Setting up Local Parameters in Arc Hydro

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1 Introduction

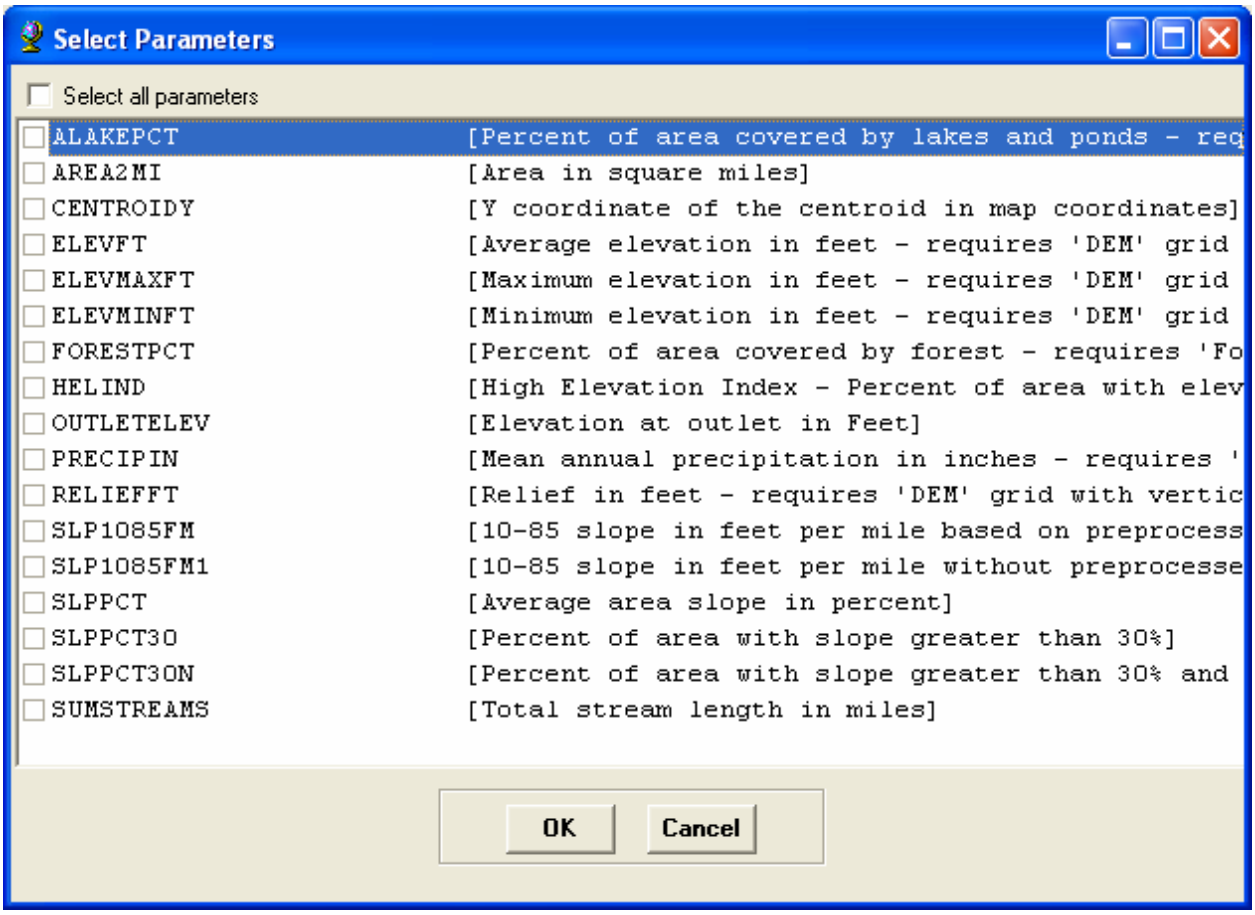
This document describes how to setup local parameters in Arc Hydro. A local parameter is a parameter computed for a local watershed, e.g. a watershed for which data (dem, etc.) is available in ArcMap.

2 Defining local parameters

The parameters available in Arc Hydro are defined in the XML associated to the map document under the node FrameworkConfig/HydroConfig/ProgParams/ApFunctions/ApFunction(WshParams). The function Compute Local Parameters reads this XML and displays the list of parameters in the Select Parameters window.

- Open a new ArcMap and save the map document.
- Select **Attribute Tools|Compute Local Parameters**.

The Select Parameters window is displayed. This form lists all the parameters that are defined in the XML and can be computed.



- Click OK to close the form.

2.1 Name Definition

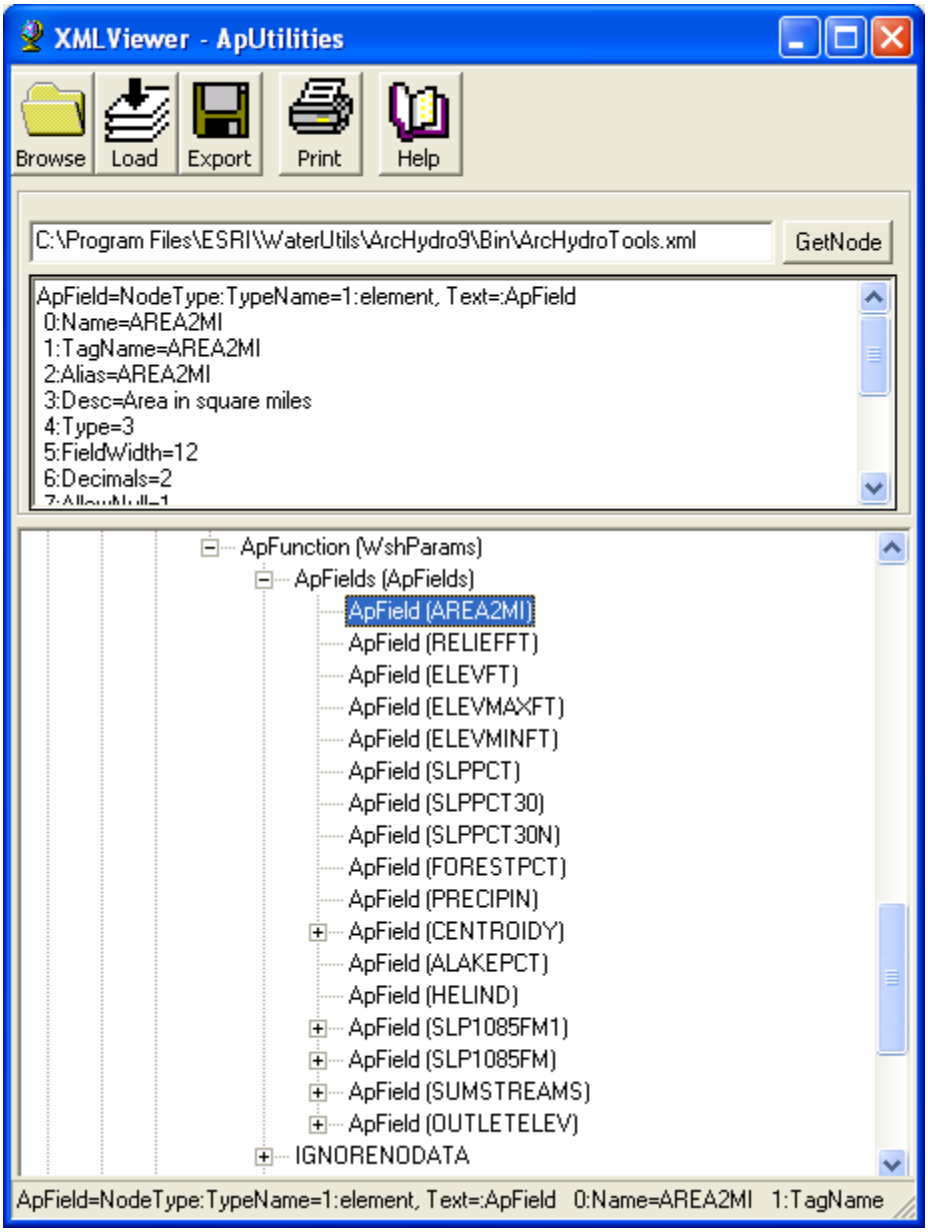
The parameter is defined with 4 types of “name”: field name, tagname, field alias and description.

Name	Description
Name	Name of the field (if you look at the field in the layer properties window you see the name and the alias whereas if you open the table you see the alias).
TagName	Name used in the list of parameters in the Select Parameters window, as well as internally by the function.
Alias	Alias corresponding to the field name (what you see when you open the attribute table).
Desc	Description associated to the parameter in the Select Parameters window (if you maximize the window you see the description on the right).

- Select **ApUtilities|XML Manager**.

The XML Viewer displays the XML associated to the map document.

