



Preparing ESRI GIS Shape Files for **DDMSW**

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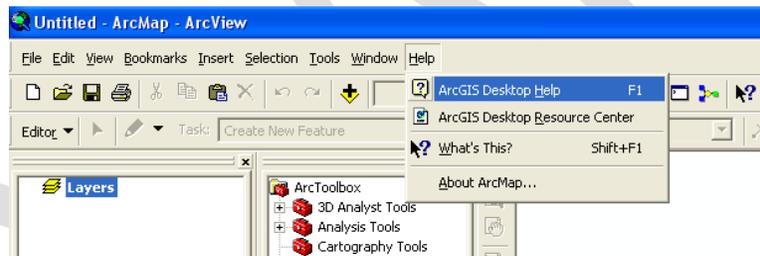
1 Introduction

When preparing ESRI GIS shape files (referred to hereafter as shape files) to be used in DDMSW to compute Hydrology parameters, a few criteria must be met for the program to function properly. This tutorial will attempt to outline the basic steps and requirements. When calculating the Hydrology data using shape files the Sub Basins shape file is always required. The other shape files such as Rainfall, Land Use, Soil and Tc are used for the Clark Unit Hydrograph or the Rainfall, Land Use, Soil, L and Lca can be used for the S-graph Unit Hydrograph, all of these are optional. The data that is loaded by these shape files can also be added manually. So there are three ways to load data into DDMSW:

- It can be entered manually
- It can be loaded in the form of ESRI shape files
- Or it can be a hybrid of these two methods
 - For example the shape files for Sub Basin and Land Use are used and the other data is entered manually

This third case is helpful in some cases where the data for the area being considered has already been recorded or if the area being considered is small and has very few Land Use or Soil types. Please note that the Sub Basin shape file must be used if map module function is selected to update the Hydrology data.

The Appendix of this document contains most of the basics of ArcMap that are helpful in preparing shape files for DDMSW and the ArcGIS Desktop *Help* is always available in ArcMap by pressing F1 or *Help* → *ArcGIS Desktop Help* as shown below. For additional information on the features of ArcMap please refer to an applicable tutorial on ArcMap.



2 Preparing ESRI Shape files in ArcMap

This section covers the steps needed to prepare ESRI shape files to be loaded into DDMSW. The instructions for each shape file are shown below. Please note that not all the shape files listed below are used in each project. For example the Tc shape file is only used if the Clark Unit Hydrograph is used and the shape files L and Lac are only used if the S-graph Unit Hydrograph is used, the data from these shape files can also be entered manually in DDMSW. The Sub Basin shape file is always required when updating the Hydrology data from shape files. The Land Use and Soil shape files are also almost always used unless the data is to be entered manually as mentioned above. To prepare the ESRI shape files one of ESRI's GIS programs should be used, in this tutorial ESRI ArcMap 9.3.1 is used.

