SISTEMAS DE INFORMACIÓN GEOGRÁFICA
SIG, GIS

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alba.mtz.h@gmail.com

PARÁMETROS MORFOMÉTRICOS DE UNA CUENCA HIDROGRÁFICA CON SIG, GIS

1.| PROPIEDADES DE LA SUPERFICIE

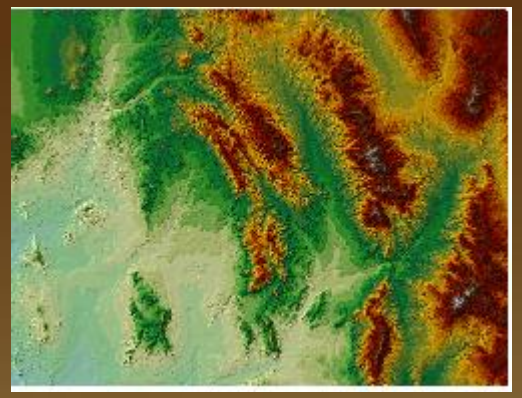
- AREA
- PERÍMETRO
- COTAS
  - MÁXIMA
  - MÍNIMA
- CENTROIDE
  - X CENTROIDE
  - Y CENTROIDE
  - Z CENTROIDE
- CURVA HIPSOMÉTRICA
- FRECUENCIA DE ALTITUDES
- ALTITUD
  - ALTITUD MEDIA
  - ALTITUD MÁS FRECUENTE
  - ALTITUD DE FRECUENCIA MEDIA
- PENDIENTE PROMEDIO

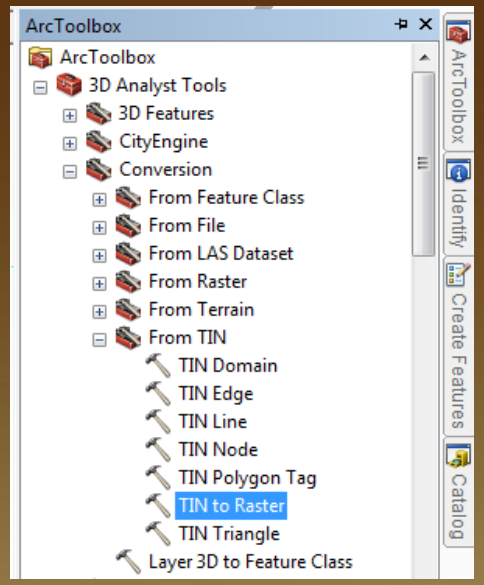
2.| Propiedades de la Red Hídrica

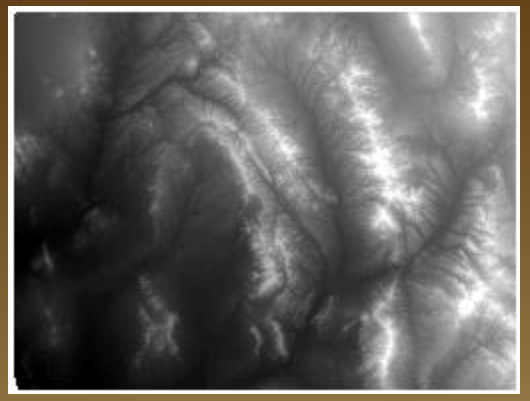
- Longitud del Curso Principal
- Orden de la Red Hídrica
- Sumatoria de las Longitudes de cada orden de la red hídrica
- Longitud Total de la red Hídrica
- Pendiente promedio de la Red Hídrica

3.| Parámetros Generados

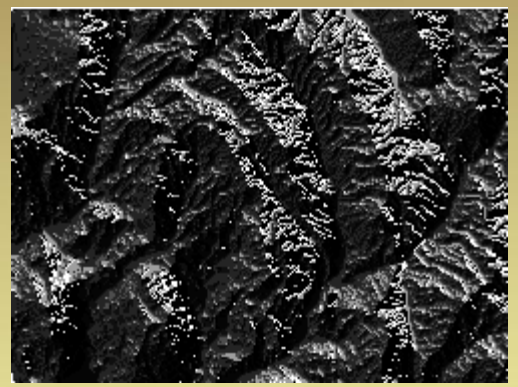
- Tiempo de Concentración
- Pendiente del cauce Principal
- ...
- ...

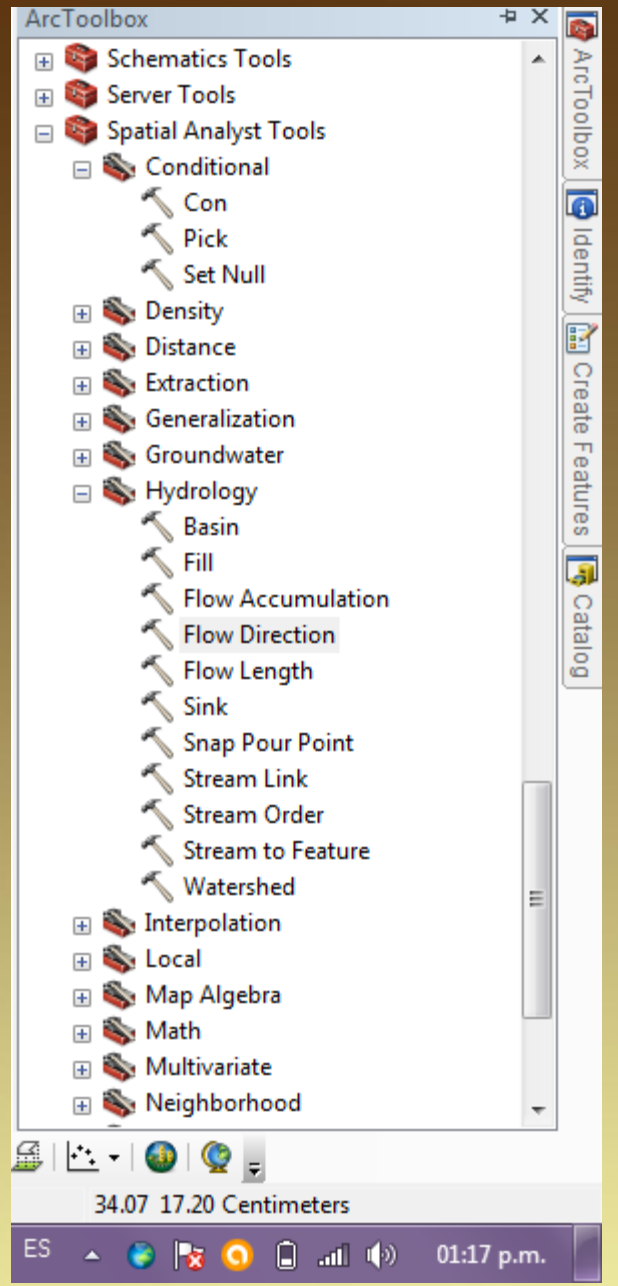


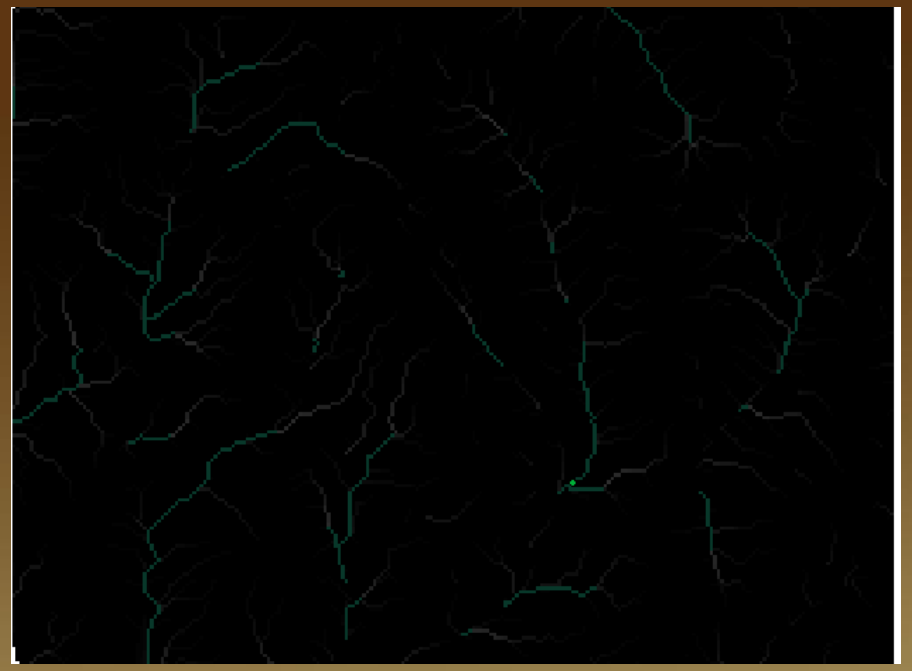


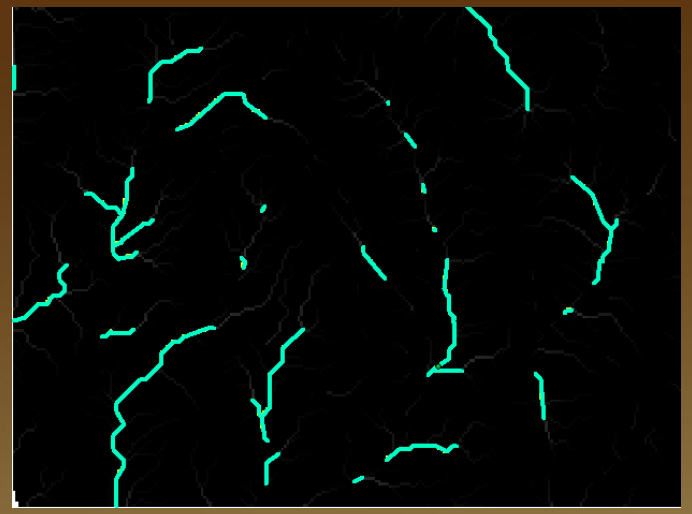


1.- TIN to Raster
2.- Spatial Analyst Tools_Hydrology
3.- Al Raster sacarle el Flow Direction
4.- Después Flow Accumulation





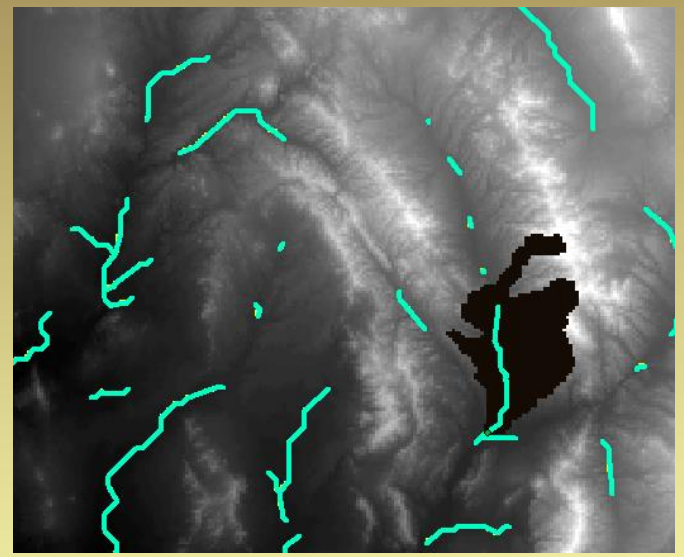


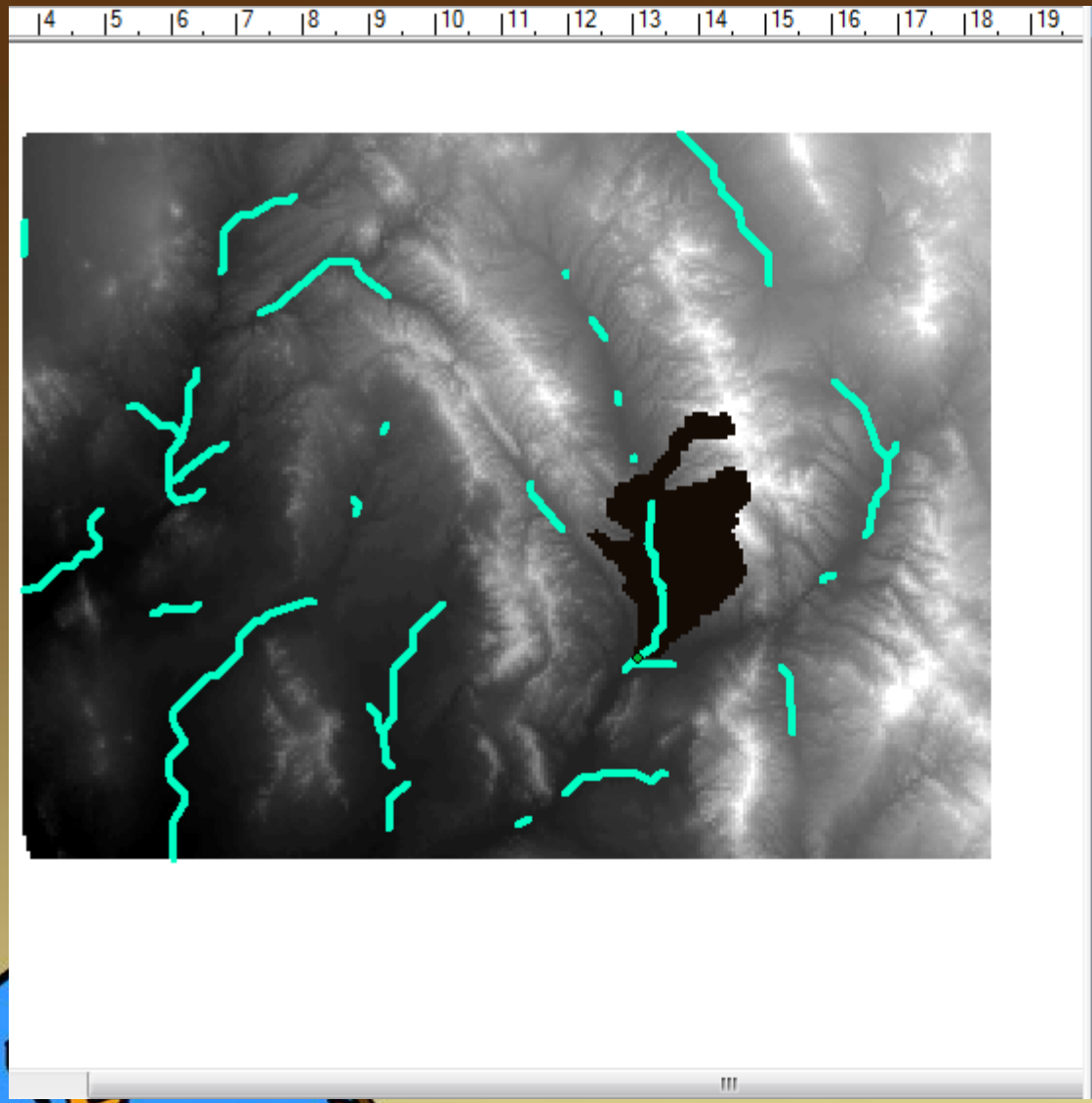


5.- Crea el punto de desfogue de la cuenca
6.- Usa Interpolate Shape para darle el valor de Z a ese punto
7.- Ponle una condicionante con la herramienta Con

8.- Te da como resultado las escorrentías desde el TIN
9.- Convierte las escorrentías en un Elemento (Feature), obvio que con su condicionante y la dirección de su flujo
10.- Utiliza watershed con las dirección de flujo_lleno y el punto interpolado desde el TIN
11.- OK

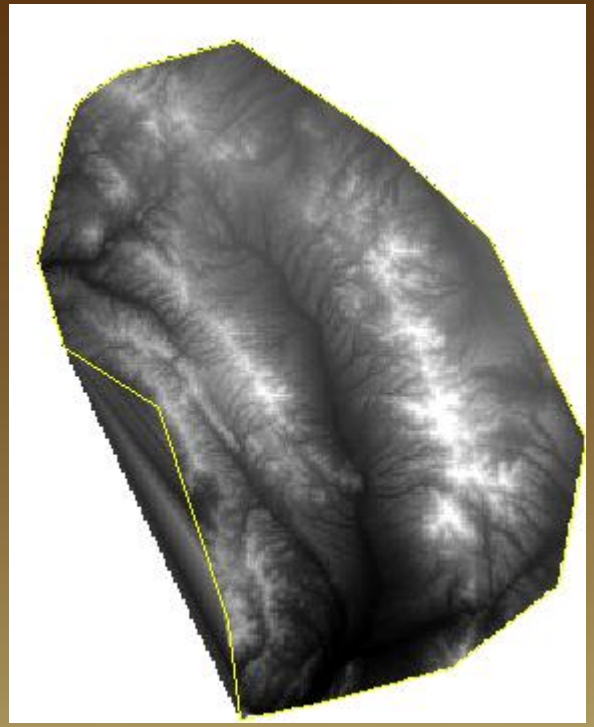
Delimita automáticamente
la cuenca hidrográfica de ese TIN