- Browse to the node FrameworkConfig/HydroConfig/ProgParams/ApFunctions/ApFunction(WshParams)/ApFields/

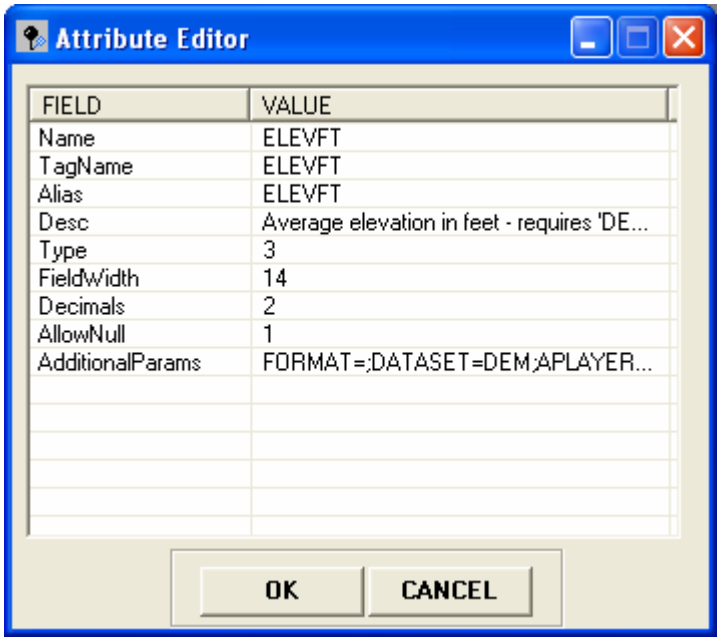


- Right-click ApField(ELEVFT) and select Copy.
- Right-click ApFields(ApFields) and select Paste.

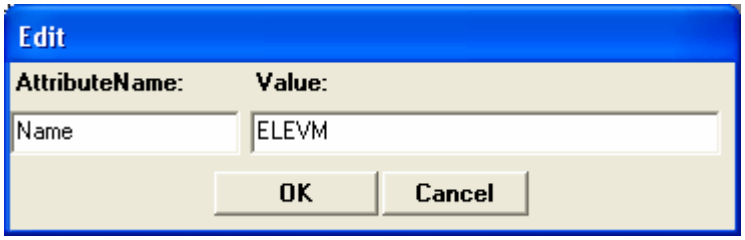
The node ApField(ELEVFT) is added under the node ApField(OUTLETELEV).

- Right-click the new node ApField(ELEVFT) and select EditAttributes.

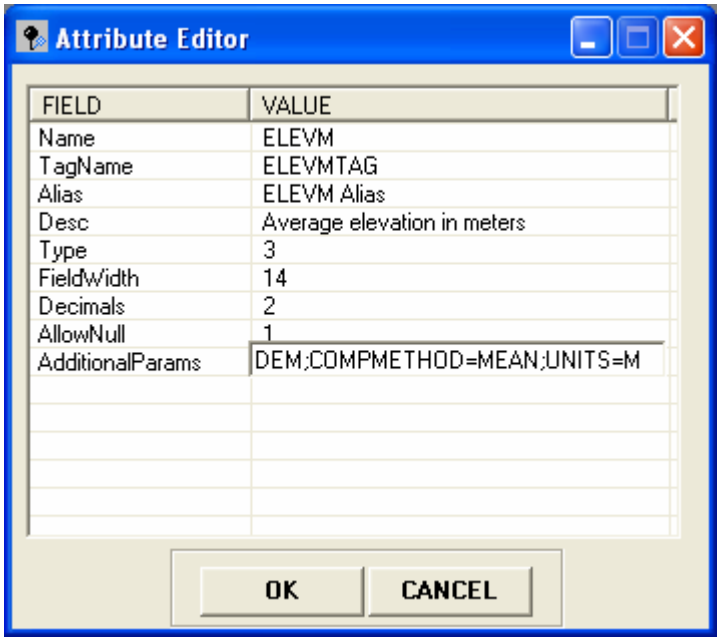
The Attribute Editor window is displayed.



- Right-click the Name record and select Edit. Enter ELEVM as value for name. Click OK



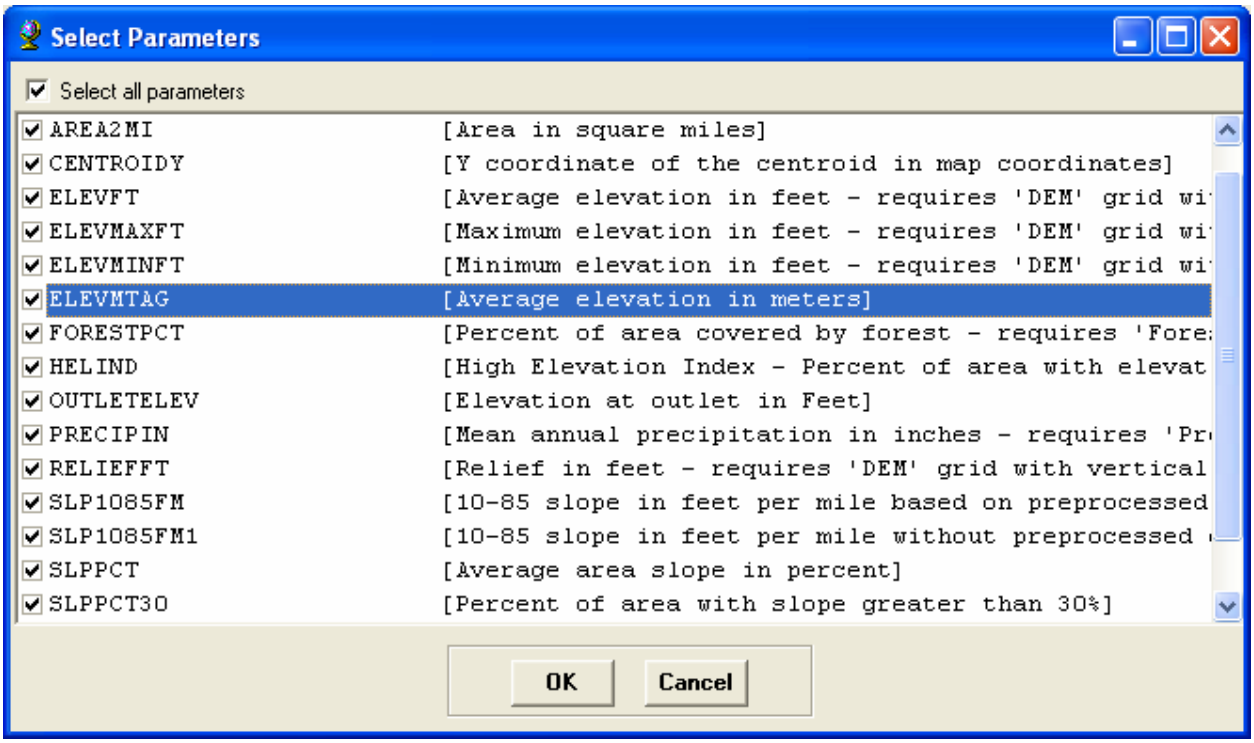
- Right-click the TagName record and select Edit. Enter ELEVMTAG as value for TagName. Click OK.
- Right-click the Alias record and select Edit. Enter ELEVM ALIAS as value for Alias. Click OK
- Right-click the Description record and select Edit. Enter “Average elevation in meters” as Description. Click OK
- Right-click the AdditionalParams record and select Edit. Replace “UNITS=FT” with “UNITS=M”. Click OK.



- Click OK to close the Attribute Editor.
- Close the XML Viewer and save the map document.
- Add a raster (dem) and a polygon feature class that overlays the dem into the Table of Contents of ArcMap.
- Select one of the polygon features since the function Compute Local Parameters works with a selected set of drainage area features.
- Select **Attribute Tools|Compute Local Parameters**.

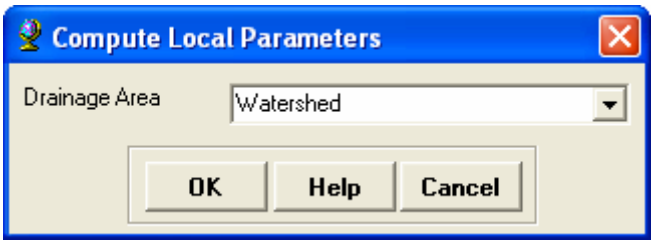
The new parameter is now visible in the Select Parameters window as:

ELEVMTAG	[Average elevation in meters]
TagName	[Description]

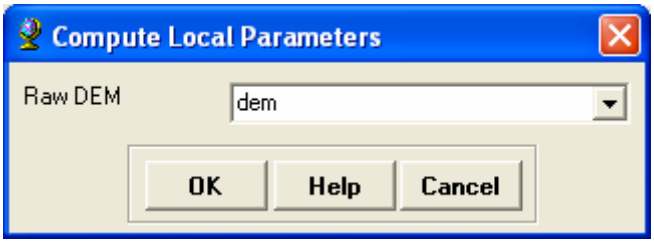


- Uncheck Select All parameters. Select ELEVFT and ELEVMTAG. Click OK.