2.1 Sub Basins (required)

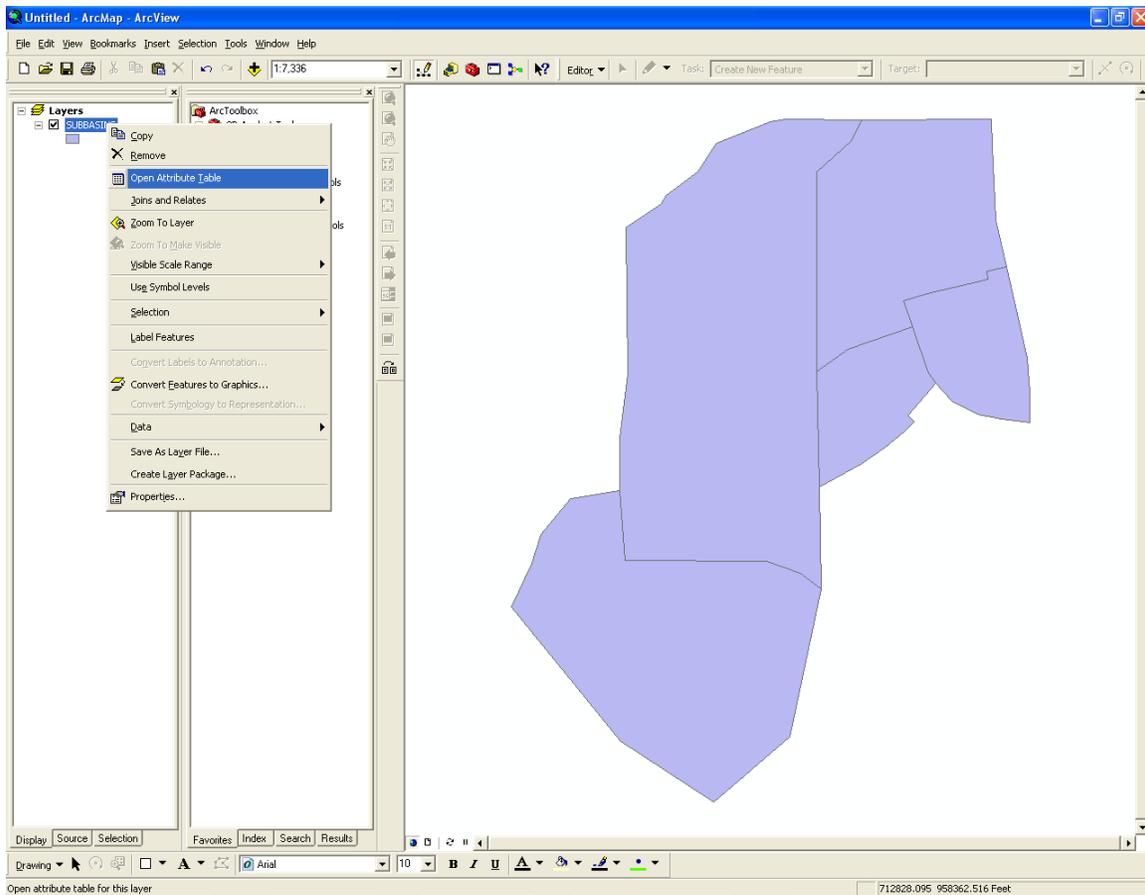
To begin, launch ArcMap and create the Sub Basin shape file. The Sub Basin shape file is composed of polygons, one polygon for each Sub Basin in the study area. See the Appendix A2.1 for help creating polygons and Appendix A2.9 for help with the 'Select' Extraction tool that is useful for creating the Sub Basin shape file.

2.1.1 Creating Fields

As can be seen in the Required Fields table in Appendix A1, the Sub Basin shape file must have three fields: AREAID, BASINID, and AREASF.

To enter these into the Sub Basin shape file:

