11	17.12	32982300
303	48	48	1	0.01	2700	27	16.96	16.97	36531900

Record: 0 Show: All Selected Records (4 out of 255 Selected) Options

3. Define Overland Preferential Node Link Schema

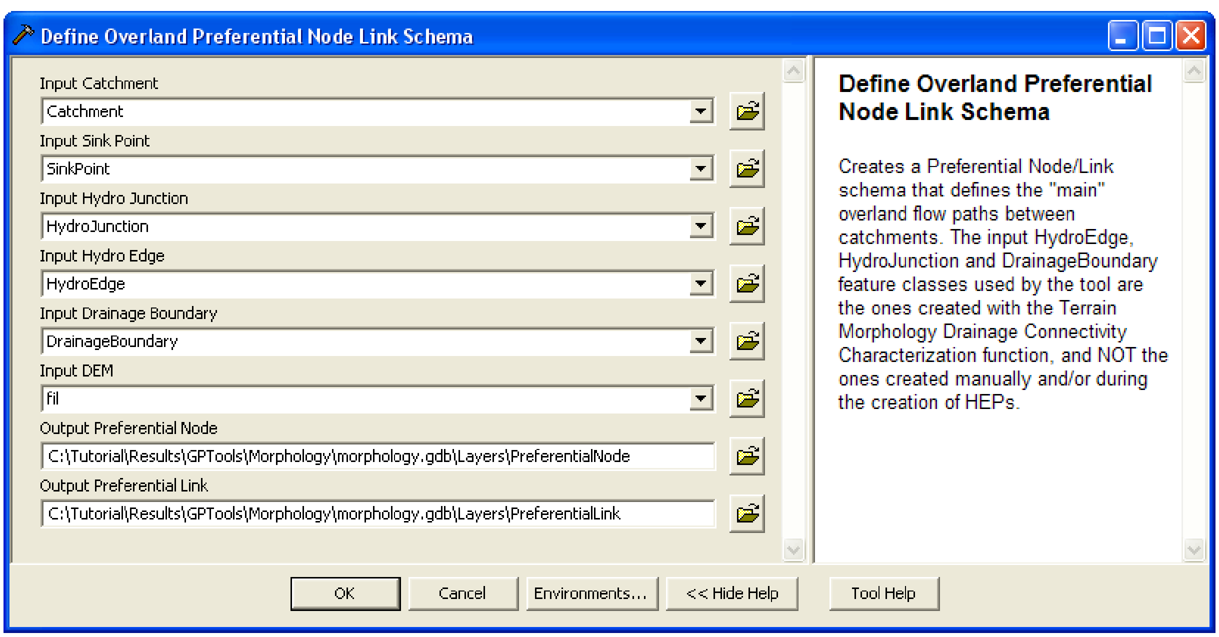
Note

Before using this tool, make sure the geoprocessing setting is set to allow you to overwrite the results of the geoprocessing operations. This setting is required to allow you to update and append/replace records in the output Preferential Node and Link feature classes. If you do not allow overwriting, two new Preferential Link/Node feature classes will be generated each time you run the tool.

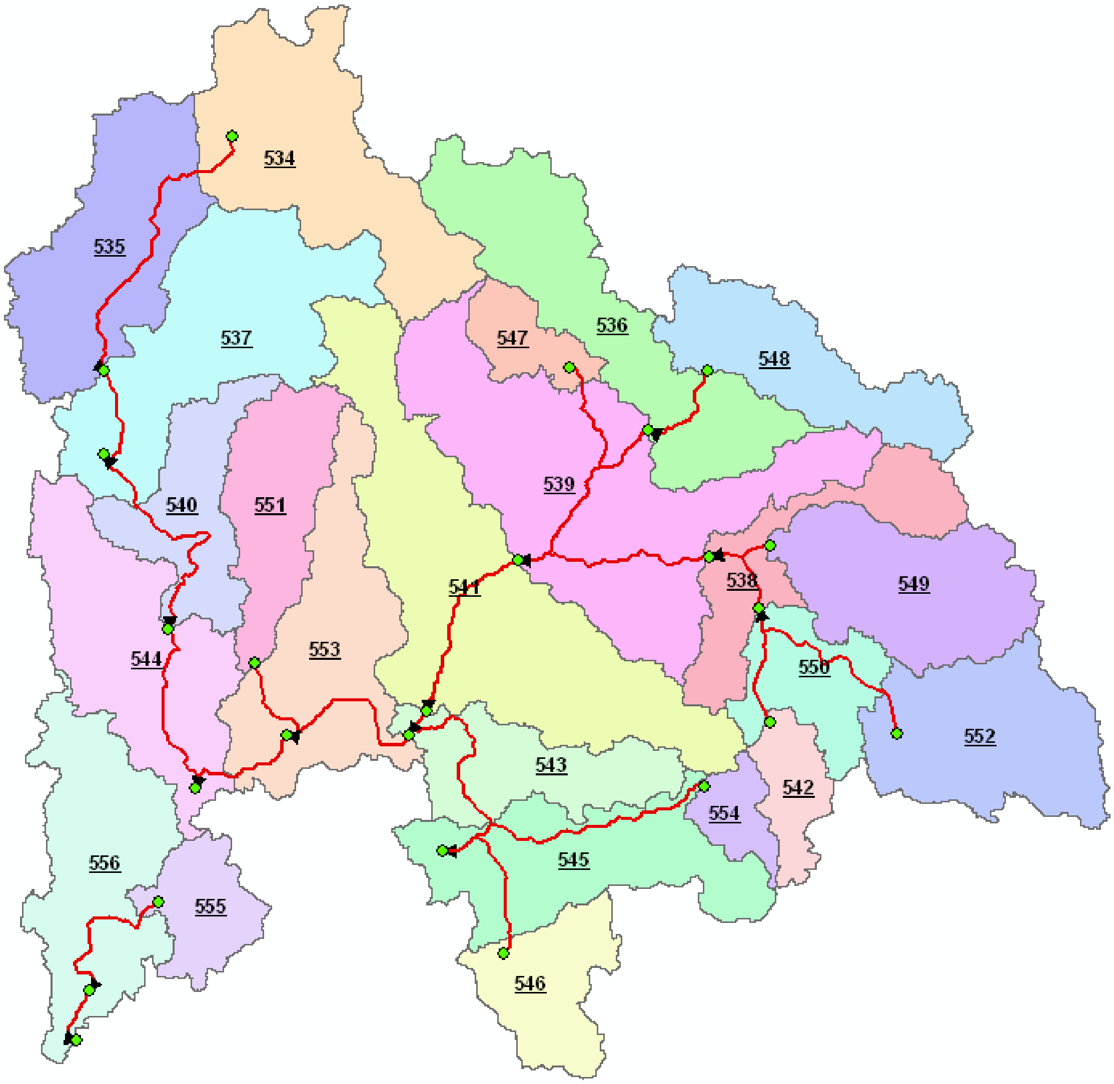
This tool allows creating a Preferential Node/Link schema that defines the “main” overland flow paths of type Boundary Link between Catchment features. The input HydroEdge, HydroJunction and DrainageBoundary feature classes used by the tool are the ones created with the Terrain Morphology Drainage Connectivity Characterization function, and NOT the ones created manually and/or during the creation of HEPs (Structure Link) that will be handled by the tools Add Point Structure HydroEdges to Preferential Path and Add Linear HydroEdges to Preferential Path.

- Double-click **Terrain Morphology > AH Connectivity Refinement Tools > Define Overland Preferential Node Link Schema**.

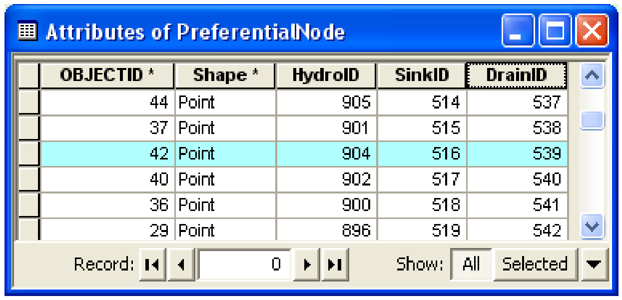
- Specify the inputs as shown and rename the output PreferentialLink “PreferentialLink”. Click OK.



The tool generates the PreferentialLink and PreferentialNode feature classes that identify the preferred path from one catchment SinkPoint into the next catchment using Boundary Link HydroEdges.



For each Catchment feature being processed, the tool finds the sink point feature within the catchment and copies this point into the output "Preferential Node" feature class. It populates the HydroID field with a new unique identifier and the field SinkID with the HydroID of the source Sink Point. The DrainID field is populated with the HydroID of the Catchment feature.



OBJECTID *	Shape *	HydroID	SinkID	DrainID
44	Point	905	514	537
37	Point	901	515	538
42	Point	904	516	539
40	Point	902	517	540
36	Point	900	518	541
29	Point	896	519	542

The tool identifies the connected catchment by looking for the HydroJunction features located on the Catchment's associated Drainage Boundary features and identifying the HydroJunction that has the lowest elevation. The elevations are retrieved from the input Drainage Boundary feature class.

The tool looks for connected HydroEdges of type 'Boundary Link' at that location that belong to an adjacent catchment:

- If the tool cannot find an adjacent HydroEdge/Catchment, it creates a Preferential Path that starts at the sink and ends at the lowest HydroJunction on the boundary. The tool creates a Preferential Node at the location of the lowest HydroJunction and populates its SinkID and DrainID with -1.

- If the tool finds one or many connected HydroEdges, for each connected feature it merges the geometries of the Hydro Edges connecting at that lowest Hydro Junction that link the sink points of these 2 catchments. It stores the resulting line in the output "Preferential Link" feature class and populates its HydroID. The tool sets the field IsPreferred to 1 in the HydroEdge features merged to create the Preferential Link.

The tool identifies the lowest HydroJunction features located along all Drainage Boundary features of the identified adjacent catchment at the exclusion of the Drainage Boundary features associated to the first catchment.
If its elevation is lower than the elevation of the HydroJunction previously identified, the first catchment is flowing into the second catchment 2. The tool sets the digitized direction of the Preferential Link from the first to the second catchment 2 and populates the fields in the attributes table of Preferential Link as follows:

- FlowDir: "WithDigitized"
- FNID: HydroID of the Preferential Node in Catchment 1
- TNID: HydroID of the Preferential Node in Catchment 2
- FeatureID1: HydroID of Catchment 1
- FeatureID2: HydroID of Catchment 2

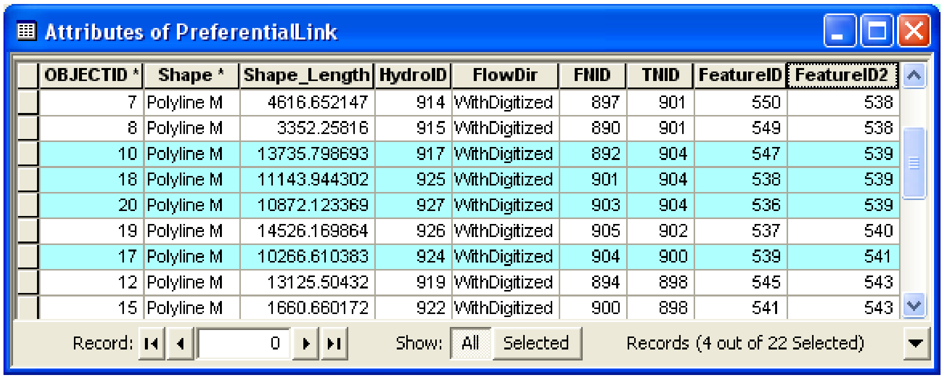
If the elevation of the second HydroJunction is higher, the second catchment is flowing into the first catchment. The tool sets the digitized direction of the Preferential Link from Catchment 2 to Catchment 1 and populates the fields in the attributes table of Preferential Link as follows:

- FlowDir: "WithDigitized"
- FNID: HydroID of the Preferential Node in Catchment 2
- TNID: HydroID of the Preferential Node in Catchment 1
- FeatureID1: HydroID of Catchment 2
- FeatureID2: HydroID of Catchment 1

If both elevations are the same, the tool sets the digitized direction of the Preferential Link from the smaller catchment to the larger catchment. The tool populates the field FlowDir with "WithDigitized".

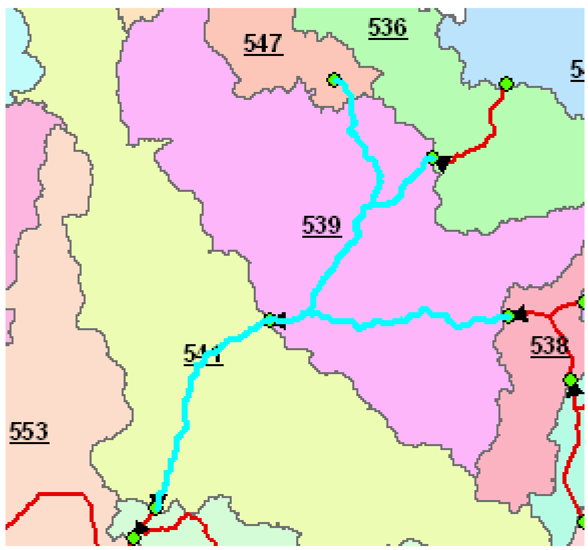
The tool sets the processing flag to both Catchments to Done to skip processing Catchment 2 in the subsequent loop. It populates the following fields in the attributes table of Preferential Link as follows:

- FlowDir: "WithDigitized"
- FNID: HydroID of the Preferential Node in smaller Catchment
- TNID: HydroID of the Preferential Node in larger Catchment
- FeatureID1: HydroID of smaller Catchment
- FeatureID2: HydroID of larger Catchment


Attributes of PreferentialLink

OBJECTID *	Shape *	Shape_Length	HydroID	FlowDir	FNID	TNID	FeatureID	FeatureID2
7	Polyline M	4616.652147	914	WithDigitized	897	901	550	538
8	Polyline M	3352.25816	915	WithDigitized	890	901	549	538
10	Polyline M	13735.798693	917	WithDigitized	892	904	547	539
18	Polyline M	11143.944302	925	WithDigitized	901	904	538	539
20	Polyline M	10872.123369	927	WithDigitized	903	904	536	539
19	Polyline M	14526.169864	926	WithDigitized	905	902	537	540
17	Polyline M	10266.610383	924	WithDigitized	904	900	539	541
12	Polyline M	13125.50432	919	WithDigitized	894	898	545	543
15	Polyline M	1660.660172	922	WithDigitized	900	898	541	543

Record: 0 Show: All Selected Records (4 out of 22 Selected)



4. Add Point Structure HydroEdges to Preferential Link

Note

Before using this tool, make sure the geoprocessing setting is set to allow you to overwrite the results of the geoprocessing operations. This setting is required to allow you to update and append/replace records in the output Preferential Node and Link feature classes. If you do not allow overwriting, two new Preferential Link/Node feature classes will be generated each time you run the tool.

This tool allows generating Preferential Links and Nodes associated to HydroJunctions of hydraulic type Culvert ('CULV'), Control Structure ('CS') or Bridge ('BRID'). The tool works on a selected set of ‘HydroJunction’ features. If nothing is selected, all features will be processed. The tool will not overwrite any existing links or nodes.

The tool loops through all selected HydroJunctions and processes only the HydroJunction features that have the following attributes:

- IsPreferred=1
- HYDRAULIC_TYPE_DESC in (‘CULV’, ‘BRID’, ‘CS’)

and are connected to at least one HydroEdge having IsPreferred=1.

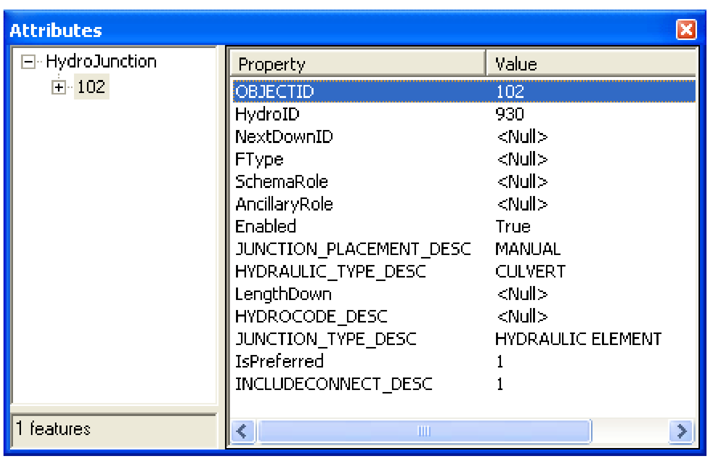
Notes

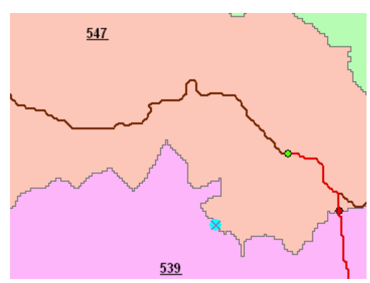
Although the tool processes all features when there is no selection, it is better to work on selected features as this is a GIS intensive function and quality control at each step is essential.

The HydroJunction/HydroEdge used by this tool may be created using the tools available in the SWFWMD – Connectivity Tools toolbar installed with Arc Hydro. Refer to the document Arc Hydro Connectivity Tools – Tutorial.pdf for more information on how to create the HydroJunction/HydroEdge features.

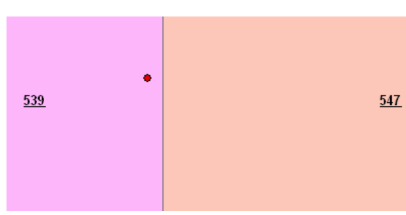
You are going to create a new HydroJunction representing a Culvert point structure on the boundary line between catchments 547 and 539.

- Start editing and add a new Hydro Junction feature on the Drainage Boundary feature between Catchment 547 and 539. Set the fields JUNCTION_PLACEMENT_DESC to ‘MANUAL’, HYDRAULIC_TYPE_DESC to ‘CULVERT’, JUNCTION_TYPE_DESC to ‘HYDRAULIC ELEMENT’, IsPreferred to ‘1’ and INCLUDECONNECT_DESC to ‘1’. Save your edits and stop editing.

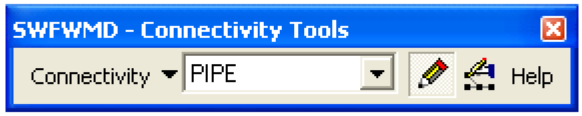




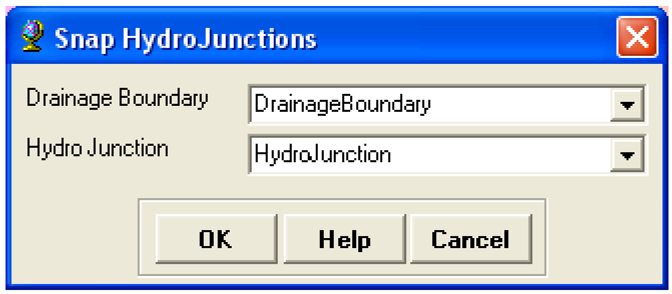
- Zoom in to the HydroJunction you just created. Since you did not set the snapping environment, the HydroJunction may not be exactly on top of the DrainageBoundary feature. You are going to snap the HydroJunction onto the boundary.



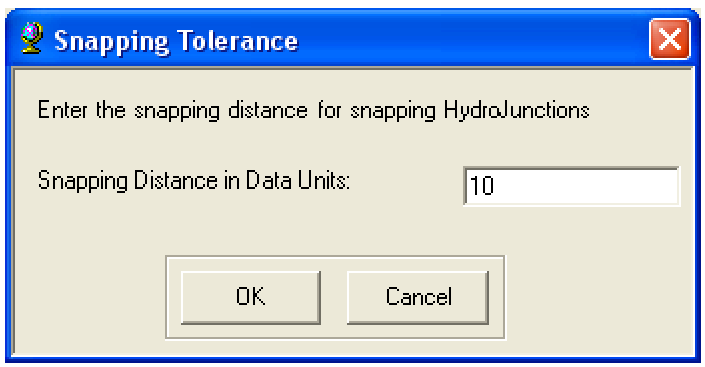
- Add the SWFWMD – Connectivity Tools toolbar.



- Select the HydroJunction you just created and select Connectivity > Snap HydroJunctions. Specify the input DrainageBoundary and Hydro Junction feature classes and click OK.

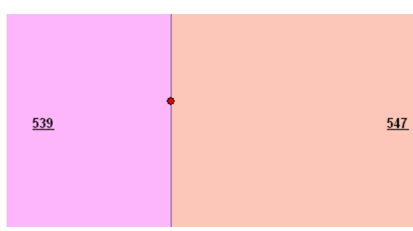


- Specify the snapping distance (e.g. 10) and click OK.



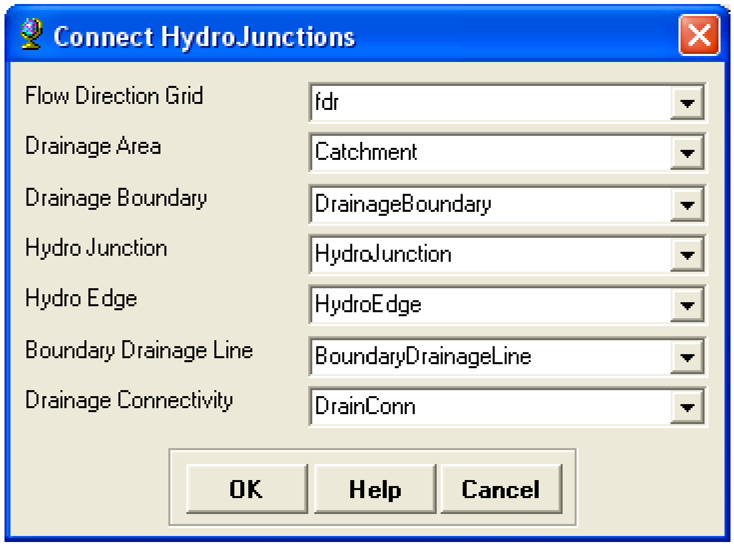
- Refresh the map.

The HydroJunction has been snapped on top of the DrainageBoundary feature.



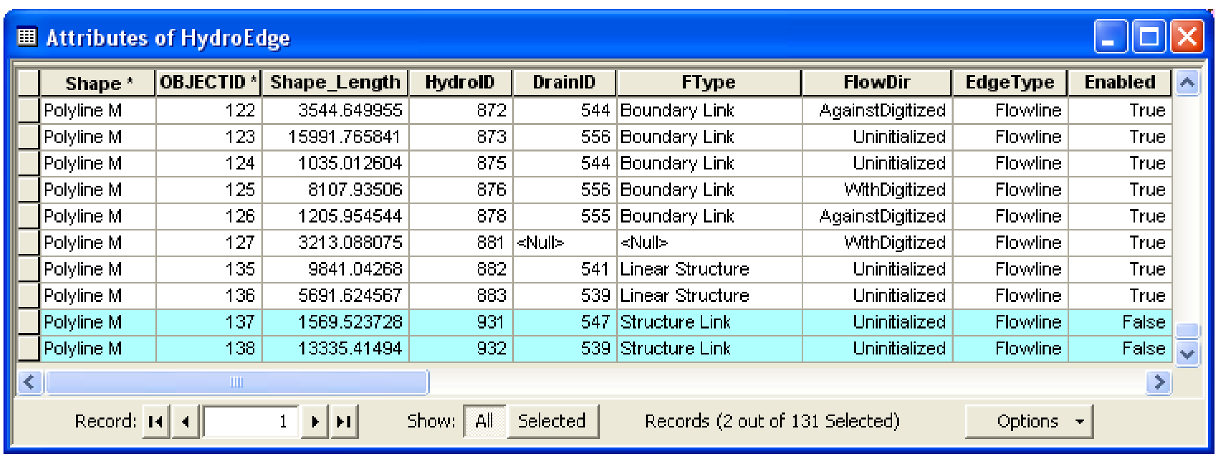
You now need to create the HydroEdges associated to this new HydroJunction – they will link the HydroJunction to the Sink Node HydroJunction in each catchment.