- Select the polygon feature class you just added as Drainage Area. This is the feature class for which parameters are computed. Click OK.

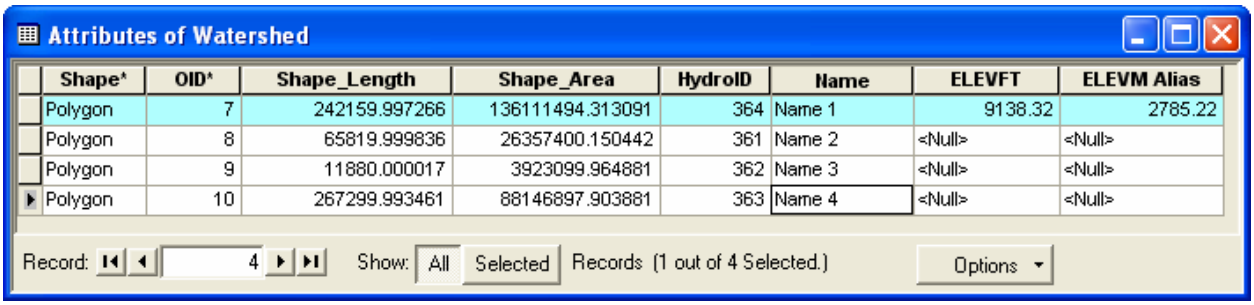


- Select the raster dem you just added as Raw DEM, which is used as input to compute the average elevation. Click OK.



- Open the attributes table of the drainage area feature class (e.g. Watershed).

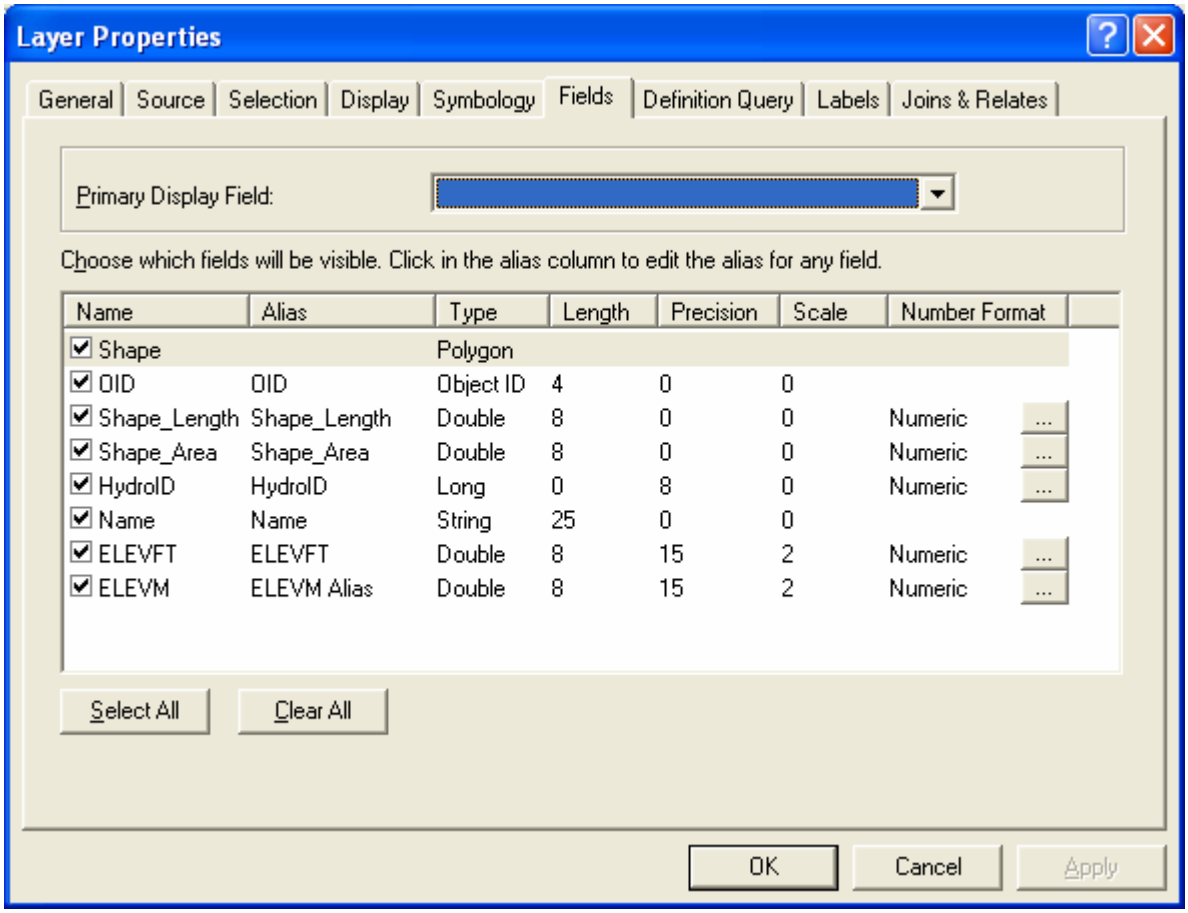
The fields ELEVFT and ELEVM Alias (aliases set in the XML) have been added to the attributes table.



Shape*	OID*	Shape_Length	Shape_Area	HydroID	Name	ELEVFT	ELEVM Alias
Polygon	7	242159.997266	136111494.313091	364	Name 1	9138.32	2785.22
Polygon	8	65819.999836	26357400.150442	361	Name 2	<Null>	<Null>
Polygon	9	11880.000017	3923099.964881	362	Name 3	<Null>	<Null>
Polygon	10	267299.993461	88146897.903881	363	Name 4	<Null>	<Null>

- Right-click the drainage area feature class (e.g. Watershed) in the Table of Contents of ArcMap and select Properties. Select the tab Fields.

The Properties window shows that a field called “ELEVM” (name) has been created. The alias for this field, that is visible when viewing the Attributes table, is “ELEVM Alias”.

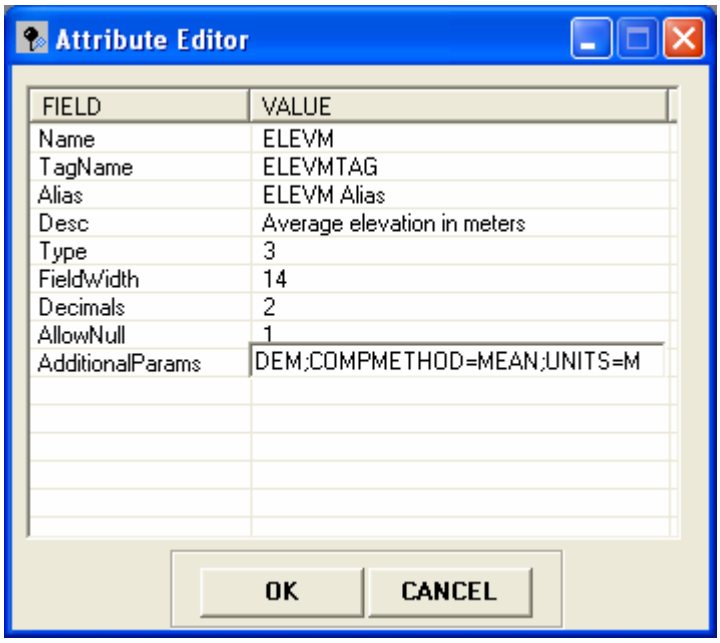


Name	Alias	Type	Length	Precision	Scale	Number Format
Shape		Polygon				
OID	OID	Object ID	4	0	0	
Shape_Length	Shape_Length	Double	8	0	0	Numeric
Shape_Area	Shape_Area	Double	8	0	0	Numeric
HydroID	HydroID	Long	0	8	0	Numeric
Name	Name	String	25	0	0	
ELEVFT	ELEVFT	Double	8	15	2	Numeric
ELEVM	ELEVM Alias	Double	8	15	2	Numeric

2.2 Field definition

The XML allows also setting the type and width of the field, as well as the number of decimals for a numeric field. The XML also sets whether the field allows null values.

Name	Description
Type	The esriFieldType associated with this field node: • 0: Integer • 1: Long integer • 3: Double • 4: String • 5: Long integer • 6: OID • 7: Geometry • 8: BLOB
FieldWidth	Number. For a string, length of the field. For a number, maximum number of digits (number) allowed without counting the decimal separator.
Decimals	Maximum number of decimals allowed (=scale) for numbers. Ignored for string
AllowNull	Indicate whether the field allows null value or must always be populated. Usually set to 1 (Allow Null).