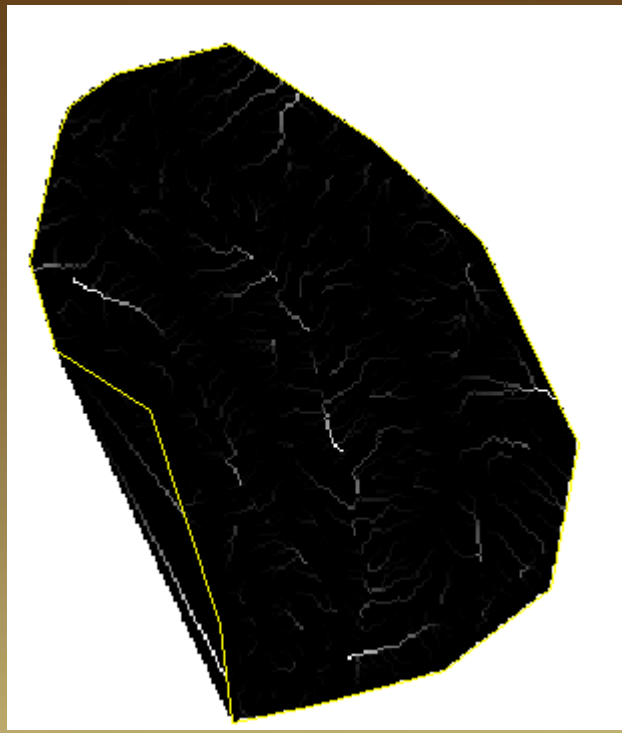


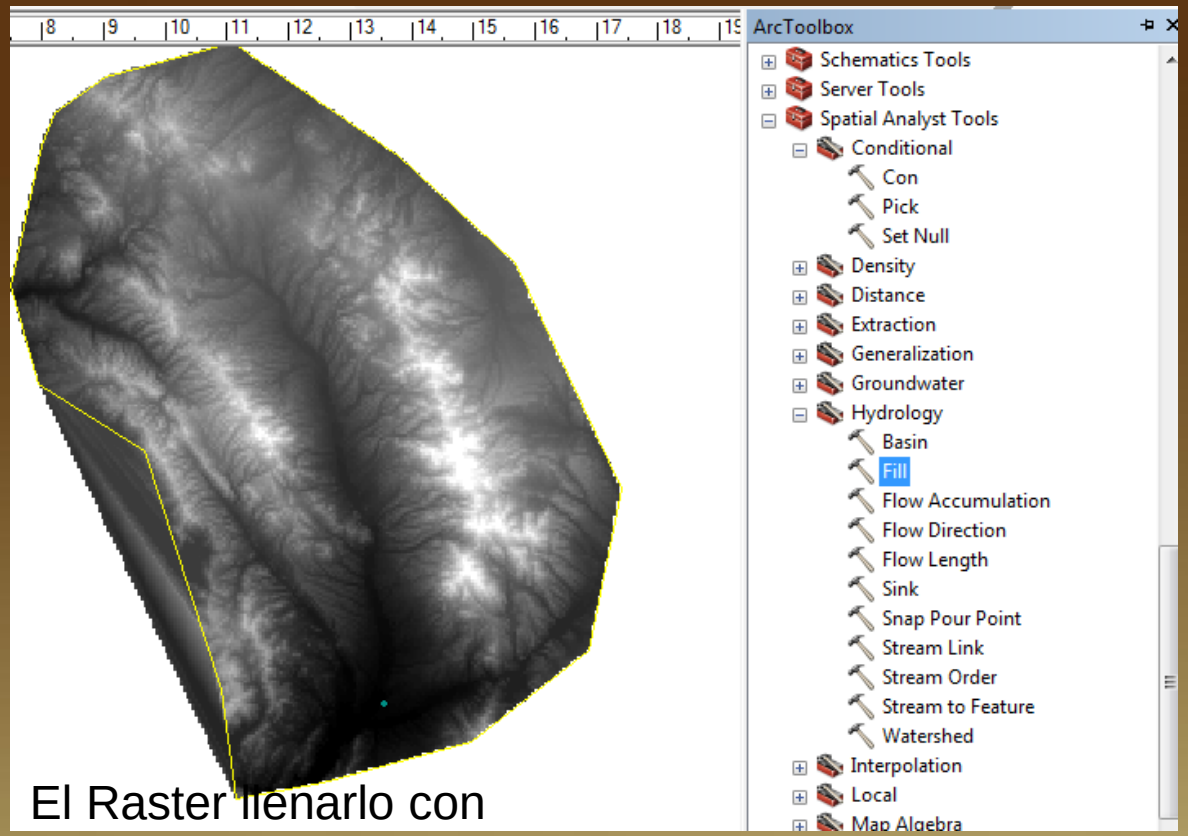


ArcToolbox

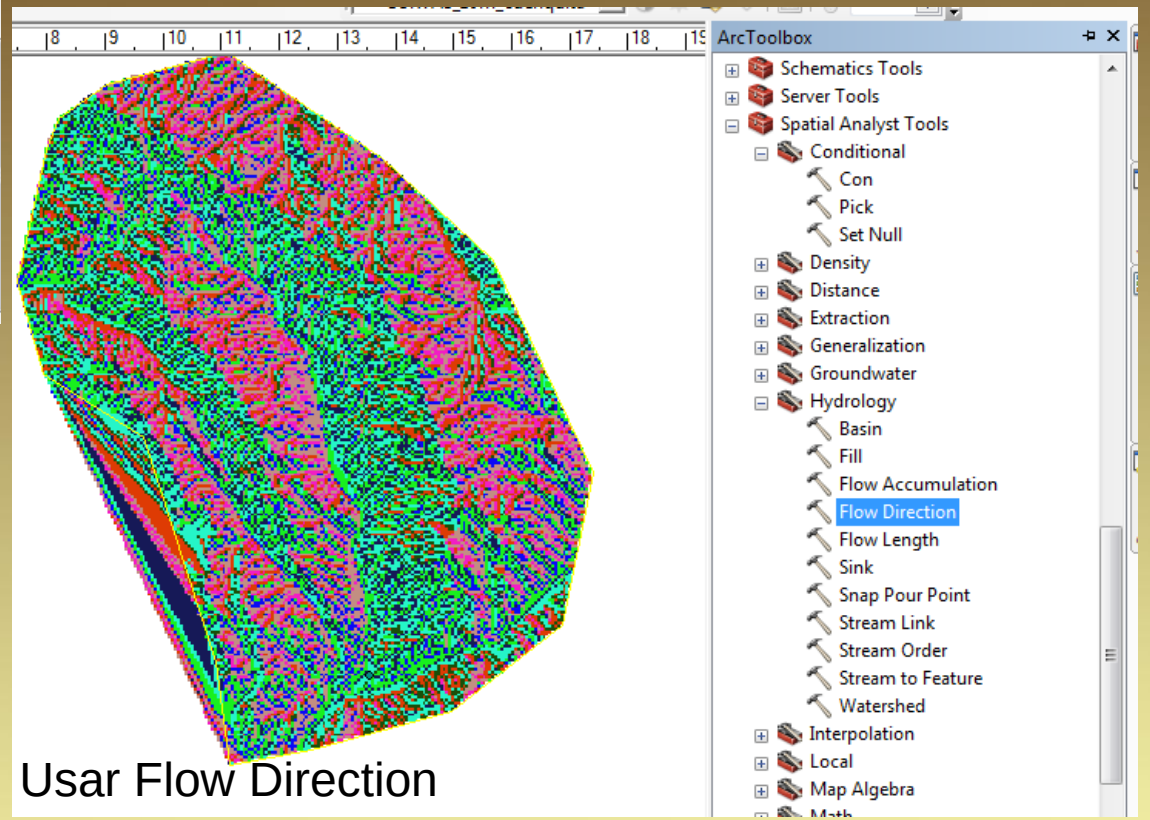
- From File
- From LAS Dataset
- From Raster
- From Terrain
- From TIN
  - TIN Domain
  - TIN Edge
  - TIN Line
  - TIN Node
  - TIN Polygon Tag
  - TIN to Raster
  - TIN Triangle
- Layer 3D to Feature Class
- Data Management
  - LAS Dataset
  - Terrain Dataset
  - TIN
    - Copy TIN
    - Create TIN
    - Delineate TIN Data Area
    - Edit TIN
- Functional Surface
  - Add Surface Information
  - Interpolate Shape
  - Intersect 3D Line With Surface
  - Stack Profile
  - Surface Volume
- Raster Interpolation
- Raster Math
- Raster Reclass