- In the SWFWMD – Connectivity Tools toolbar, select Connectivity > Connect HydroJunctions. Specify the inputs as shown below and click OK.



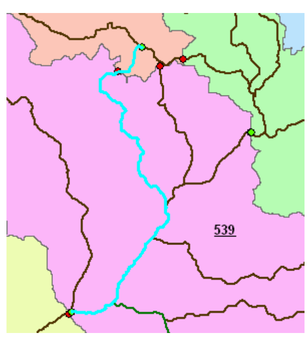
- Refresh the map.

The function creates 2 new HydroEdge features of type Structure Link with their attribute IsPreferred set to 1.


Attributes of HydroEdge

Shape *	OBJECTID *	Shape_Length	HydroID	DrainID	FType	FlowDir	EdgeType	Enabled
Polyline M	122	3544.649955	872	544	Boundary Link	AgainstDigitized	Flowline	True
Polyline M	123	15991.765841	873	556	Boundary Link	Uninitialized	Flowline	True
Polyline M	124	1035.012604	875	544	Boundary Link	Uninitialized	Flowline	True
Polyline M	125	8107.93506	876	556	Boundary Link	WithDigitized	Flowline	True
Polyline M	126	1205.954544	878	555	Boundary Link	AgainstDigitized	Flowline	True
Polyline M	127	3213.088075	881	<Null>	<Null>	WithDigitized	Flowline	True
Polyline M	135	9841.04268	882	541	Linear Structure	Uninitialized	Flowline	True
Polyline M	136	5691.624567	883	539	Linear Structure	Uninitialized	Flowline	True
Polyline M	137	1569.523728	931	547	Structure Link	Uninitialized	Flowline	False
Polyline M	138	13335.41494	932	539	Structure Link	Uninitialized	Flowline	False

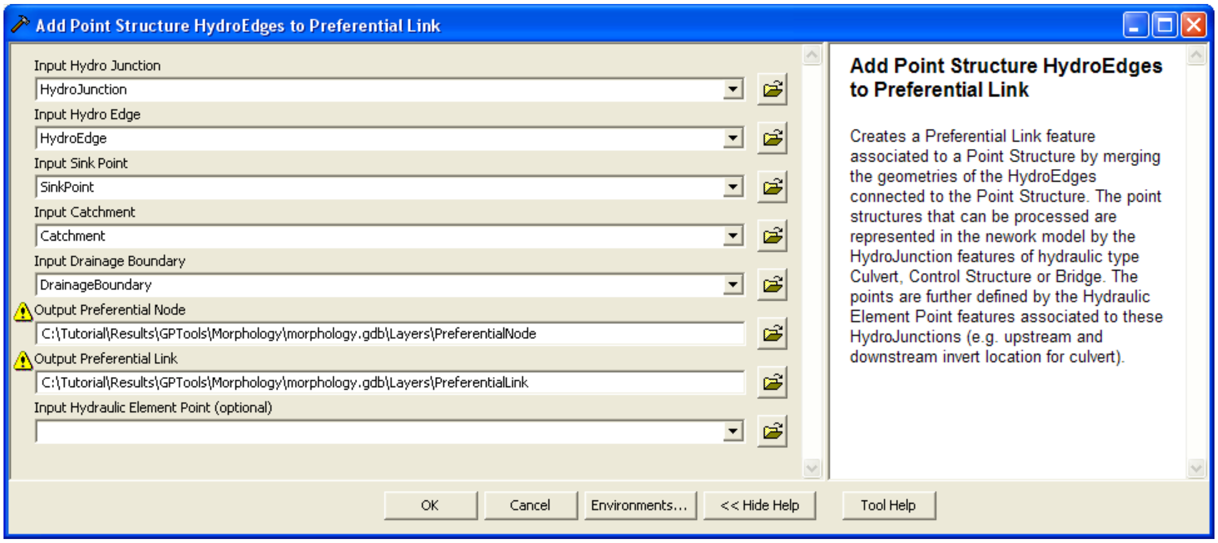
Record: 1 Show: All Selected Records (2 out of 131 Selected) Options



- Select the HydroJunction feature of type Culvert you just created. Double-click **Terrain Morphology > AH Connectivity Refinement Tools > Add Point Linear Structure HydroEdges to Preferential Link**.

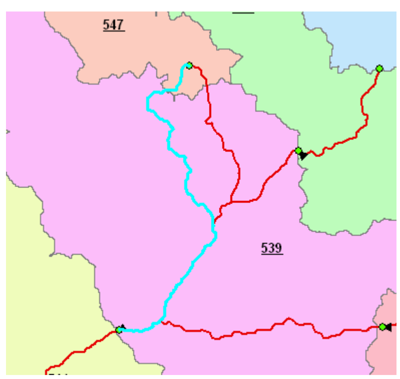
- Select the input Hydro Junction, Hydro Edge, Sink Point, Catchment and Drainage Boundary feature classes. Specify the Preferential Link and Preferential Node you just created as output so that the tool updates these existing feature classes. Set the optional Hydraulic Element Point feature class to blank.

The tool will display a yellow warning sign indicating that the feature classes will be overwritten. In reality, the tool will append new records in these feature classes and not overwrite the existing Preferential Link and Node features.



- Click OK to proceed.

The tool generates a new Preferential Link connecting the via the selected HydroJunction feature of Hydraulic_Type_Desc Culvert.



Point Structure Preferential Link

Attributes of PreferentialLink

OBJECTID *	Shape *	Shape_Length	HydroID	FlowDir	FNID	TNID	FeatureID1	FeatureID2
18	Polyline M	11143.944302	925	WithDigitized	901	904	538	539
19	Polyline M	14526.169864	926	WithDigitized	905	902	537	540
20	Polyline M	10872.123369	927	WithDigitized	903	904	536	539
21	Polyline M	5568.305192	928	WithDigitized	907	905	535	537
22	Polyline M	17014.175311	929	WithDigitized	906	907	534	535
23	Polyline M	14904.938668	933	WithDigitized	892	904	547	539

Record: 1 Show: All Selected Records (1 out of 23 Selected) Options

The tool did not create new Preferential Node features in this case but used the existing nodes associated to the sink points at the ends of the link (892 and 904).

Note

If the optional Hydraulic Element Point feature class had been specified and that layer contains features associated to the HydroJunction of HYDRAULIC_TYPE_DESC Culvert being processed, the direction of the preferential link will be set using the direction set by the elements instead of using the lowest elevation on the boundary of the catchments.

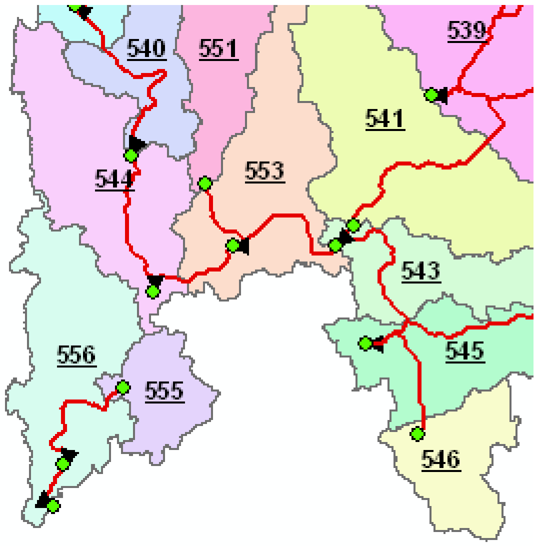
5. Update Preferential Node Link Schema

Note

Before using this tool, make sure the geoprocessing setting is set to allow you to overwrite the results of the geoprocessing operations. This setting is required to allow you to update and append/replace records in the output Preferential Node and Link feature classes. If you do not allow overwriting, two new Preferential Link/Node feature classes will be generated each time you run the tool.

This tool allows generating the Preferential Node and Link feature classes by using the HydroEdge features of FType Boundary Link or Structure Link having the field IsPreferred set to 1. This tool may be used after editing the field IsPreferred in the HydroEdge features of type Boundary Link or Structure Link to modify the desired Preferential Paths.

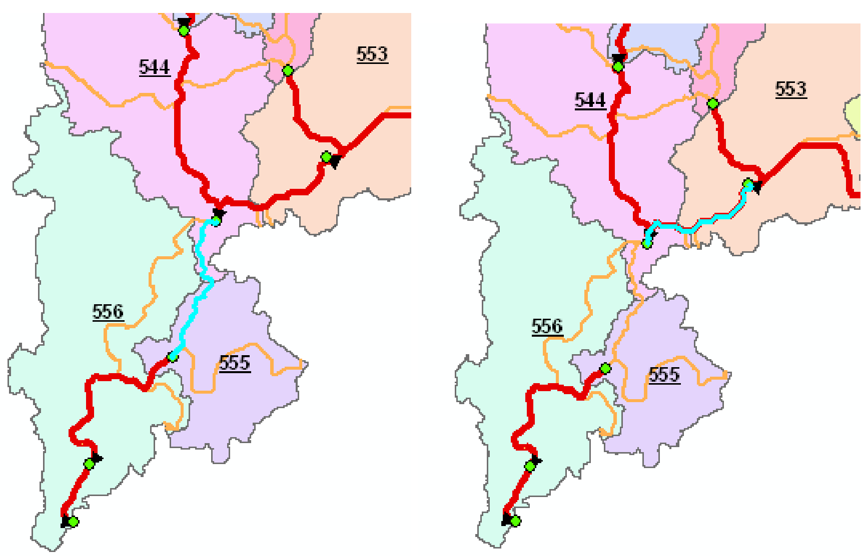
For example, you are now going to modify the preferential path so that Catchment 544 is not terminal but flows into Catchment 555.



- Set the field IsPreferred to 1 for the 2 HydroEdges connecting 544 and 555.

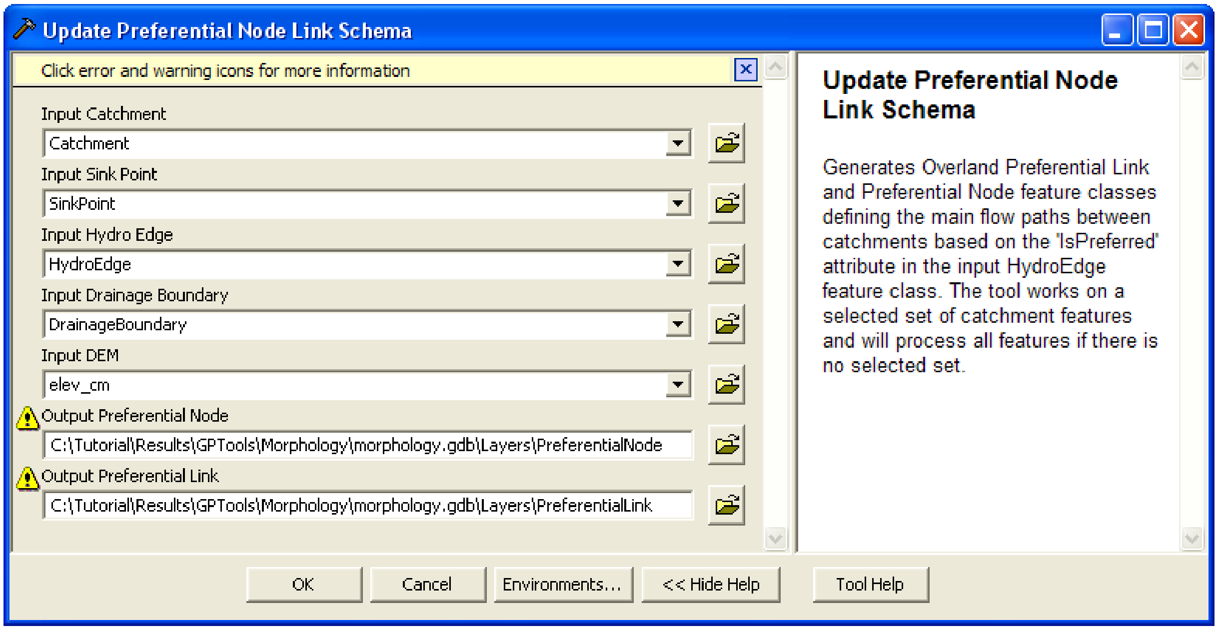
For the second modification, you will edit the Hydro Edges so that Catchment 553 flows into Catchment 543 instead of 544.

- Set the field IsPreferred to 0 for the HydroEdges connecting 544 and 553 as shown below.

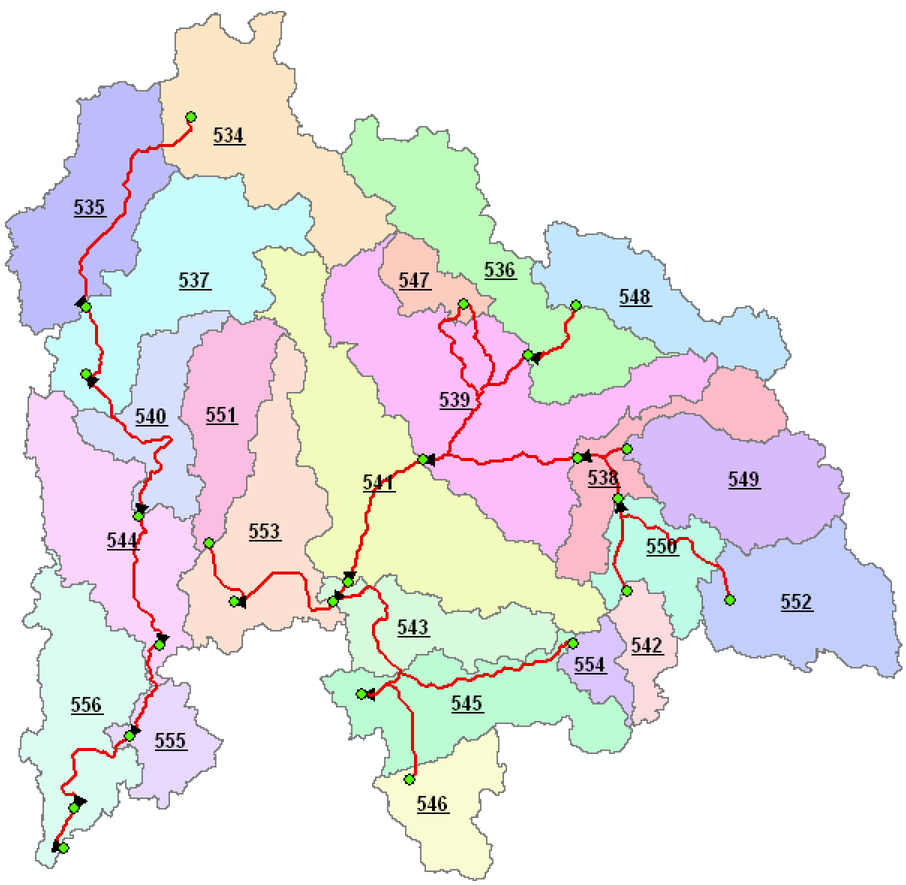


- Select Catchment 544 as the catchment to process.

- Double-click **Terrain Morphology > AH Connectivity Refinement Tools > Update Preferential Node Link Schema**. Specify the inputs as shown below. Make sure that the existing PreferentialNode and PreferentialLink features classes are set as outputs so that these feature classes are updated by the tool. Click OK.



The tool updates the existing Preferential Node and Preferential Link feature class based on the IsPreferred attribute in the input Hydro Edge feature class. The link between 544 and 553 is removed and a new link is added between 544 and 555.



6. Add Linear Structure HydroEdges to Preferential Link

Note

Before using this tool, make sure the geoprocessing setting is set to allow you to overwrite the results of the geoprocessing operations. This setting is required to allow you to update and append/replace records in the output Preferential Node and Link feature classes. If you do not allow overwriting, two new Preferential Link/Node feature classes will be generated each time you run the tool.

This tool allows generating Preferential Links and Nodes associated to HydroEdges of type Linear Structure. The tool works on a selected set of HydroEdge features. If nothing is selected, all features will be processed. The tool will not overwrite any existing links or nodes.

The tool loops through all selected HydroEdges and processes only the HydroEdge features that have the following attributes:

- IsPreferred=1
- FType="Linear Structure"

and have their From Point intersecting the FromPoint of another HydroEdge feature.

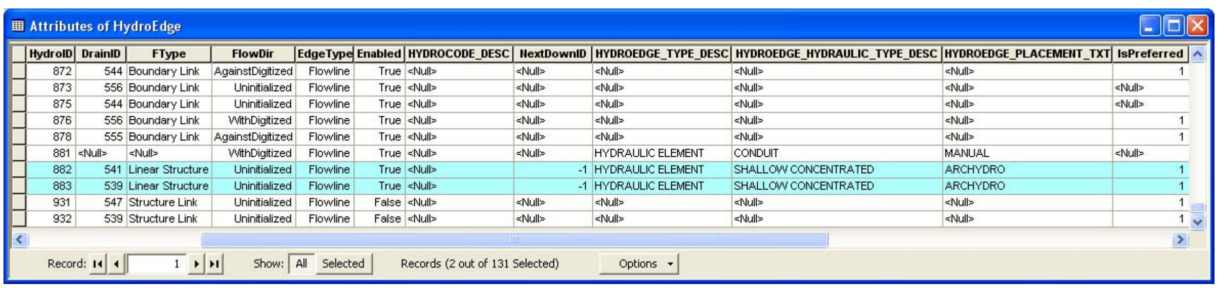
Notes

Although the tool processes all features when there is no selection, it is better to work on selected features as this is a GIS intensive function and quality control at each step is essential.

The HydroEdges MUST have the flow direction set in the geometric network. You can set the flow direction if needed by running the Set Flow Direction function in the Network Tools menu.

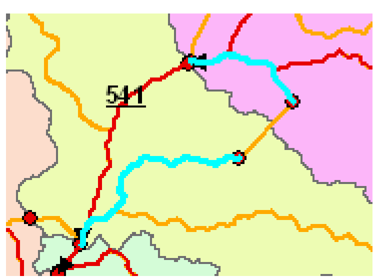
- Click Network Tools > Set Flow Direction and set the Flow Direction in the digitized direction.

- Select the HydroEdge features having FType="Linear Structure" you previously created.


Attributes of HydroEdge

HydroID	DrainID	FType	FlowDir	EdgeType	Enabled	HYDROCODE_DESC	NextDownID	HYDROEDGE_TYPE_DESC	HYDROEDGE_HYDRAULIC_TYPE_DESC	HYDROEDGE_PLACEMENT_TXT	IsPreferred
872	544	Boundary Link	AgainstDigitized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	1
873	556	Boundary Link	Uninitialized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
875	544	Boundary Link	Uninitialized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
876	556	Boundary Link	WithDigitized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	1
878	555	Boundary Link	AgainstDigitized	Flowline	True	<Null>	<Null>	<Null>	<Null>	<Null>	1
881	<Null>	<Null>	WithDigitized	Flowline	True	<Null>	<Null>	HYDRAULIC ELEMENT	CONDUIT	MANUAL	<Null>
882	541	Linear Structure	Uninitialized	Flowline	True	<Null>	-1	HYDRAULIC ELEMENT	SHALLOW CONCENTRATED	ARCHYDRO	1
883	539	Linear Structure	Uninitialized	Flowline	True	<Null>	-1	HYDRAULIC ELEMENT	SHALLOW CONCENTRATED	ARCHYDRO	1
931	547	Structure Link	Uninitialized	Flowline	False	<Null>	<Null>	<Null>	<Null>	<Null>	1
932	539	Structure Link	Uninitialized	Flowline	False	<Null>	<Null>	<Null>	<Null>	<Null>	1

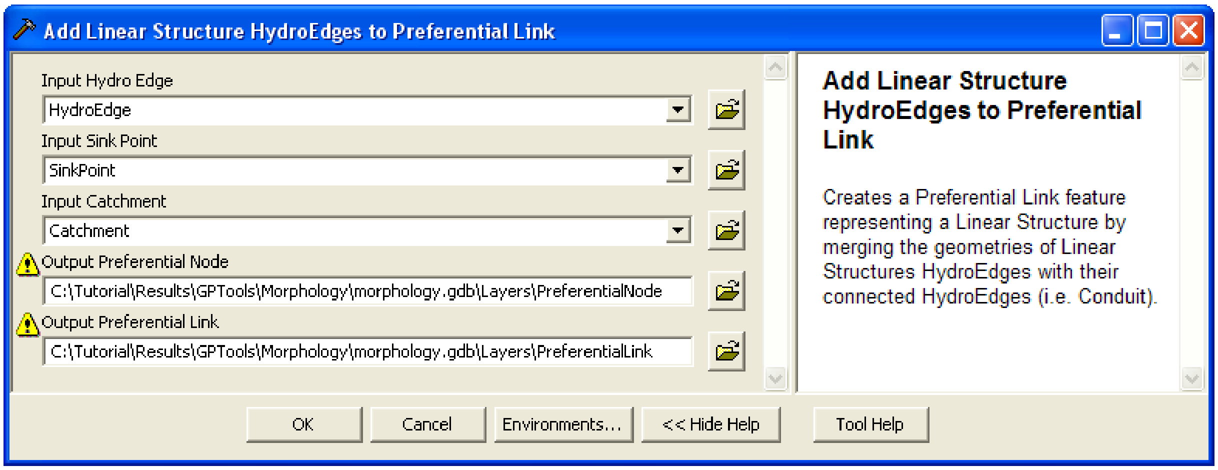
Record: 1 Show: All Selected Records (2 out of 131 Selected) Options



- Double-click **Terrain Morphology > AH Connectivity Refinement Tools > Add Linear Structure HydroEdges to Preferential Link**.

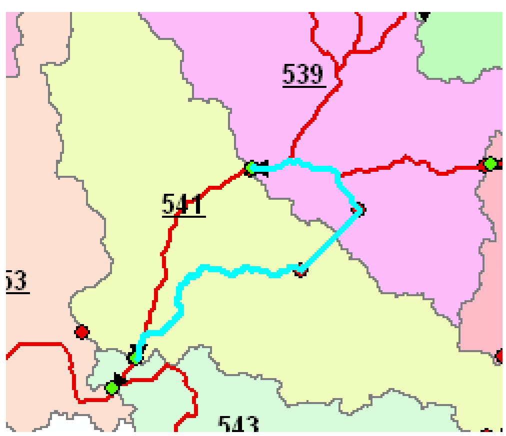
- Select the input Hydro Edge, Sink Point and Catchment feature classes. Specify the Preferential Link and Preferential Node you just created as output so that the tool updates these existing feature classes.

The tool will display a yellow warning sign indicating that the feature classes will be overwritten. In reality, the tool will append additional records into the existing feature classes. Note that took will not delete the existing overland Preferential Link existing between the Catchments linked by the control structure.

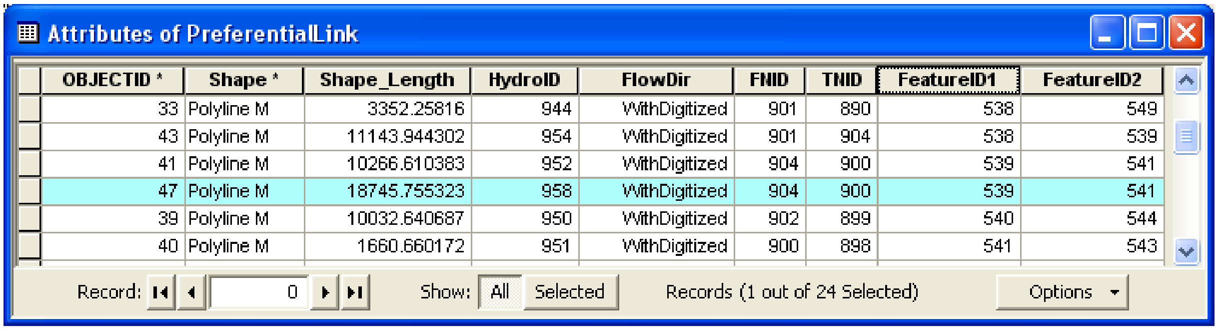


- Click OK to proceed.

The tool adds a new Preferential Link feature between Catchments 539 and 541 in addition to the one that was generated with the tool Define Overland Preferential Node Link Schema. It does not replace the existing link.