2.3 Computation Method Definition

The computation method, as well as the parameter's units, are defined in AdditionalParams.

AdditionalParams

Name	Description
COMPMETHOD	Computation method used to compute the local parameter. Available operations are: • MEAN: average value of input raster within the drainage area. • MAX: maximum value of input raster. • MIN: minimum value of input raster. • RANGE: (maximum-minimum) for input raster. • STD: standard deviation for input raster. • SUM: sum of raster values within the drainage area. • COUNT: number of cells within the drainage area. • FRACTION: ratio of cells with values 1. Input raster must be a grid with values 0 or 1 • PERCENT: percent of cells with values 1. Input raster must be a grid with values 0 or 1 • AREA: area covering the cells from input raster with a value of 1. Input raster must be a grid with values 0 or 1. • CUSTTYPE: custom operation (e.g. CentroidY)
CUSTOPNAME	Name of the custom operation used when COMPMETHOD=CUSTTYPE. e.g. CUSTOPNAME=wshptools9.CentroidYOp Available custom operators: • AreaOp • CentroidYOp • PointExtractOp • LFPathOp • LFPathPreproOp • LineLengthOp See section 3.2 for a detailed description of these operators.
UNITS	Units used for the parameter. Available values for standard parameters: • FT • FT2 • ACRE • MI • MI2 • M • M2 • HECTARE • KM • KM2 • FT/MI • M/KM

Parameters required by custom functions can be defined as new AdditionalParams (e.g. PROJECTIONFILENAME for the Y-Coordinate of the Centroid). The custom operators retrieve these parameters as needed.

Name	Operator	Description
PROJECTIONFILENAME	CentroidYOp	Optional. Parameter used for CENTROIDY. Define the name of the projection file used for the Y coordinate of the Centroid. Defined as PROJECTIONFILENAME =Transverse_Mercator.prj. The file is located under the Archydro\bin directory.
SMOOTH	LFPathOp LFPPathPreproOp	SMOOTH=1: resulting 3D Longest Flow Path feature class is smoothed. SMOOTH=0: not smoothed
EXPRESSION	PointExtractOp	Value added to the resulting parameter. • EXPRESSION=1: add 1 to value after unit conversion. • EXPRESSION=-2: subtract 2 from value.

2.4 Input/Output Layers Definition

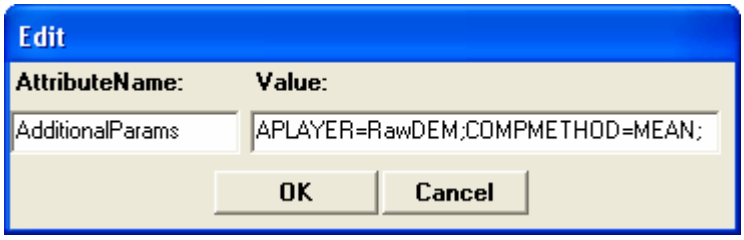
Standard parameters are computed by using an input raster that may be defined in 2 ways:

1. Using ApLayer
2. Using ApLayers

Custom parameters' inputs/outputs are always defined using the ApLayers method.

2.4.1.1 With ApLayer (standard parameters only)

Standard parameters are the parameters defined with a standard operation method, i.e. no a custom operator. They are using one and only one input, a raster layer. This input may be defined with APLAYER= TagName within AdditionalParams.

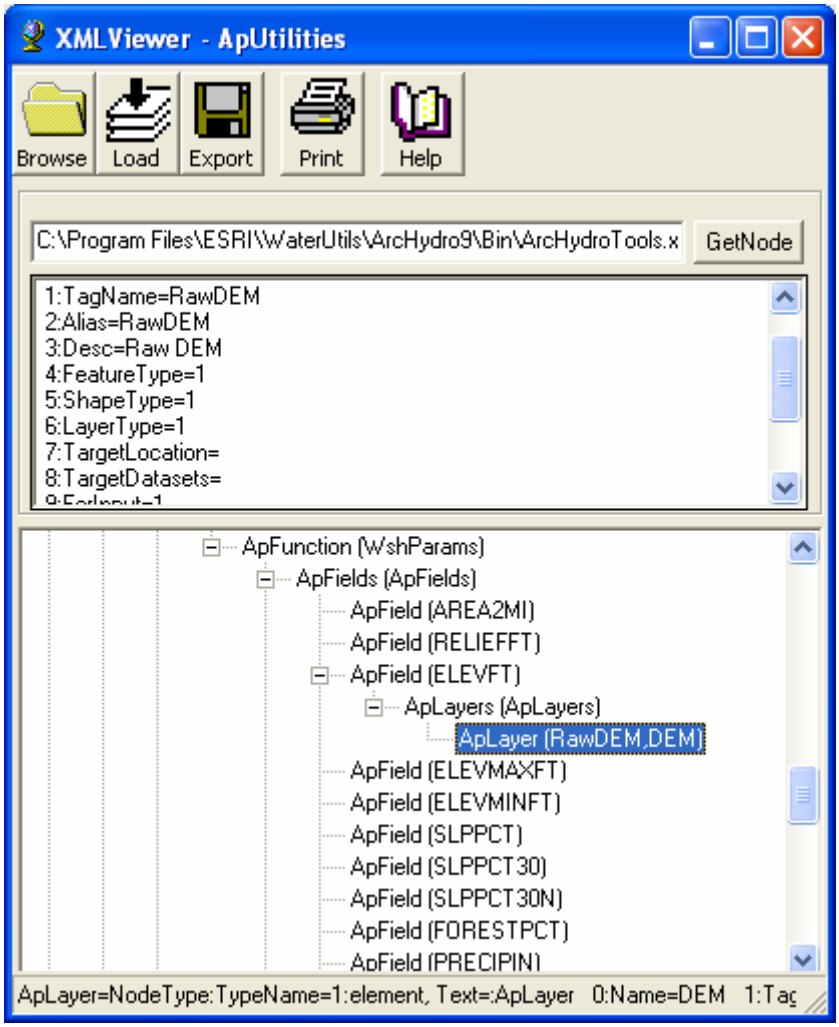


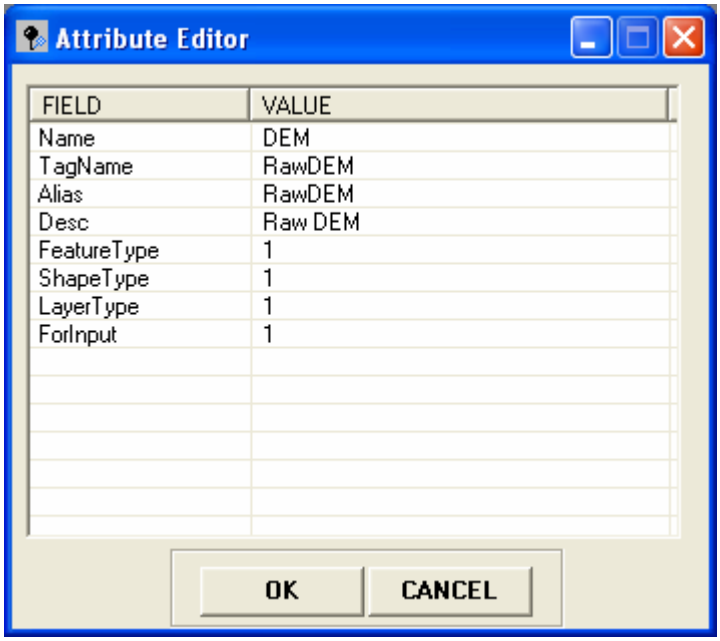
2.4.1.2 With ApLayers (standard and custom parameters)

- **Standard parameters (i.e. one raster input)**

For standard parameters, one ApLayer defining the input raster required by the function is configured.

The figure below illustrates how to setup the RawDEM tag as input for the parameter ELEVFT (average elevation).