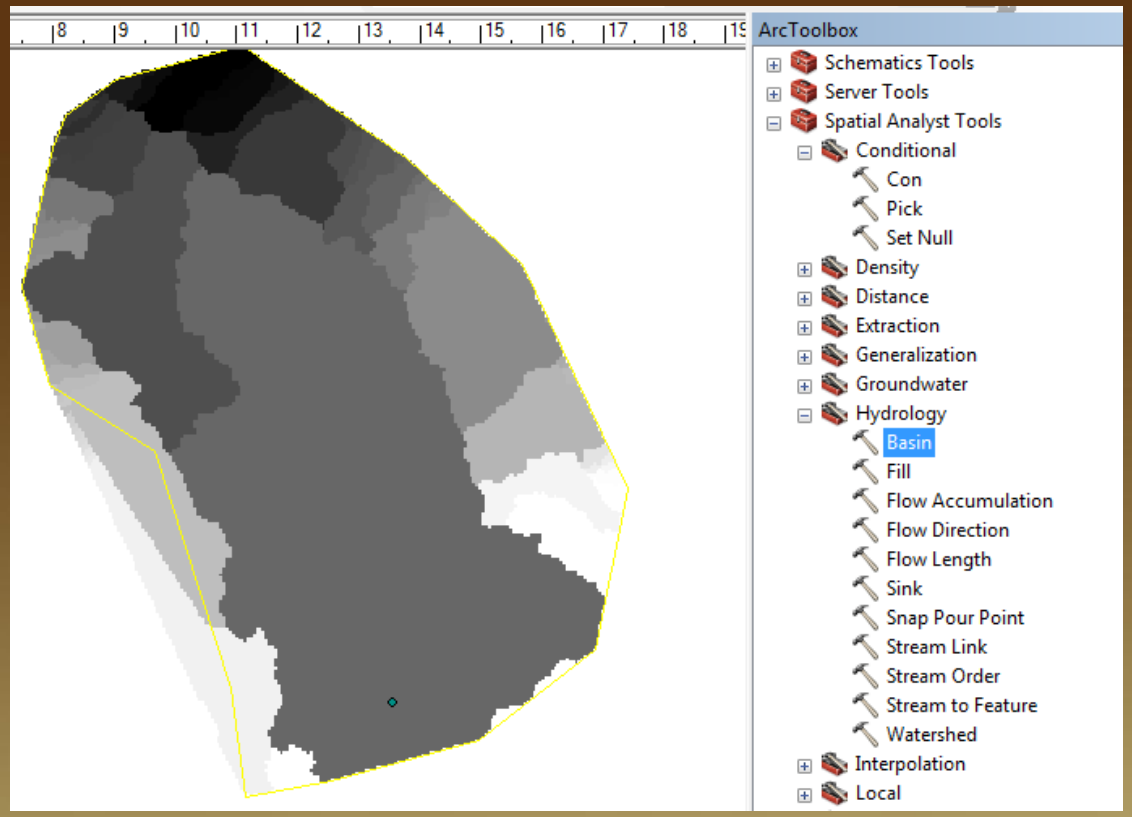




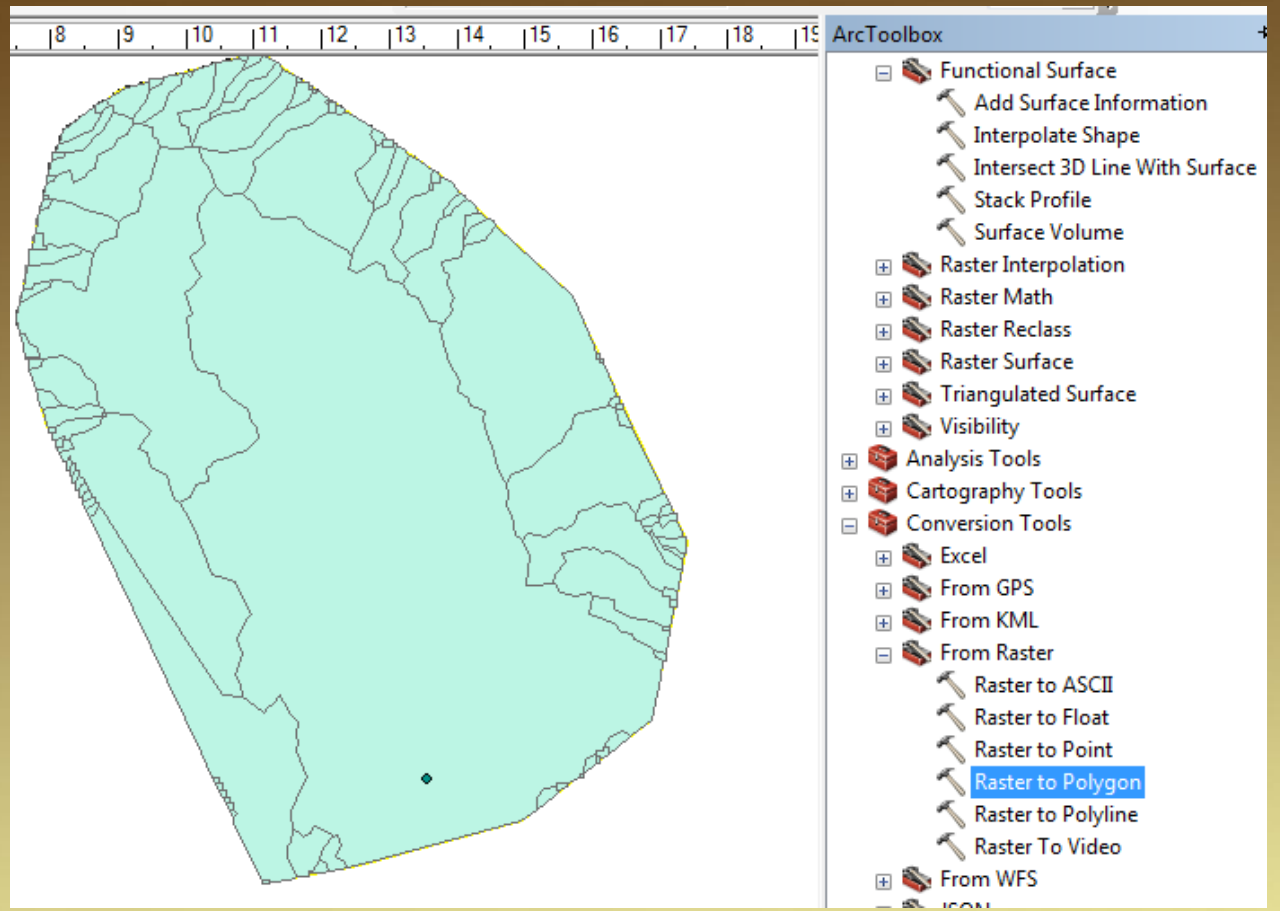
El Raster llenarlo con HYDROLOGY/FILL



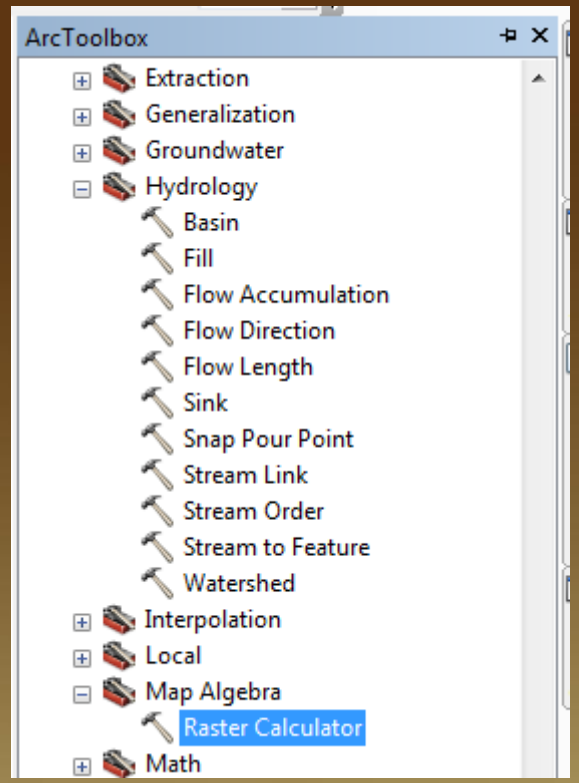
Usar Flow Direction

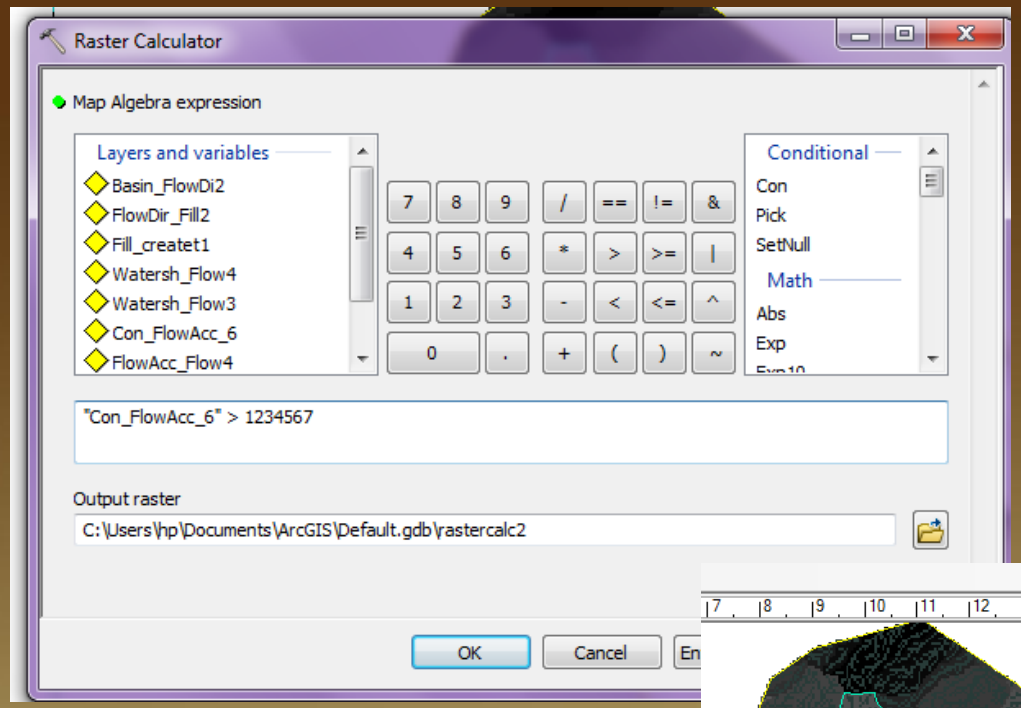


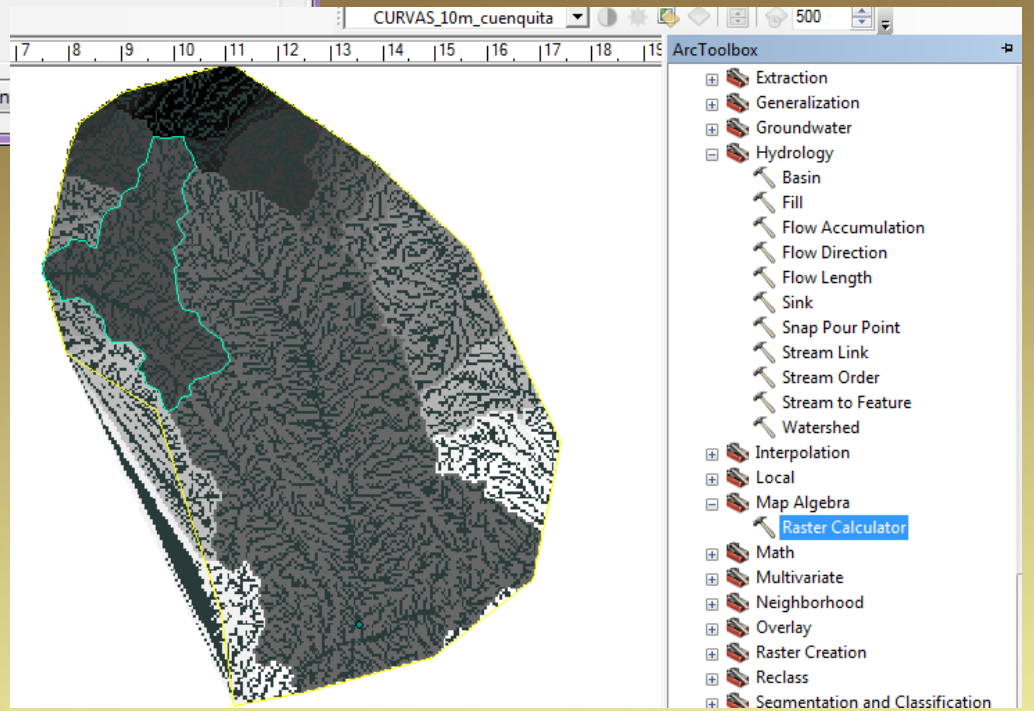
Usar Basin con el Flow Direction anterior



Convertir el Raster de Basin a polígono
Con Convertion tools

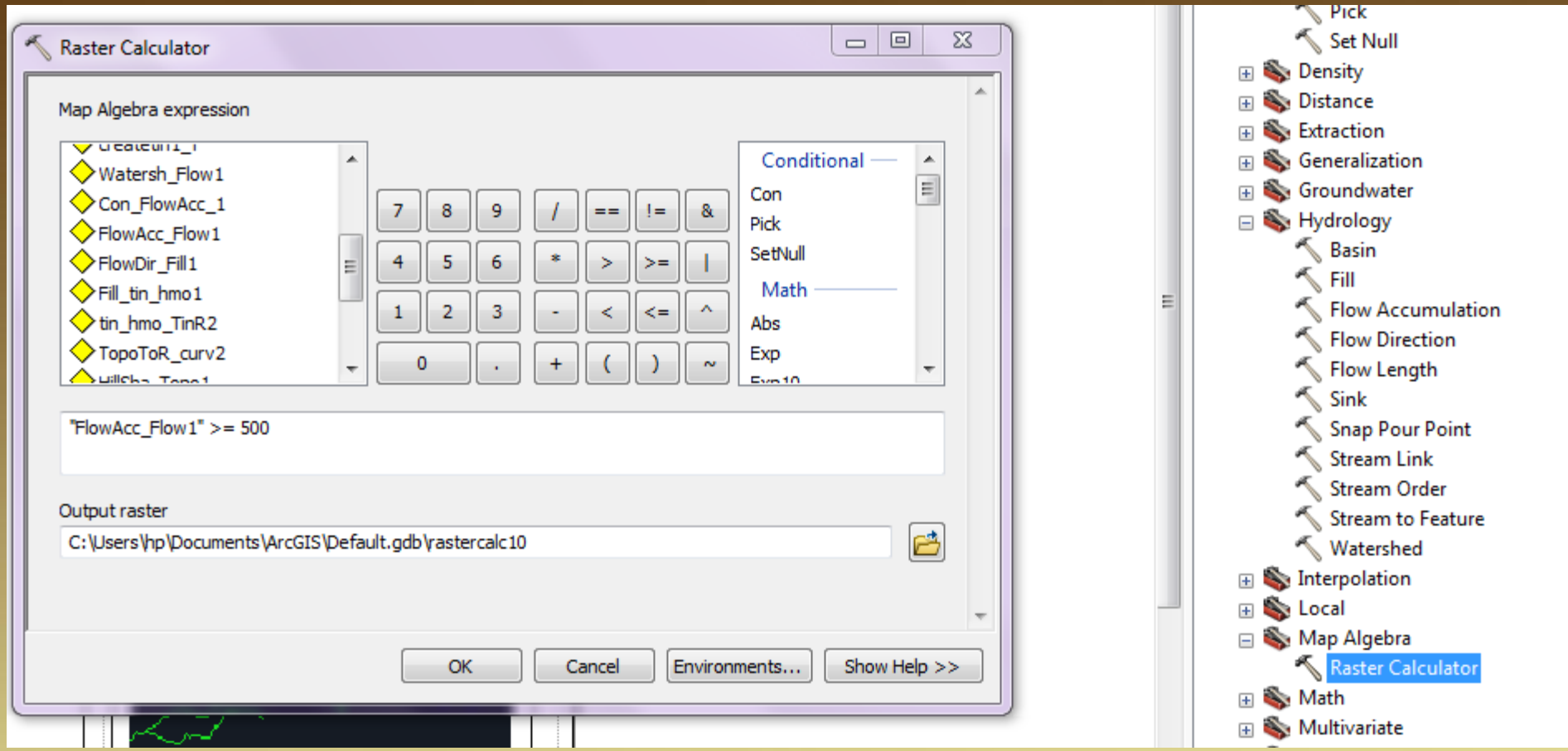


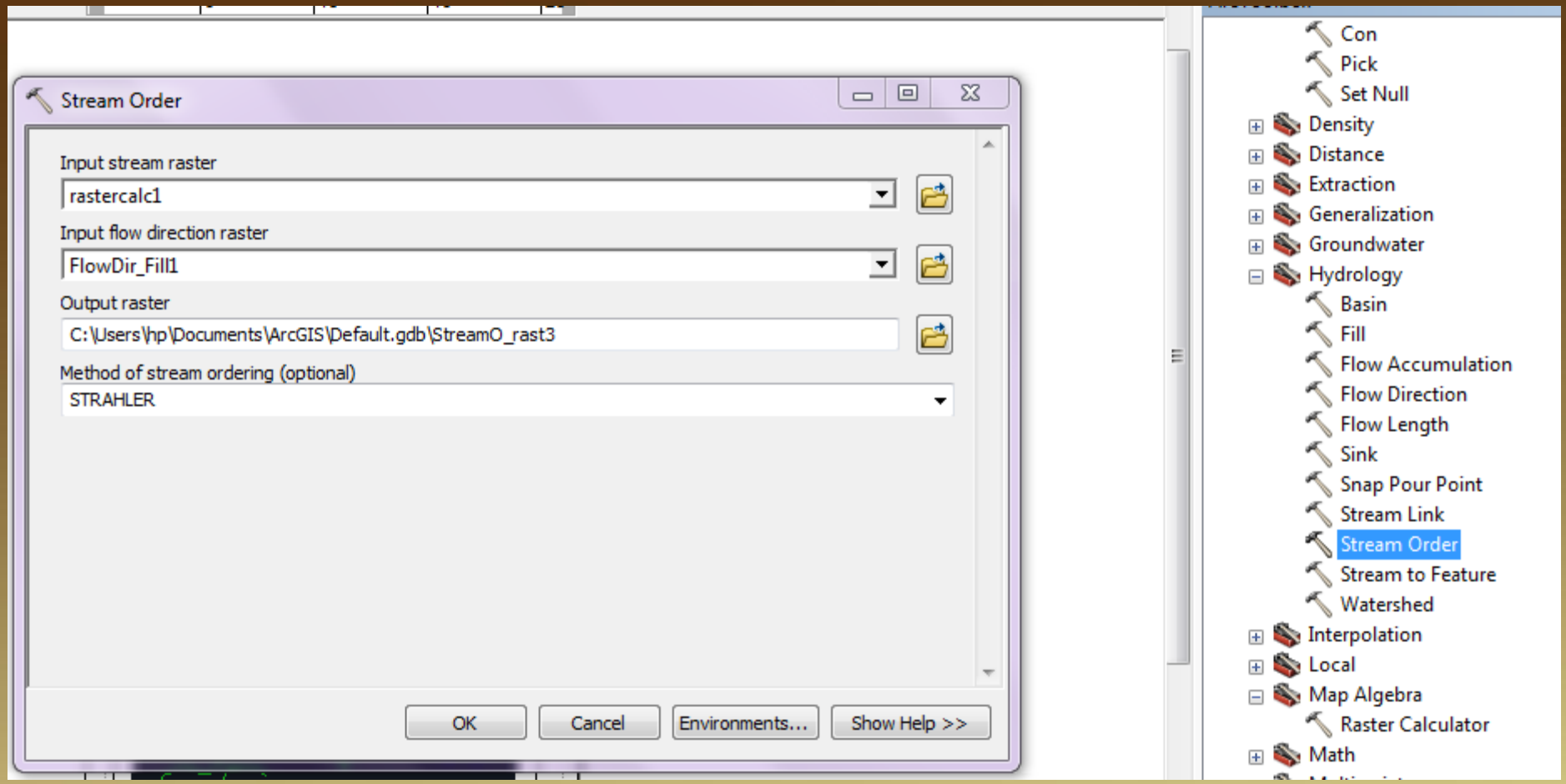


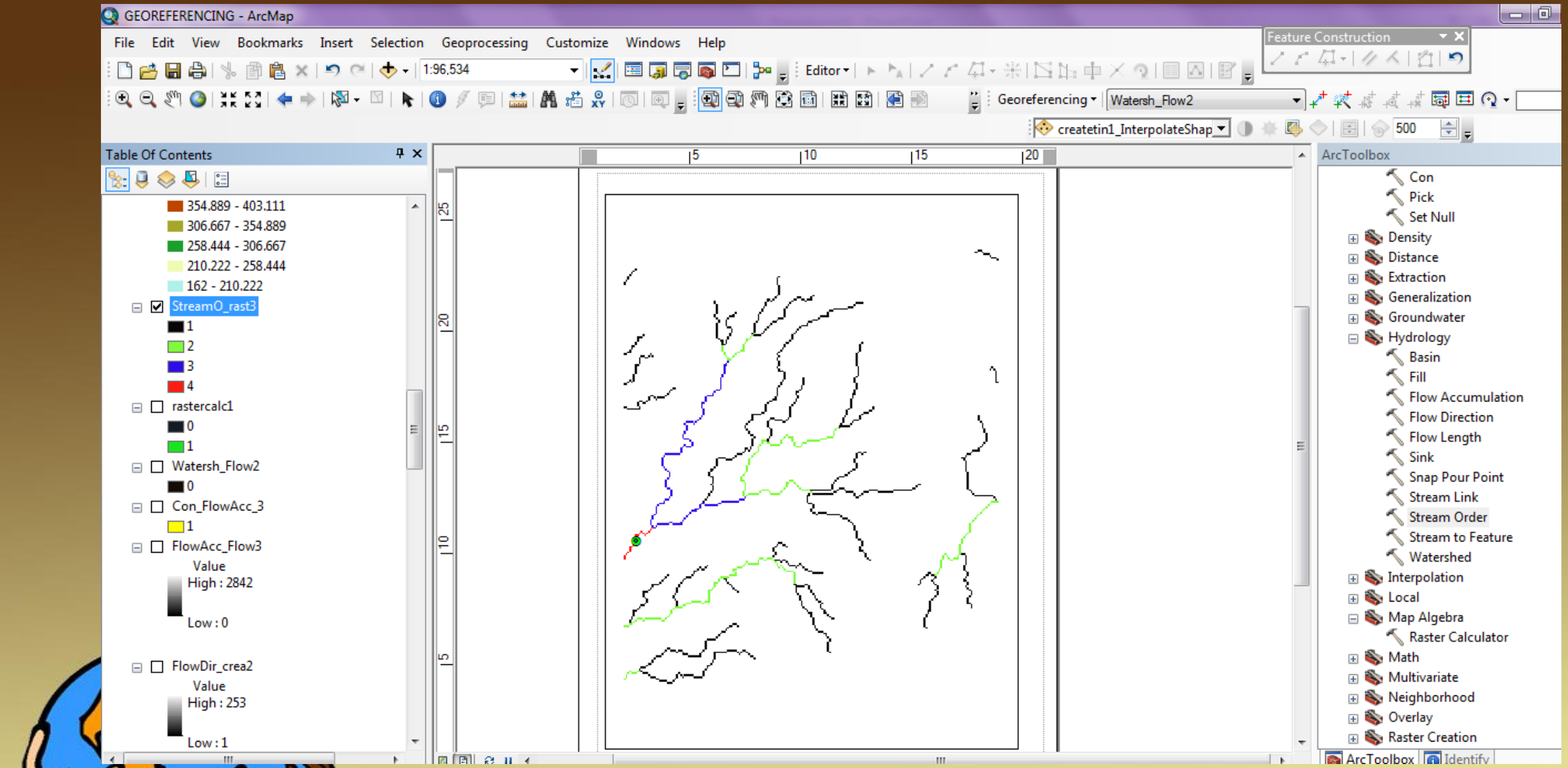


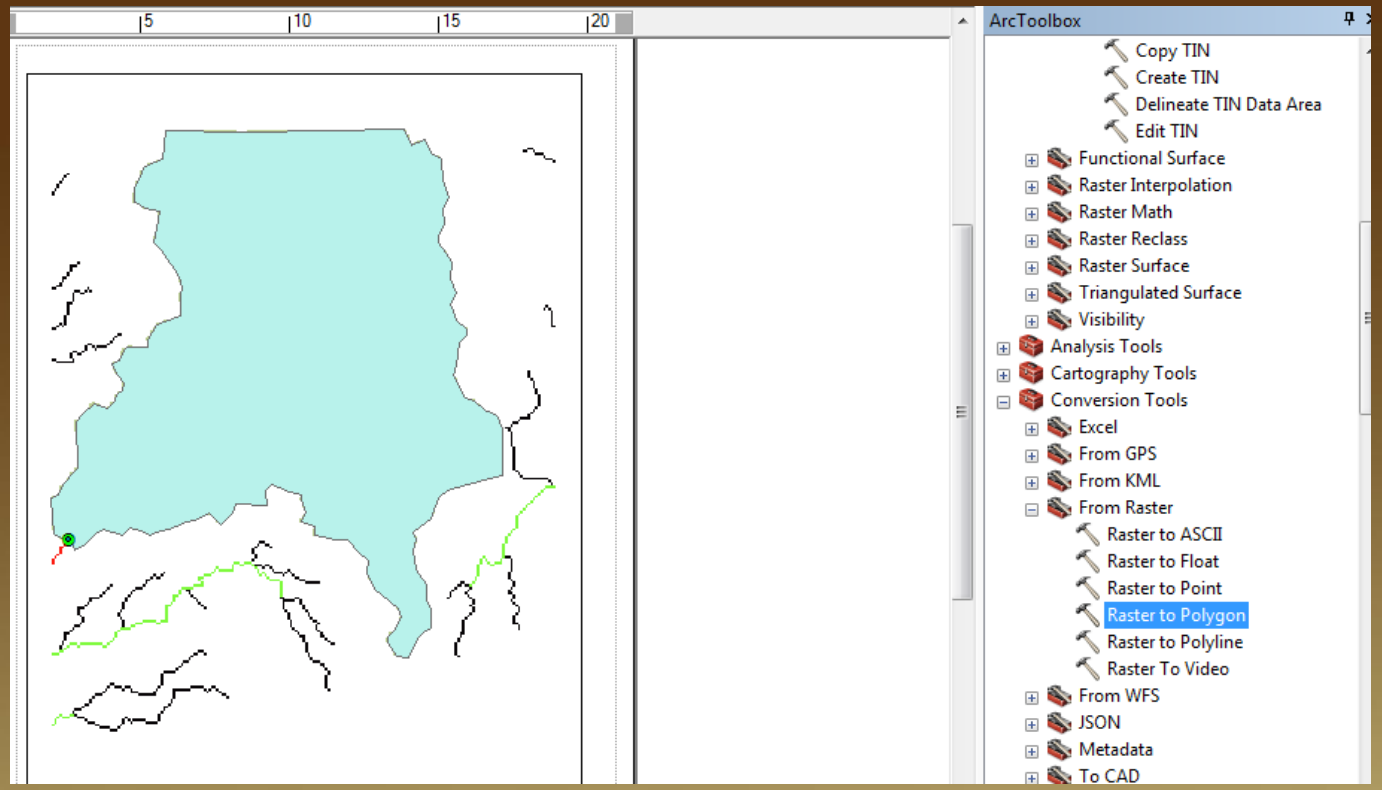
Definir la red hidrográfica primaria con Map Algebra para el Flow accumulation original