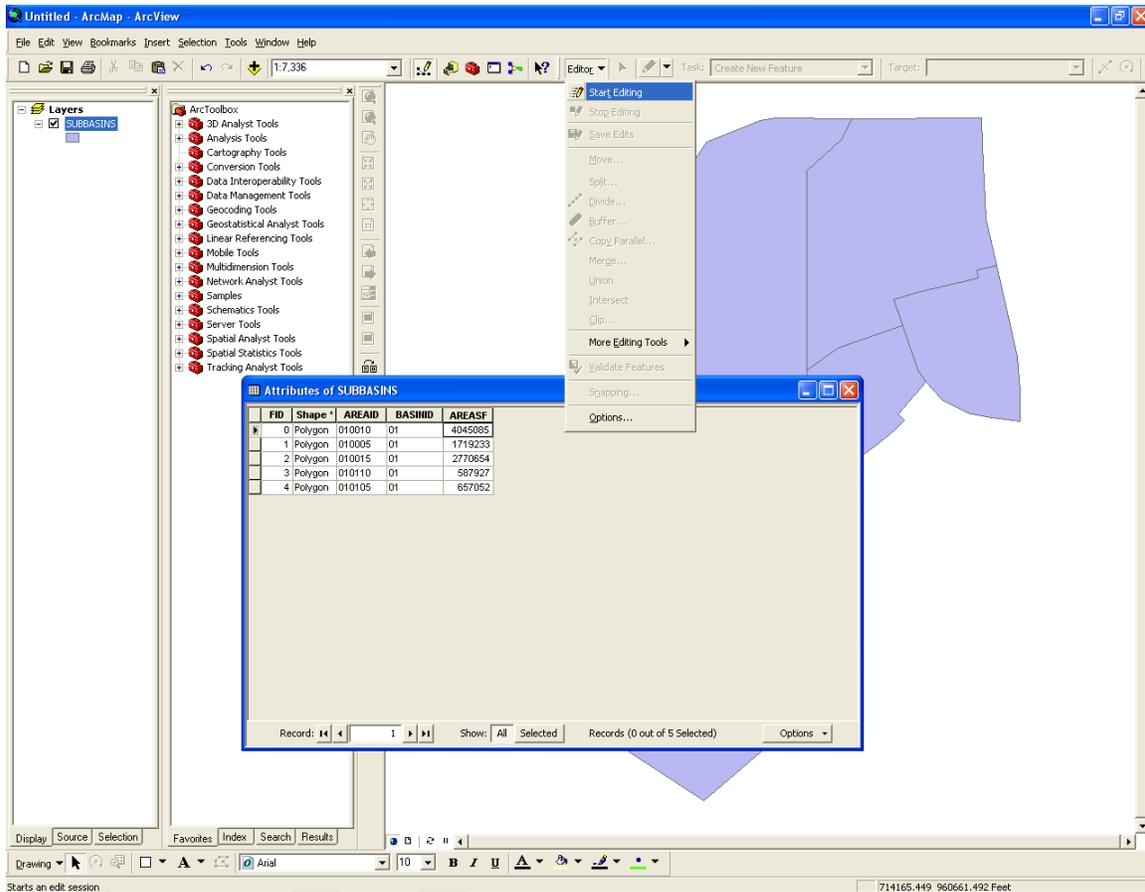
- Ensure that the shape file editing mode is off, otherwise the following cannot be performed
 - To determine if the editing mode is on:
 - Go to the *Editor tab*
 - If the *Start Editing* button can be clicked on then the editing mode is off
 - If the *Start Editing* button is not available then click the *Stop Editing* button to terminate the editing session
- Right click on the Sub Basin shape file in the display list on the left of the screen in ArcMap
- Then select *Open Attribute Table* from the pull down menu
- In the **Attribute** table window select *Options → Add New Field...*
- Enter the information for AREAID
 - In the **New Field** window enter AREAID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since AREAID is specified as a 'Character' data type
 - Then change the length to 6 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the BASINID
 - Select *Options → Add New Field...*
 - In the **New Field** window enter BASINID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since BASINID is specified as a 'Character' data type
 - Then change the length to 2 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the AREASF
 - Select *Options → Add New Field...*
 - In the **New Field** window enter AREASF for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since AREASF is specified as a 'Numeric' data type
 - Then change the precision to 12 as specified in the Table of Required Fields in Appendix A1
 - Set/leave the scale set to zero
 - Then click *OK* in the **New Field** window



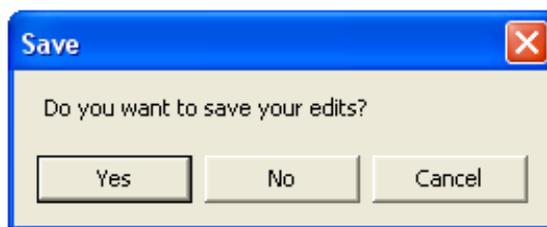
2.1.2 Entering Data

Before entering the applicable data, in the **Attribute** table of the shape file in ArcMap, that file must be selected for editing. To do this select the shape file by clicking on it, then go to the ArcMap *Editor* tab in the toolbar and select *Start Editing*. Data may now be entered into the **Attribute** table. It is important to remember the type of data that is required in the data fields, for example if the data type is 'Numeric' then the data must be a real number. For the AREAID any unique string of Characters may be entered into the data field, the purpose of this data field is to identify the Sub Basin. The BASINID is the Major Basin ID that the Sub Basin is in. DDMSW by default begins with Major Basin 01; if more Major Basins are required they may be added in DDMSW. If multiple Major Basins are being used, then use the applicable Major Basin ID for the data. The AREASF field is a numeric value; it is the area in square feet that each