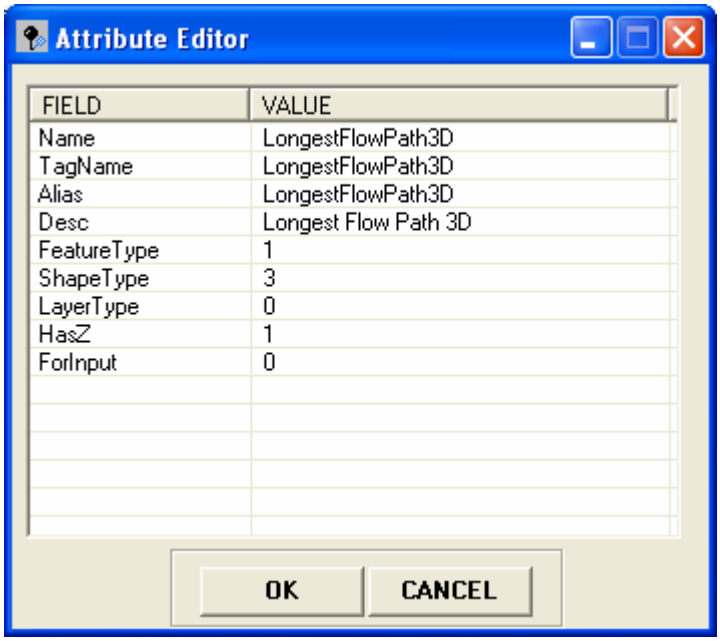
- **Custom parameters (none to multiple inputs/outputs)**

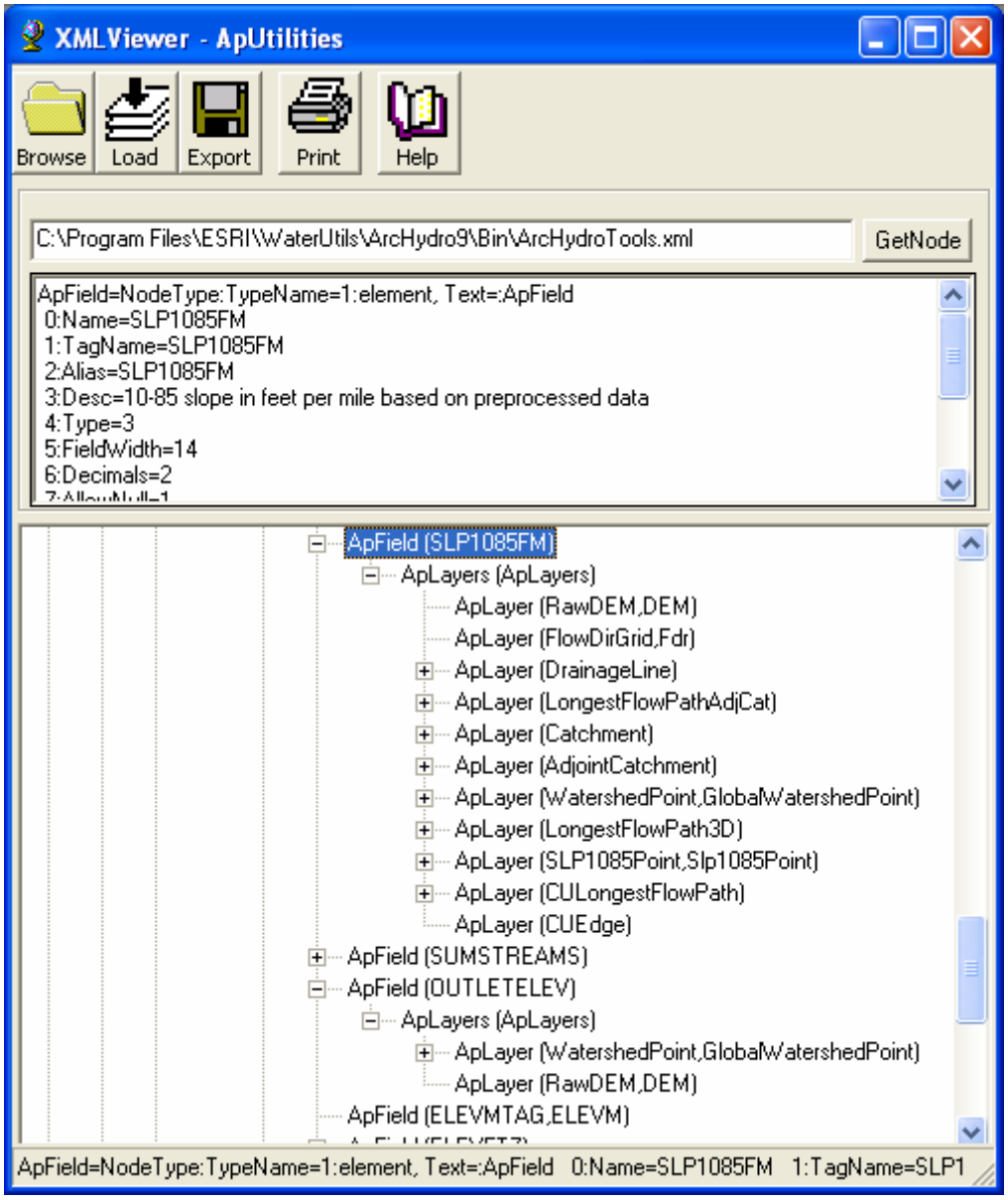
Custom parameters may require multiple input/output feature classes. Each feature class is defined as an ApLayer in the ApLayers collection associated to the parameters. Fields may also be defined for each layer. The parameter FoInput indicates whether the layer is a required input or an output layer that will be generated during the computation.

For example, when computing the parameter SLP1085FM (slope 10-85 in feet per mile using preprocessed data), 2 output feature classes are used:

- LongestFlowPath3D, storing the output longest flow path feature.
- SLP1085Point, storing the output 10 and 85 points.

The parameter ForInput set to 0 indicates that the layer is an output layer that will be created if it does not already exist (ForInput set to 1 indicates an input layer, which is the default).


Attribute Editor
FIELD
VALUE
Name
LongestFlowPath3D
TagName
LongestFlowPath3D
Alias
LongestFlowPath3D
Desc
Longest Flow Path 3D
FeatureType
1
ShapeType
3
LayerType
0
HasZ
1
ForInput
0
OK
CANCEL

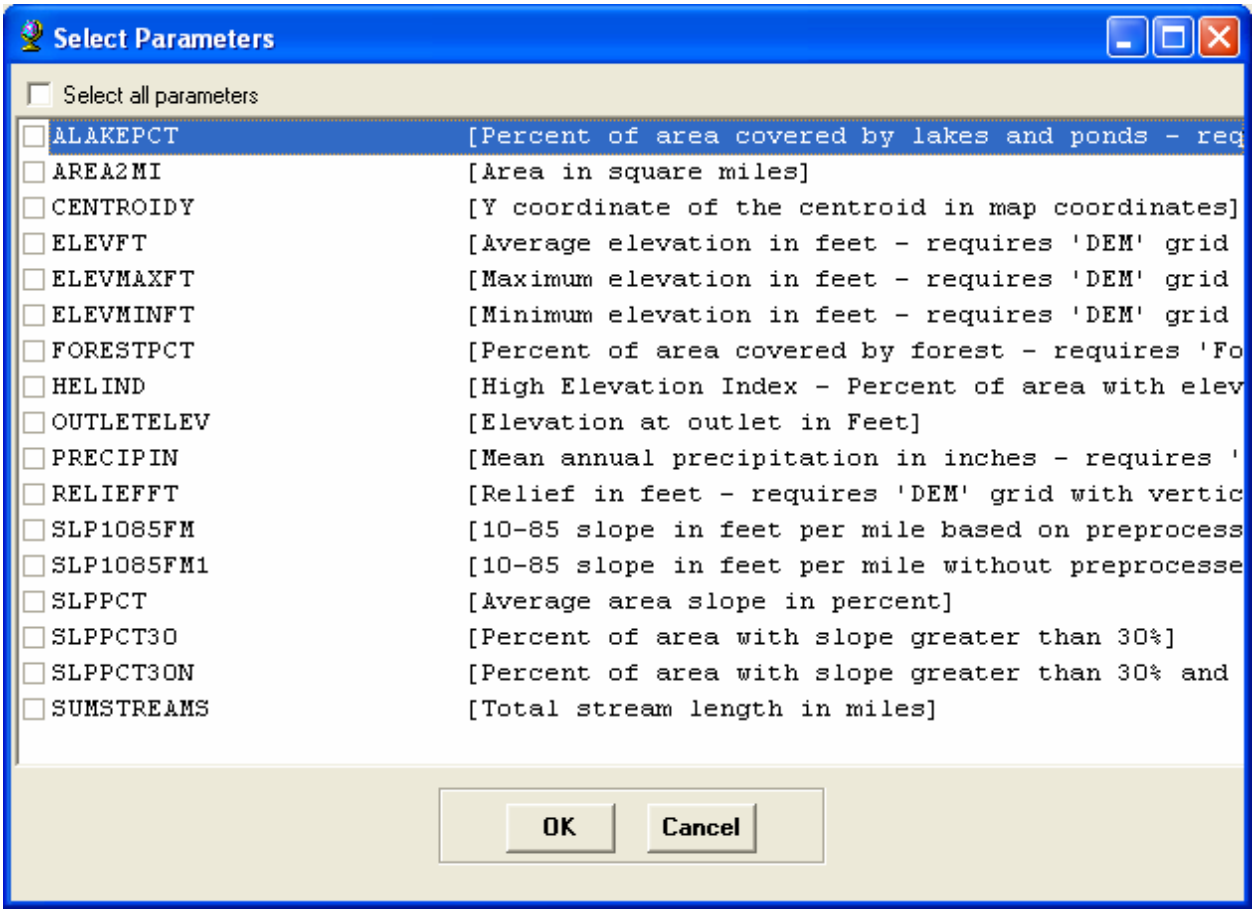


Name	Description
ForInput	Indicate whether the layer is an input or output layer.