Linear Structure Preferential Link

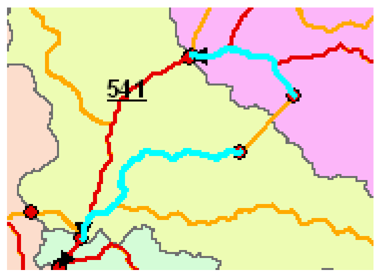


Attributes of PreferentialLink

OBJECTID *	Shape *	Shape_Length	HydroID	FlowDir	FNID	TNID	FeatureID1	FeatureID2
33	Polyline M	3352.25816	944	WithDigitized	901	890	538	549
43	Polyline M	11143.944302	954	WithDigitized	901	904	538	539
41	Polyline M	10266.610383	952	WithDigitized	904	900	539	541
47	Polyline M	18745.755323	958	WithDigitized	904	900	539	541
39	Polyline M	10032.640687	950	WithDigitized	902	899	540	544
40	Polyline M	1660.660172	951	WithDigitized	900	898	541	543

The tool did not create new Preferential Node features in this case but used the existing nodes associated to the sink points at the ends of the link (900 and 904).

The tool traced first from the FromPoint of each selected Hydro Edge features of type Linear Structure to find all downstream HydroEdges (Conduit as well as Linear Structures Edges). The tool merged the geometries of all resulting HydroEdges to create a new PreferentialLink feature having 'FlowDir=WithDigitized'.



The FromPoint of the Preferential Link feature is the ToPoint of the HydroEdge feature of FType Linear Structure associated to from point of the conduit being processed and its ToPoint is at the end of the trace (i.e. the ToPoint of the HydroEdge of FType Linear Structure at the downstream end of the Conduit (sink)).

The tool creates output Preferential Node features if they do not already exist at each Sink Point located at the ToPoint of the Linear Structure HydroEdges at both ends of the Preferential Link. The SinkID is populated with the HydroID of the Sink Point.

For Preferential Links, the tool sets FNID=HydroID of the 'From Preferential Node' and TNID= HydroID of the 'To Preferential Node'.

The tool populates the fields FeatureID1 and FeatureID2 with the HydroID of the From and To Catchments associated to a Preferential Link. Catchments are retrieved by spatial query using the Sink Point features.

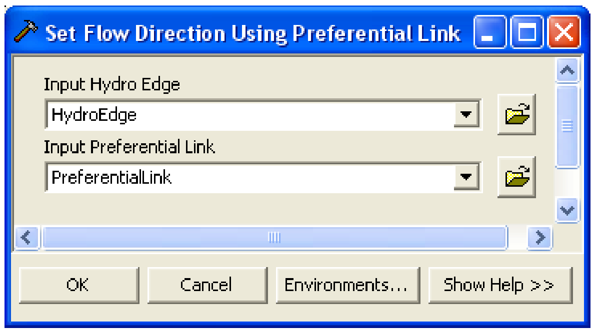
Note

When the HydroEdges that are pipes (HEP lines) cross Linear Structures, the digitized direction (FromNode and ToNode) will not be maintained since new vertices will be introduced at the intersecting points. However FNID, TNID, FeatureID1 and FeatureID2 will be maintained to establish the flow.

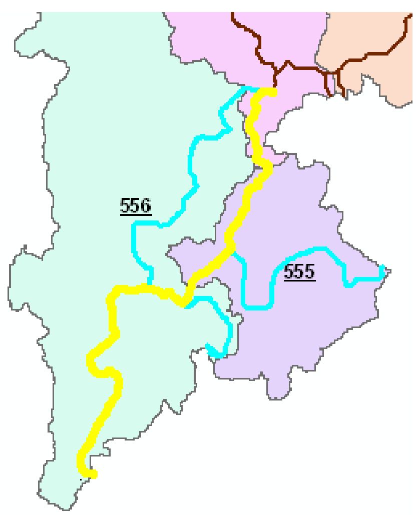
7. Set Flow Direction Using Preferential Link

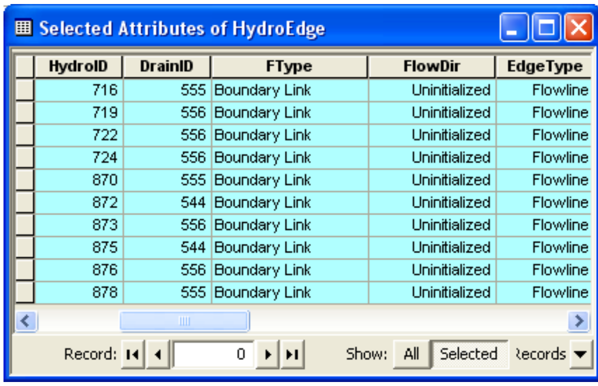
This tool allows settings the flow direction for the HydroEdges based on the direction of the Preferential Links.

- Double-click Terrain **Morphology** > **AH Connectivity Refinement Tools** > **Set Flow Direction Using Preferential Link**.
- Specify the inputs/outputs as shown below and click OK.



The tool updates the field FlowDir in the attributes table of HydroEdge based on the direction of the associated Preferential Link. The HydroEdges highlighted in yellow in the picture and table below are the ones associated with a Preferential Link.

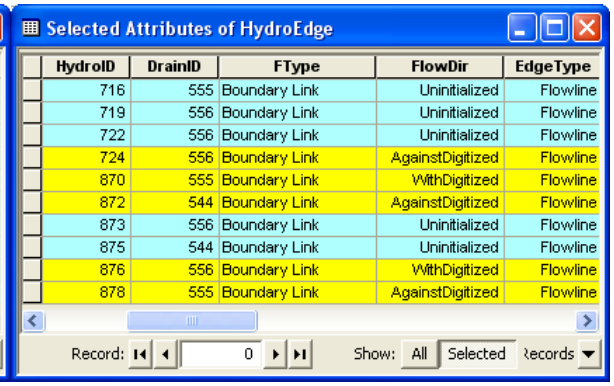




Selected Attributes of HydroEdge

HydroID	DrainID	FType	FlowDir	EdgeType
716	555	Boundary Link	Uninitialized	Flowline
719	556	Boundary Link	Uninitialized	Flowline
722	556	Boundary Link	Uninitialized	Flowline
724	556	Boundary Link	Uninitialized	Flowline
870	555	Boundary Link	Uninitialized	Flowline
872	544	Boundary Link	Uninitialized	Flowline
873	556	Boundary Link	Uninitialized	Flowline
875	544	Boundary Link	Uninitialized	Flowline
876	556	Boundary Link	Uninitialized	Flowline
878	555	Boundary Link	Uninitialized	Flowline

Record: 0 Show: All Selected Records



Selected Attributes of HydroEdge

HydroID	DrainID	FType	FlowDir	EdgeType
716	555	Boundary Link	Uninitialized	Flowline
719	556	Boundary Link	Uninitialized	Flowline
722	556	Boundary Link	Uninitialized	Flowline
724	556	Boundary Link	AgainstDigitized	Flowline
870	555	Boundary Link	WithDigitized	Flowline
872	544	Boundary Link	AgainstDigitized	Flowline
873	556	Boundary Link	Uninitialized	Flowline
875	544	Boundary Link	Uninitialized	Flowline
876	556	Boundary Link	WithDigitized	Flowline
878	555	Boundary Link	AgainstDigitized	Flowline

Record: 0 Show: All Selected Records

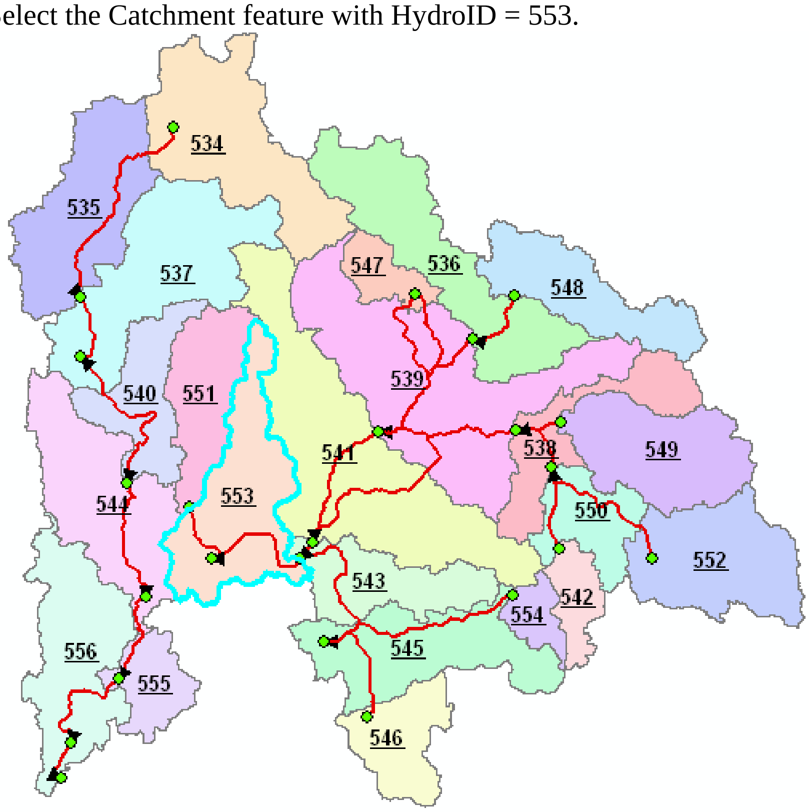
Grouping Toolset

The Grouping Toolset contains a set of tools that allows regrouping catchment to facilitate analyses.

1. Select Upstream Catchments using Preferential Node Link

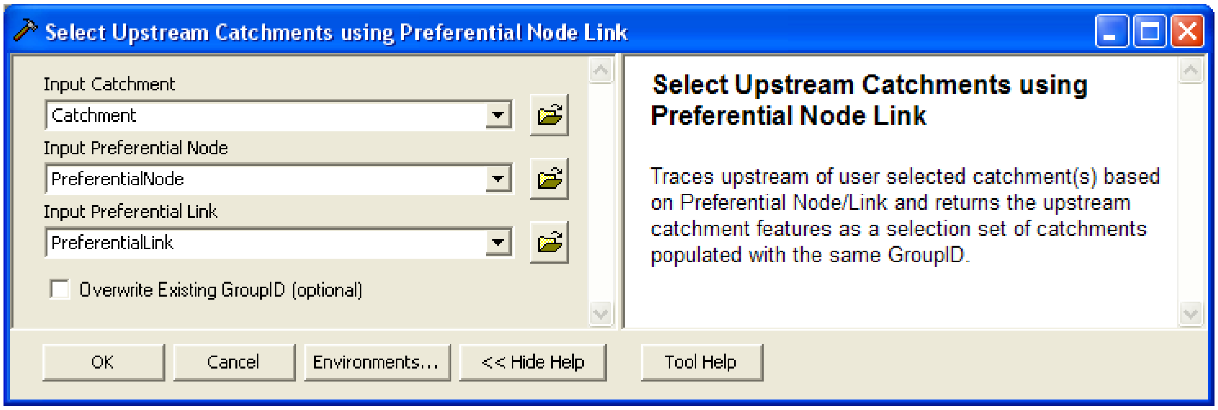
This tool allows identifying the Catchment features located upstream of the selected Catchment features based on the Preferential Link and Node feature classes and populating the GroupID field in these Catchments with the same identifier.

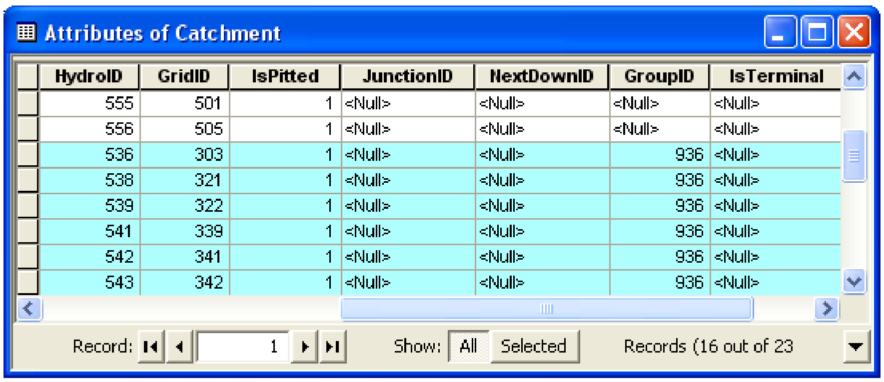
- Select the Catchment feature with HydroID = 553.



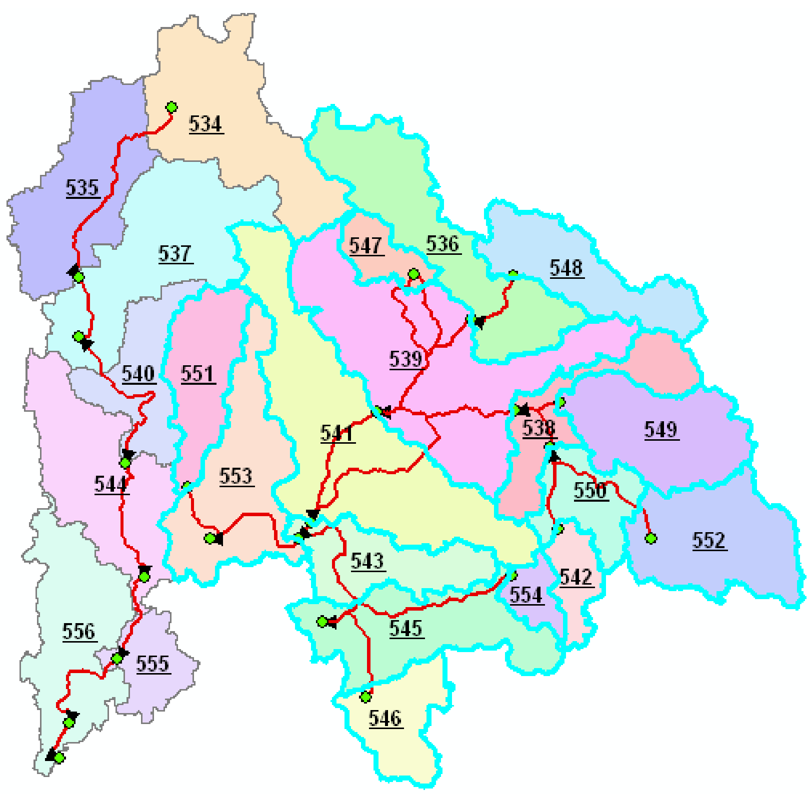
- Double-click **Terrain Morphology** > **Grouping Toolset** > **Select Upstream Catchments using Preferential Node Link**.

- Specify the input Catchment, Preferential Node and Preferential Link feature classes and click OK.



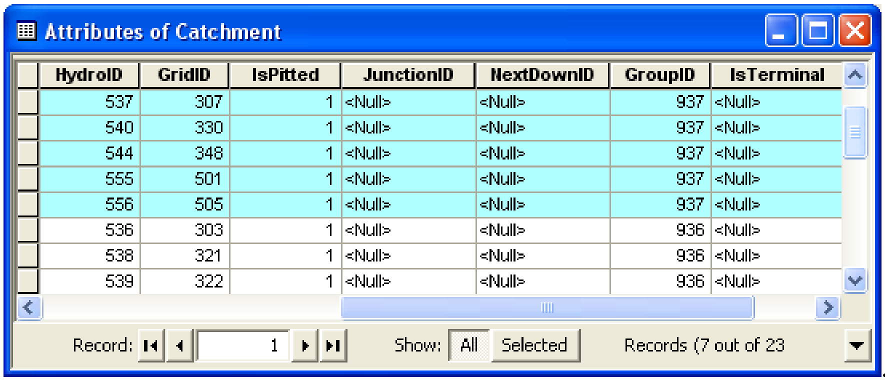


HydroID	GridID	IsPitted	JunctionID	NextDownID	GroupID	IsTerminal
555	501	1	<Null>	<Null>	<Null>	<Null>
556	505	1	<Null>	<Null>	<Null>	<Null>
536	303	1	<Null>	<Null>	936	<Null>
538	321	1	<Null>	<Null>	936	<Null>
539	322	1	<Null>	<Null>	936	<Null>
541	339	1	<Null>	<Null>	936	<Null>
542	341	1	<Null>	<Null>	936	<Null>
543	342	1	<Null>	<Null>	936	<Null>



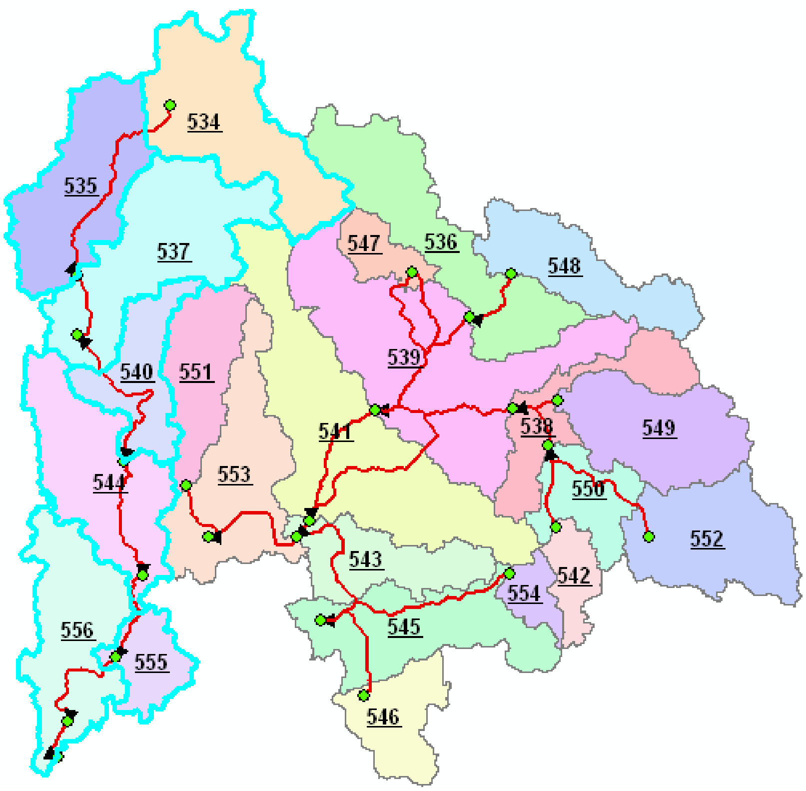
- Select the Catchment feature with HydroID 556 and rerun the function without the overwrite option).

The tool selects and populates the field GroupID for the remaining group.


Attributes of Catchment

HydroID	GridID	IsPitted	JunctionID	NextDownID	GroupID	IsTerminal
537	307	1	<Null>	<Null>	937	<Null>
540	330	1	<Null>	<Null>	937	<Null>
544	348	1	<Null>	<Null>	937	<Null>
555	501	1	<Null>	<Null>	937	<Null>
556	505	1	<Null>	<Null>	937	<Null>
536	303	1	<Null>	<Null>	936	<Null>
538	321	1	<Null>	<Null>	936	<Null>
539	322	1	<Null>	<Null>	936	<Null>

Record: 1 Show: All Selected Records (7 out of 23

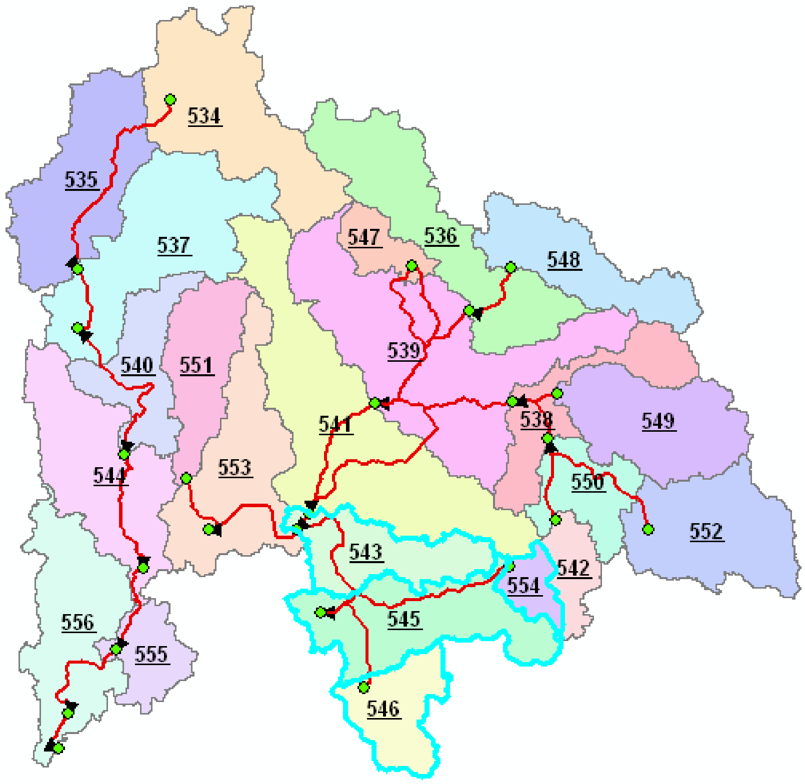


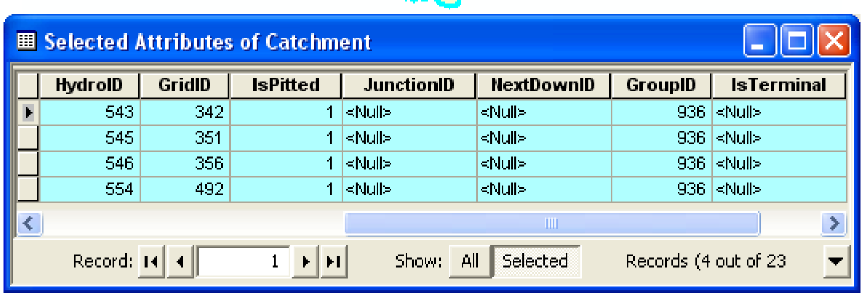
2. Group Selected Catchment

This tool allows manually modifying the GroupID attribute for the selected Catchments. This GroupID may have been assigned by the tool Select Upstream Catchments using Preferential Node/Link.

You are going to regroup the 4 Catchment features at the bottom right (HydroIDs 543, 545, 546 and 554).

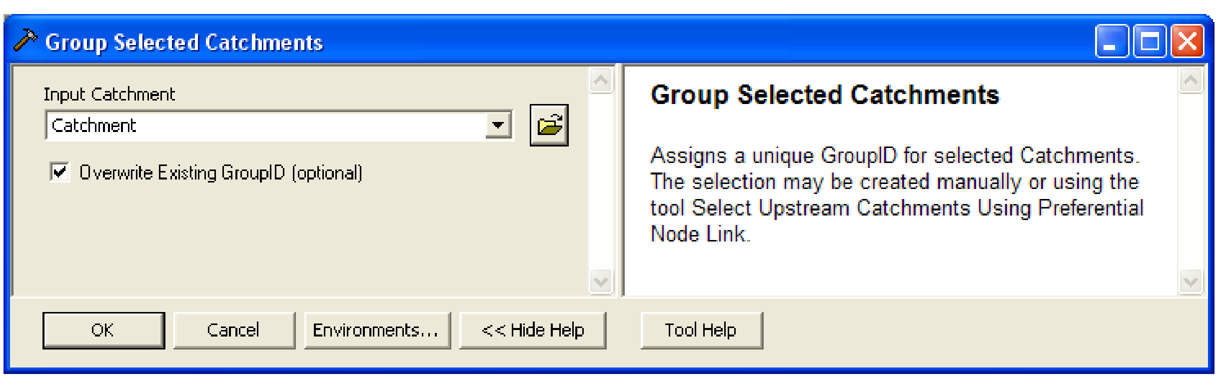
- Select these Catchments. They currently belong to group 936.