Condiciónalo a valores superiores al millón (1234567) y se despliega la red principal



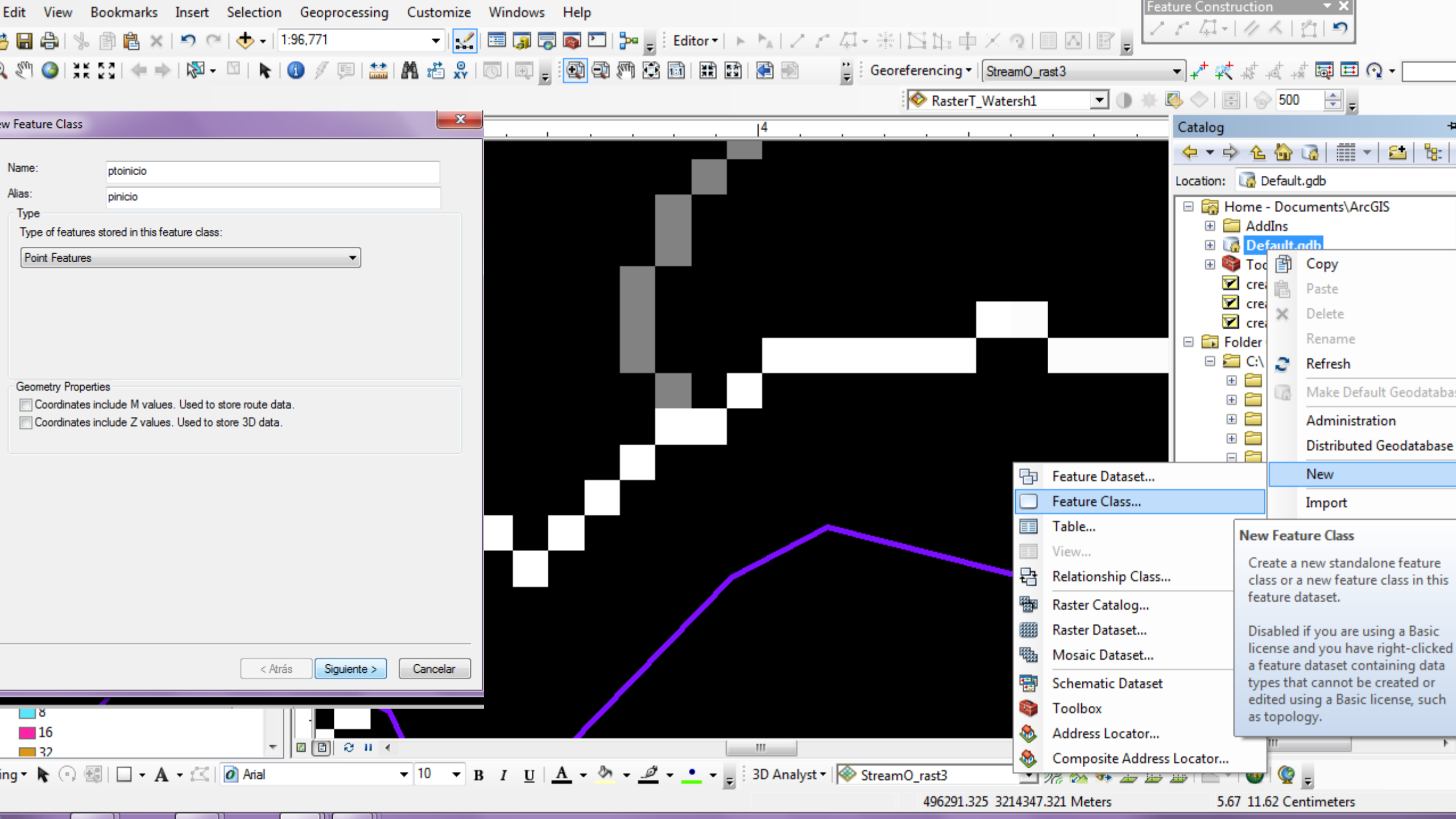


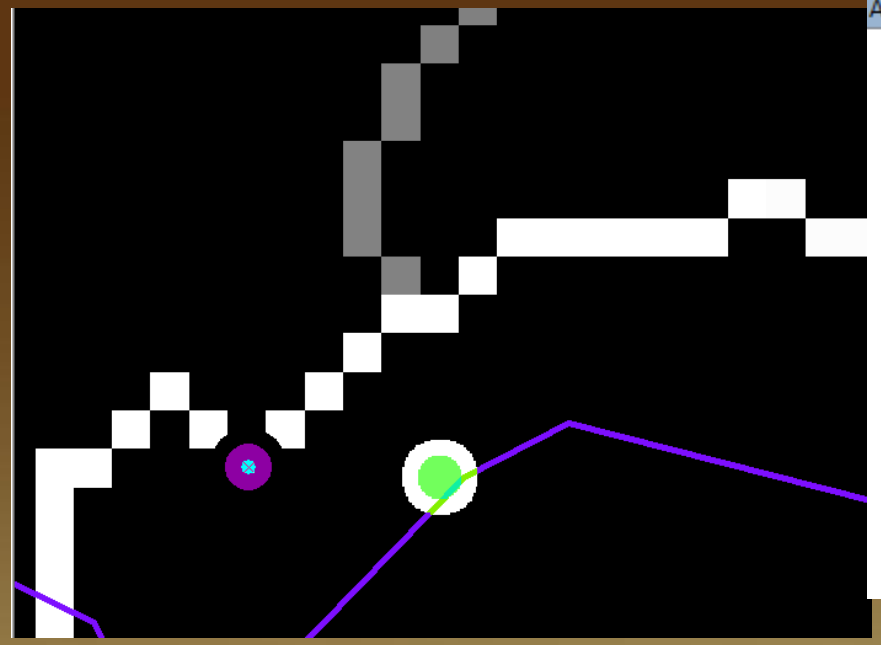


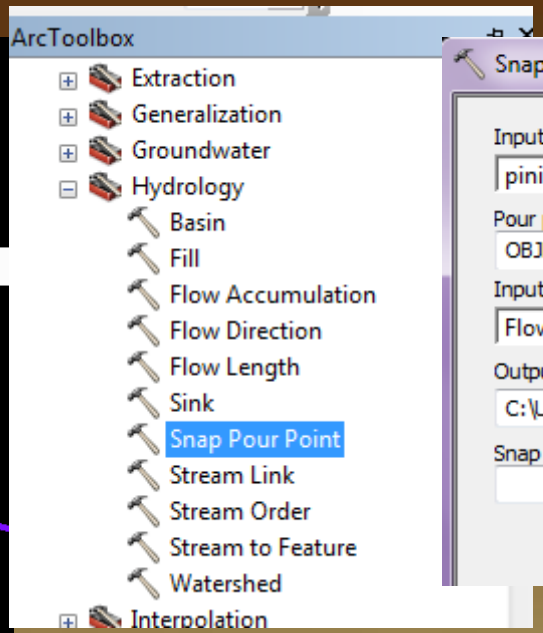


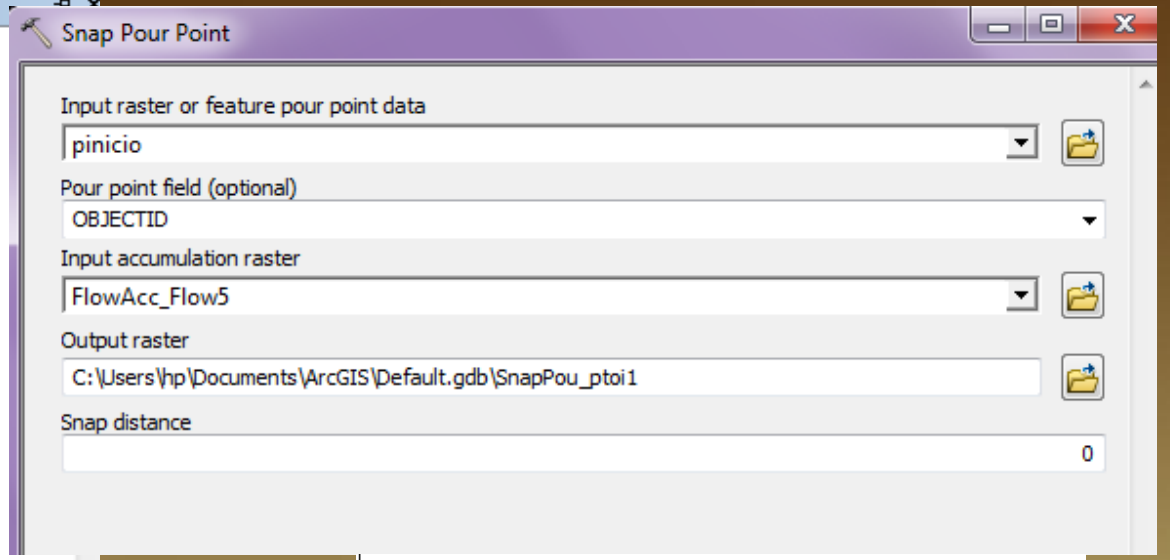
ArcToolbox

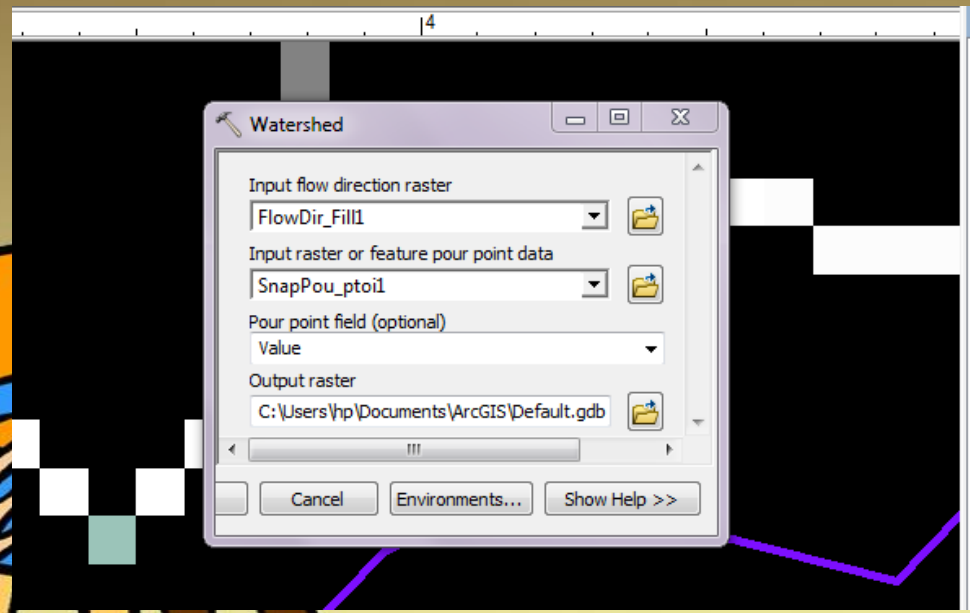
- Copy TIN
- Create TIN
- Delineate TIN Data Area
- Edit TIN
- Functional Surface
- Raster Interpolation
- Raster Math
- Raster Reclass
- Raster Surface
- Triangulated Surface
- Visibility
- Analysis Tools
- Cartography Tools
- Conversion Tools
  - Excel
  - From GPS
  - From KML
  - From Raster
    - Raster to ASCII
    - Raster to Float
    - Raster to Point
    - Raster to Polygon
    - Raster to Polyline
    - Raster To Video
  - From WFS
  - JSON
  - Metadata
  - To CAD

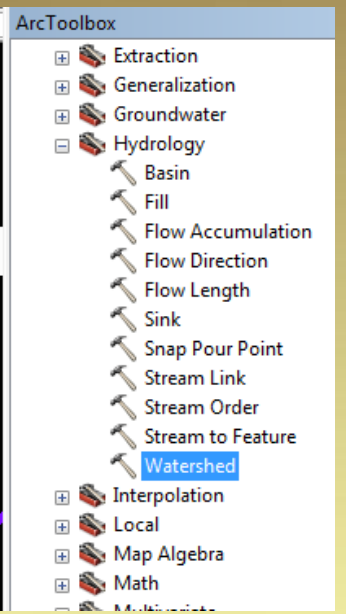

Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:96,771
Editor
Georeferencing
StreamO_rast3
RasterT_Watersh1
500
Feature Construction
ew Feature Class
Name:
ptoinicio
Alias:
pinicio
Type
Type of features stored in this feature class:
Point Features
Geometry Properties
Coordinates include M values. Used to store route data.
Coordinates include Z values. Used to store 3D data.
< Atrás
Siguiente >
Cancelar
Catalog
Location:
Default.gdb
Home - Documents\ArcGIS
AddIns
Default.gdb
Folder
C:\
Copy
Paste
Delete
Rename
Refresh
Make Default Geodatabase
Administration
Distributed Geodatabase
New
Import
Feature Dataset...
Feature Class...
Table...
View...
Relationship Class...
Raster Catalog...
Raster Dataset...
Mosaic Dataset...
Schematic Dataset
Toolbox
Address Locator...
Composite Address Locator...
New Feature Class
Create a new standalone feature class or a new feature class in this feature dataset.
Disabled if you are using a Basic license and you have right-clicked a feature dataset containing data types that cannot be created or edited using a Basic license, such as topology.
8
16
32
Arial
10
3D Analyst
StreamO_rast3
496291.325 3214347.321 Meters
5.67 11.62 Centimeters

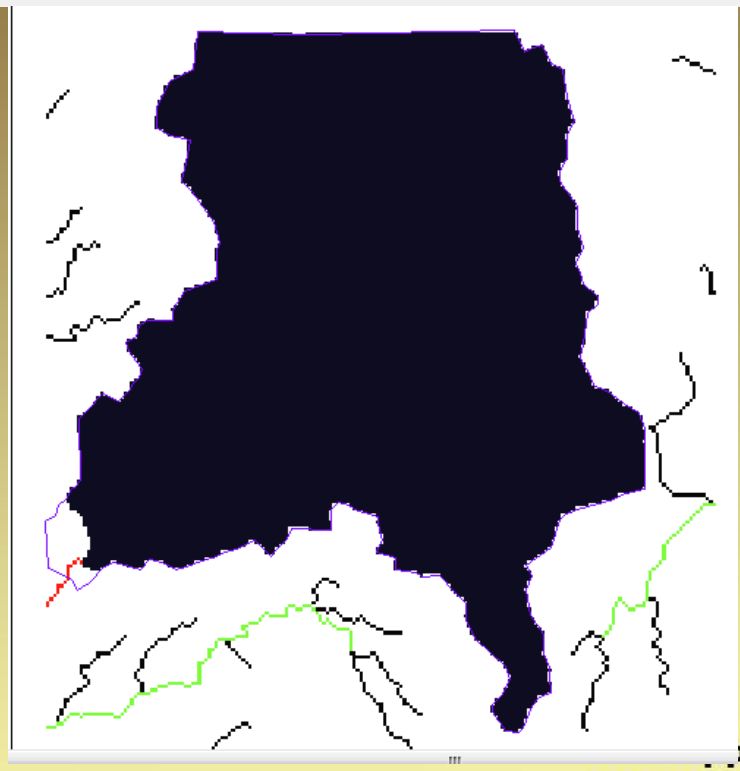


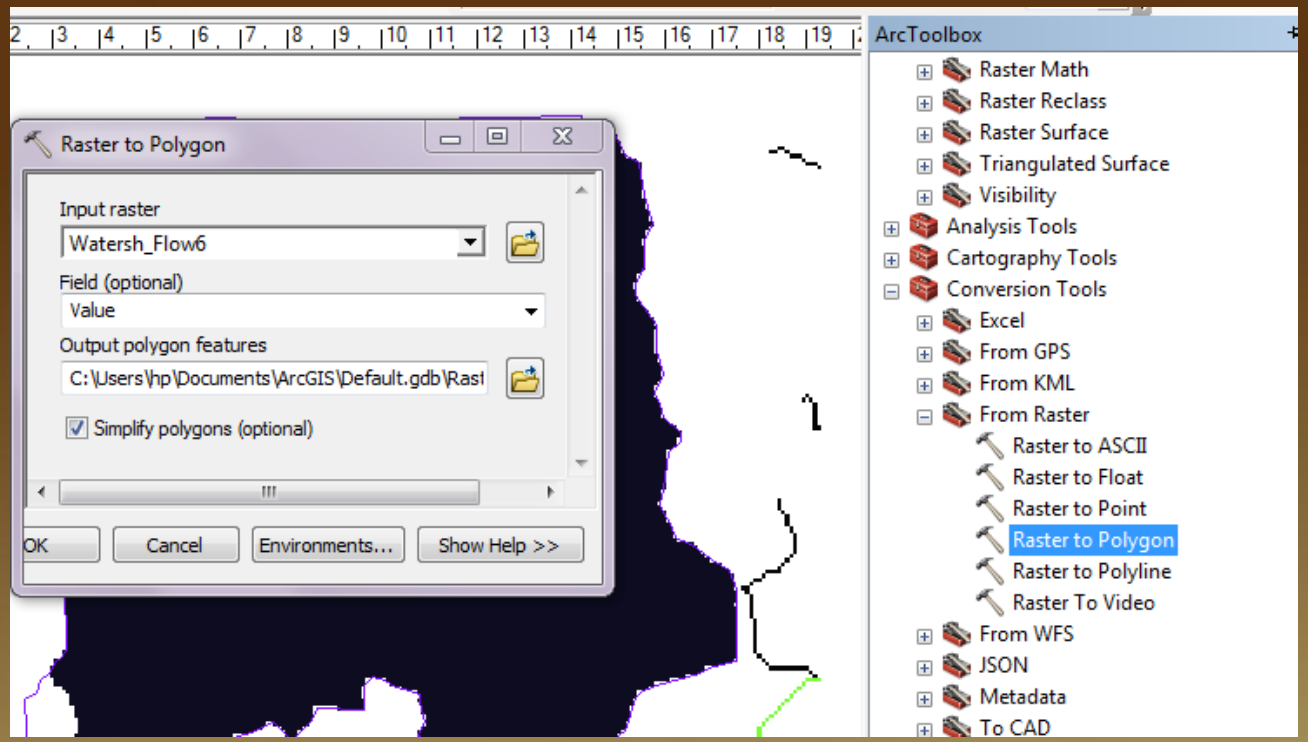

ArcToolbox
Extraction
Generalization
Groundwater
Hydrology
Basin
Fill
Flow Accumulation
Flow Direction
Flow Length
Sink
Snap Pour Point
Stream Link
Stream Order
Stream to Feature
Watershed
Interpolation