3 Default local parameters in Arc Hydro

3.1 Parameters Description

The following parameters are available by default in Arc Hydro:



Name	Definition	Layers	AdditionalParams
ALAKEPCT	Area of lakes and ponds in percent.	LAKES grid with values: • 1 for lakes • 0 otherwise	APLAYER=WshLake; COMPMETHOD=PERCENT
AREA2MI	Area in square miles.		COMPMETHOD=CUSTTYPE; CUSTOPNAME=wshptools9.AreaOp; UNITS=MI2
CENTROIDY	Y coordinate of the centroid in the projection file coordinates system (or in map coordinates if there is no projection file).	Centroid (output, optional) Optional. Projection file stored in the ArcHydro9\bin directory (e.g. Transverse_Mercator.prj)	COMPMETHOD=CUSTTYPE; CUSTOPNAME=wshptools9.CentroidYOp; PROJECTIONFILENAME= Transverse_Mercator.prj
ELEVFT	Average elevation in feet.	RawDEM	COMPMETHOD=MEAN; APLAYER=RawDEM; UNITS=FT
ELEVMAXFT	Maximum elevation in feet.	RawDEM	COMPMETHOD=MAX; APLAYER=RawDEM; UNITS=FT
ELEVMINFT	Minimum elevation in feet.	RawDEM	COMPMETHOD=MIN; APLAYER=RawDEM; UNITS=FT
FORESTPCT	Percentage of area of type forest.	FOREST grid with values: • 1 for forest landuse • 0 otherwise	COMPMETHOD=PERCENT; APLAYER=WshForest
HELIND	High elevation index.	High elevation grid: • 1 if elev > high elevation • 0 otherwise	COMPMETHOD=PERCENT; APLAYER=WshHelind
OUTLETELEV	Elevation at the outlet in feet.	Watershed Point Raw DEM	COMPMETHOD=CUSTTYPE; CUSTOPNAME=wshptools9.PointExtractOp; UNITS=FT; EXPRESSION=
PRECIPIN	Mean precipitation in input grid unit.	RAINFALL grid	COMPMETHOD=MEAN; APLAYER=WshPrecip
RELIEFFT	Relief in feet (Difference between the maximum and the minimum elevation).	RawDEM	APLAYER=RawDEM; COMPMETHOD=RANGE; UNITS=FT

Name	Definition	Layers	AdditionalParams
SLP1085FM	10-85 slope in feet/mile using preprocessed data.	RawDEM Flow Direction grid DrainageLine Longest Flow Path Adjoint Catchment Catchment Adjoint Catchment Watershed Point LongestFlowPath3D (output, optional) Slp1085Point (output, optional)	COMPMETHOD=CUSTTYPE; CUSTOPNAME=wshptools9.LFPathPreproOp; SMOOTH=1; UNITS=FT/MI
SLP1085FM1	10-85 slope in feet/mile.	RawDEM Flow Direction grid DrainageLine LongestFlowPath3D (output, optional) Slp1085Point (output, optional)	COMPMETHOD=CUSTTYPE; CUSTOPNAME=wshptools9.LFPathOp; SMOOTH=1; UNITS=FT/MI
SLPPCT	Average slope in percent.	Slope grid in percent.	COMPMETHOD=MEAN; APLAYER=WshSlope
SLPPCT30	Percentage of slopes greater than or equal to 30%.	Slope30 grid	COMPMETHOD=PERCENT; APLAYER=WshSlopeGE30
SLPPCT30N	Percentage of slopes facing North and greater than or equal to 30%.	Slope30N grid	COMPMETHOD=PERCENT; APLAYER=WshSlopeGE30N
SUMSTREAMS	Total stream length in mile.	Stream layer	COMPMETHOD=CUSTTYPE; CUSTOPNAME=wshptools9.LineLengthOp; UNITS=MI

3.2 Default custom operators

3.2.1 AreaOp

This operator converts the area of each selected drainage area feature into the specified unit. If no units are set, the unit of the Drainage Area feature class is used.

COMPMETHOD=CUSTTYPE;
CUSTOPNAME=wshptools9.AreaOp;
UNITS=MI2

Available units are:

- KM2
- M2
- HECTARE
- MI2
- FT2
- ACRE

3.2.2 CentroidYOp

This operator computes the Y coordinate of the centroid of the input drainage area in the coordinates of the specified input projection file. If no projection file is specified, the Y coordinate is provided in the coordinates system of the map.

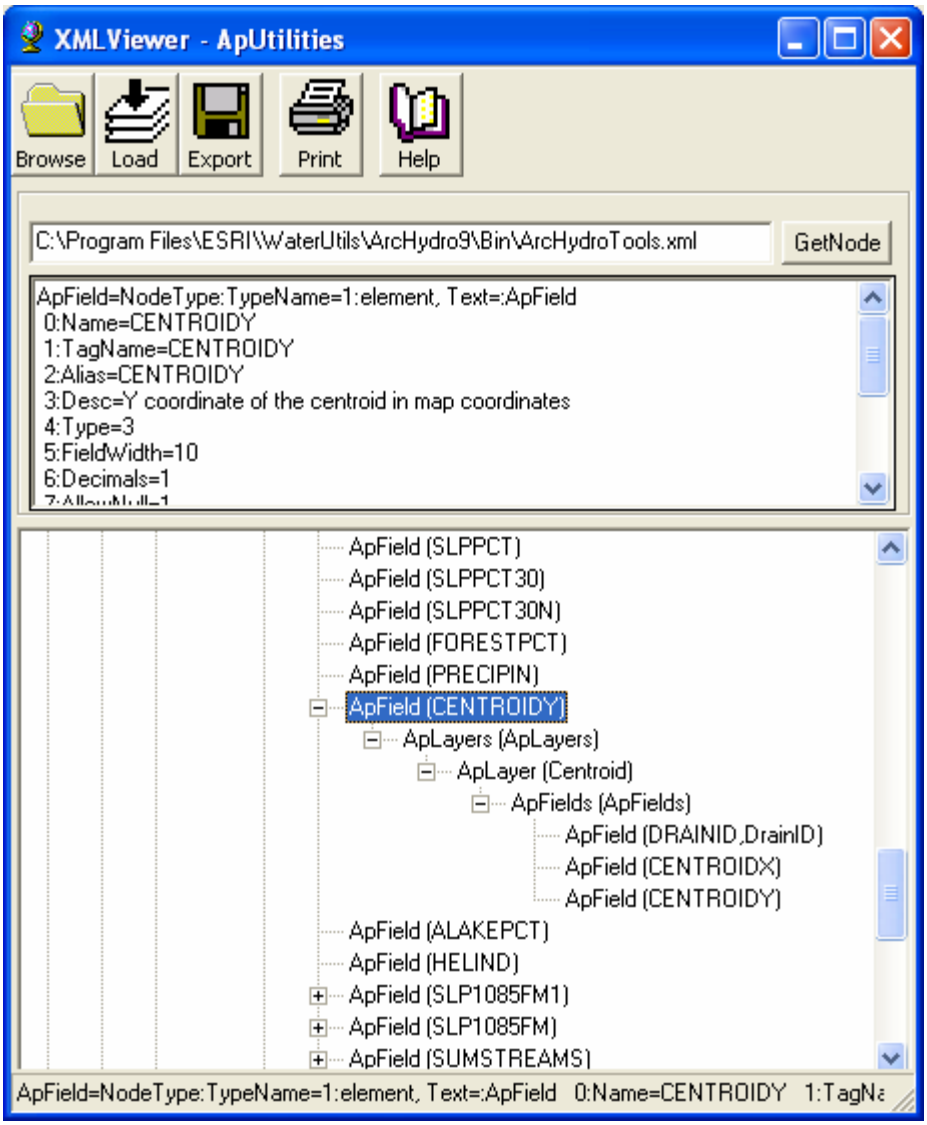
COMPMETHOD=CUSTTYPE;
CUSTOPNAME=wshptools9.CentroidYOp;
PROJECTIONFILENAME= Transverse_Mercator.prj

Where Transverse_Mercator.prj is stored in the \ArcHydro9\bin directory. This parameter is optional.