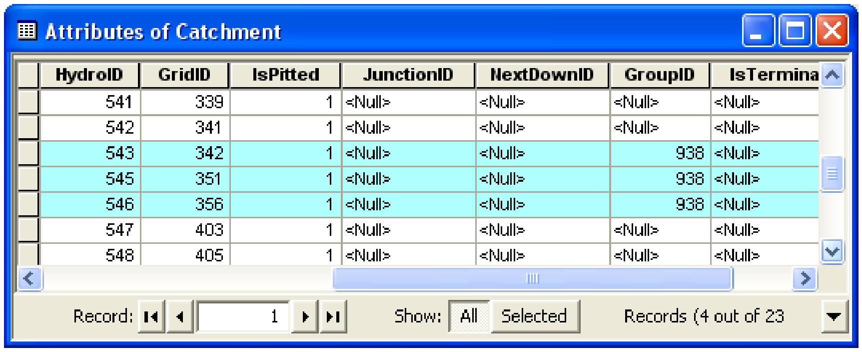


HydroID	GridID	IsPitted	JunctionID	NextDownID	GroupID	IsTerminal
543	342	1	<Null>	<Null>	936	<Null>
545	351	1	<Null>	<Null>	936	<Null>
546	356	1	<Null>	<Null>	936	<Null>
554	492	1	<Null>	<Null>	936	<Null>

- Double-click **Terrain Morphology > Grouping Toolset > Group Selected Catchments**. Select Catchment as input Catchment feature class, check the Overwrite option since the GroupID field is already populated and click OK.



The tool updates the field GroupID for the selected features and resets to Null the GroupID of the other features that had the same GroupID (936) before the update.



Attributes of Catchment

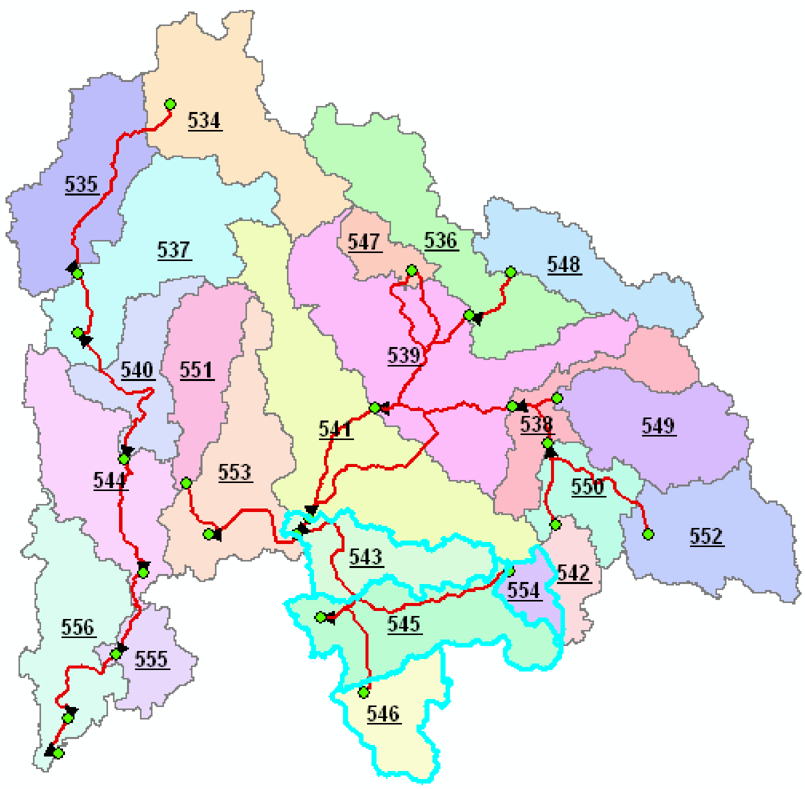
HydroID	GridID	IsPitted	JunctionID	NextDownID	GroupID	IsTermina
541	339	1	<Null>	<Null>	<Null>	<Null>
542	341	1	<Null>	<Null>	<Null>	<Null>
543	342	1	<Null>	<Null>	938	<Null>
545	351	1	<Null>	<Null>	938	<Null>
546	356	1	<Null>	<Null>	938	<Null>
547	403	1	<Null>	<Null>	<Null>	<Null>
548	405	1	<Null>	<Null>	<Null>	<Null>

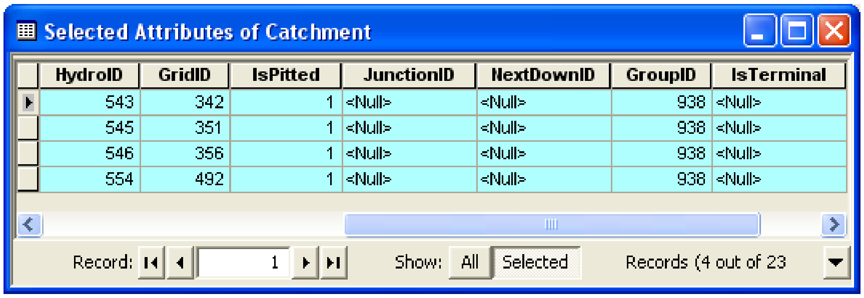
Record: 1 Show: All Selected Records (4 out of 23

3. Ungroup Selected Catchments

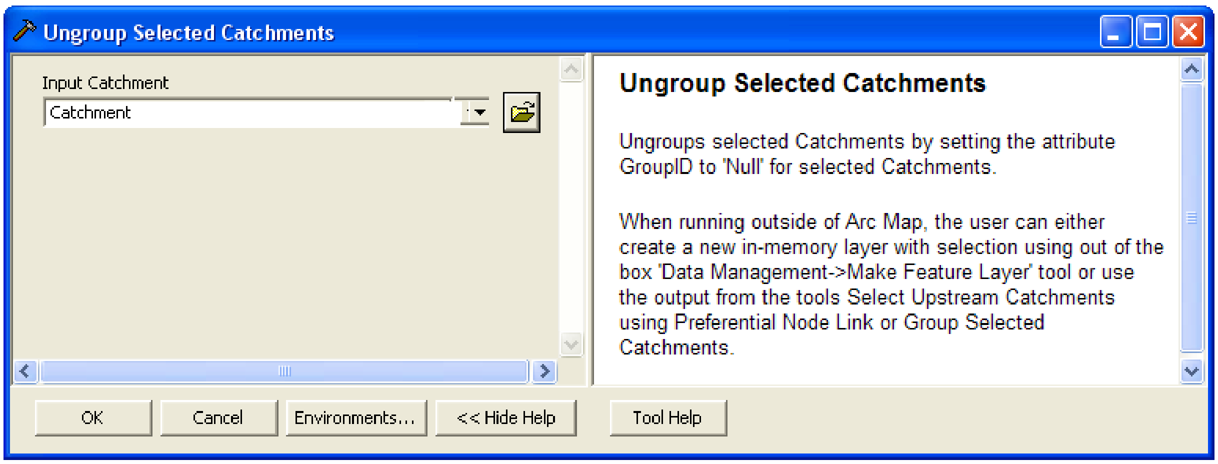
This tool allows resetting the GroupID to Null for the selected Catchments.

- Select the 4 Catchment features at the bottom right corner that have the field GroupID populated.

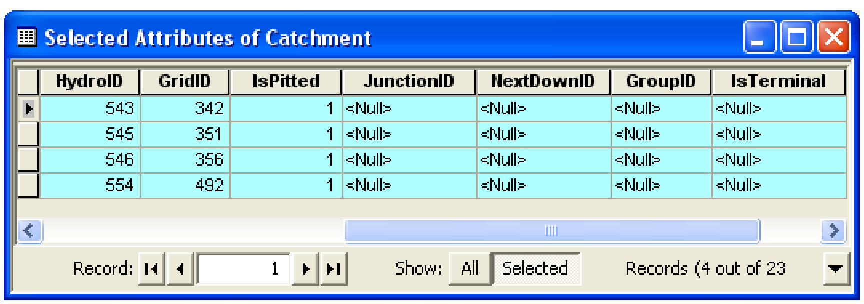




- Double-click **Terrain Morphology > Grouping Toolset > Ungroup Selected Catchments**. Select Catchment as input Catchment feature class and click OK.



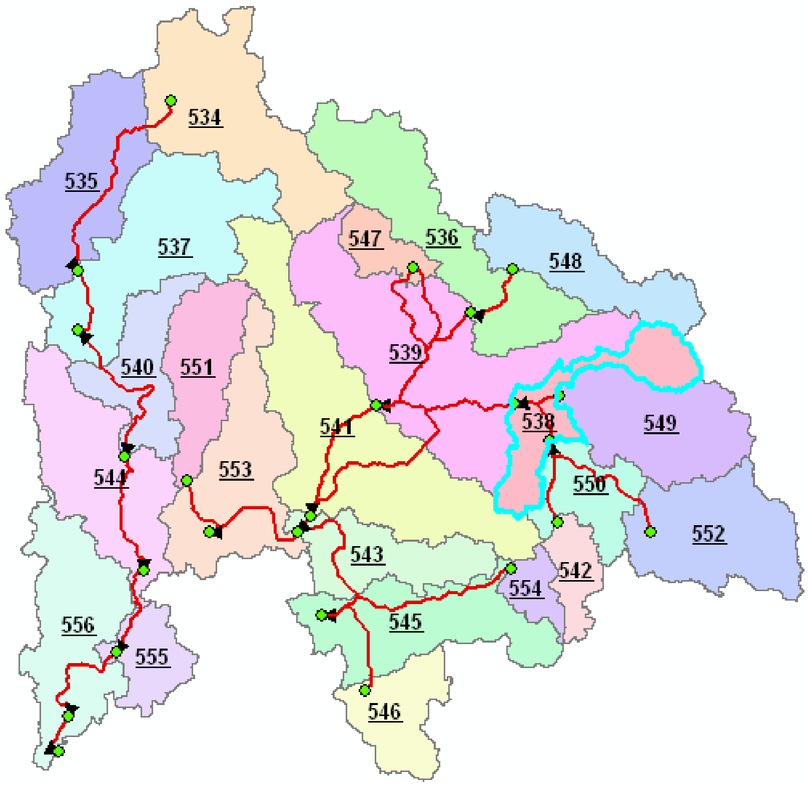
The tool resets the GroupID for the selected fields to Null.



4. Generate Group Basin

This tool allows dissolving Catchment features based on the GroupID attribute to create the output Group Basin polygon feature class.

- Clear the selection and select the Catchments with HydroID 538 as shown below.



- Run the tool Select Upstream Catchments using Preferential Node Link without the overwrite option checked to repopulate the null GroupIDs for this group.

- Repeat this operation after selecting first 541, then 543 and finally 553 with the option to overwrite kept unchecked to populate the remaining GroupIDs.

- Double-click Terrain **Morphology** > **Grouping Toolset** > **Generate Group Basin**.

The tool merges the Catchments having the same GroupID to create the output GroupBasin feature class. The HydroID field is populated with the GroupID, which is the unique identifier for a group.

Attributes of GroupBasin

OBJECTID *	Shape *	GroupID	Shape_Length	Shape_Area	HYDROID
1	Polygon	937	246540	533098800.000001	943
2	Polygon	939	124860	256249799.999987	944
3	Polygon	940	205080	487181699.999995	945
4	Polygon	941	116340	180735299.999996	946
5	Polygon	942	91920	134938799.999995	947

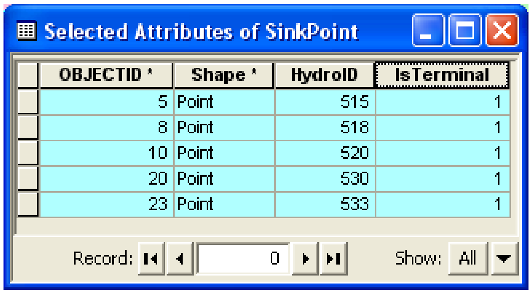
Record: 1 Show: All Selected Records (0 out of 5

The tool also populates the field IsTerminal with 1 for the Catchment and Sink Point features located at the downstream end of a group.

Selected Attributes of Catchment

OBJECTID *	Shape *	GRIDCODE	Shape_Length	Shape_Area	HydroID	GridID	IsPitted	J
5	Polygon	321	79260	48712499.999998	538	321	1	<Nu
8	Polygon	339	122520	153482400.000008	541	339	1	<Nu
10	Polygon	342	60060	49153500.000006	543	342	1	<Nu
20	Polygon	487	81180	84628800	553	487	1	<Nu
23	Polygon	505	86040	81864899.999999	556	505	1	<Nu

Record: 1 Show: All Selected Records (5 out of 23 Selected) Options



Selected Attributes of SinkPoint

OBJECTID *	Shape *	HydroID	IsTerminal
5	Point	515	1
8	Point	518	1
10	Point	520	1
20	Point	530	1
23	Point	533	1

Record: 0 Show: All

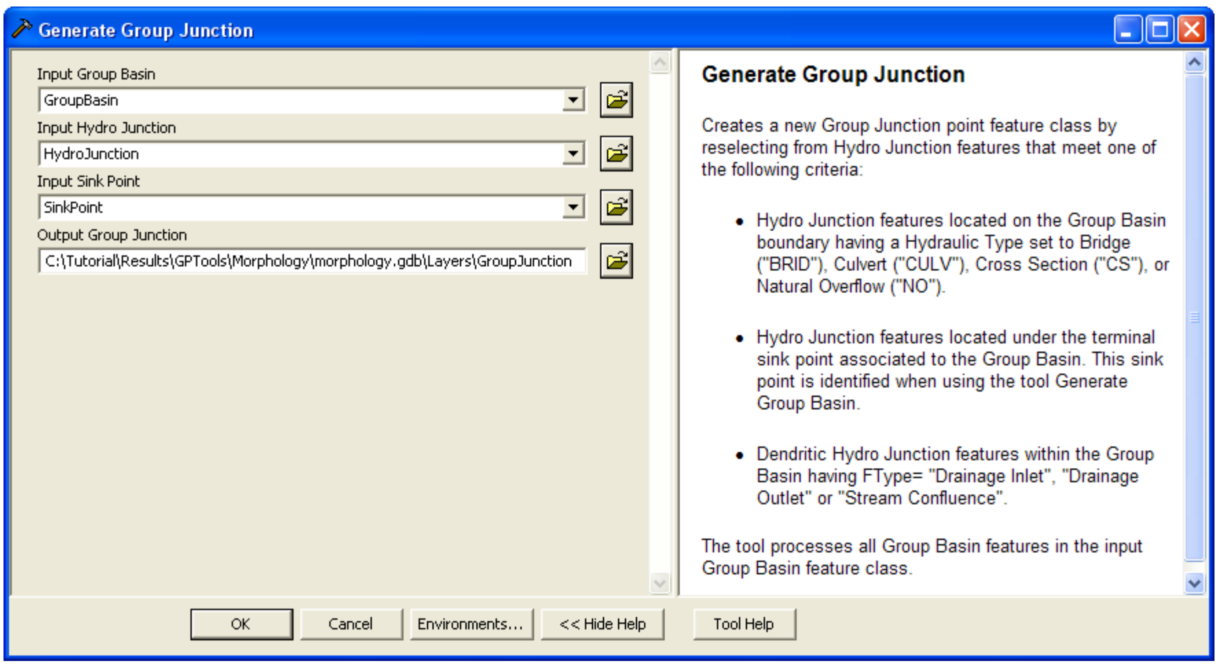
5. Generate Group Junction

This tool allows generating Group Hydro Junctions associated to the Group Basins the same way Hydro Junctions are associated to Catchment. This tool will create 3 types of Group Hydro Junction features:

- Junction located on the Group Basin boundary usually associated to structures (Bridge, culvert, cross section, natural overflow).
- Hydro Junction associated to Group Basin sink point (e.g. terminal sink point)
- Dendritic Hydro Junction within the Group Basin

- Double-click **Terrain Morphology > Grouping Toolset > Generate Group Junction**.

- Specify the input Group Basin, Hydro Junction and Sink Point features, enter a name for the output Group Junction feature class and click OK.



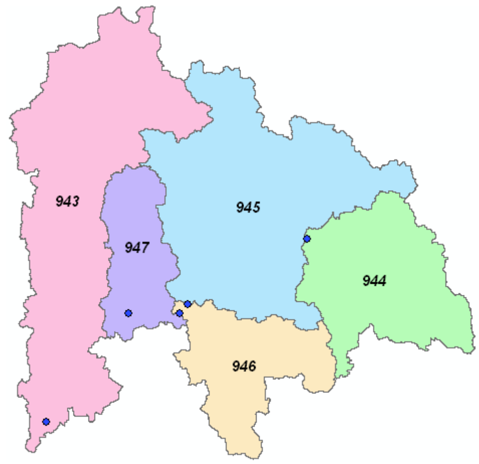
The tool processes each Group Basin feature in the input Group Basin feature class. For each Group Basin, it creates Group Hydro Junction for each structure located on its boundary, for its sink point and for each dendritic junction located within the Group Basin.

In this example, the tool only creates 5 Group Junctions corresponding to the 5 identified terminal sinks in the input Sink Point feature class.

Attributes of GroupJunction

OBJECTID *	Shape *	HydroID	FType	FeatureID
1	Point	948	SINK	720
2	Point	949	SINK	673
3	Point	950	SINK	753
4	Point	951	SINK	679
5	Point	952	SINK	711

Record: 1 Show: All



The tool populates the field IsPitted with 1 for Group Basin features containing a terminal Group Junction.

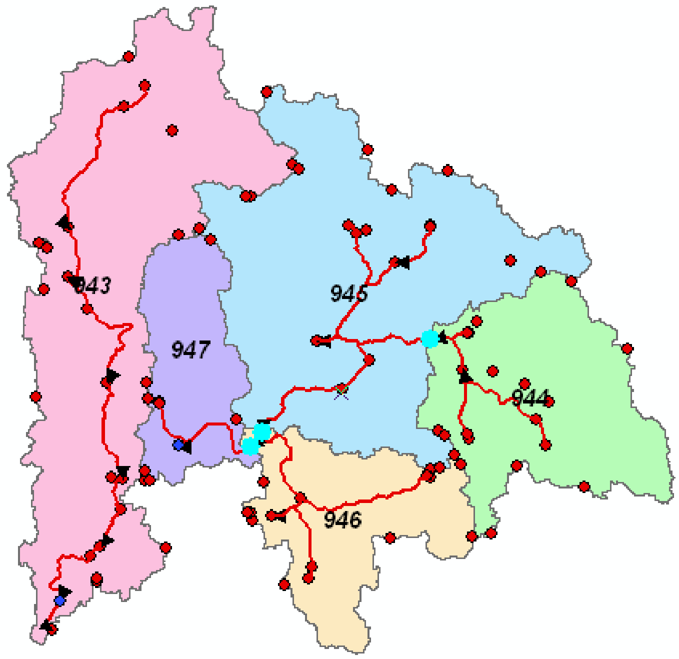
Attributes of GroupBasin

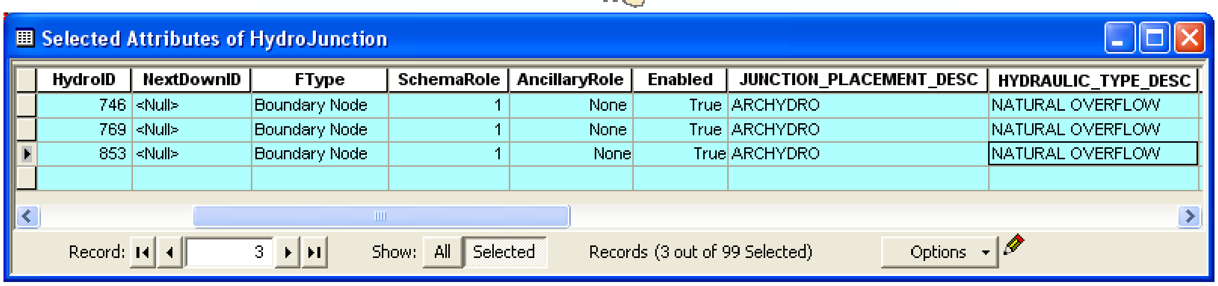
OBJECTID *	Shape *	GroupID	Shape_Length	Shape_Area	HYDROID	IsPitted
1	Polygon	937	246540	533098800.000001	943	1
2	Polygon	939	124860	256249799.999987	944	1
3	Polygon	940	205080	487181699.999995	945	1
4	Polygon	941	116340	180735299.999996	946	1
5	Polygon	942	91920	134938799.999995	947	1

Record: 5 Show: All Selected Records (0 out of 5

You are now going to modify the Hydraulic Type for the Hydro Junctions located on the Group Basin Boundary on the preferential links to add Group Junction on the Group Basin boundaries.

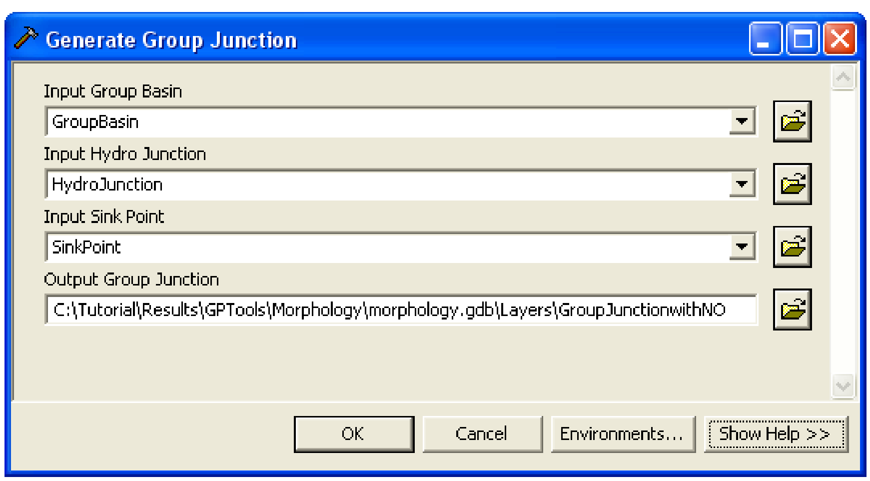
- Identify the 3 Hydro Junction features located on the preferential paths and on the Group Basin boundaries and change their HYDRAULIC_TYPE_DESC to NATURAL OVERFLOW (‘NO’).



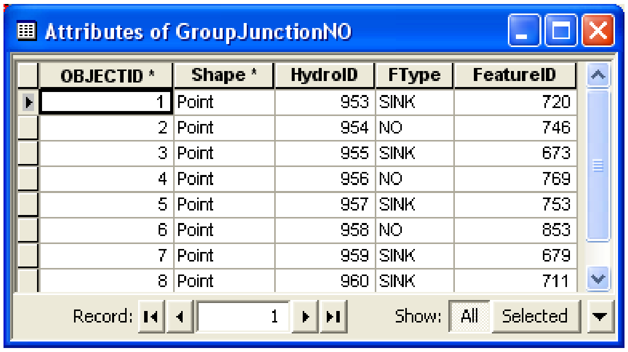


HydroID	NextDownID	FType	SchemaRole	AncillaryRole	Enabled	JUNCTION_PLACEMENT_DESC	HYDRAULIC_TYPE_DESC
746	<Null>	Boundary Node	1	None	True	ARCHYDRO	NATURAL OVERFLOW
769	<Null>	Boundary Node	1	None	True	ARCHYDRO	NATURAL OVERFLOW
853	<Null>	Boundary Node	1	None	True	ARCHYDRO	NATURAL OVERFLOW

- Double-click **Terrain Morphology > Grouping Toolset > Generate Group Junction** and specify GroupJunctionwithNO as name for the output Group Junction feature class. Click OK.



The GroupJunction now contains junctions corresponding to the terminal sink points (SINK) and to the Natural Overflow junctions.