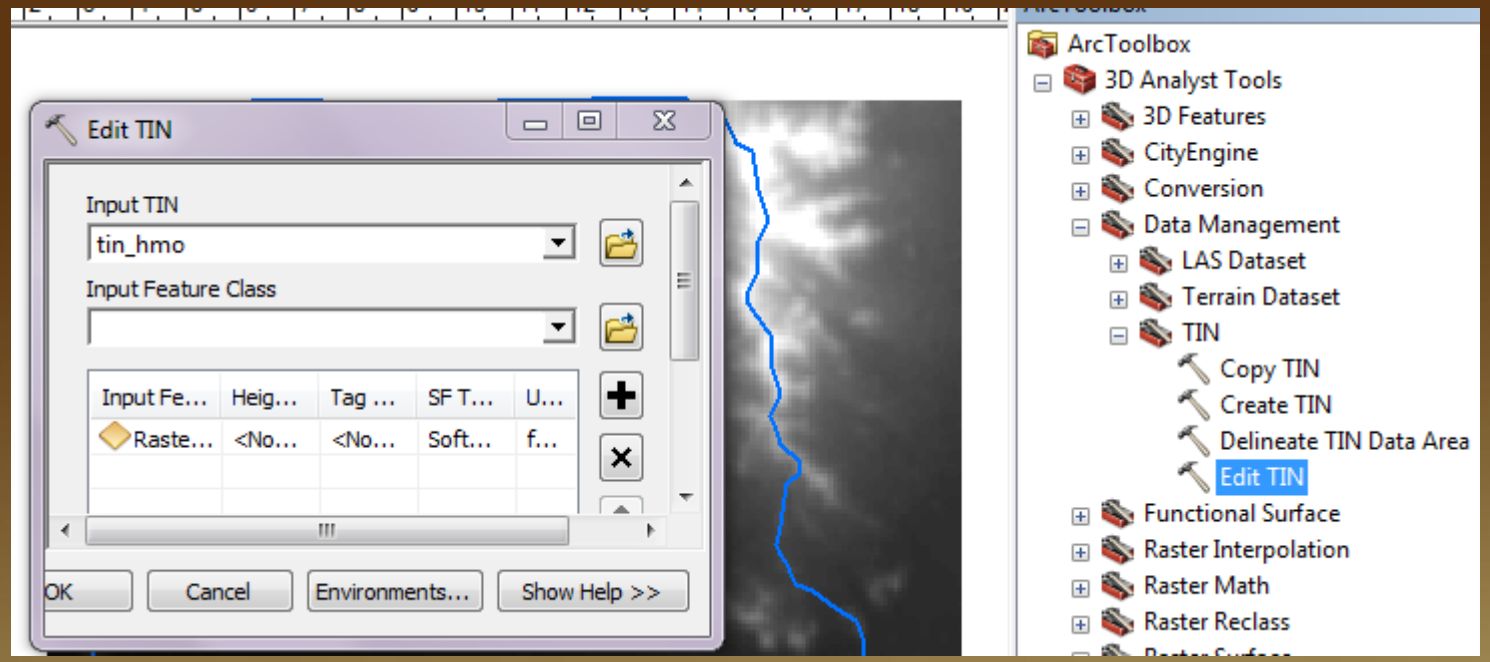

Snap Pour Point
Input raster or feature pour point data
pinicio
Pour point field (optional)
OBJECTID
Input accumulation raster
FlowAcc_Flow5
Output raster
C:\Users\hp\Documents\ArcGIS\Default.gdb\SnapPou_ptoi1
Snap distance
0


Watershed
Input flow direction raster
FlowDir_Fill1
Input raster or feature pour point data
SnapPou_ptoi1
Pour point field (optional)
Value
Output raster
C:\Users\hp\Documents\ArcGIS\Default.gdb
Cancel
Environments...
Show Help >>

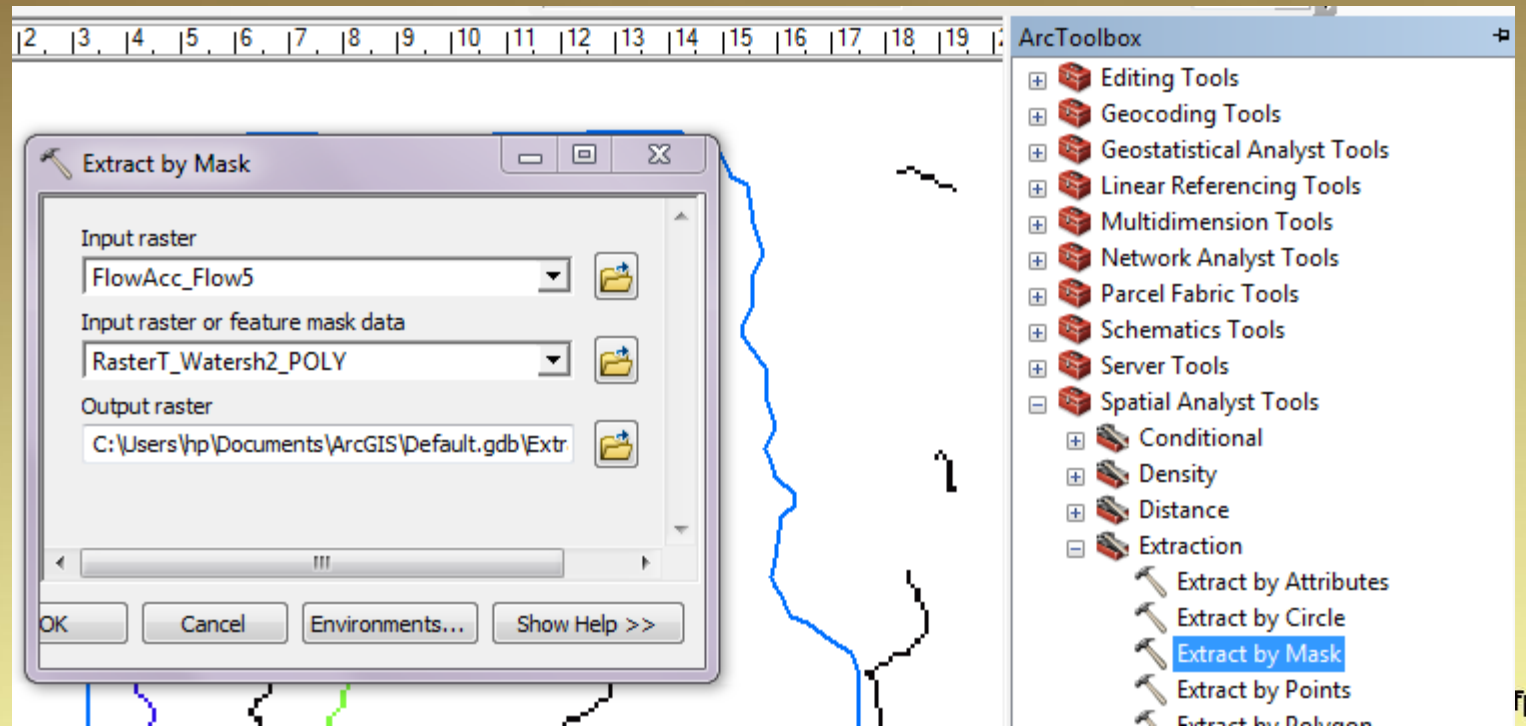

ArcToolbox
Extraction
Generalization
Groundwater
Hydrology
Basin
Fill
Flow Accumulation
Flow Direction
Flow Length
Sink
Snap Pour Point
Stream Link
Stream Order
Stream to Feature
Watershed
Interpolation
Local
Map Algebra
Math







Todo cortarlo al tamaño de la cuenca
-Editar el TIN
-cortar FlowDir
-Cortar FlorAcc



Layers
- pinicio
- StreamT_StreamO2
- RasterT_Watersh2_POLY
- RasterT_Watersh1
- tin_hmo
- Extract_Flow3_DIR
  - 1
  - 2
  - 4
  - 8
  - 16
  - 32
  - 64
  - 128
- Extract_Flow2_ACC
  - Value
  - High : 20875
  - Low : 0

Table

RasterT_Watersh2_POLY

OBJECTID *	Shape *	Id	gridcode
1	Polygon	1	1

1

RasterT_Watersh2_POLY

Add Field

Name: AREA1

Type: Double

Field Properties

Alias	
Allow NULL Values	Yes
Default Value	

OK Cancel

Table

RasterT_Watersh2_POLY

OBJECTID *	Shape *	Id	gridcode	Shape_Length	Shape_Area	AREA1
1	Polygon	1	1	63470.549818	140557305.110395	<Null>

0 (0 out of 1 Selected)

RasterT_Watersh2_POLY

Sort Ascending
Sort Descending
Advanced Sorting...
Summarize...
Statistics...
Field Calculator...
Calculate Geometry...
Turn Field Off
Freeze/Unfreeze Column
Delete Field
Properties...

Calculate Geometry

Populate or update the values of this field to be geometric values derived from the features that the table represents, such as area, perimeter, length, etc. The dialog that appears lets you choose whether all the records will be calculated or just the selected records. This command is disabled if the table is not the attribute table of a feature class or

Table

RasterT_Watersh2_POLY

OBJECTID *	Shape *	Id
1	Polygon	1

Calculate Geometry

Property: Area

Coordinate System

Use coordinate system of the data source:

PCS: WGS 1984 UTM Zone 12N

Use coordinate system of the data frame:

PCS: WGS 1984 UTM Zone 12N

Units: Square Kilometers [sq km]

- Acres US [ac]
- Ares [a]
- Hectares [ha]
- Square Decimeters [sq dm]
- Square Feet US [sq ft]
- Square Kilometers [sq km]
- Square Meters [sq m]
- Square Miles US [sq mi]

Calculate select

About calculating g

0

RasterT_Watersh2_POLY

Calculate Geometry

Property: Area

- Area
- Perimeter
- X Coordinate of Centroid
- Y Coordinate of Centroid

Coordinate Syste

Use coordinate

PCS: WGS 1984 UTM Zone 12N

Use coordinate system of the data frame:

PCS: WGS 1984 UTM Zone 12N

Units: Square Meters [sq m]

Calculate selected records only

About calculating geometry

OK Cancel

Table

RasterT_Watersh2_POLY

OBJECTID *	Shape *	Id	gridcode	Shape_Length	Shape_Area	AREA1
1	Polygon	1	1	63470.549818	140557305.110395	140.557305

0 (0 out of 1 Selected)

RasterT_Watersh2_POLY

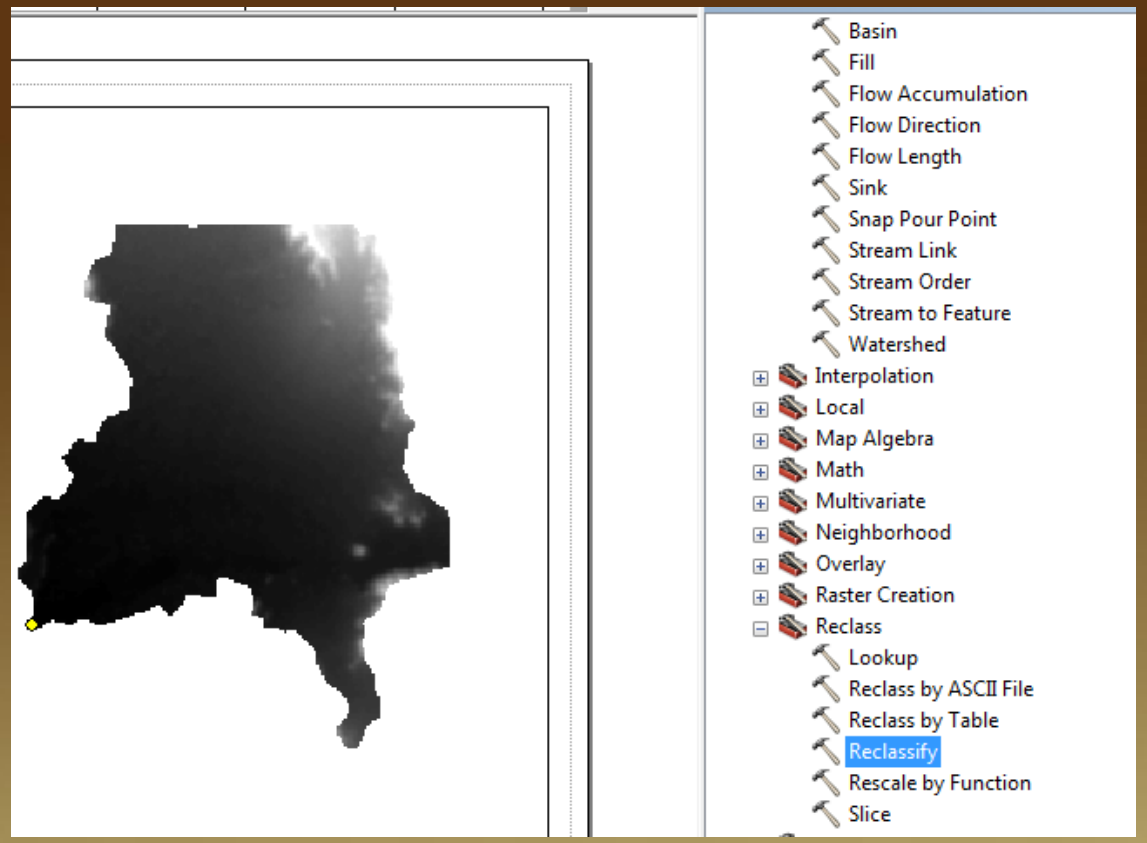
Table

RasterT_Watersh2_POLY

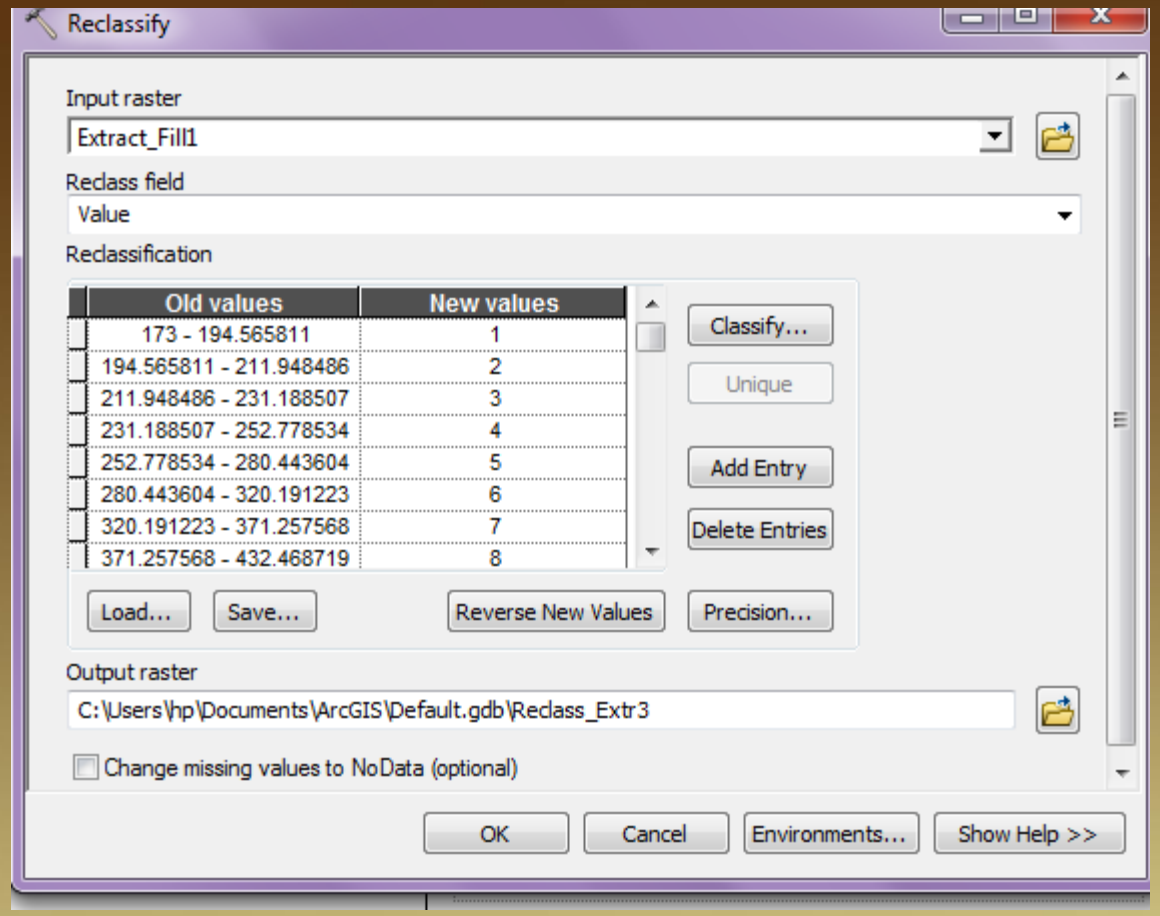
	gridcode	Shape_Length	Shape_Area	AREA1	PERIMETRO1	CENTROID_X	CENTROID_Y
▶	1	63470.549818	140557305.110395	140.557305	63.47055	501	3219544.748407