If an output Centroid feature class is specified in the XML for the CENTROIDY parameter, the centroid point will be stored with the following attributes (provided that the corresponding fields are also specified):

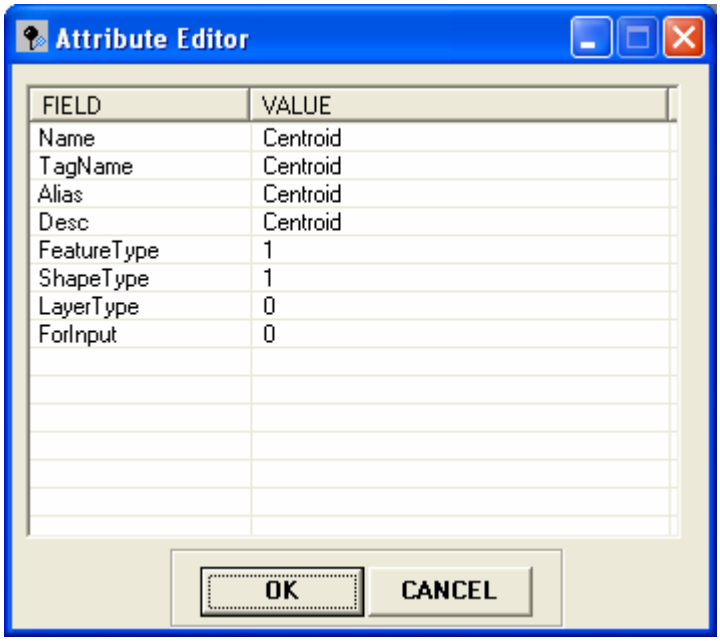
- DrainID: HydroID of the corresponding drainage area.
- CentroidX: X coordinate of the Centroid.
- CentroidY: Y coordinate of the Centroid.

The output layer needs to have the tag name Centroid.



Note
If the node corresponding to the Centroid layer is deleted, the Y-coordinate is computed but the corresponding Centroid point is not stored.

The parameter ForInput is set to 0 indicating that Centroid is an output layer.



3.2.3 PointExtractOp

This operator extract the value of a raster at a point linked to the input drainage area through the DrainID/HydroID relationship. The HydroID of the drainage area is stored in the DrainID of the related point. This operator may be used for example to compute the elevation at the outlet of the watershed (parameter OUTLETELEV).

This function requires 2 inputs:

1. raster layer storing the value to retrieve
2. point feature class with the DrainID field.

Any tag name can be used to setup these layers as the function is looking for a raster and point feature class, not for specific tag names.

Note
If there is more than one point related to the input drainage area through the DrainID/HydroID, the first point found is used.

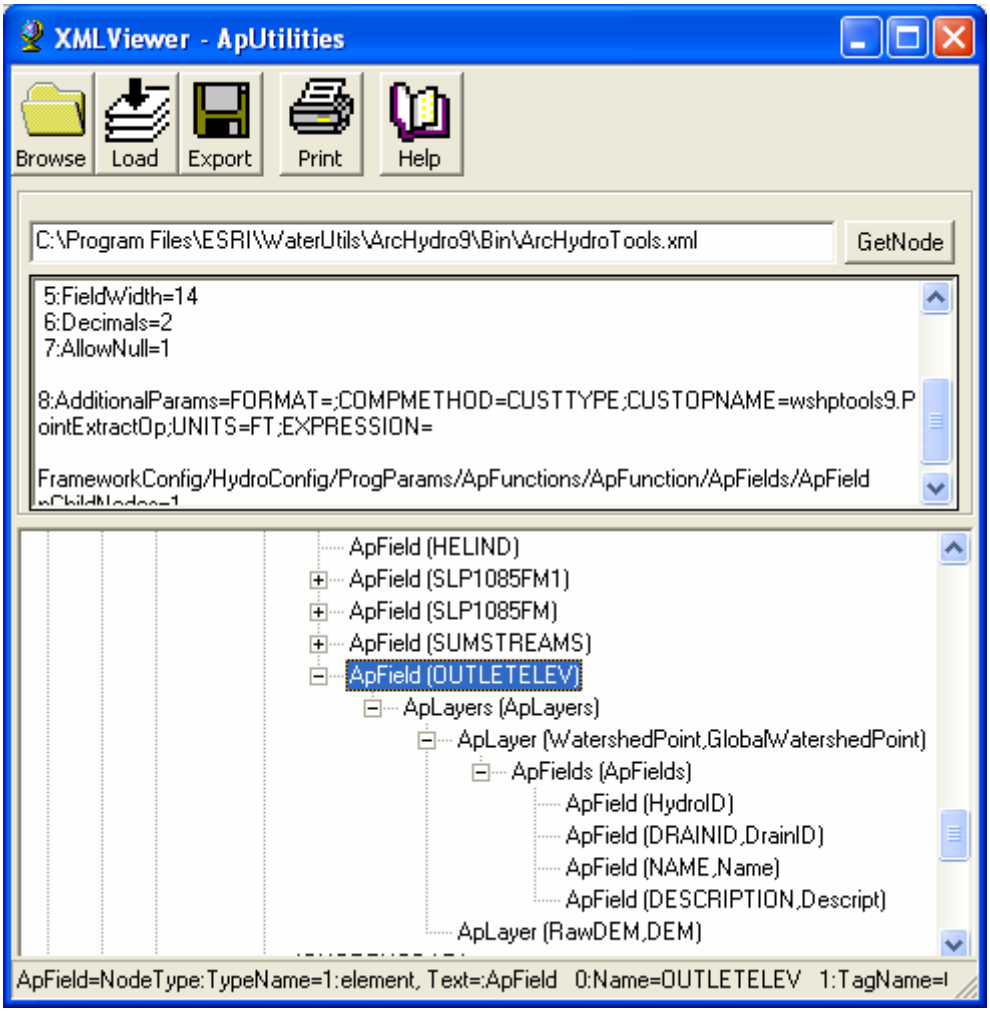
The operator retrieves the value at the first point found and performs a unit conversion if a unit has been specified in AdditionalParams.

The Expression attributes allows adding a value to the parameter computed after unit conversion:

- EXPRESSION=1: add 1 to the converted value
- EXPRESSION=-2: subtract 2 from the converted value

COMPMETHOD=CUSTTYPE;
CUSTOPNAME=wshptools9.PointExtractOp;
UNITS=FT;
EXPRESSION=

The 2 input layers are set as ApLayer belonging to the ApLayers collection associated to the parameter. The point feature class contains the ApField (belonging to ApFields) DrainID.



3.2.4 LFPathOp

This operator computes the 10-85 slope in the specified units, and generate the associated longest flow path and 10-85 points.

It requires as input the following layers:

- RawDEM
- Flow Direction grid
- DrainageLine

2 output layers are generated if they are specified in the XML:

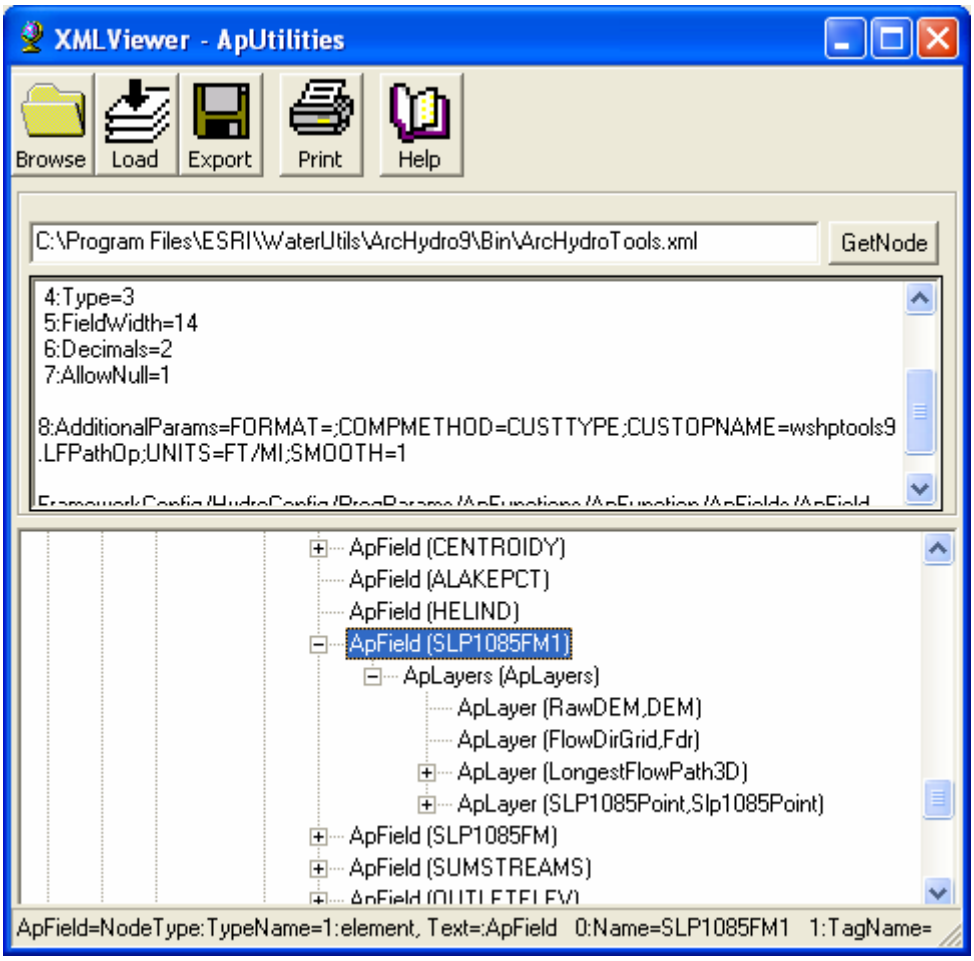
- LongestFlowPath3D (output, optional)
  - DrainID
  - Slp1085
  - Slp
  - ElevUP
  - ElevDS