Sub Basin contains. The area in square feet may be entered manually if known or the Geometry Calculator in ArcMap may be used as explained in Appendix A2.4. After the data has been entered go back to the *Editor* tab and select *Stop Editing*. Some of the data fields that appear in the attribute table, such as FID, Shape, and Id, are built-in data fields that are created by the shape file when the shapes (polygons or polylines) are drawn. While entering data into the table, the user does not have to enter anything in these fields, they are filled automatically by the system.



Click **Yes** on the window that comes up to save the changes and continue.



2.2 Land Use (optional)

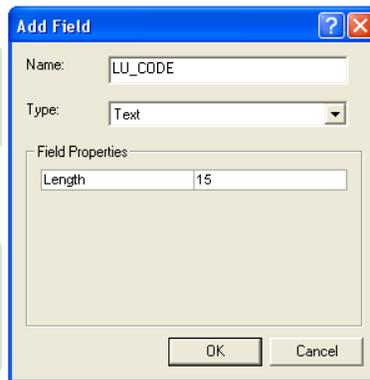
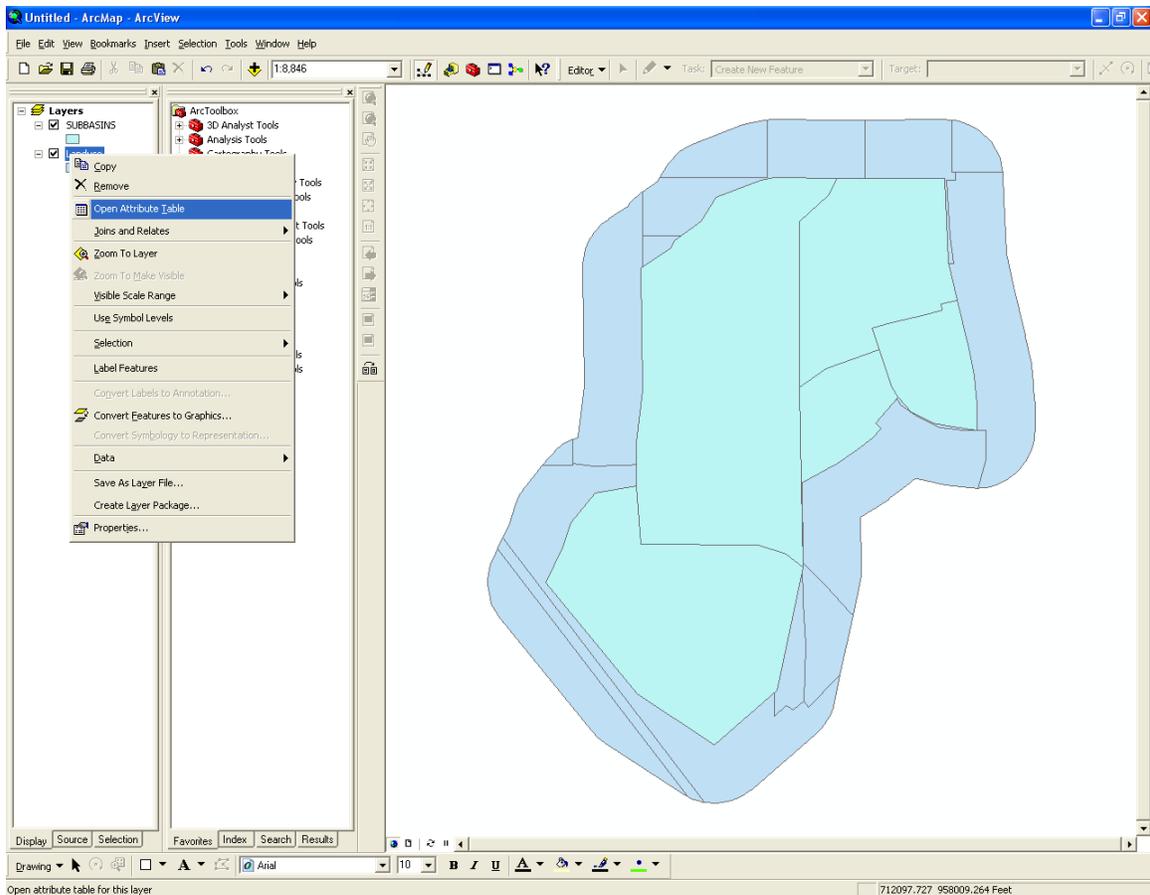
To begin creating the Land Use shape file, launch ArcMap. The Land Use shape file is created using polygons, each polygon designates a different land use type. A common practice is to use the 'Clip' or 'Intersect' tool in ArcMap to extract the data desired from the County wide land use shape file used by the County. The Land Use shape file must either be exactly the same size as the Sub Basins shape file or slightly larger. See Appendix A2.3 and A2.6 respectively for help with using the 'Clip' or 'Intersect' tools and A2.1 for help creating polygons in ArcMap.