OBJECTID *	Shape *	HydroID	FType	FeatureID
1	Point	953	SINK	720
2	Point	954	NO	746
3	Point	955	SINK	673
4	Point	956	NO	769
5	Point	957	SINK	753
6	Point	958	NO	853
7	Point	959	SINK	679
8	Point	960	SINK	711

6. Group Terrain Processing

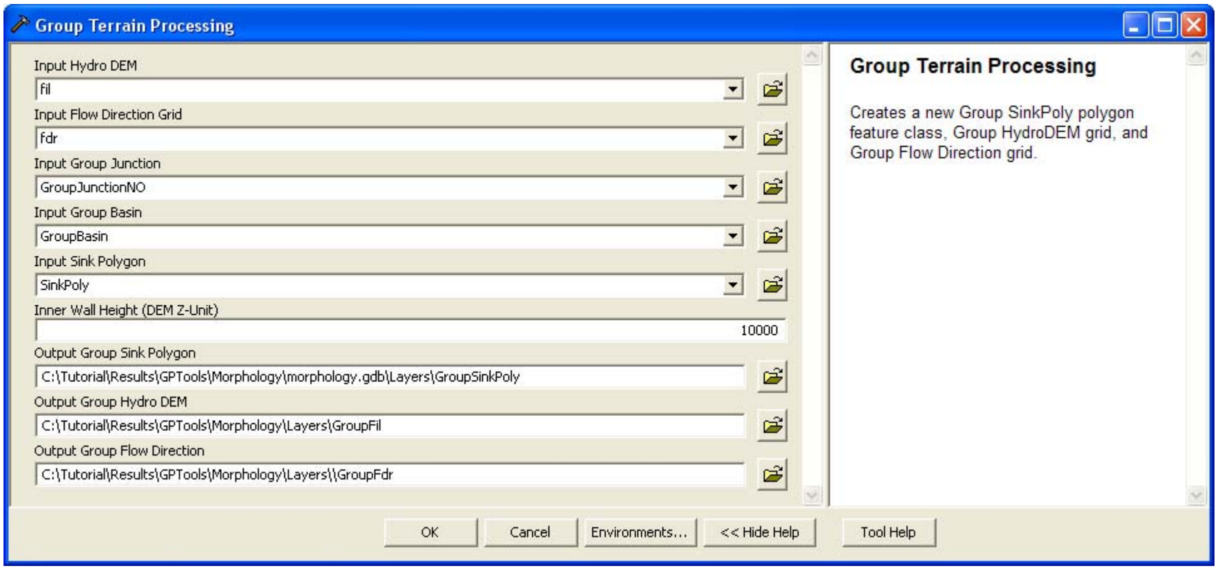
This tool allows generating the Group Sink Polygon feature class as well as the Group Hydro DEM and Group Flow Direction grids:

- The Group Sink Polygons are a subset of the input Sink Polygon and are the ones associated to the terminal sink points.
- The Group Hydro DEM grid is the input Hydro DEM grid that gets filled in the pitted Group Basin everywhere except in the Group Sink Polygons.
- The Group Flow Direction Grid is generated by modifying the flow direction in the pitted Group Basin only and replacing these cells with the flow direction generated from the Group Hydro DEM and modified within the Group Sink Polygon to ensure all cells flows into the same sink point into a Sink Polygon.

- Double-click **Terrain Morphology > Grouping Toolset > Group Terrain Processing**.

- Specify the input Hydro DEM and Flow Direction grids and Group Basin and Sink Polygon feature classes. Specify names for the outputs Group Sink Polygon feature class and Group Hydro DEM and Group Flow Direction grids.

- Specify a value higher than maximum elevation of the input Hydro DEM in Z unit as Inner Wall Height for example. This value is added to the input HydroDEM to burn in walls at the boundaries of the pitted Group Basin to force the water into their pits.



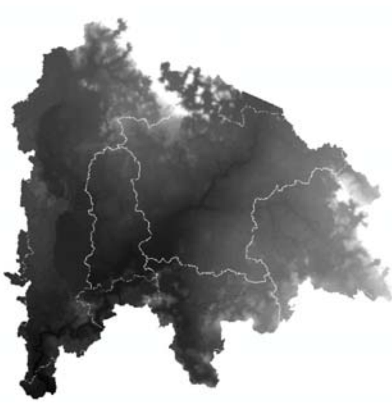
The tool creates a new Group Sink Polygon feature class by reselecting from the input Sink Polygon feature class the polygon features that contains Group Junction features having FType="Sink" (e.g. terminal sinks). It populates the FeatureID field with the HydroID of the source Sink Polygon feature.

Attributes of GroupSinkPoly

OBJECTID *	Shape *	Shape_Length	Shape_Area	HydroID	FeatureID
1	Polygon	180	1800	961	321
2	Polygon	300	3600	962	339
3	Polygon	120	900	963	342
4	Polygon	240	1800	964	487
5	Polygon	240	1800	965	505

Record: 1 Show: All Selected Records (0 out of

The tool creates a filled Group Hydro DEM Grid with sinks from Group Sink Polygon. It uses the input Hydro DEM grid and fills all except within Group Sink Polygon features so that only the terminal sinks remain. The tool fences the Group Basin boundaries (internal and external) and maintains original Hydro DEM values within Group Sink Polygon.



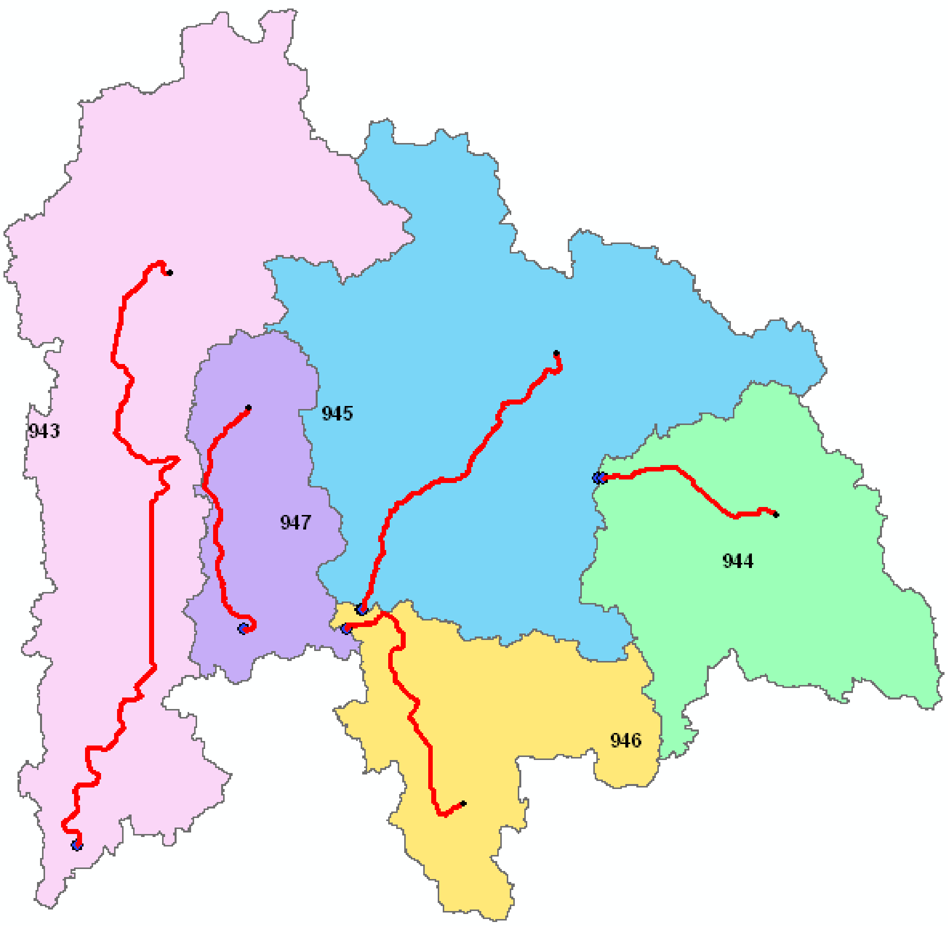
The tool edits the input Flow Direction grid to create an output Group Flow Direction grid. It maintains the original Flow Direction values in the dendritic part of the terrain but modifies the Flow

Direction within the pitted Group Basins. Flow Direction within the Group Sink Polygon features is computed using the geoprocessing tool Flow Direction with Sinks. This ensures that the water flows toward the same point within each sink polygon.

- On the Arc Hydro toolbar, select **Watershed Processing > Data Management Watershed Delineation** and set the Flow Direction Grid to the new GroupFdr grid.

- Click the Flow Path tracing tool () on the Arc Hydro toolbar and perform a trace in each Group Basin.

The trace goes across the Catchments into the Group Sink Point.

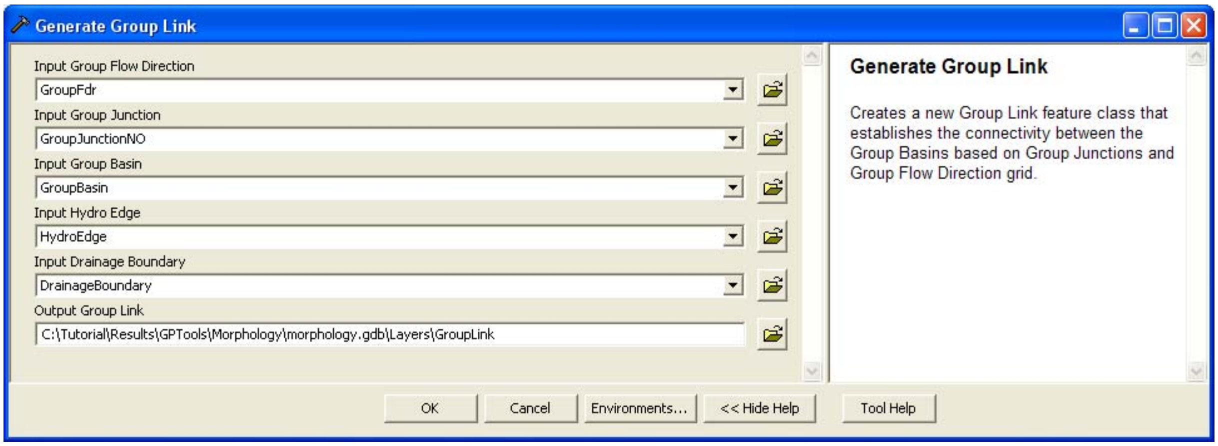


7. Generate Group Link

This tool allows generating the Group Link feature class.

- Double-click **Terrain Morphology > Grouping Toolset > Generate Group Link**.

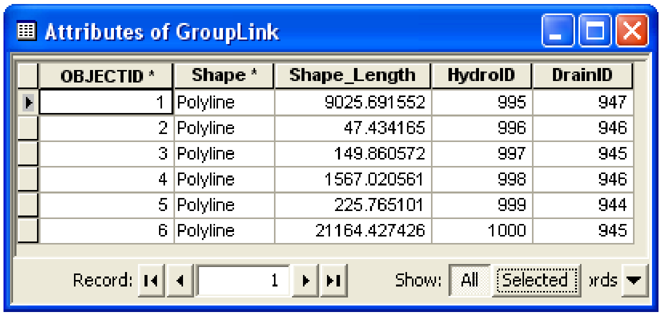
- Specify the input Group Flow Direction grid as well as the input Group Junction, Group Basin, Hydro Edge and Drainage Boundary feature classes. Specify the name of the output Group Link feature class and click OK.



The tool generates the GroupLink feature class storing the preferential links between the Group Basin features. It follows a 2 steps process to identify and generate the links:

1. It looks for the Group Junction features of FType Stream Confluence. For each identified Group Junction, it looks for the overlaying Group Basin (only 1 is expected) and for the HydroEdge features connecting at the Group Junction. It creates one link for each Hydro Edge feature not already processed and populates the DrainID field with the Hydro ID of the Group Basin.

2. It looks for the Group Junction features located on each Group Basin boundaries and identifies the lowest Group Junction for each Group Basin. It snaps the lowest Group Junction into each of the Group Basin features separated by the Group Junction and performs a trace using the GroupFdr grid from this point until it reaches the Sink or another Group Link feature. If it intersects an existing Group Link, the trace stops at the intersection and the tool creates a new Group Junction of FType ‘CONFLUENCE’ at that location.



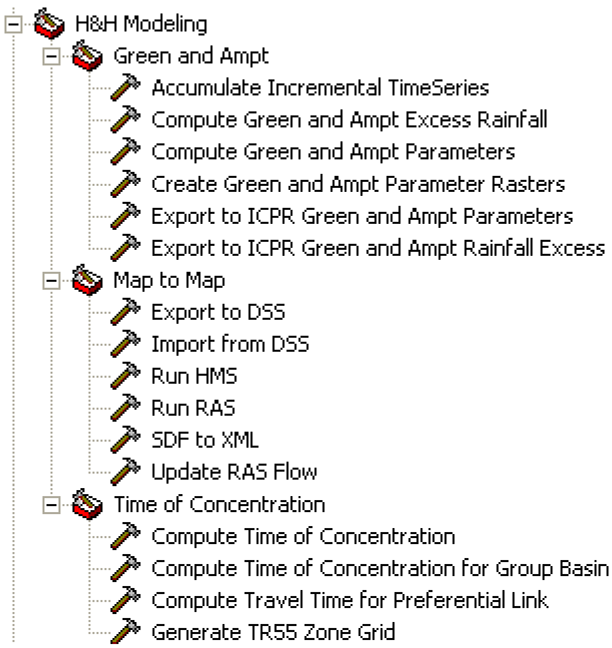
Attributes of GroupLink

OBJECTID *	Shape *	Shape_Length	HydroID	DrainID
1	Polyline	9025.691552	995	947
2	Polyline	47.434165	996	946
3	Polyline	149.860572	997	945
4	Polyline	1567.020561	998	946
5	Polyline	225.765101	999	944
6	Polyline	21164.427426	1000	945

Record: 1 Show: All Selected

H&H Modeling

The H&H Modeling (Hydrologic and Hydraulic Modeling) toolset contains 3 subtoolsets:



Time of Concentration Toolset

This set of tools allows computing the time of concentration for basins and group basins. You will use the tutorial data from the DataGp\TimeofConcentration directory to test these tools.

- Copy the DataGP\TimeofConcentration directory (e.g. Results\GPTools\ TimeofConcentration).

- Open a new map. Add the Catchment and the DrainagePoint feature classes from the newly copied Morphology.gdb geodatabase, the elevation grid elev_cm and the filled DEM Fil. Save the map as TimeofConcentration.mxd.

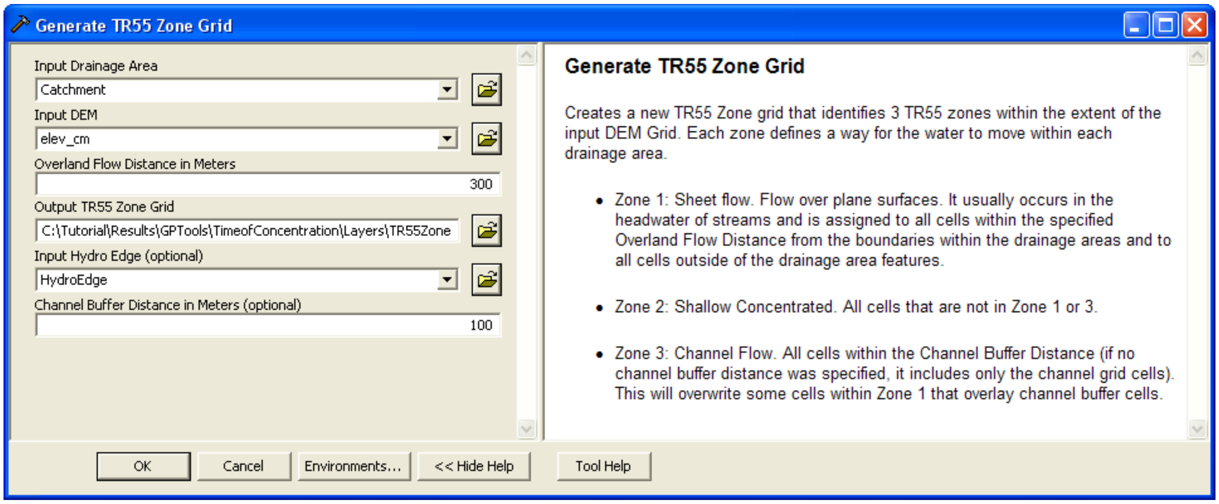
1. Generate TR55 Zone Grid

This tool generates the TR55 Zone Grid defining the way the water is moving across the land. This grid will be used as input by the tool Compute Time of Concentration. The tool will process all input drainage areas and set the extent using the input DEM grid.

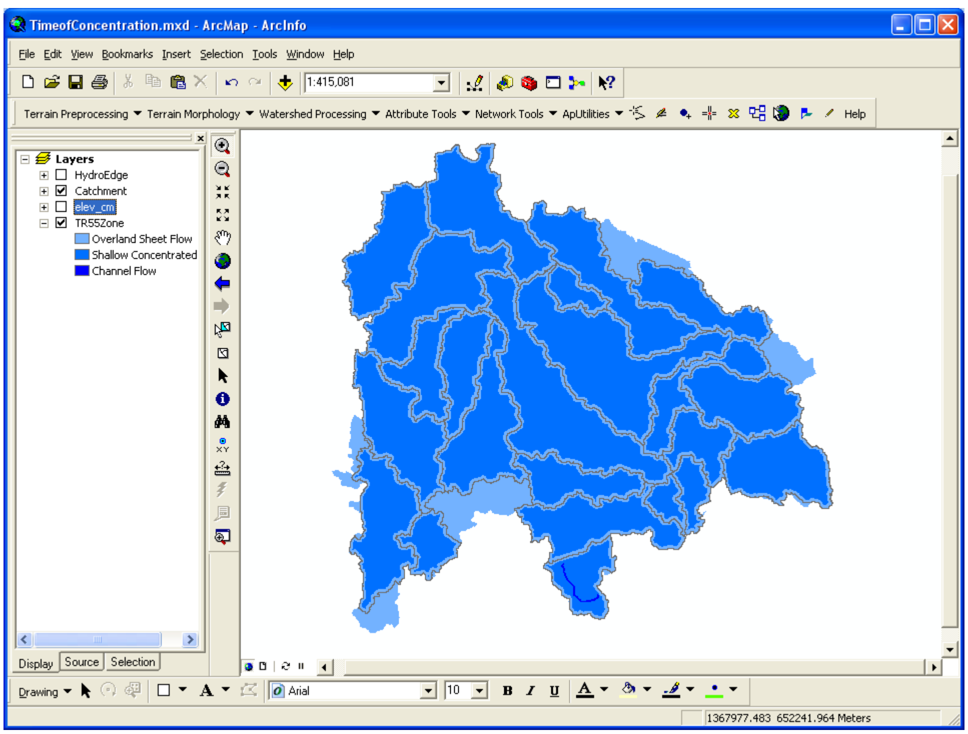
The input Hydro Edge feature class is optional. If specified, only the features having HYDROEDGE_HYDRAULIC_TYPE_DESC='CHAN' (CHANNEL) will be used to define Zone 3.

- Double-click **H&H Modeling > Time of Concentration > Generate TR55 Grid**.

- Specify the input Drainage Area feature class (e.g. Catchment) and the input DEM grid used to set the cell size and extent of the output grid. Enter the Overland Flow Distance in meters. Enter a name for the output TR55 Zone Grid. Click OK.



The tool generates the output TR55 Zone grid.



2. Compute Time of Concentration

This tool uses as input the TR55 Zone Grid generated by the previous tool – the zone grid defines the equation to use for each cell to compute the time of travel for that cell. The tool then generates the longest flow path using the time of travel grid as weight to obtain the longest time of travel associated to each input Drainage Area feature (i.e. time of concentration) and its associated flow path.

Other input grids (dimensionless slope, 2-year 24 hours rainfall in inches, Manning's N) are parameters used in some of the equations. The input surface grid must have a value of 1 in the paved area – it is used to determine which equation to use as well.

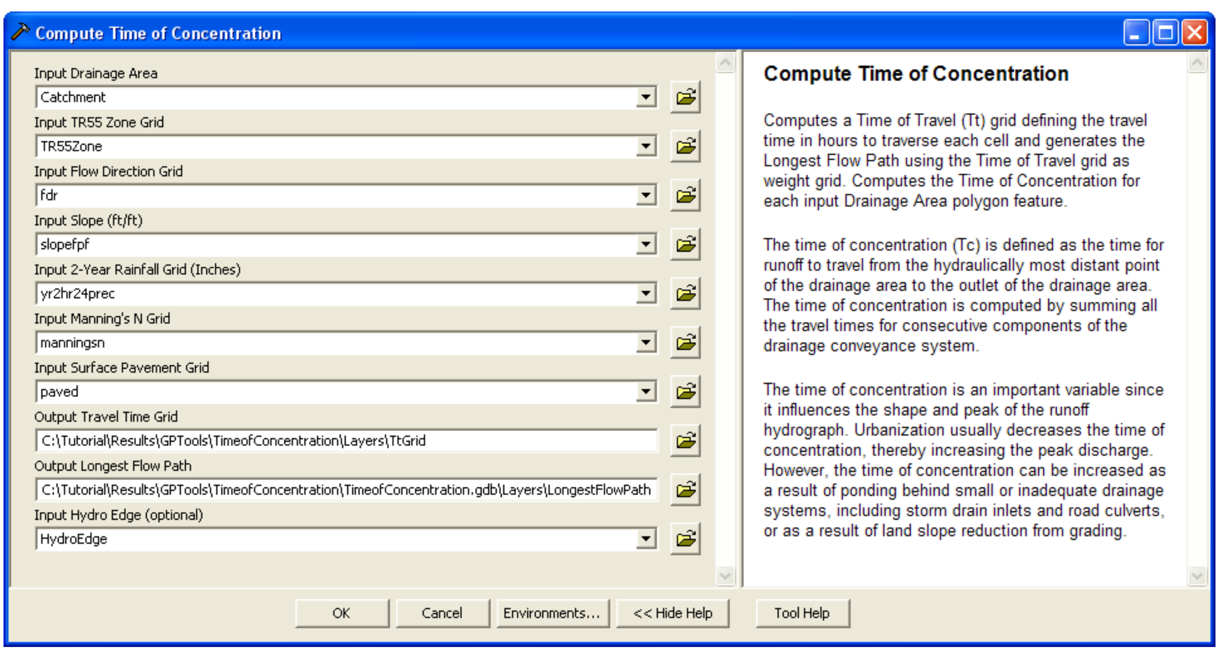
Additional parameters used in the equation are specified in the attributes table of Hydro Edge for the features having HYDROEDGE_HYDRAULIC_TYPE_DESC='CHAN' (optional input): MANNINGSN, WETPERIFT, CSAREAFT2.

- Add the Flow Direction grid (fdr), slope grid (slopefpf), the 2-year 24-hour rainfall grid (yr2hr24prec, the Mannings' N grid (manningsn) and the surface pavement grid (paved) into the Table of Contents of ArcMap.

Notes

The slope grid was derived from the input elevation grid.
The 2-year 24-hour rainfall grid used in this example is a constant grid where all cells have for value 5 inches.
The surface pavement grid was built based on the NLCD for Florida by settings the categories 23 and 24 (Developed, Medium Intensity and Developed High Intensity) as paved.
Mannings' N grid was built as a constant grid of value 0.02.

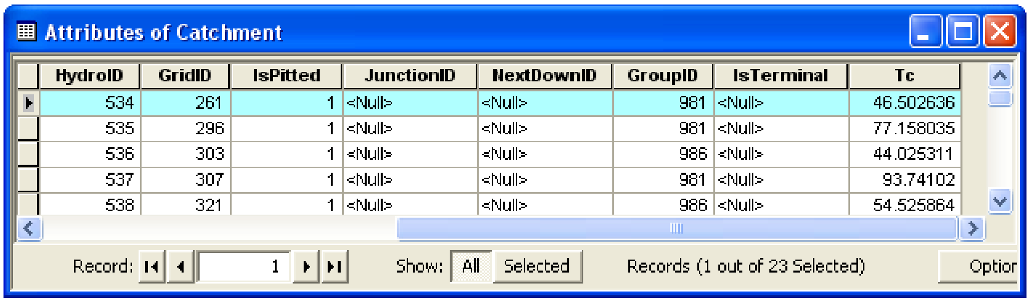
- Double-click **H&H Modeling** > **Time of Concentration** > **Compute Time of Concentration.**



The tool generates 2 outputs:

- Travel time grid
- Longest Flow Path (based on travel time)

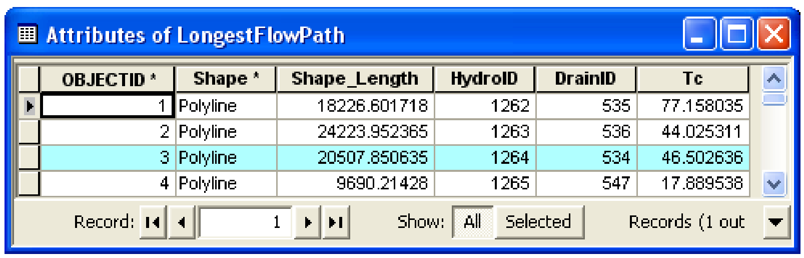
It populates the field Tc (Time of Concentration) for the input Drainage Area features and output Longest Flow path features.