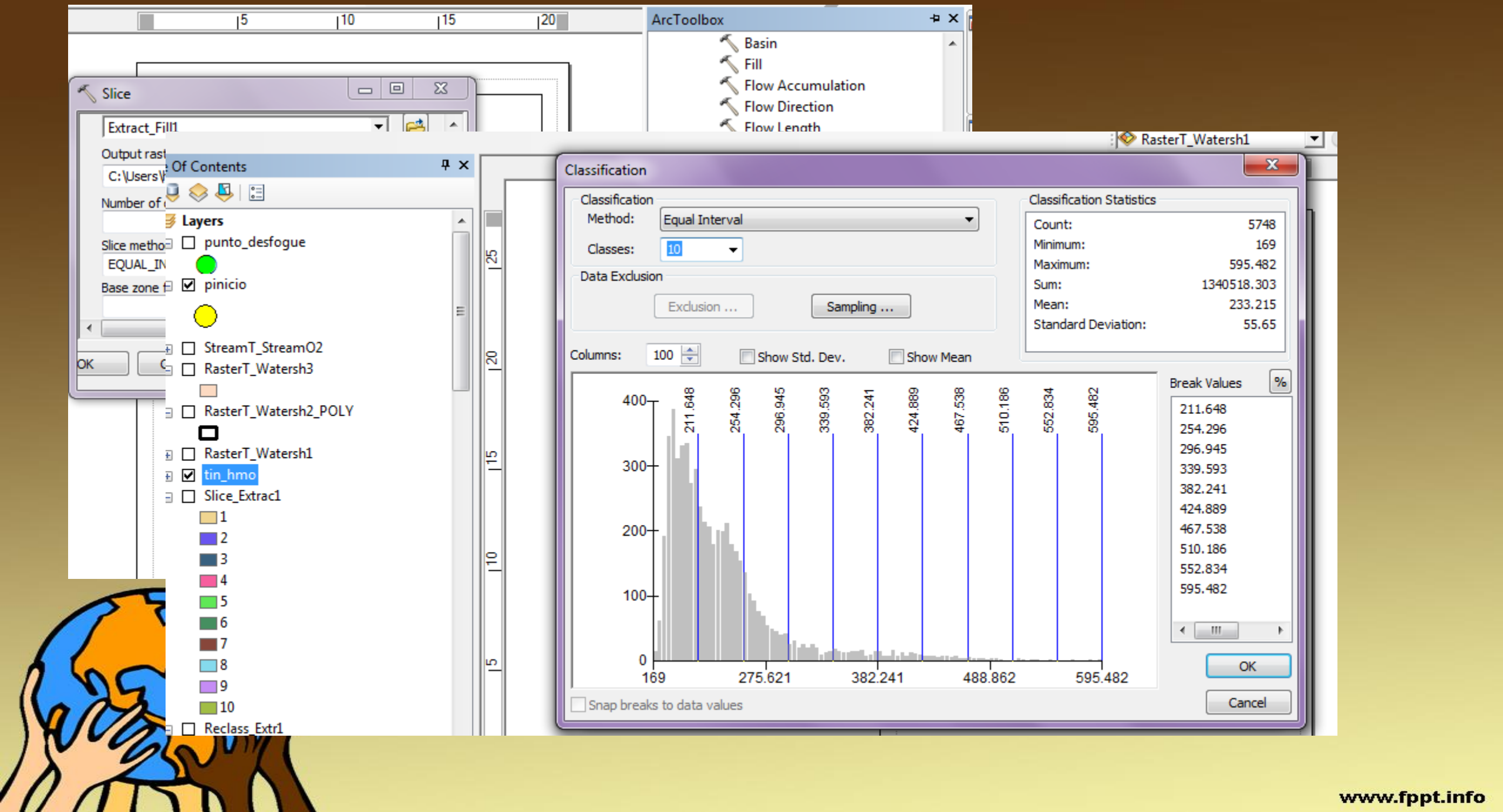
1 (0 out of 1 Selected)

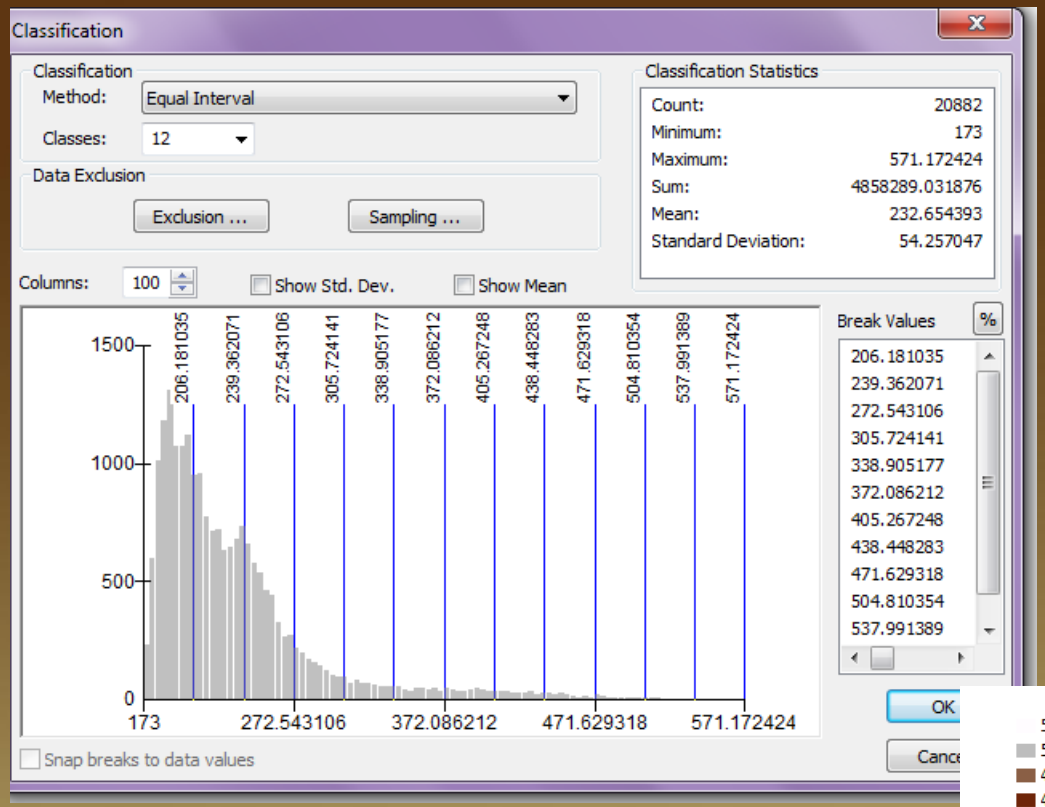
RasterT_Watersh2_POLY

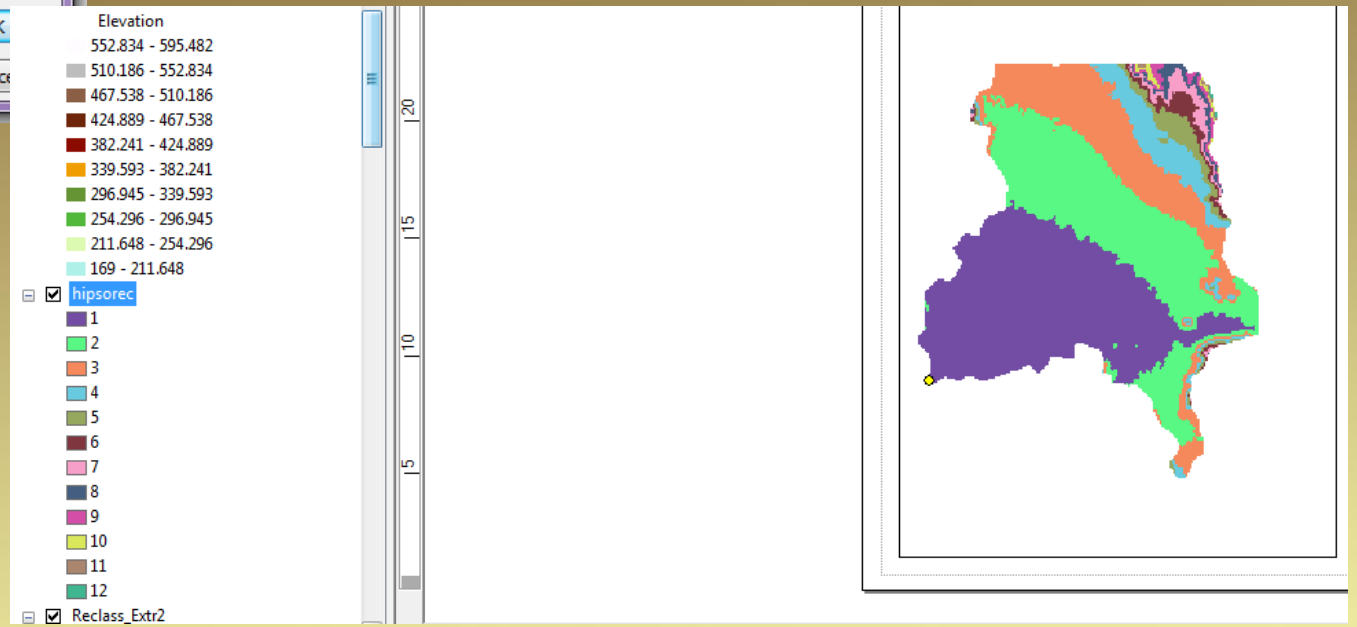


- Basin
- Fill
- Flow Accumulation
- Flow Direction
- Flow Length
- Sink
- Snap Pour Point
- Stream Link
- Stream Order
- Stream to Feature
- Watershed
- Interpolation
- Local
- Map Algebra
- Math
- Multivariate
- Neighborhood
- Overlay
- Raster Creation
- Reclass
  - Lookup
  - Reclass by ASCII File
  - Reclass by Table
  - Reclassify
  - Rescale by Function
  - Slice









Elevation
552.834 - 595.482
510.186 - 552.834
467.538 - 510.186
424.889 - 467.538
382.241 - 424.889
339.593 - 382.241
296.945 - 339.593
254.296 - 296.945
211.648 - 254.296
169 - 211.648
hipsorec
1
2
3
4
5
6
7

Table

hipsorec

Rowid	VALUE	COUNT
0	1	7932
1	2	6223
2	3	3768
3	4	1227
4	5	544
5	6	367
6	7	330
7	8	236
8	9	149
9	10	72
10	11	24
11	12	10

0

hipsorec

5 10 15 20

Zonal Statistics as Table

Input raster or feature zone data
hipsorec

Zone field
VALUE

Input value raster
Extract_Fill1

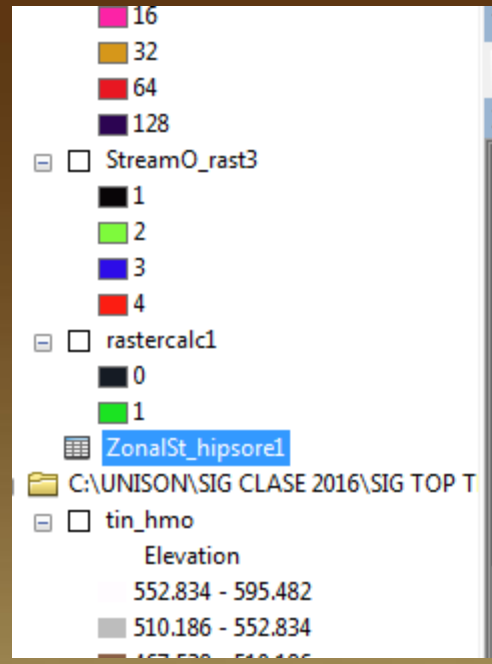
Output table
C:\Users\hp\Documents\ArcGIS\Default.gdb\ZonalSt_hipsore1

Ignore NoData in calculations (optional)

Statistics type (optional)
ALL

OK Cancel Environments... Show Help >>

ArcToolbox
Watershed
Interpolation
Local
Map Algebra
Math
Multivariate
Neighborhood
Overlay
Raster Creation
Reclass
Lookup
Reclass by ASCII File
Reclass by Table
Reclassify
Rescale by Function
Slice
Segmentation and Classification
Solar Radiation
Surface
Zonal
Tabulate Area
Zonal Fill
Zonal Geometry
Zonal Geometry as Table
Zonal Histogram
Zonal Statistics
Zonal Statistics as Table
Spatial Statistics Tools