2.2.1 Creating Fields

As can be seen in the Required Fields table in Appendix A1, the Land Use shape file only has one field, LU_CODE. As shown in the Required Fields table the field name of land use data can be changed by the user. Currently LUCODE and LU_CODE are most well-adopted field names for the land use code used by most agencies. Please note that the land use is the only field that has "options" for its field name. The Flood Control District of Maricopa County generally uses LU_CODE, for this reason the examples shown in this tutorial will use LU_CODE. DDMSW will recognize any other name as long as it is "told" what name to use. See the section on Loading ESRI GIS Shape Files into DDMSW for instructions on how to change the field name for DDMSW to recognize.

To enter this into the Land Use shape file:

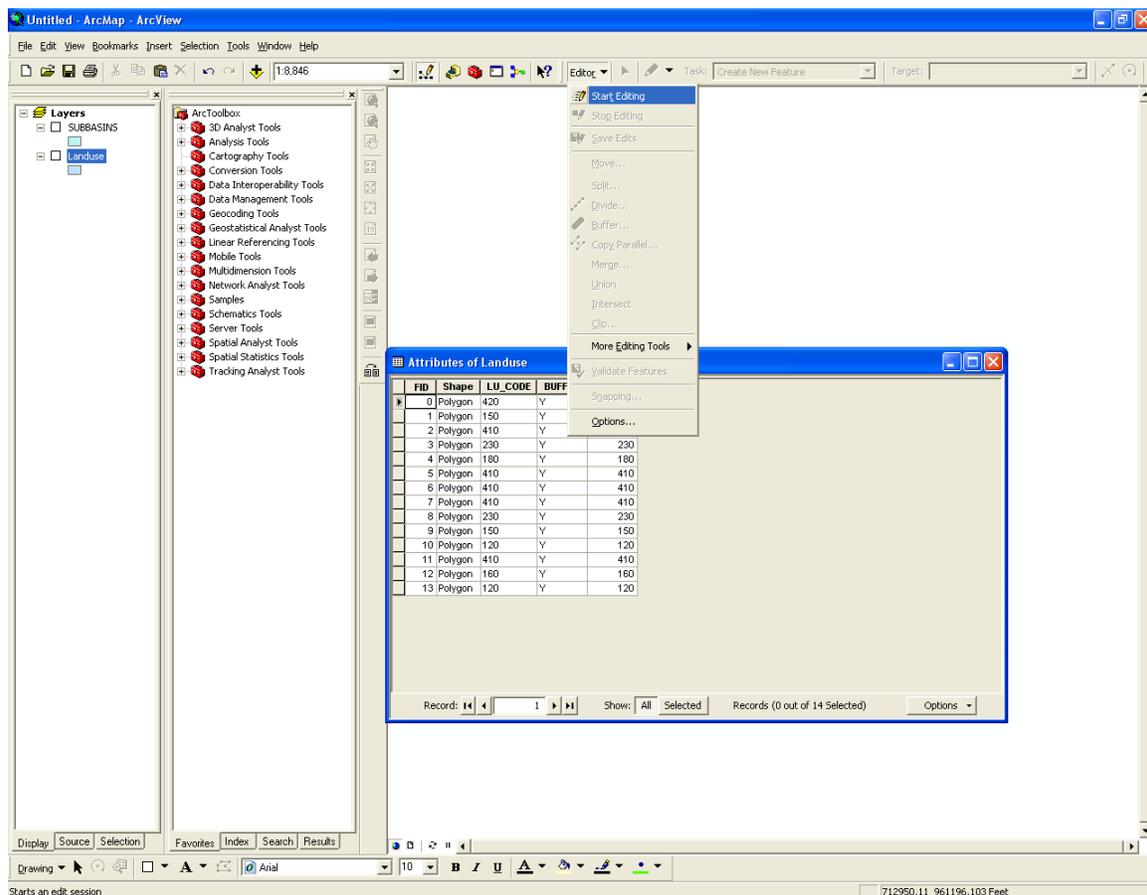
- Ensure that the shape file editing mode is off, otherwise the following cannot be performed
 - To determine if the editing mode is on:
 - Go to the *Editor tab*
 - If the *Start Editing* button can be clicked on then the editing mode is off
 - If the *Start Editing* button is not available then click the *Stop Editing* button to terminate the editing session
- Right click on the Land Use shape file in the display list on the left of the screen in ArcMap
- Then select *Open Attribute Table* from the pull down menu
- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for LU_CODE
 - In the **New Field** window enter LU_CODE for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since LU_CODE is specified as a 'Character' data type
 - Then change the length to 15 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window



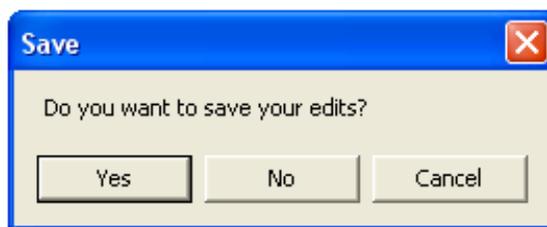
2.2.2 Entering Data

Before entering the applicable data, in the **Attribute** table of the shape file in ArcMap, that file must be selected for editing. To do this select the shape file by clicking on it, then go to the ArcMap *Editor* tab in the toolbar and select *Start Editing*. Data may now be entered into the **Attribute** table. The data that is entered into the **Attribute** table for the Land Use shape file should correspond to the Land Use Codes in DDMSW, see Appendix A3.1 for where these codes can be found and how to create custom ones. After the data has been entered go back to the *Editor* tab and select *Stop Editing*. Some of the data fields that appear in the attribute table, such as FID, Shape, and Id, are built-in data fields that are created by the

shape file when the shapes (polygons or polylines) are drawn. While entering data into the table, the user does not have to enter anything in these fields, they are filled automatically by the system.



Click Yes on the window that comes up to save the changes and continue.