Attributes of Catchment

HydroID	GridID	IsPitted	JunctionID	NextDownID	GroupID	IsTerminal	Tc
534	261	1	<Null>	<Null>	981	<Null>	46.502636
535	296	1	<Null>	<Null>	981	<Null>	77.158035
536	303	1	<Null>	<Null>	986	<Null>	44.025311
537	307	1	<Null>	<Null>	981	<Null>	93.74102
538	321	1	<Null>	<Null>	986	<Null>	54.525864

Record: 1 Show: All Selected Records (1 out of 23 Selected) Optior



Attributes of LongestFlowPath

OBJECTID *	Shape *	Shape_Length	HydroID	DrainID	Tc
1	Polyline	18226.601718	1262	535	77.158035
2	Polyline	24223.952365	1263	536	44.025311
3	Polyline	20507.850635	1264	534	46.502636
4	Polyline	9690.21428	1265	547	17.889538

Record: 1 Show: All Selected Records (1 out

3. Compute Travel Time for Preferential Link

This tool computes the travel times through preferential links by computing the travel times for the Hydro Edge segments of hydraulic type Conduit, Channel and Shallow Concentrated associated to each input Preferential Link feature.

It stores the travel time in 3 fields in the attributes table of the Preferential Link feature class:

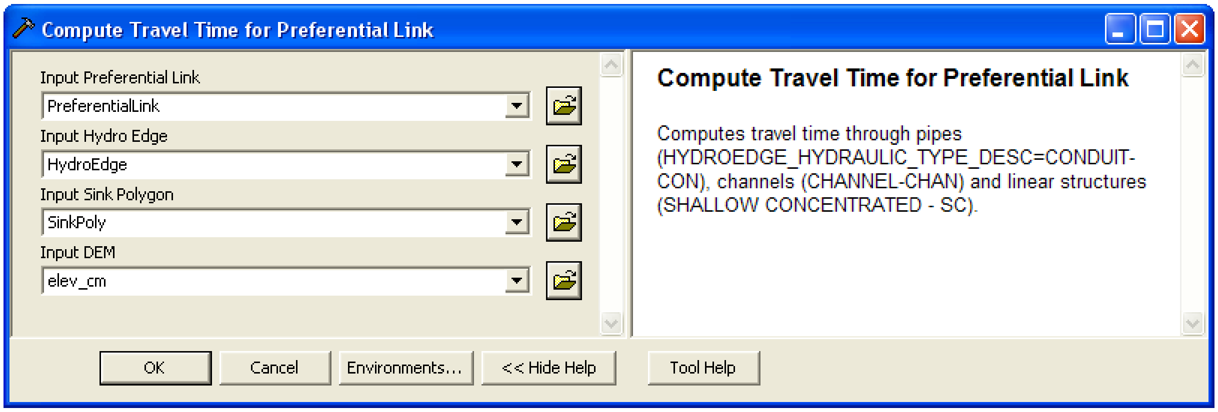
- Tt_Pipe: travel time through Hydro Edge associated to preferential link having HYDROEDGE_HYDRAULIC_TYPE_DESC='CON' (Conduit).

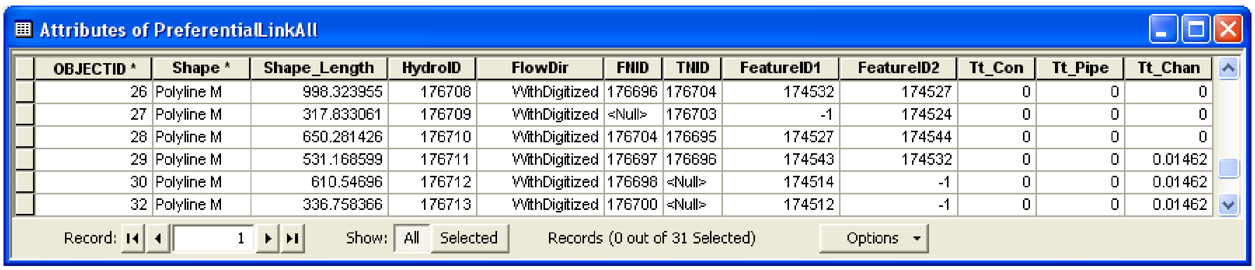
- Tt_Chan: travel time through Hydro Edge associated to preferential link having HYDROEDGE_HYDRAULIC_TYPE_DESC='CHAN' (Channel).

- Tt_Con: travel time through Hydro Edge associated to preferential link having HYDROEDGE_HYDRAULIC_TYPE_DESC='SC' (shallow concentrated).

Note
The 3 time of travel fields will be populated with non zeros values only for the Preferential Links that are associated to HydroEdges of type Conduit, Channel or Shallow Concentrated. Hence the Preferential Links created with the function Define Overland Preferential Node Link Schema will always have the time of travels sets to 0.

- Add the SinkPolygon and the Preferential Link feature class into the Table of Contents of ArcMap.
- Double-click **H&H Modeling** > **Time of Concentration** > **Compute Travel Time for Preferential Link.**
- Specify the input Preferential Link, HydroEdge, and Sink Polygon feature classes as well as the input DEM and click OK.





Attributes of PreferentialLinkAll

OBJECTID *	Shape *	Shape_Length	HydroID	FlowDir	FNID	TNID	FeatureID1	FeatureID2	Tt_Con	Tt_Pipe	Tt_Chan
26	Polyline M	998.323955	176708	WithDigitized	176696	176704	174532	174527	0	0	0
27	Polyline M	317.833061	176709	WithDigitized	<Null>	176703	-1	174524	0	0	0
28	Polyline M	650.281426	176710	WithDigitized	176704	176695	174527	174544	0	0	0
29	Polyline M	531.168599	176711	WithDigitized	176697	176696	174543	174532	0	0	0.01462
30	Polyline M	610.54696	176712	WithDigitized	176698	<Null>	174514	-1	0	0	0.01462
32	Polyline M	336.758366	176713	WithDigitized	176700	<Null>	174512	-1	0	0	0.01462

Record: 1 Show: All Selected Records (0 out of 31 Selected) Options

4. Compute Time of Concentration for Group Basin

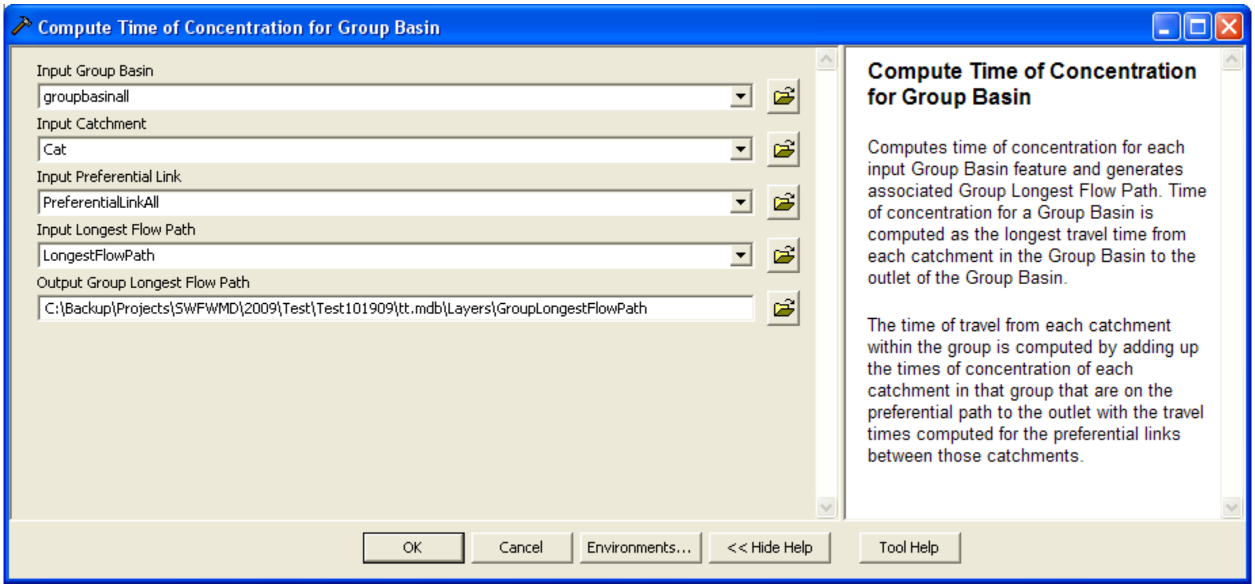
This tool computes the time of concentration for a Group Basin and generates the associated Group Longest Flow Path. The time of concentration is stored in the Tc field in both the input Group Basin features and the generated Group Longest Flow Path features.

The tool works on a selected set of Group Basin features or on all features if there is no selected set.

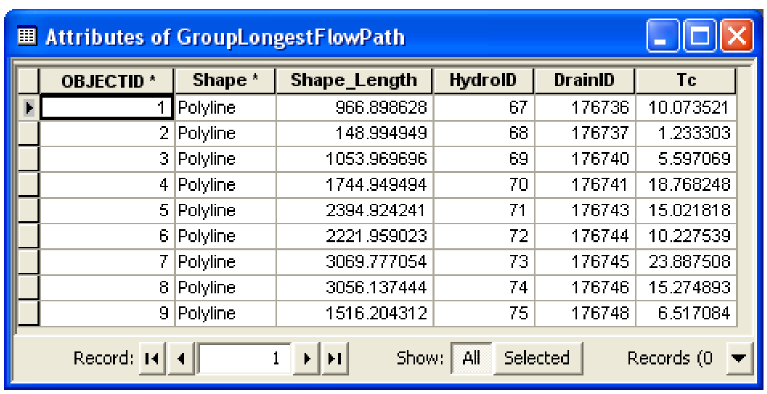
The Group Basin feature class must contain the fields HydroID and GroupID. GroupID is used to relate to the Catchment features, i.e. finding the Catchments that belong to a given Group Basin. In addition to GroupID, the Catchment feature class must also have the HydroID field used to relate to the Preferential Link features, the IsTerminal field that indicates whether the Catchment is terminal for the Group and the Tc field storing the time of concentration for the catchment computed with the tool Compute Time of Concentration.

The input Preferential Link feature class must contain the fields FeatureID1 that identifies the origin Catchment and FeatureID2 that identifies the destination Catchment, as well as the fields Tt_Pipe, Tt_Con and Tt_Chan storing time of travels associated to the link. The time of travel fields are created and populated by the tool Compute Time of Travel for Preferential Link.

- Double-click **H&H Modeling > Time of Concentration > Compute Time of Concentration for Group Basin.**
- Specify the input Group Basin, Catchment, Preferential Link and Longest Flow Path feature classes and enter a name for the output Group Longest Flow Path feature class. Click OK.



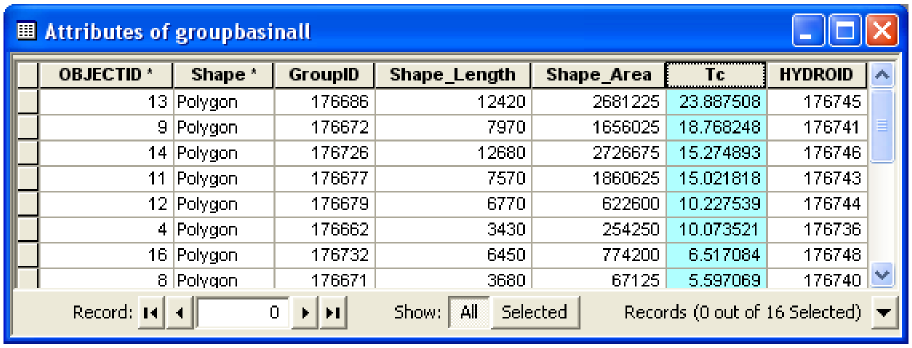
The tool generates the output GroupLongestFlowPath feature class.


Attributes of GroupLongestFlowPath

OBJECTID *	Shape *	Shape_Length	HydroID	DrainID	Tc
1	Polyline	966.898628	67	176736	10.073521
2	Polyline	148.994949	68	176737	1.233303
3	Polyline	1053.969696	69	176740	5.597069
4	Polyline	1744.949494	70	176741	18.768248
5	Polyline	2394.924241	71	176743	15.021818
6	Polyline	2221.959023	72	176744	10.227539
7	Polyline	3069.777054	73	176745	23.887508
8	Polyline	3056.137444	74	176746	15.274893
9	Polyline	1516.204312	75	176748	6.517084

Record: 1 Show: All Selected Records (0

The tool populates the Tc field in the Group Basin feature class.



OBJECTID *	Shape *	GroupID	Shape_Length	Shape_Area	Tc	HYDROID
13	Polygon	176686	12420	2681225	23.887508	176745
9	Polygon	176672	7970	1656025	18.768248	176741
14	Polygon	176726	12680	2726675	15.274893	176746
11	Polygon	176677	7570	1860625	15.021818	176743
12	Polygon	176679	6770	622600	10.227539	176744
4	Polygon	176662	3430	254250	10.073521	176736
16	Polygon	176732	6450	774200	6.517084	176748
8	Polygon	176671	3680	67125	5.597069	176740

Green and Ampt Toolset

1. Accumulate Incremental TimeSeries

This tool allows accumulating the time series steps from the input incremental time series associated to each input subwatershed feature. For each feature in the input Subwatershed feature class, the function retrieves the specified associated incremental time series steps for the requested interval. It accumulates the time steps and stores them as a new time series of the specified output type in the target time series table.

- Double-click **H&H Modeling** > **Accumulate Incremental TimeSeries**.

- Specify the Subwatershed feature class you want to process and its associated TimeSeries and TSTypeInfo tables. The TimeSeries table stores the time series steps while the TSTypeInfo table defines the available time series variables.

Required fields

TimeSeries

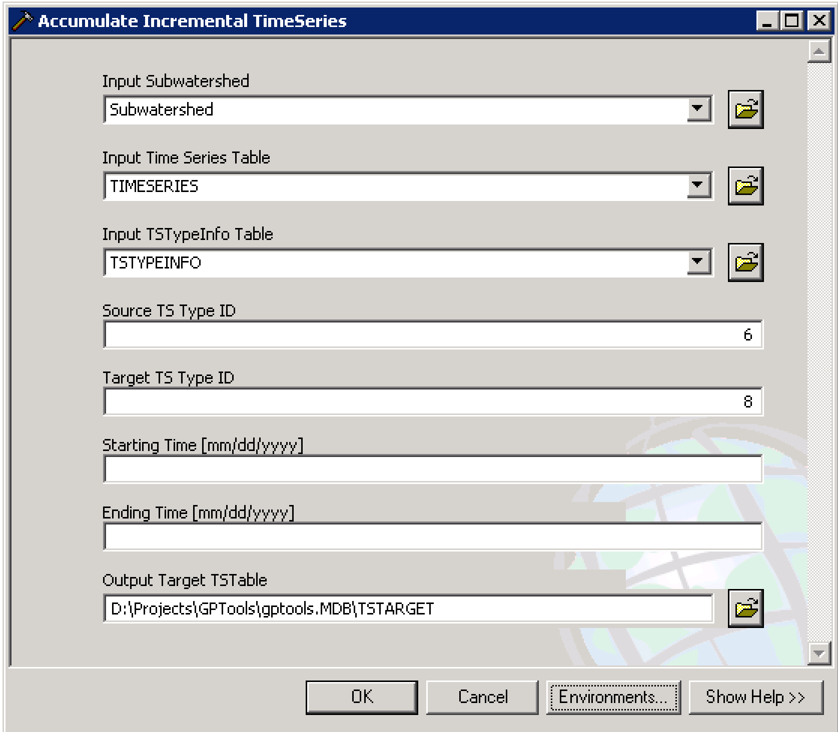
- FeatureID
- TSTypeID
- TSDateTime
- TSValue

TSTypeInfo

- TSTypeID
- TSInterval
- Datatype

- Specify the source and target TS Type IDs. The Source TS Type ID must be associated to an incremental time series (i.e. DataType = 3, Incremental).

- Specify the start and end date/time for the time series to accumulate (cannot be left blank) as well as the target Time Series table and click OK.

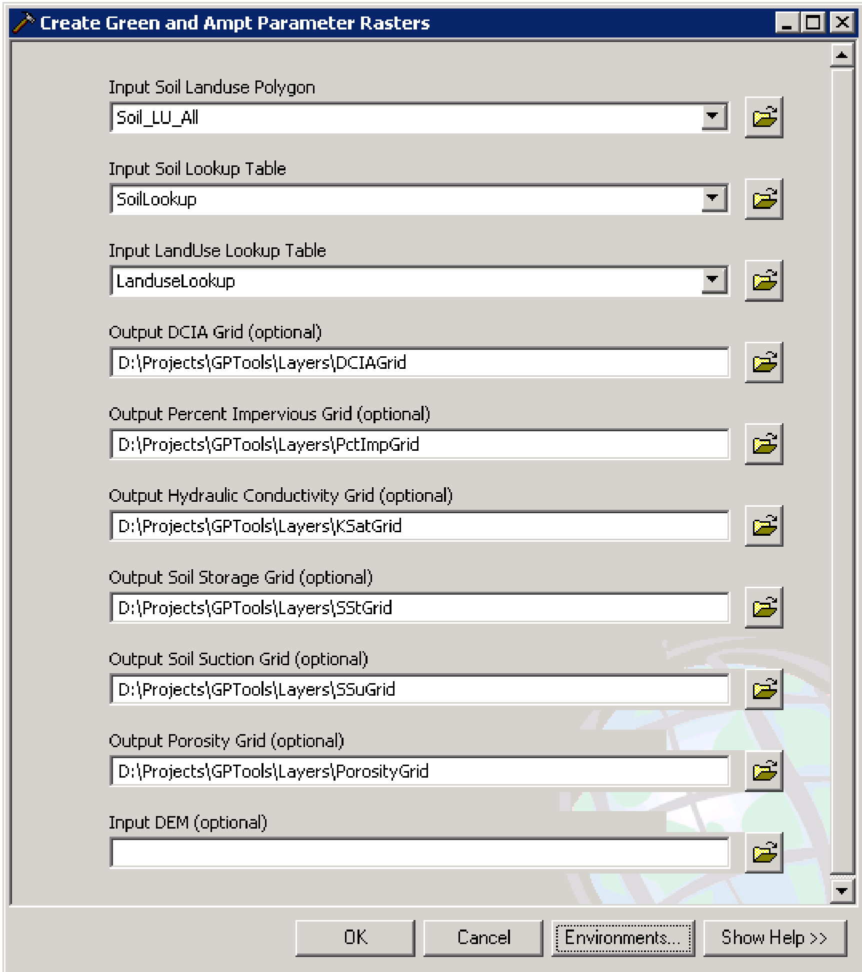


For each input subwatershed feature, the tool accumulates the incremental time steps of the specified type for the selected period and stores the accumulated steps in the target time series table.

2. Create Green and Ampt Parameter Rasters

This tool allows creating parameter rasters based on an input Soil Landuse polygon created by intersecting a soil feature class with a landuse feature class using the Intersect Areas geoprocessing tool for example, and the associated Soil and Landuse lookup tables. The optional input DEM is used to set the cell size for the output rasters. If it not set, the default raster environment will be used.

- Double-click **H&H Modeling** > **Create Green and Ampt Parameter Rasters**.



The Input Soil Landuse Polygon must contain 2 fields that will be used to join with respectively a Landuse and a Soil lookup tables. The names of these fields are currently read from the configuration xml. The default names are MUKEY for the SoilCode field and FLUCCSCODE for the LandUseCode field and can be modified in the configuration xml.

The Input Soil Lookup table must contain the SoilCode field (e.g. MUKEY) as well as the Ksat, Porosity, SSt and SSu fields.

Attributes of SoilLookup

OBJECTID	TEXTURE_DE	MUKEY *	COMP_NAME	MUNAME	HYDGRP	Ksat	Porosity	SSt	SSu
1	fine sand	1017080	Adamsville	Adamsville soils and Urban land - 0 to 5 percent slopes	C	33.12	0.419735	0.042697	5
2	fine sand	1384380	Adamsville	Adamsville fine sand	C	33.12	0.419735	0.042697	5
3	fine sand	1406969	Adamsville	Adamsville fine sand	C	33.12	0.419735	0.042697	5
4	fine sand	1414061	Adamsville	Adamsville fine sand - 0 to 5 percent slopes	C	33.12	0.419735	0.042697	5
5	fine sand	1425021	Adamsville	Adamsville fine sand	C	33.12	0.419735	0.042697	5
6	fine sand	1425038	Adamsville	Adamsville-Urban land complex	C	33.12	0.419735	0.042697	5
7	fine sand	321056	Adamsville	Adamsville fine sand	C	33.026399	0.419735	0.042697	5
8	fine sand	322071	Adamsville	Adamsville fine sand	C	33.12	0.419735	0.042697	5
9	fine sand	323179	Adamsville	Adamsville fine sand	C	33.12	0.419735	0.042697	5
10	fine sand	323622	Adamsville	Adamsville fine sand - bouldery subsurface	C	33.12	0.419735	0.042697	5
11	fine sand	323650	Adamsville	Adamsville fine sand	C	33.12	0.419735	0.042697	5
12	sand	1712886	Adamsville	Adamsville sand - 0 to 5 percent slopes	C	33.12	0.419735	0.042697	5
13	fine sand	1384076	Adamsville variant	Adamsville variant fine sand	C	33.12	0.419735	0.042697	5
14	fine sand	1712888	Anclote	Anclote-Tomoka complex - depressional	A/D	33.12	0.419811	0.03213	5
15	fine sand	1017083	Anclote	Anclote fine sand - depressional	D	33.12	0.419811	0.03213	5
16	fine sand	1386896	Anclote	Anclote mucky fine sand - depressional	D	33.12	0.419811	0.03213	5
17	fine sand	1413540	Anclote	Anclote-Basinger fine sand - frequently flooded	D	33.12	0.419811	0.03213	5
18	fine sand	1425024	Anclote	Anclote mucky fine sand - depressional	D	33.12	0.419811	0.03213	5
19	fine sand	1453456	Anclote	Anclote sand - depressional	D	33.12	0.419811	0.03213	5
20	fine sand	1603130	Anclote	Anclote fine sand	D	33.12	0.419811	0.03213	5

Record: 0 Show: All Selected Records (0 out of 907 Selected) Options

The Landuse Lookup table must contain the LanduseCode field (e.g. FLUCCSCODE) as well as the DCIA and PctImp (Percent Impervious) fields.

Attributes of LanduseLookup

OBJECTID *	Gdescript	Man	DCIA	FLUCCSCODE *	PctImp
55	Wet Prairies	0.06	100	6430	100
56	Emergent Aquatic Vegetation	0.06	100	6440	100
57	Shorelines	0.06	100	6520	100
58	Intermittent Ponds	0.06	100	6530	100
59	Mining	0.3	0	7400	0
60	Transportation / Utilities	0.15	25	8100	25
61	Communications	0.15	25	8200	25
62	Utilities	0.15	25	8300	25
63	Sewage Treatment	0.15	25	8340	25
64	Solid Waste Disposal	0.15	25	8350	25

Record: 0 Show: All Selected Records (0 out of 64

The tool will join the attributes table of the input LandUse poly with the LandUse and Soil lookup tables and generate parameter raster for each requested output grid parameter. The outputs are optional and will not be generated if left blank.