- Elev10
- Elev85

- Slp1085Point (output, optional)
  - Name
  - DrainID
  - Elev

The LongestFlowPath3D feature is smoothed if the SMOOTH parameter is set to any value (e.g. SMOOTH=1) except 0. The smoothing does not occur only if SMOOTH=0.

Available Units
- FT/MI
- M/KM



3.2.5 LFPathPreproOp

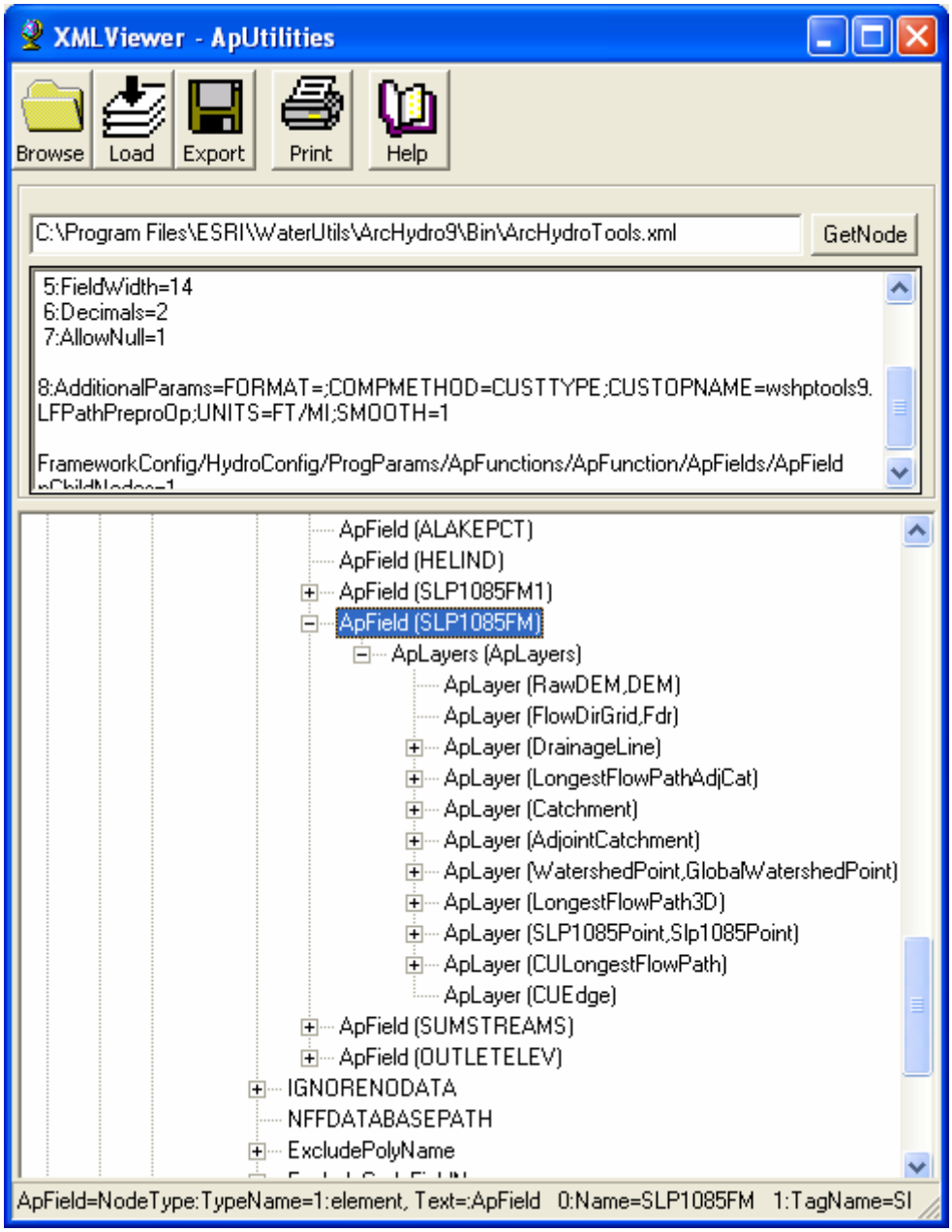
This operator computes the 10-85 slope in the specified unit, and generate the associated longest flow path and 10-85 points using preprocessed data to speed up the process. In works like the previous operator but requires additional input layers.

Input layers

- RawDEM
- Flow Direction grid
- DrainageLine
- Longest Flow Path Adjoint Catchment
- Catchment
- Adjoint Catchment
- Watershed Point

Output layers (optional)

- LongestFlowPath3D (output, optional)
- Slp1085Point (output, optional)

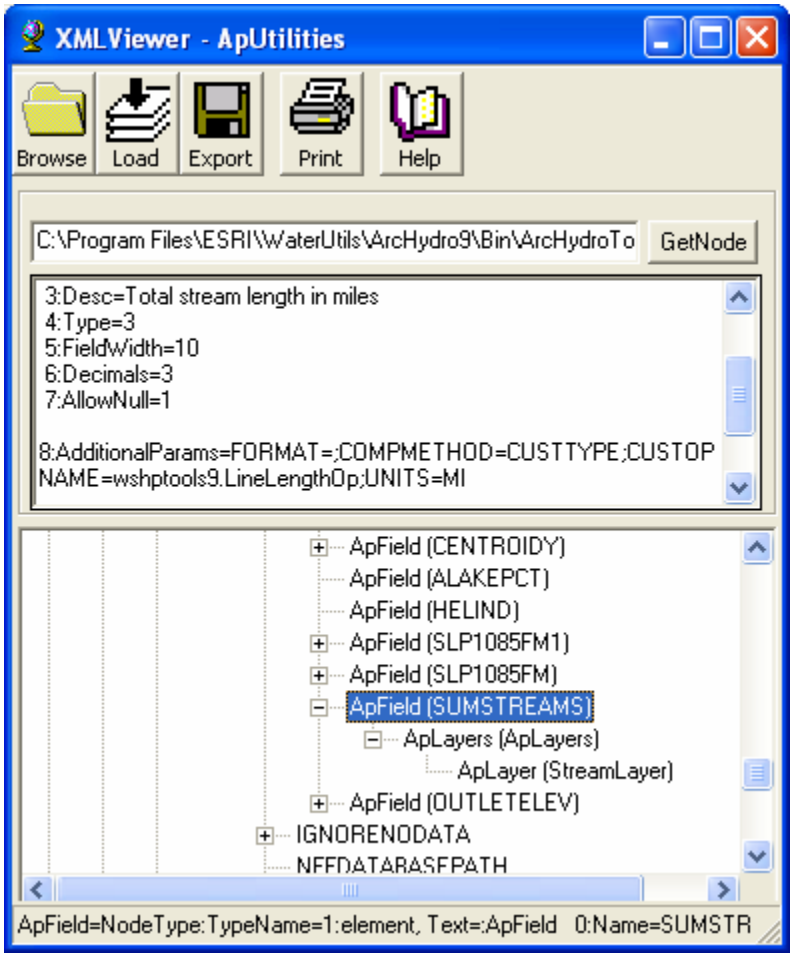


Note
The layers CULongestFlowPath and CUEdge are not required to compute the local 10-85 slope. They are used to compute the global parameter.

3.2.6 LineLengthOp

This operator computes the total length of all lines or partial lines from the specified input line layer that are within a drainage area and converts it into the specified unit. It requires as input a line feature class (e.g. Streamlayer). The tagname of the line feature class does not matter, as the function is looking only for a line feature class.

COMPMETHOD=CUSTTYPE;
CUSTOPNAME=wshptools9.LineLengthOp;
UNITS=MI

Available units are:

- KM
- M
- MI
- FT