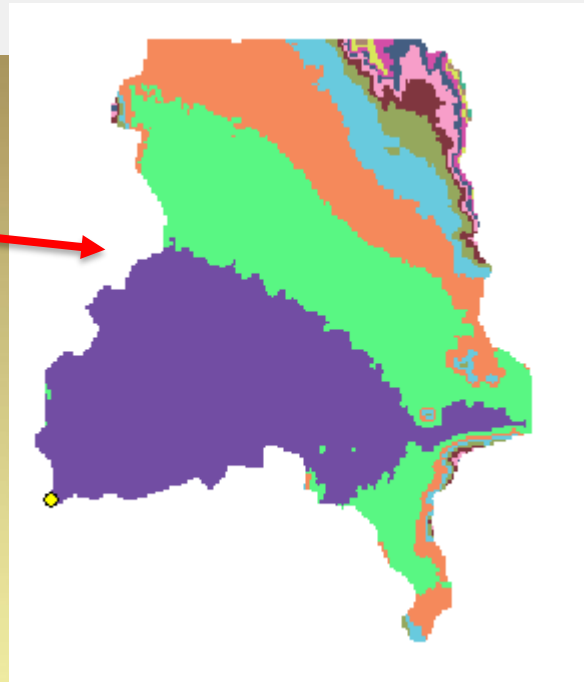


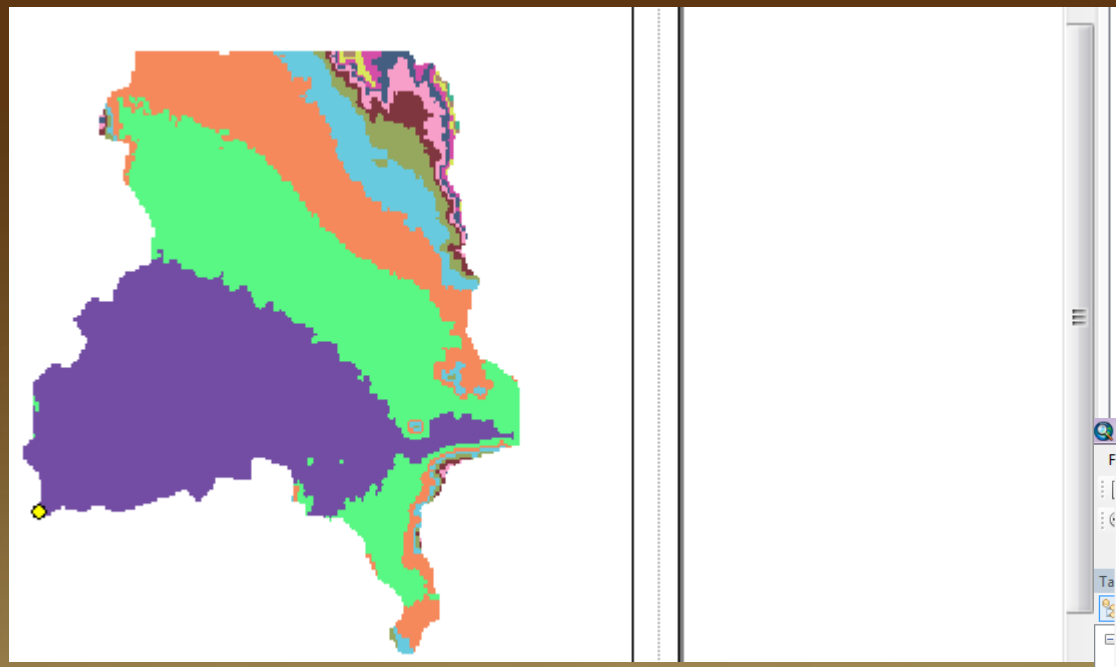
Table

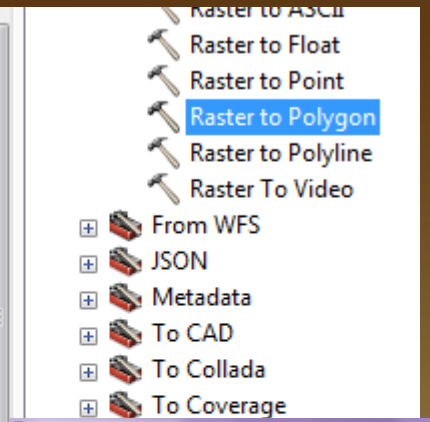
ZonalSt_hipsore1

OBJECTID *	VALUE	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
1	1	7932	53415022.764881	173	206.175934	33.175934	191.893973	8.098599	1522102.996902
2	2	6223	41906415.363824	206.184006	239.359924	33.175919	221.691216	9.88015	1379584.438324
3	3	3768	25374156.048672	239.362305	272.517883	33.155579	252.921678	9.191377	953008.882843
4	4	1227	8262762.598652	272.545197	305.660095	33.114899	286.330866	9.303329	351327.973175
5	5	544	3663360.108938	305.779968	338.86377	33.083801	320.55297	9.438535	174380.815948
6	6	367	2471421.249964	338.916504	372.005493	33.088989	354.922411	9.818844	130256.524994
7	7	330	2222258.889613	372.105469	405.243591	33.138123	388.283467	9.644464	128133.544128
8	8	236	1589251.811966	405.326996	438.271088	32.944092	421.028268	9.781095	99362.671234
9	9	149	1003383.55925	438.540161	470.897736	32.357574	451.490582	8.922274	67272.096649
10	10	72	484856.485006	471.924713	503.154205	31.229492	484.342451	9.660943	34872.656494
11	11	24	161618.828335	505.525299	534.637695	29.112396	517.408998	9.33956	12417.815948
12	12	10	67341.178473	544.553406	571.172424	26.619019	556.861523	7.580988	5568.615234

Éstos son los parámetros del shape de la cuenca
Ahora hacer lo mismo para el raster hipsométrico, obtener parámetros







morfometria - ArcMap

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Table

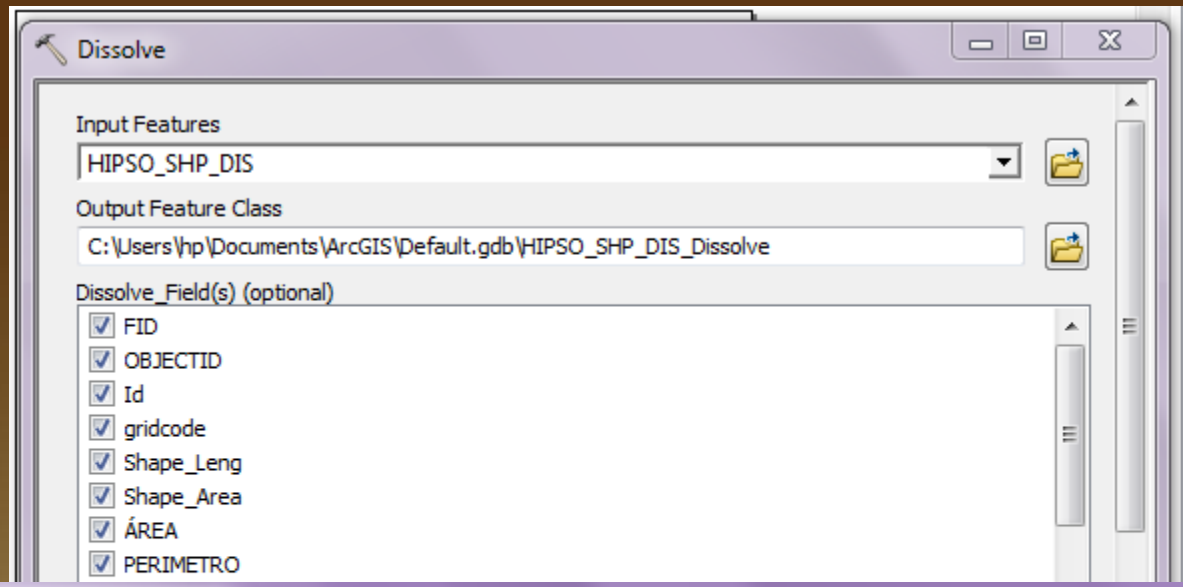
RasterT_hipsore1

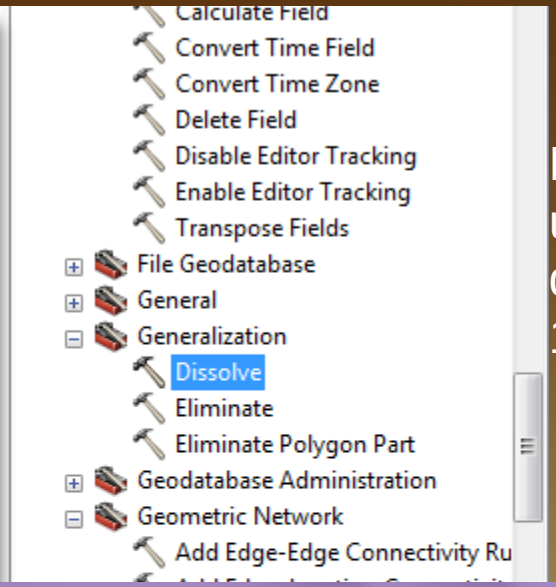
OBJECTID *	Shape *	Id	gridcode	Shape_Length	Shape_Area	ÁREA	PERIMETRO	CENTROIDE_X	CENTROIDE_Y
158	Polygon	158	1	46456.916479	53452273.423773	53452273.423773	46456.916479	499019.644026	3216768.952584
111	Polygon	111	2	986.777087	35763.004068	35763.004068	986.777087	494058.397956	3216749.206275
117	Polygon	117	2	307.717148	4312.449946	4312.449946	307.717148	494021.95533	3215838.441695
129	Polygon	129	2	309.606743	4610.56197	4610.56197	309.606743	502724.805332	3215101.570396
133	Polygon	133	2	723.635535	30625.01022	30625.01022	723.635535	501853.539446	3215111.448919
156	Polygon	156	2	2805.591755	218536.284507	218536.284507	2805.591755	501672.149394	3214070.391472
157	Polygon	157	2	307.717221	4312.451551	4312.451551	307.717221	502316.180717	3213534.718304
160	Polygon	160	2	307.717221	4312.451552	4312.451552	307.717221	502398.242388	3213464.649838
172	Polygon	172	2	903.286704	43009.84151	43009.84151	903.286704	505333.510733	3211295.042323
173	Polygon	173	2	68162.255489	41573025.125596	41573025.125596	68162.255489	501865.055841	3219662.22086
2	Polygon	2	3	464.375028	9194.773465	9194.773465	464.375028	501039.539436	3226593.997705
28	Polygon	28	3	307.717221	4312.451552	4312.451552	307.717221	501735.752417	3225439.657202
43	Polygon	43	3	582.672738	15953.975496	15953.975496	582.672738	497170.781779	3224982.52572
50	Polygon	50	3	465.596356	9090.053184	9090.053184	465.596356	498044.185767	3224664.364781
62	Polygon	62	3	309.606811	4610.564169	4610.564169	309.606811	496980.488362	3224210.415825
63	Polygon	63	3	465.59673	9090.063941	9090.063941	465.59673	499325.223179	3223967.335182
105	Polygon	105	3	328.246684	6734.117847	6734.117847	328.246684	507568.127661	3217479.675115
106	Polygon	106	3	328.246684	6734.117847	6734.117847	328.246684	507650.189332	3217397.613444
107	Polygon	107	3	328.246684	6734.117847	6734.117847	328.246684	506008.955912	3216987.305089
110	Polygon	110	3	49382.89586	22633253.416052	22633253.416052	49382.89586	501513.838614	3223432.998692
112	Polygon	112	3	820.61671	26936.47139	26936.47139	820.61671	504819.061682	3216248.75005
115	Polygon	115	3	656.493368	20202.353542	20202.353542	656.493368	505024.21586	3216084.626708
116	Polygon	116	3	1366.933081	49699.52865	49699.52865	1366.933081	504729.671292	3215990.276931
119	Polygon	119	3	2117.000295	96906.576768	96906.576768	2117.000295	507141.355311	3215542.149576
121	Polygon	121	3	2185.015954	74615.887663	74615.887663	2185.015954	506109.023973	3215394.01642
122	Polygon	122	3	492.370026	13468.235694	13468.235694	492.370026	505557.616721	3215264.009998
152	Polygon	152	3	1016.207748	44524.031584	44524.031584	1016.207748	501429.453034	3214205.627836
169	Polygon	169	3	1195.801432	52983.598106	52983.598106	1195.801432	503555.837845	3212305.929878
170	Polygon	170	3	492.370026	13468.235695	13468.235695	492.370026	503711.229124	3211940.512322
171	Polygon	171	3	10379.067881	1164462.719452	1164462.719452	10379.067881	504926.75104	3213058.107539
175	Polygon	175	3	4680.95062	1023744.859951	1023744.859951	4680.95062	504878.054985	3210630.66765
27	Polygon	27	4	472.270453	7826.269567	7826.269567	472.270453	501637.137794	3225439.657202

0 (0 out of 176 Selected)

RasterT_hipsore1

Convertir el hipsométrico en polígono (*.shp)
Obtener áreas y demás parámetros
Simplificar resultados





Disolver el shape hipsométrico únicamente por el gridcode, si lo que quieres es un resumen de los 12 intervalos de valores

morfometría - ArcMap

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Table

HIPSO_SHP_DIS_Dissolve1

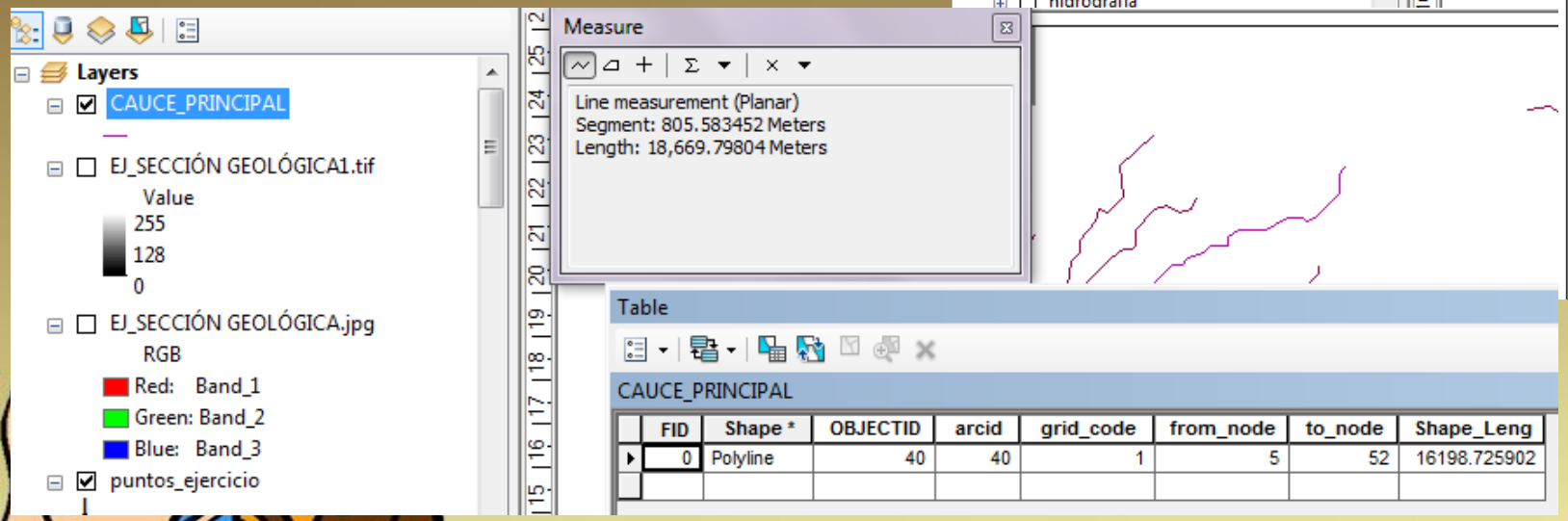
Shape *	gridcode	Shape_Length	Shape_Area	AREA	PERIMETRO	CENTROIDE_X	CENTROIDE_Y
Polygon	1	46456.916724	53452273.541798	53452273.541798	46456.916724	499019.644027	3216768.952581
Polygon	2	74814.305457	41918507.297722	41918507.297722	74814.305457	501860.329105	3219616.510657
Polygon	3	78366.027835	25286720.184348	25286720.184348	78366.027835	501861.140559	3222303.111523
Polygon	4	47358.86338	8237667.102943	8237667.102943	47358.86338	503778.980736	3222401.592261
Polygon	5	34532.358916	3658310.79237	3658310.79237	34532.358916	504331.682184	3222745.48247
Polygon	6	29576.44431	2461263.163331	2461263.163331	29576.44431	504461.703422	3223597.492847
Polygon	7	26742.949975	2224932.287706	2224932.287706	26742.949975	504583.418702	3224621.724682
Polygon	8	25153.521828	1574256.193483	1574256.193483	25153.521828	504546.279956	3225302.484358
Polygon	9	20193.755139	1008233.537047	1008233.537047	20193.755139	504591.958196	3225360.877218
Polygon	10	10819.803035	480567.23112	480567.23112	10819.803035	504370.444925	3225610.34284
Polygon	11	4592.214417	159330.252715	159330.252715	4592.214417	504782.674871	3225800.542736
Polygon	12	1845.163817	63073.561475	63073.561475	1845.163817	505854.740429	3225240.156951