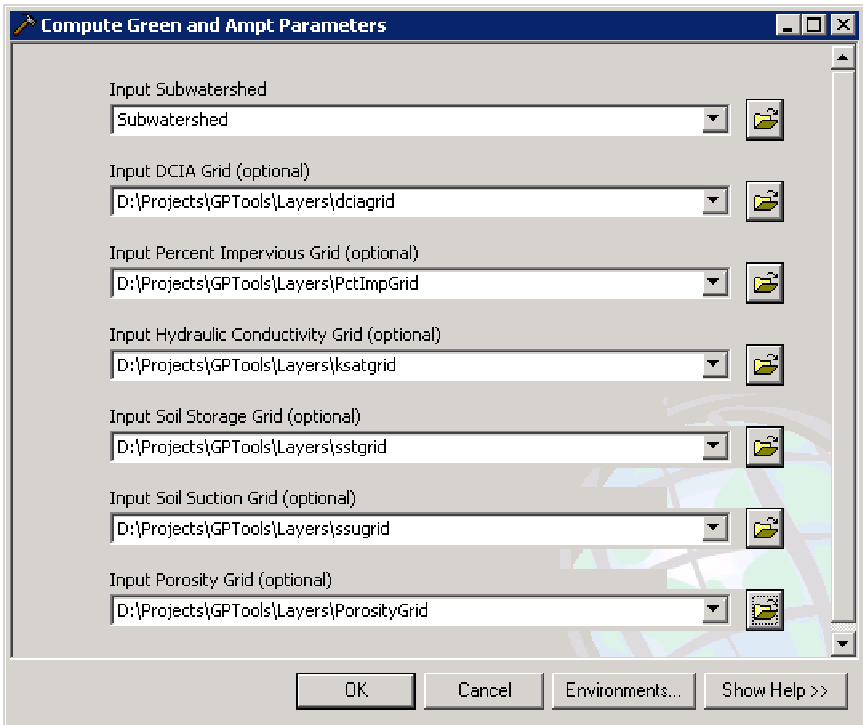
- Click OK.

The new parameter grids are added into the map.

3. Compute Green and Ampt Parameters

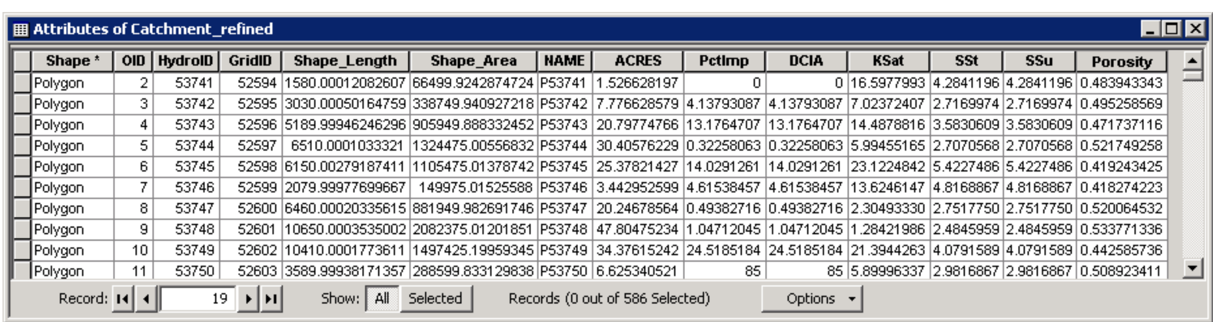
This tool allows computing the Green and Ampt parameters for an input polygon feature class using the grids generated with the tool Create Green and Ampt Parameter Raster.

- Double-click **H&H Modeling > Compute Green and Ampt Parameters**.



- Select as Input Subwatershed the polygon feature class for which you want to populate the Green and Ampt parameters. This feature class must contain the HydroID field and it must be populated with unique values. Click OK.

The tool computes the average value of each requested parameter by performing a zonal statistics operation on each grid using HydroID to define the zones in the input Subwatershed feature class. The Green Ampt fields are created if they do not already exist and populated for each polygon feature.



Attributes of Catchment_refined

Shape *	OID	HydroID	GridID	Shape_Length	Shape_Area	NAME	ACRES	PctImp	DCIA	KSat	SSt	SSu	Porosity
Polygon	2	53741	52594	1580.00012082607	66499.9242874724	P53741	1.526628197	0	0	16.5977993	4.2841196	4.2841196	0.483943343
Polygon	3	53742	52595	3030.00050164759	338749.940927218	P53742	7.776628579	4.13793087	4.13793087	7.02372407	2.7169974	2.7169974	0.495258569
Polygon	4	53743	52596	5189.99946246296	905949.888332452	P53743	20.79774766	13.1764707	13.1764707	14.4878816	3.5830609	3.5830609	0.471737116
Polygon	5	53744	52597	6510.0001033321	1324475.00556832	P53744	30.40576229	0.32258063	0.32258063	5.99455165	2.7070568	2.7070568	0.521749258
Polygon	6	53745	52598	6150.00279187411	1105475.01378742	P53745	25.37821427	14.0291261	14.0291261	23.1224842	5.4227486	5.4227486	0.419243425
Polygon	7	53746	52599	2079.99977699667	149975.01525588	P53746	3.442952599	4.61538457	4.61538457	13.6246147	4.8168867	4.8168867	0.418274223
Polygon	8	53747	52600	6460.00020335615	881949.982691746	P53747	20.24678564	0.49382716	0.49382716	2.30493330	2.7517750	2.7517750	0.520064532
Polygon	9	53748	52601	10650.0003535002	2082375.01201851	P53748	47.80475234	1.04712045	1.04712045	1.28421986	2.4845959	2.4845959	0.533771336
Polygon	10	53749	52602	10410.0001773611	1497425.19959345	P53749	34.37615242	24.5185184	24.5185184	21.3944263	4.0791589	4.0791589	0.442585736
Polygon	11	53750	52603	3589.99938171357	288599.833129838	P53750	6.625340521	85	85	5.89996337	2.9816867	2.9816867	0.508923411

Record: 19 Show: All Selected Records (0 out of 586 Selected) Options

4. Compute Green and Ampt Excess Rainfall

This tool allows computing the Green and Ampt Excess Rainfall time series for the selected input subwatershed features using an associated Soil Landuse Precipitation polygon feature class (i.e. SLURP) and Soil and Landuse lookup tables.

- Select the subwatershed features of interest.
- Double-click **H&H Modeling > Compute Green and Ampt Excess Rainfall**.
- Click Spatial Parameters and select the input Subwatershed and SLURP feature classes, as well as the associated Soil and Landuse Lookup tables.

Required fields
- Subwatershed
- HydroID
- Name

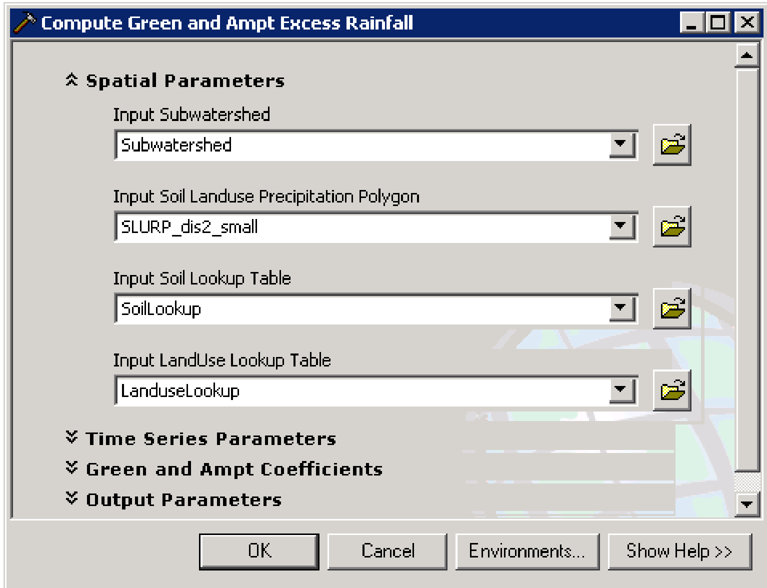
SLURP
- HydroID
- KeyFrom (HydroID of associated subwatershed)
- PctFrom (Percent of area from associated subwatershed)
- MUKEY (SoilCode – may be modified)
- FLUCCSCODE (LandUseCode – may be modified)
- Soil Lookup table
- MUKEY (Soil key field)
- KSat
- Sst (Soil storage)
- Ssu (Soil suction)

Landuse Lookup table
- FLUCCSCODE (Land use key field)
- PctImp
- DCIA

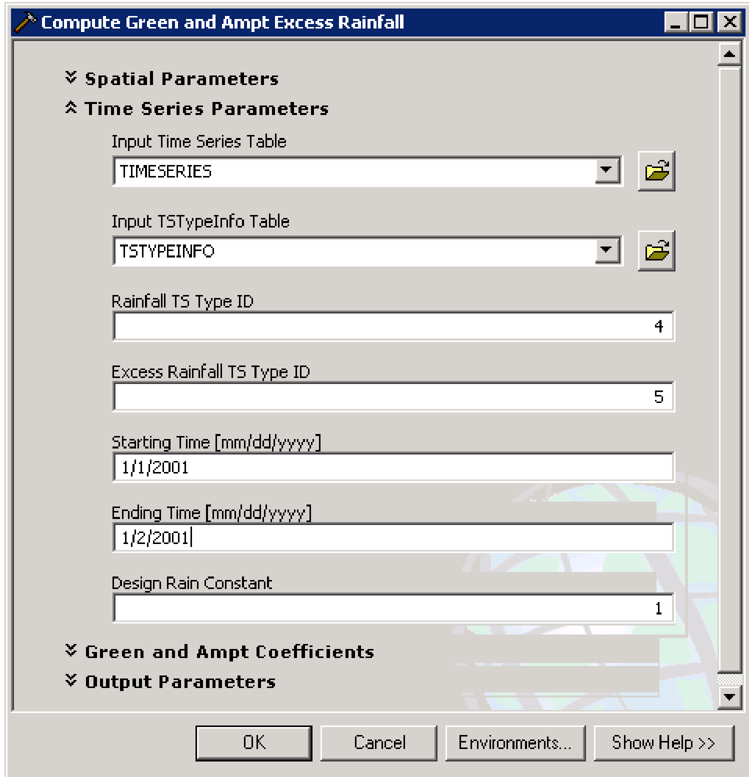
Note

You can modify the names of the soil key and landuse key field used in your current session by updating the active configuration. You need to modify the Name attribute of the corresponding ApField in the ApLayer of interest under the MapViews node you are currently using.

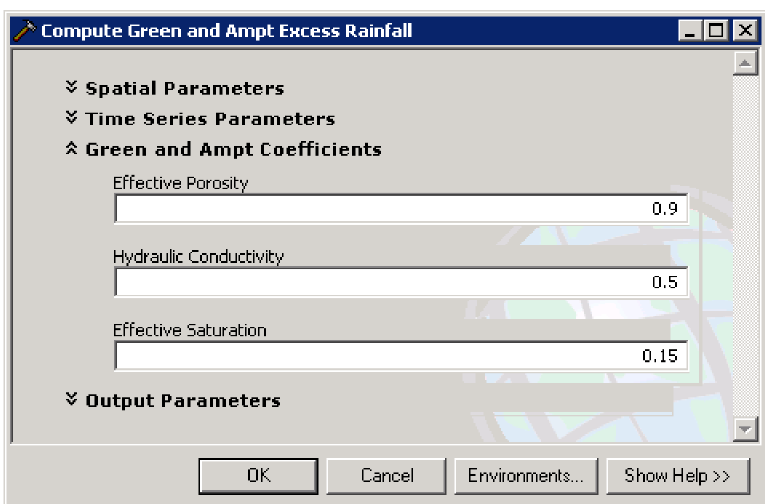
If you want to modify the default configuration for all new ArcMap/ArcCatalog sessions, you need to edit the XML configuration file ArcHydroTools.xml located in the ArcHydro9/bin folder (Make sure you back it up first). In that file, you need to edit the ApFields for the ApLayers defined under the TemplateView node.



- Click Time Series Parameters and select the input Time Series table and Time Series Type Info table associated to the subwatershed. Enter the time series type for input rainfall (has to point to a cumulative type, e.g. design S-curve, or incremental type) and for the output excess rainfall type. Both should be defined in TSTYPEINFO. Specify the start date/time and end date/time for the time series only if the input time series is incremental and the Design Rain Constant is set to 1. The Design Rain Constant is a multiplier that can be applied to an existing time series to get the design conditions based on a unit hydrograph. The Starting Time and Ending Time parameters will be ignored in all other cases and may be left blank.

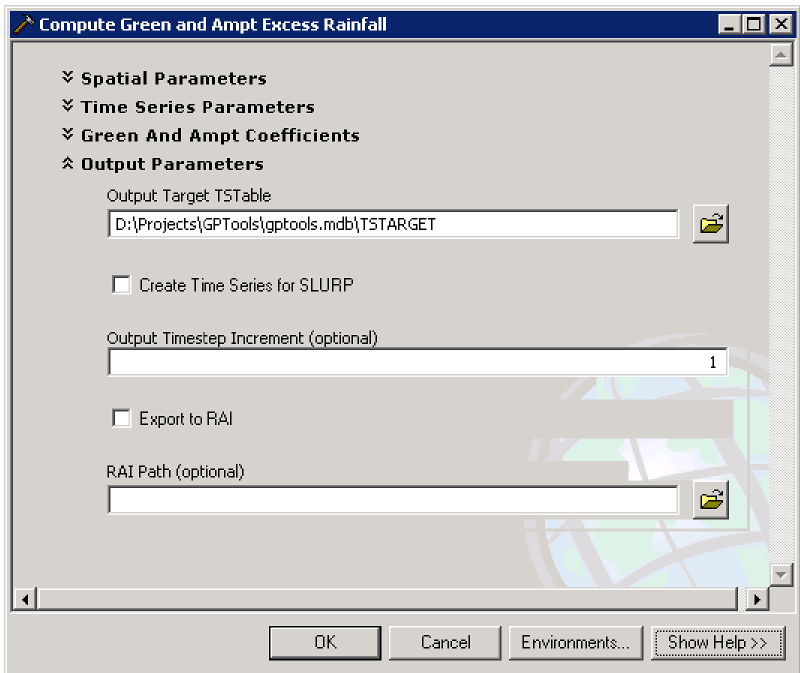


- Click Green and Ampt Coefficients and enter the coefficients. The values specified will be saved in the parameters EffectivePorosityCoefficient, HydraulicConductivityCoefficient and EffectiveSaturationCoefficient under the ApFunction(GreenAmptCalculation) in the XML configuration associated with the map document in ArcMap. These values will be used by default the next time the tool is run.



- Click Output Parameters and specify the output Time Series target table. It is recommended to store the results in a separate time series table to improve performance and ease maintenance. When “Create Time Series for SLURP” is checked, the tool will create an excess rainfall time series for the SLURP features in addition to the time series created for the subwatershed features. At this point ICPR cannot take advantage of these computations so they might be of use only for testing purposes. In general, this should not be checked as it will significantly increase the processing time. The "Output Timestep Increment" parameter allows specifying the increments for the output time series. A value of 1 means that the same time steps will be used. A value of 2 that every other time steps will be used, etc.

- Check "Export to RAI" and specify the directory where the resulting RAI files should be exported. Click OK. These files will be used by the Export to ICPR tools. The path will be stored in the parameter ApFunction(GreenAmptCalculation)/RAIDirectory in the XML configuration associated with the map document in ArcMap.



The tool creates if needed and populates the following fields in the SLURP layer:

- PctImp
- DCIA
- KSat
- Sst (Soil storage)
- Ssu (Soil suction)
- Porosity

The tool creates and populates the output Target TSTable table with the excess rainfall time series associated to the input subwatershed features. If Create Time Series for SLURP is checked, it also creates an excess rainfall time series for the input SLURP features.
The resulting RAI files (if that option was selected) storing the excess rainfall information are exported into the location defined as RAI Path. The RAI path is stored in the configuration so that it will be proposed to the user as default when running the Export to ICPR Green and Ampt Excess Rainfall tool.

Note

The number of digits used for rounding the excess rainfall values is retrieved from the parameter ApFunction(GreenAmptCalculation)/RoundingConstant in the active configuration. The rounding defaults to 3.

5. Export to ICPR Green and Ampt Parameters

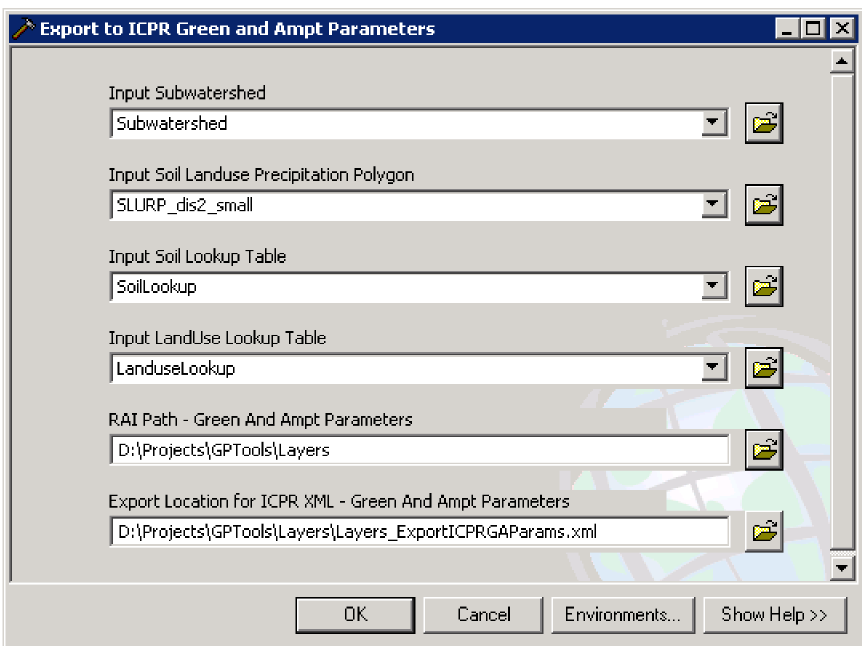
Warning

This function works in ArcMap only. It does not work in ArcCatalog.

This tool creates the ICPR XML file required to run ICPR with the Green and Ampt option. This option uses RAI files storing information on rainfall, not excess rainfall (i.e. losses have not been taken into account). These RAI files may be created with the Export SCurve to RAI function available under Attribute Tools > Timer Series Processing. The Export tool will copy the files from the user-specified location.

Since the Green and Amt computation will be performed by ICPR, the ICPR XML file must contain, in addition to information on the subwatersheds, data on the associated soils, landuses and precipitation.

- Double-click H**&H Modeling** > **Export to ICPR Green and Ampt Parameters**.



- Specify the input Subwatershed feature class. It must contain the fields HydroID and Name.

- Specify the associated input Soil Land Use Precipitation polygon as well as the Soil and Landuse lookup tables.

The SLURP polygon must contain the following fields:

- HydroID

- KeyFrom
- SoilCode (set by default to MUKEY)
- LandUseCode (set by default to FLUCCSCODE)
- PctImp

The Soil table must contain the following fields;

- SoilCode (set by default to MUKEY)
- KSat
- Sst (Soil storage)
- Ssu (Soil suction)
- Porosity

The Landuse table must contain the following fields:

- LandUseCode (set by default to FLUCCSCODE)
- PctImp
- DCIA

- Specify the location of the RAI files previously generated. This location defaults to the value of the parameter ApFunction(GreenAmptCalculation)/RAIDirectorySCurve in the configuration XML associated to the map document (if relevant).

The tool retrieves the name of the control file for the export from the parameter ApFunction(GreenAmptCalculation)/ICPRExportControlGAParams in the active configuration. This file must exist in the ArcHydro9/bin directory. It defaults to ICPRExportControlGAParams.xml.

The tool retrieves the name of the transformation file for the export from the parameter ApFunction(GreenAmptCalculation)/GWIS2ICPRXMLGAParams in the active configuration. This file must exist in the ArcHydro9/bin directory. It defaults to GWIS2ICPRXMLGAParams.xsl

The tool generates the intermediate file GIS2ICPRTmpFileGAParams.xml as well as the output ICPR XML. It copies the RAI files into the RAI subdirectory located in the same location as the exported XML and saves the value of the RAI Path in the parameter ApFunction(GreenAmptCalculation)/RAIDirectorySCurve in the XML associated with the map document in ArcMap.

The tool sets the parameter ApFunction(GreenAmptCalculation)/XMLTargetDirectory to the export path for the XML.

Note

The tool retrieves the 2 following Green and Ampt coefficient used to generate the Export XML from the active configuration:

- EffectivePorosityCoefficient
- HydraulicConductivityCoefficient

6. Export to ICPR Green and Ampt Rainfall Excess

Warning

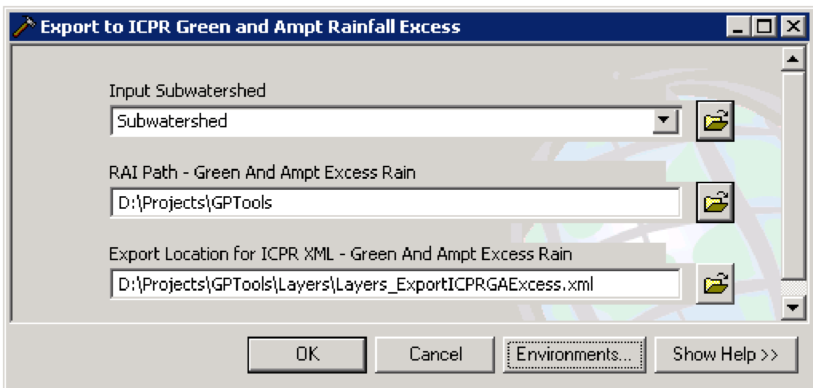
This function works in ArcMap only. It does not work in ArcCatalog.

This tool creates the ICPR XML file required to run ICPR with the Impervious SCS option. Since the losses are computed using the Create Green and Ampt Excess Rainfall tool, the resulting excess rainfall stored in the .rai files is used in ICPR to run with the SCS option.

The export process will export the GIS data into an XML with the required structure for ICPR and will copy rai files previously generated into the target directory where the XML file is being generated.

Since the excess rainfall is going to be used as input into ICPR modeling, ICPR does NOT need to perform loss calculations. This will be accomplished by "tricking" ICPR by defining that each subwatershed has 100% DCIA. This also means that it is not necessary to export information for each SLURP, but just subwatershed information.

- Double-click **H&H Modeling** > **Export to ICPR Green and Ampt Rainfall Excess**.



- Specify the input Subwatershed feature class and the location of the RAI files previously generated. This layer must contain the fields HydroID and Name.

- Specify the path to the existing RAI files storing the associated excess rainfall. This location defaults to the value of the parameter ApFunction(GreenAmptCalculation)/RAIDirectory.

- Enter a path and name for the output ICPR XML file for Green and Ampt Excess Rain and click OK.

The tool retrieves the name of the control file for the export from the parameter ApFunction(GreenAmptCalculation)/ICPRExportControlGAExcess in the active configuration. This file must exist in the ArcHydro9/bin directory. It defaults to ICPRExportControlGAExcess.xml.

The tool retrieves the name of the transformation file for the export from the parameter ApFunction(GreenAmptCalculation)/GWIS2ICPRXMLGAExcess in the active configuration. This file must exist in the ArcHydro9/bin directory. It defaults to GWIS2ICPRXMLGAExcess.xsl

The tool generates the intermediate file GIS2ICPRTmpFileGAParams.xml as well as the output ICPR XML. It copies the rai files into the RAI subdirectory located in the same location as the exported XML and saves the value of the RAI Path in the parameter

ApFunction(GreenAmptCalculation)/RAIDirectory in the XML associated with the map document in ArcMap.

The tool sets the parameter ApFunction(GreenAmptCalculation)/XMLTargetDirectory to the export path for the XML.

Map to Map Toolset

Prerequisites

- HEC-HMS
- HEC-RAS
- HEC-DSSVUE

Copy the DataGP\TimeSeries folder. Open a new ArcMap and add the super_radar_cal feature class and the TIMESERIES and TSTYPEINFO tables. Save the map document as DSS.mxd.

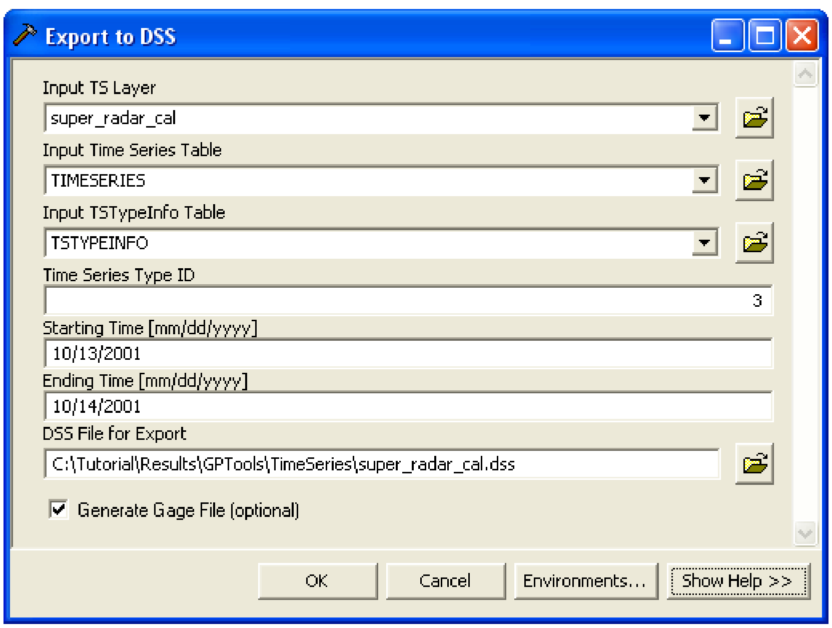
1. Export to DSS

This tool allows exporting time series data associated to input features of interest into the DSS format. The input feature class for which the time series needs to be exported must contain the name field.

- Open the attributes table of super_radar_cal and select Options > Add Field. Add the field Name as Text and populate it with the ObjectID for example.

- Double-click **H&H Modeling** > **Map to Map** > **Export to DSS**.

- Specify the inputs/outputs as shown below and click OK.



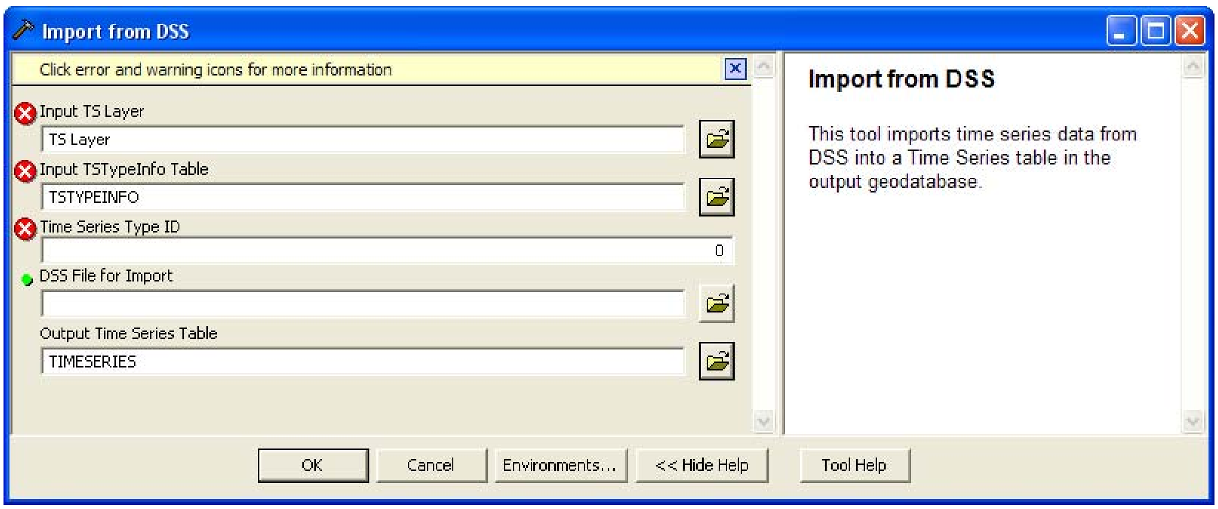
The tool generate the output DSS file (*.dss) and the gage file (.gage) if requested. The DSS file may be opened using the HEC-DSSVUE application.

2. Import from DSS

This tool allows importing time series data in the DSS format into the Arc Hydro time series format in a geodatabase.

- Double-click **H&H Modeling** > **Map to Map** > **Import from DSS**.

- Specify the input Time Series layer. Select the input and its associated Time Series and TSTypeInfo tables as well as the time series variable to import and the path to the DSS file to import. Click OK.



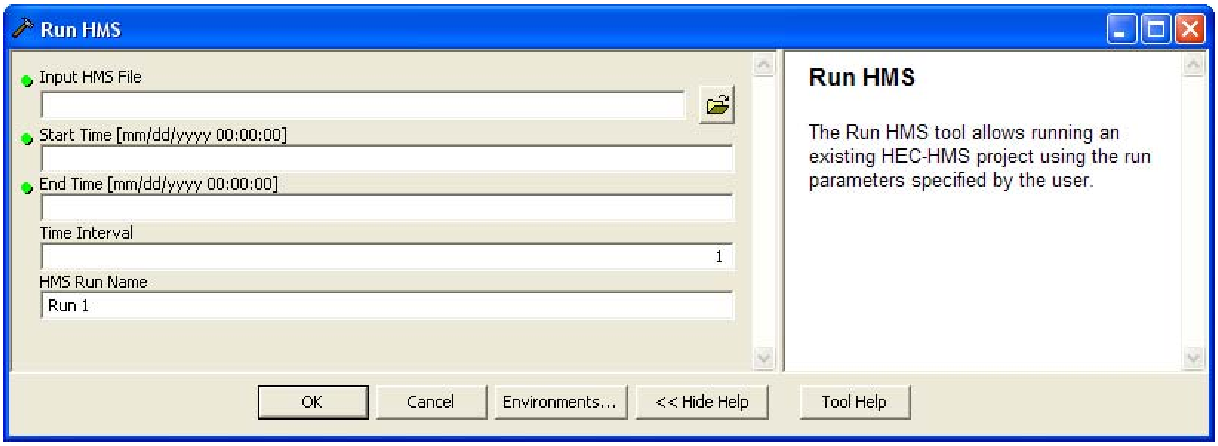
To be developed

3. Run HMS

This tool requires that HEC-HMS be installed on your computer. Refer to the US Army of Engineers web page http://www.hec.usace.army.mil/software/hec-hms/ for more information on installing HEC-HMS.

The start and end times may be determined by examining the gage file using HEC-DSSVUE. This application may be downloaded from the US Army Corps of Engineers web site as well (http://www.hec.usace.army.mil/software/hec-dss/hecdssvue-dssvue.htm).

- Double-click **H&H Modeling** > **Map to Map** > **Run HMS**.

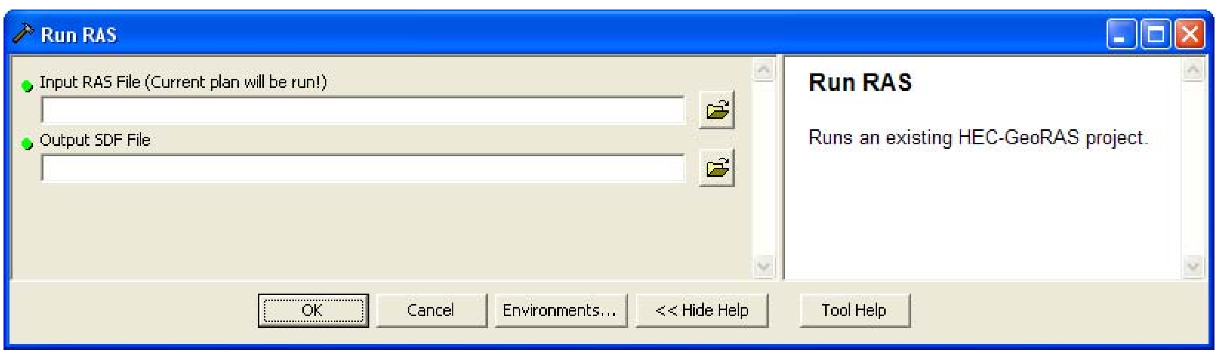


To be developed

4. Run RAS

This tool requires that HEC-RAS be installed on your computer. Refer to the US Army of Engineers web page http://www.hec.usace.army.mil/software/hec-ras/ for more information on installing HEC-RAS.

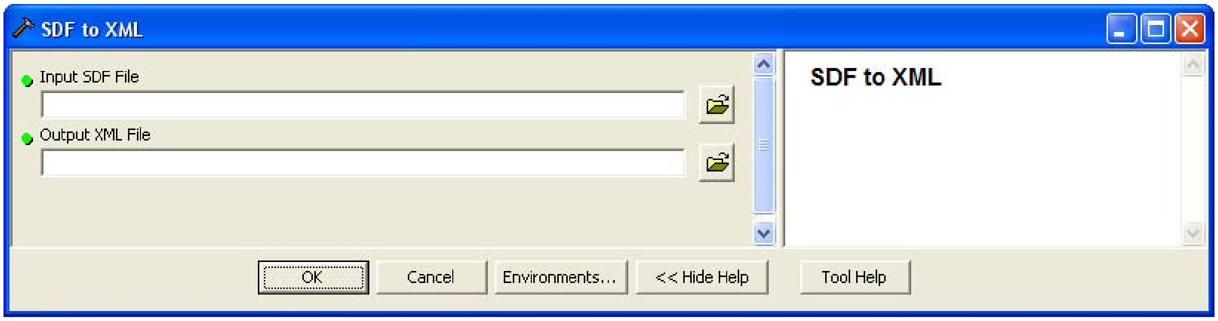
- Double-click **H&H Modeling** > **Map to Map** > **Run RAS**.



To be developed

5. SDF to XML

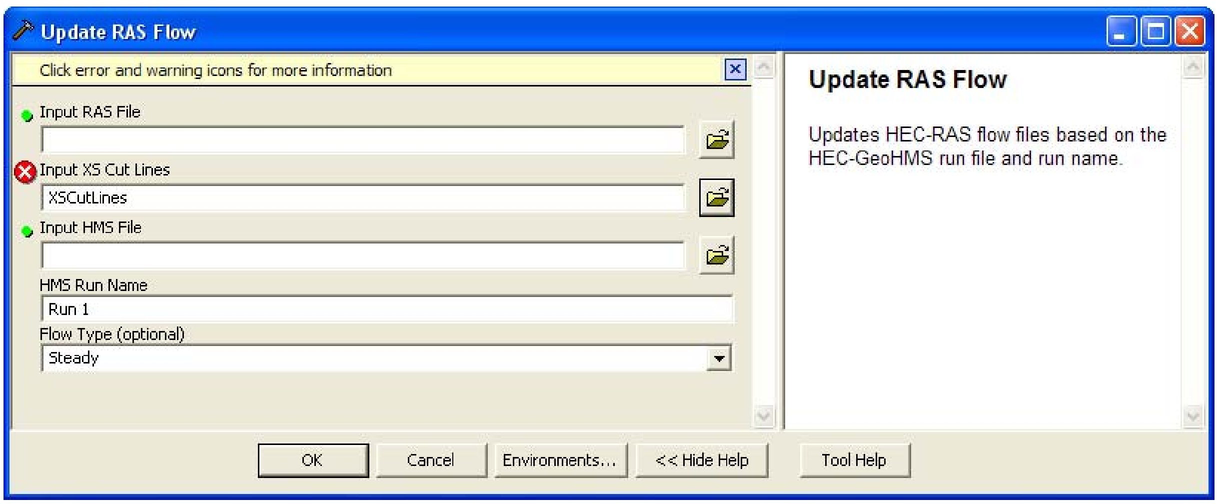
- Double-click **H&H Modeling** > **Map to Map** > **SDF to XML**.



To be developed

6. Update RAS Flow

- Double-click **H&H Modeling** > **Map to Map** > **Update RAS Flow**.



To be developed

GIS Data Exchange

The GIS Data Exchange toolset contains a set of tools that allow importing/exporting data between a geodatabase and an XML file. For additional information of these tools and their configuration, refer to the document XML Based Spatial Data Exchange User’s Guide.

You will export a small geodatabase containing feature classes and tables as an example using tutorial data and control files.

- Copy the directory DataGP\GISDataExchange.

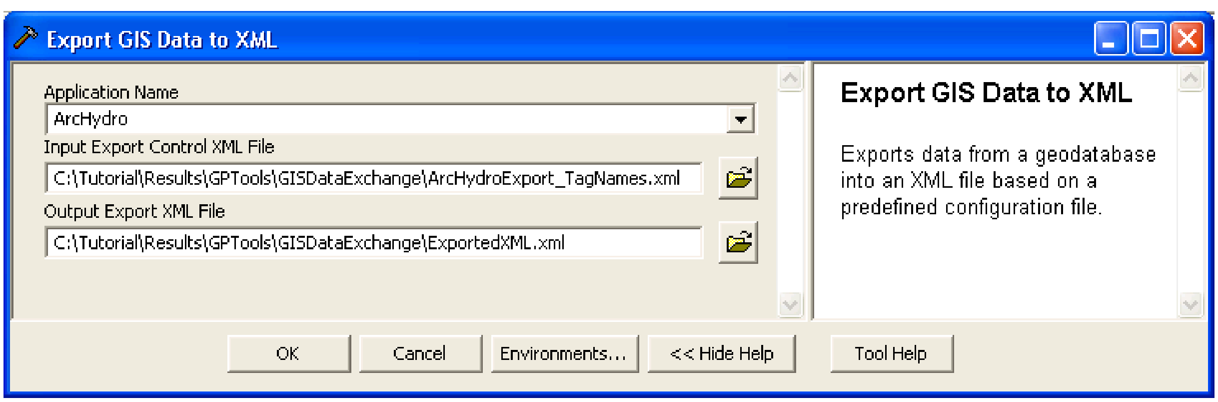
This directory contains a sample geodatabase and control files that will be used for the export/import.

- Open a new map document and add the Watershed and WatershedPoint feature classes into the map. Save the map as Export.mxd for example.

1. Export GIS Data to XML

This tool allows exporting layers and tables from the map document or from a geodatabase on the disk into an output XML file based on a configuration file.

- Double-click **GIS Data Exchange > Export GIS Data to XML**.



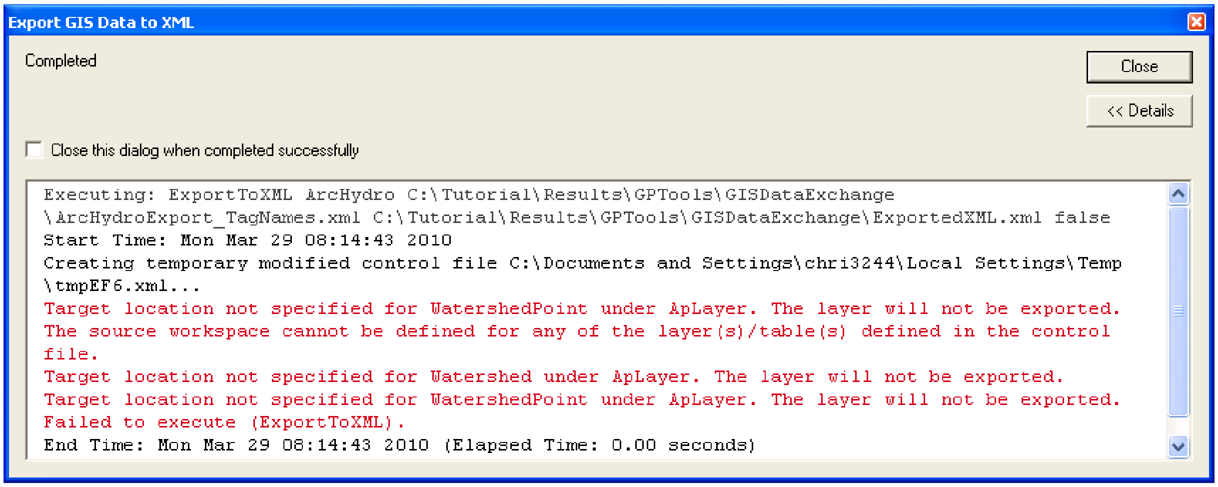
The Application Name parameter defines the node that will be read in the configuration file (HydroConfig, GeoHMSConfig, etc.) when looking for layers associated to tag names.

The input Export Control XML File defines the data that needs to be exported and how it maps to the output export XML File. There are 2 main ways to define the data that will be exported:

- Using LayerName/TableName
- Using TagName

- Browse to the control file “” in the directory where you copied the data and specify the output location for the XML file (e.g.). Click OK.

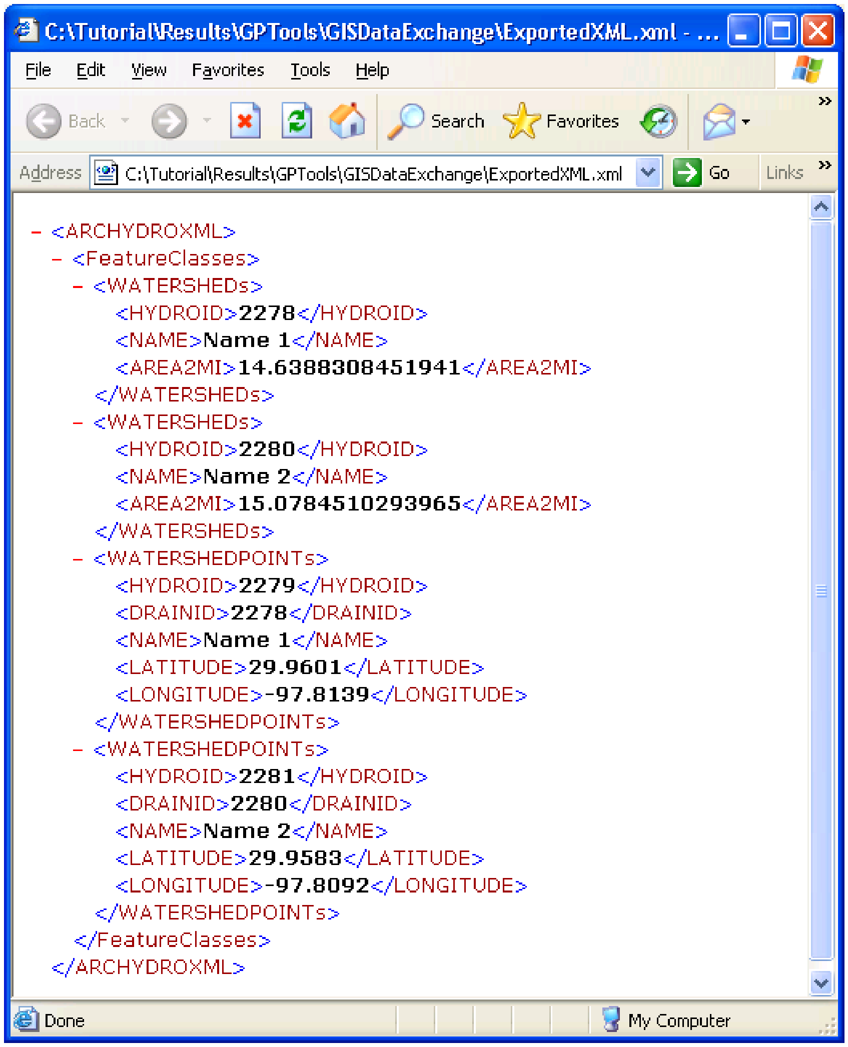
The tool fails with the following error messages:



This failure occurred because the control file is using tag names to identify the layer and no layers have been explicitly set yet for the tags. The tags set when using the Arc Hydro tools or when using the Data Management functions.

- Select Watershed Processing > Data Management Watershed Delineation on the Arc Hydro toolbar and the tags for Watershed and Watershed Point. Click OK and then rerun the Export tool.

- Open the export XML file created by the tool and review its content.



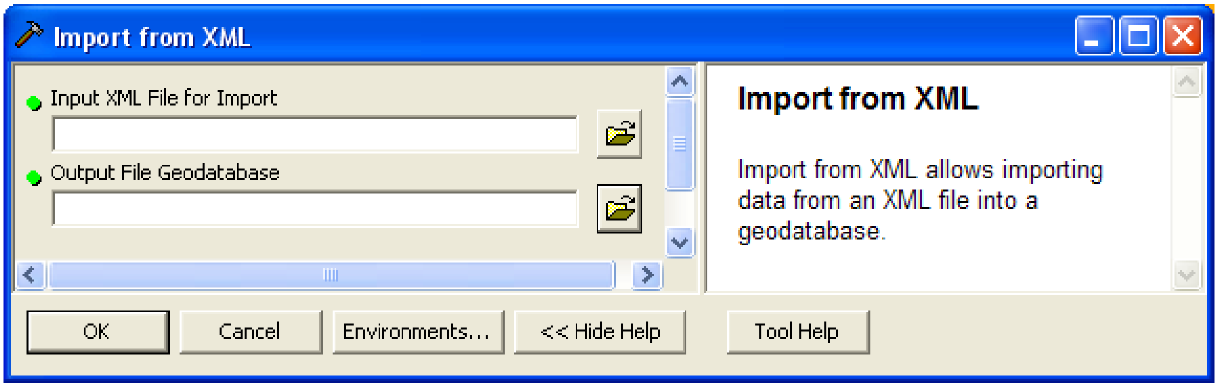
You are now going to export additional information on the feature classes so that the resulting XML can be transformed and imported back into a new geodatabase.

To be developed

2. Import from XML

This tool allows importing data from an XML file that meets ESRI geodatabase XML schema into a geodatabase. This formatted XML file may be generated by using the tool Transform XML.

- Double-click **GIS Data Exchange > Import from XML**.
- Browse to the input XML file meeting ESRI geodatabase schema and specify the name of the new output file geodatabase. Click OK.

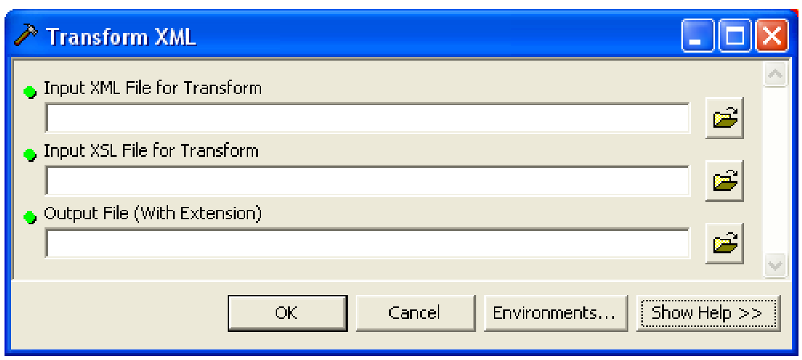


To be developed

3. Transform XML

This tool allows transforming an input XML file using an input XSL file to produce an output XML file. In particular, this tool can be used to create an XML file that meets ESRI geodatabase XML schema and can then be used as input by the Import from XML tool.

- Double-click **GIS Data Exchange** > **Import from XML**.
- Specify the input XML file to process and the input XSL file, as well as the path and name to the output file. Click OK.



The tool parses the input XML file using the XSL file to create the transformed output file.

To be developed

Troubleshooting

1. ArcMap crashes when opening or adding the map or the toolbox

- Delete the ArcMap mxd template Normal.mxt located by default at C:\Documents and Settings\username\Application Data\ESRI\ArcMap\Templates\Normal.mxt.
- Delete ArcToolbox.dat located at C:\Documents and Settings\username\Application Data\ESRI\ArcToolbox.

2. Geoprocessing tools open in blank forms but work in the command line.

- Use Regedit to rename the registry key HKEY_CURRENT_USER\Software\ESRI to ESRI_OLD to recreate the key and reset the default settings for the user's profile.

3. Adding an Arc Hydro tool to a toolbox crashes ArcMap

- Unregister ESRI.APWR.ArcHydroGPTools.dll using regasm /u, cleanup the registry with ApRegWork looking for the ESRI.APWR.ArcHydroGPTools.dll (delete the entry) and reregister the dll using regasm /codebase.