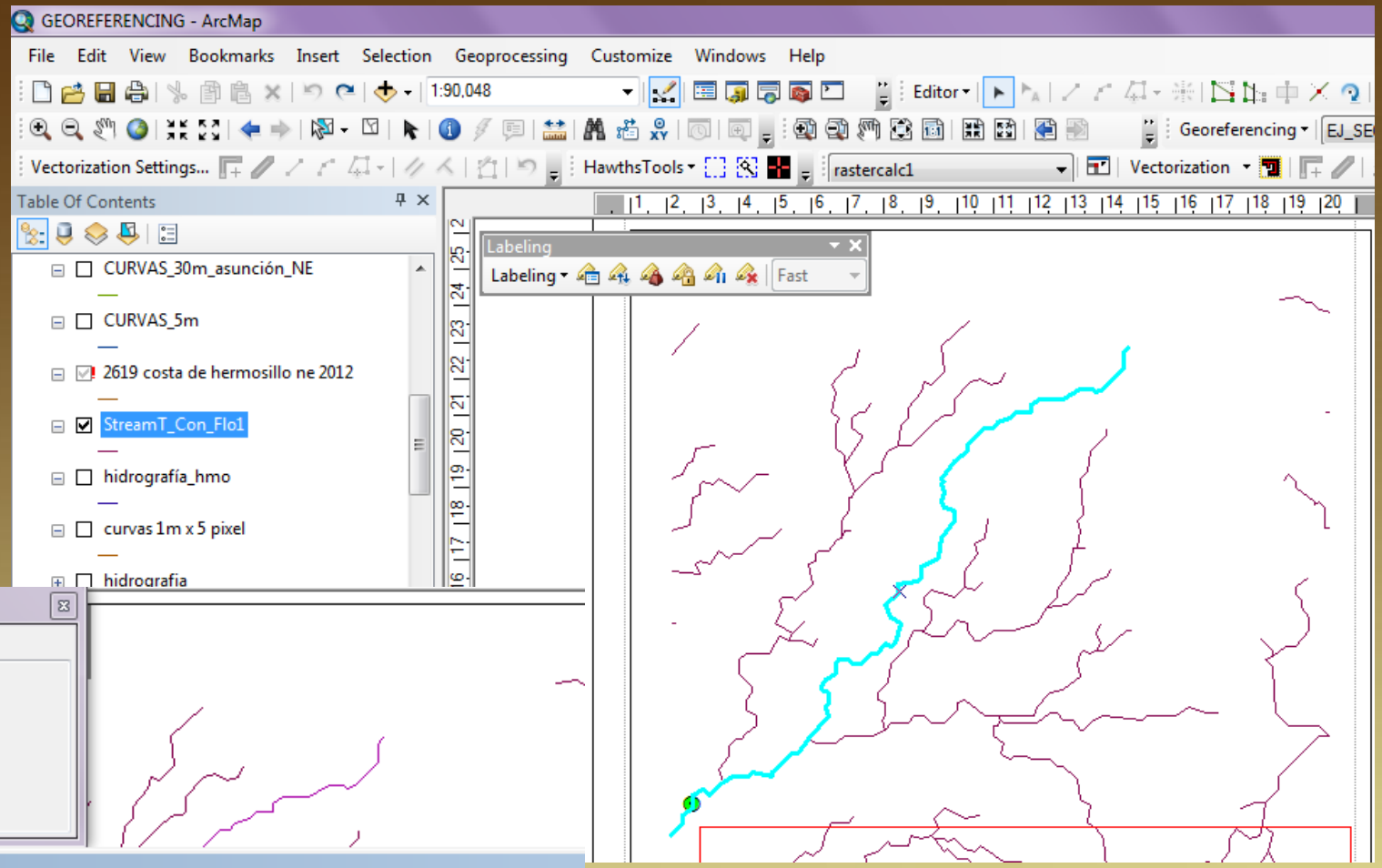
Feature Construction

PENDIENTE GENERAL DEL CAUCE PRINCIPAL

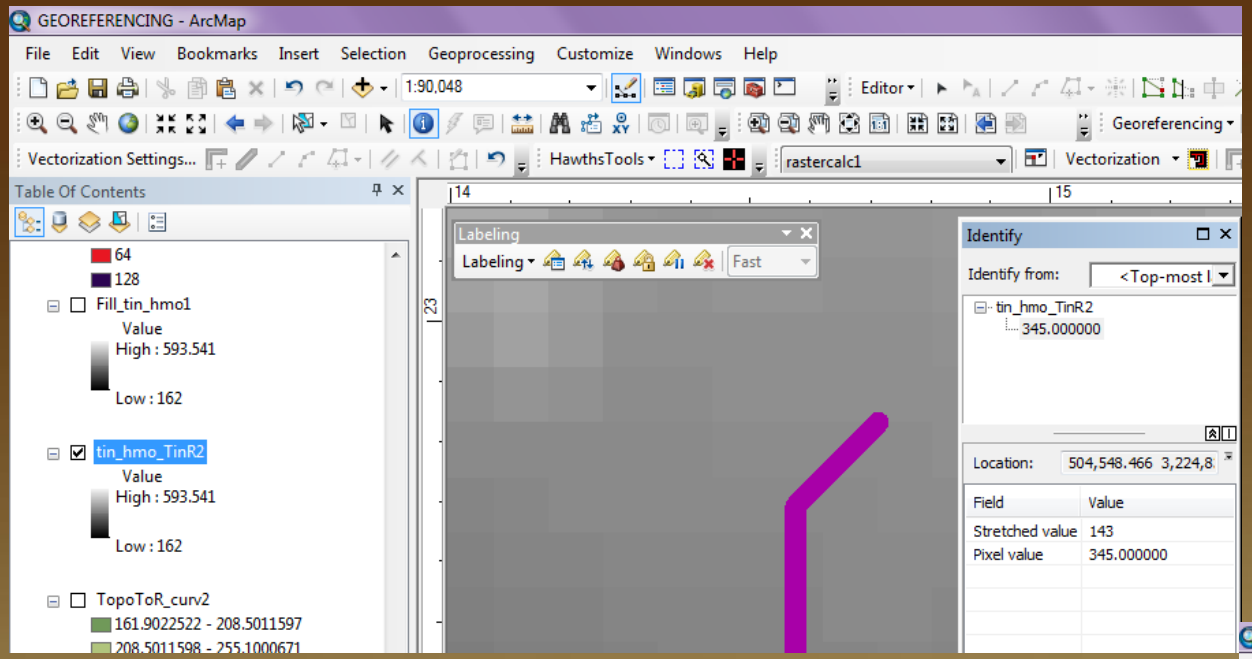
Pendiente = cota máxima-cota mínima
longitud de cauce

1- Exportar el cauce principal
2- Sacar la longitud con la calculadora





16.198 Km= 16,198.72 m
longitud de cauce principal

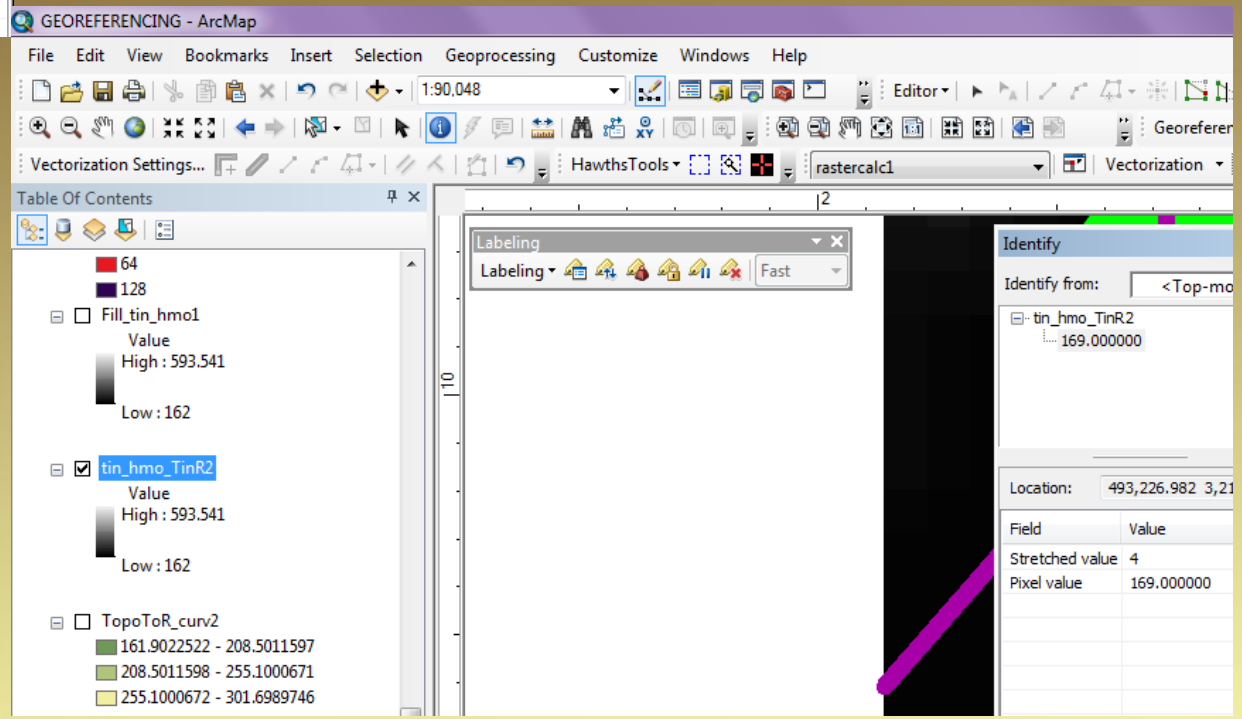


Pendiente = cota máxima-cota mínima
longitud de cauce

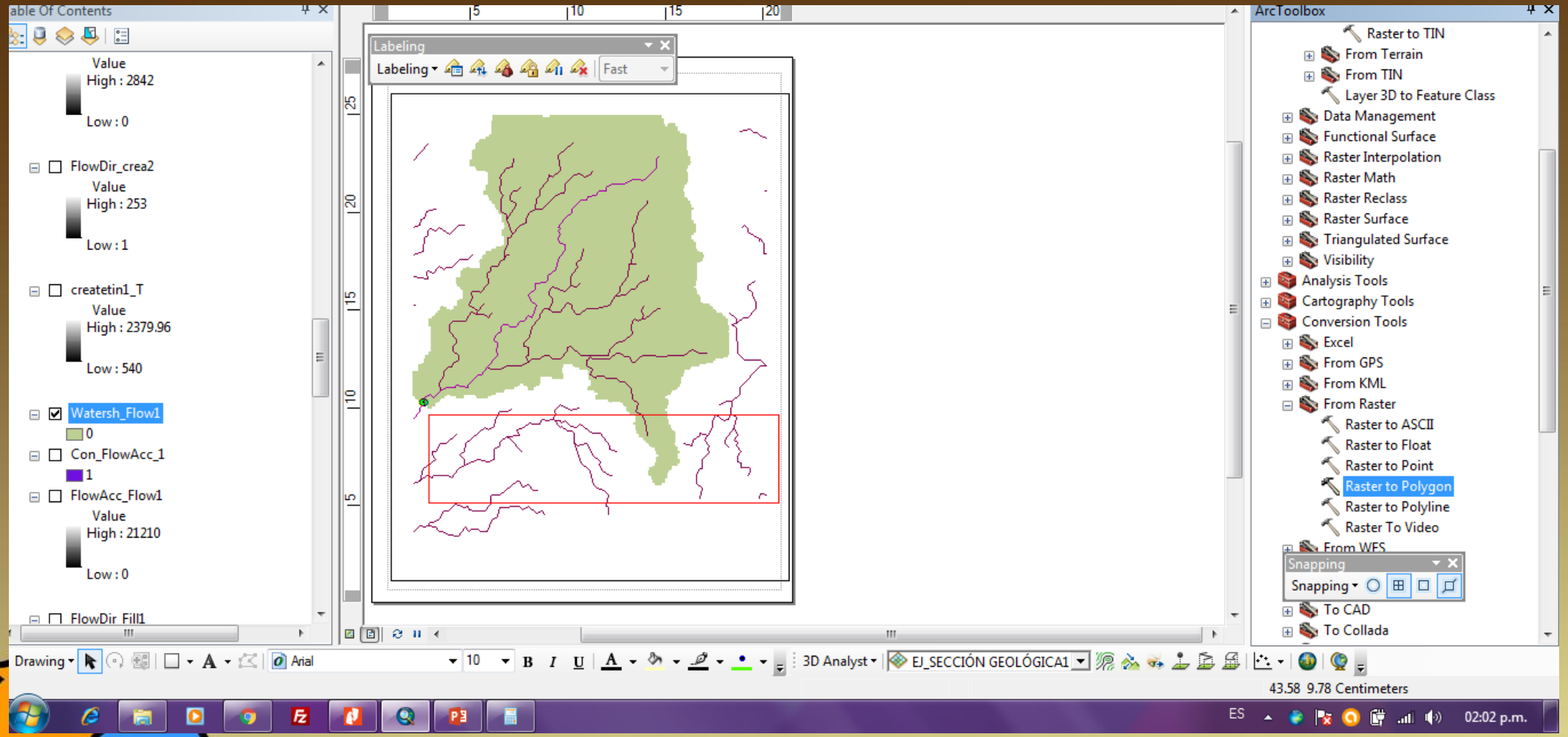
Pendiente = (345 – 169)/ 16,198.72 = 0.010865056

Cota máxima con el identificador desde el Raster inicial, donde comienza la escorrentía = 345 m

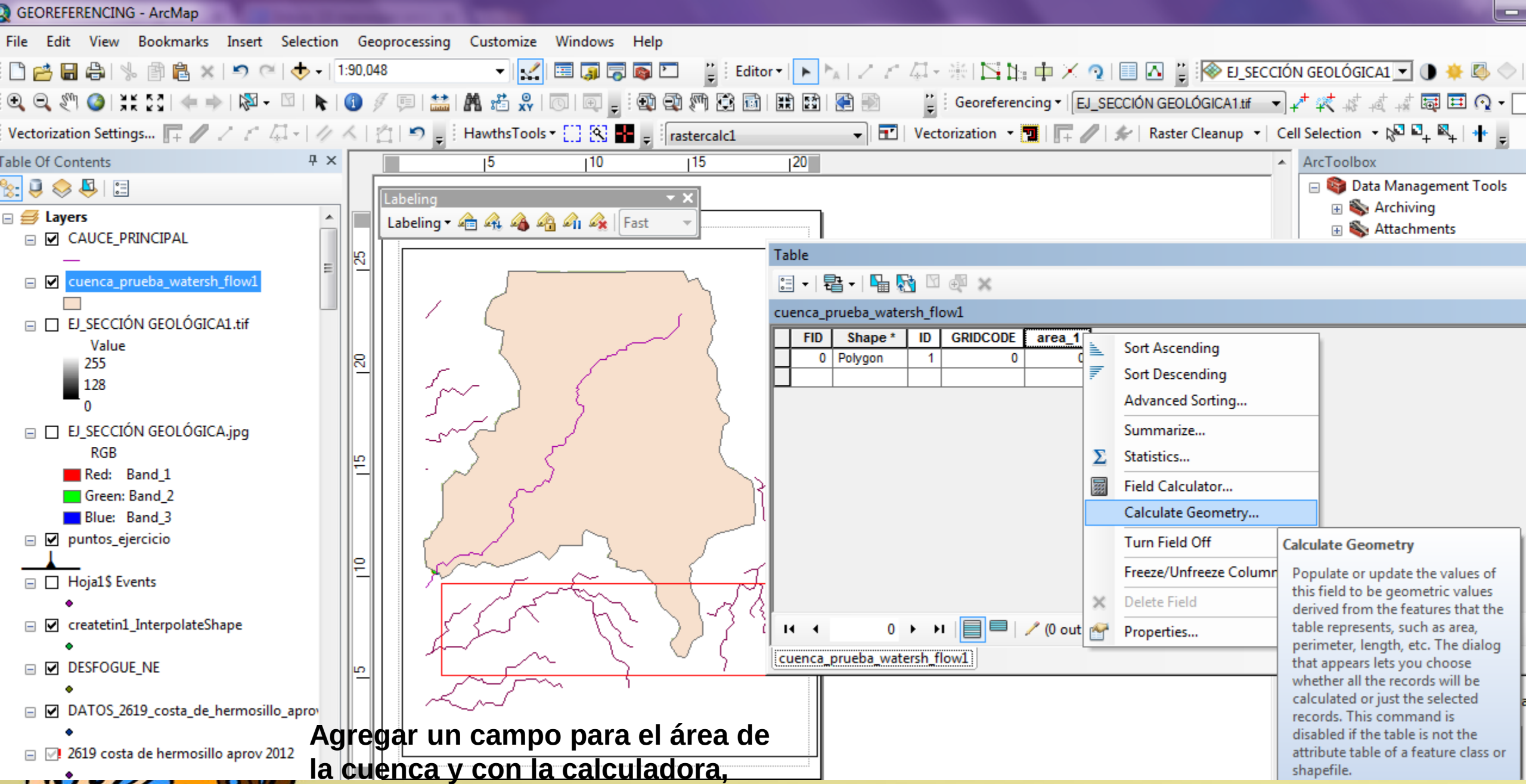
Cota mínima con el identificador desde el Raster inicial, donde termina la escorrentía = 169 m



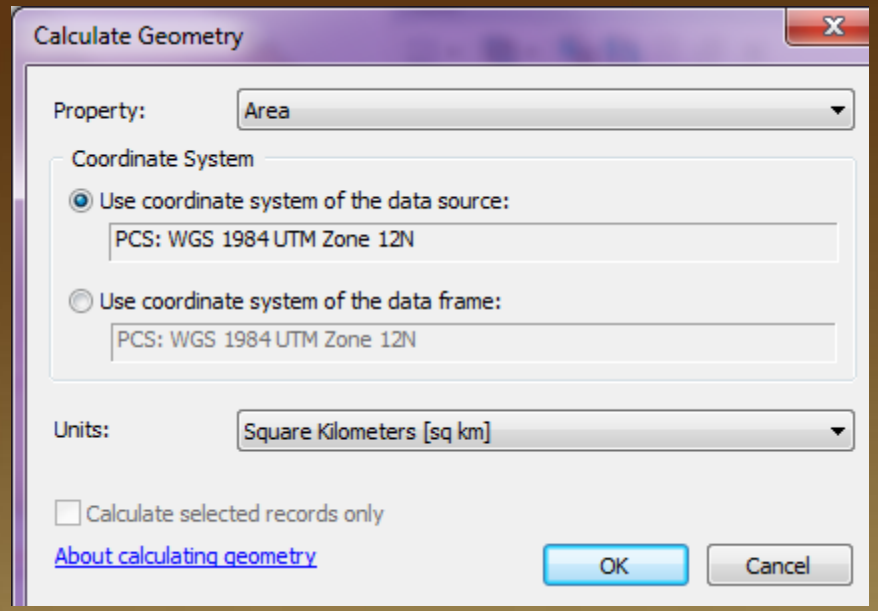
ÁREA DE LA CUENCA Y TIEMPO DE CONCENTRACIÓN

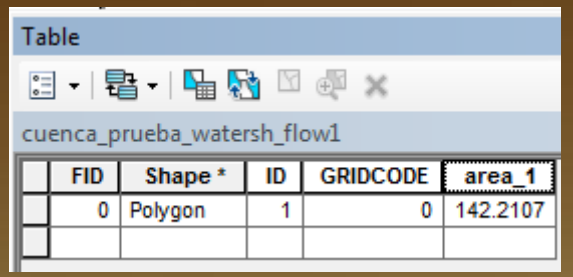


Convertir de Raster a polígono la cuenca obtenida en pasos arriba



Agregar un campo para el área de la cuenca y con la calculadora, click Calculate Geometry





Área de la cuenca

Longitud de cauce 16,198.72 m
Pendiente de cauce 0.010865056

TIEMPO DE CONCENTRACIÓN

TC = 0.0195 * ((longitud cauce ^0.77) / (pendiente de cauce ^0.385))
TC = 0.0195 * ((16,198.72^0.77) / (0.010865056 ^0.385))
TC = 193.848498 ó 0.94939639

CÁLCULO DE EROSIÓN DE SUELO UTILIZANDO SIG, GIS