2.3 Soil (optional)

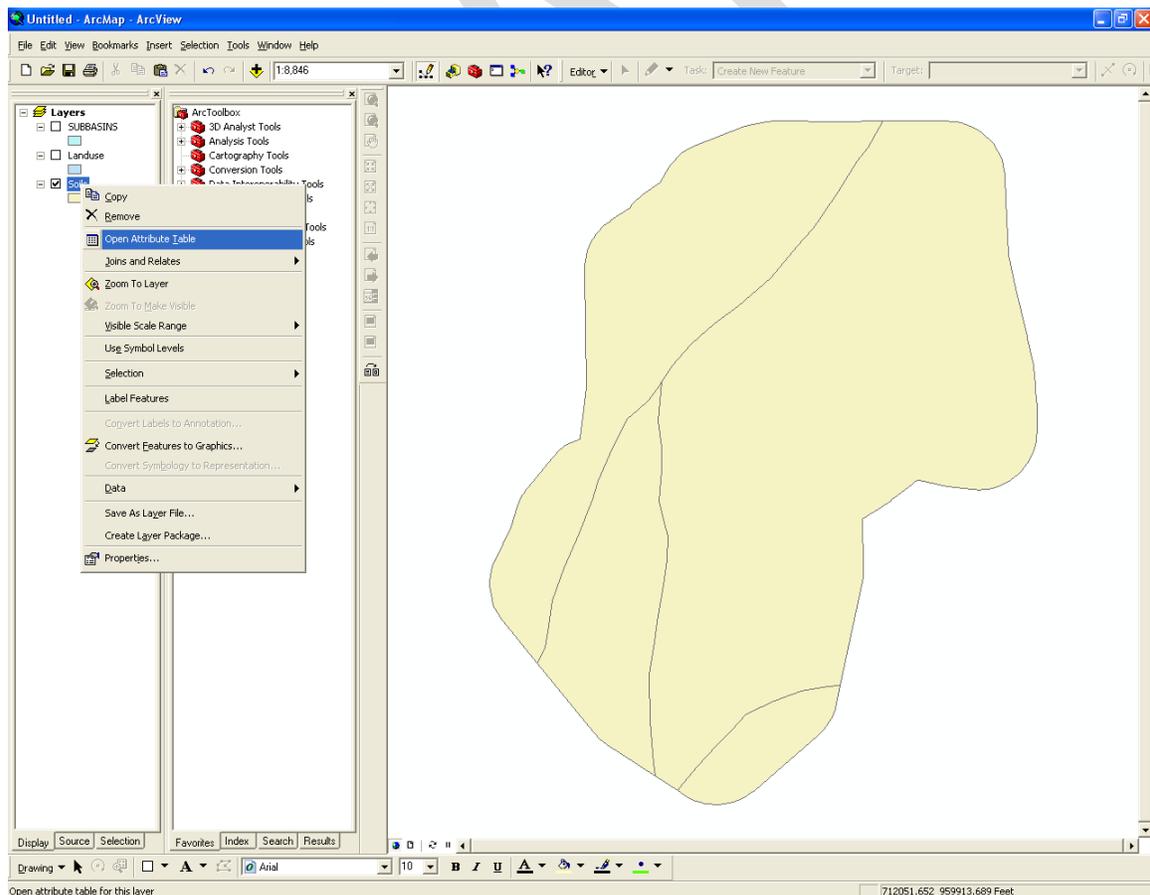
To start creating the Soil shape file, launch ArcMap. The Soil shape file consists of polygons created in ArcMap, each polygon designates a different type of soil. A common practice is to use the 'Clip' or 'Intersect' tool in ArcMap to extract the desired data from the County wide Soil shape file used by the County. The Soil shape file must either be exactly the same size as the Sub Basins shape file or slightly larger. See Appendix A2.3 and A2.6 respectively for help with using the 'Clip' or 'Intersect' tools and A2.1 for help creating polygons in ArcMap.

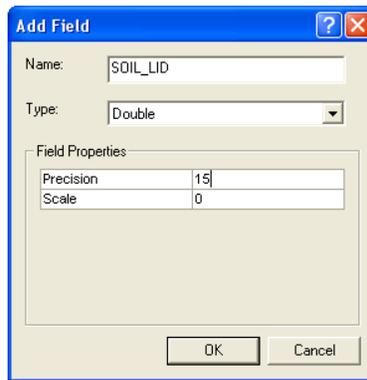
2.3.1 Creating Fields

As can be seen in the Required Fields table in Appendix A1, the Soil shape file only has one field, SOIL_LID.

To enter this into the Soil shape file:

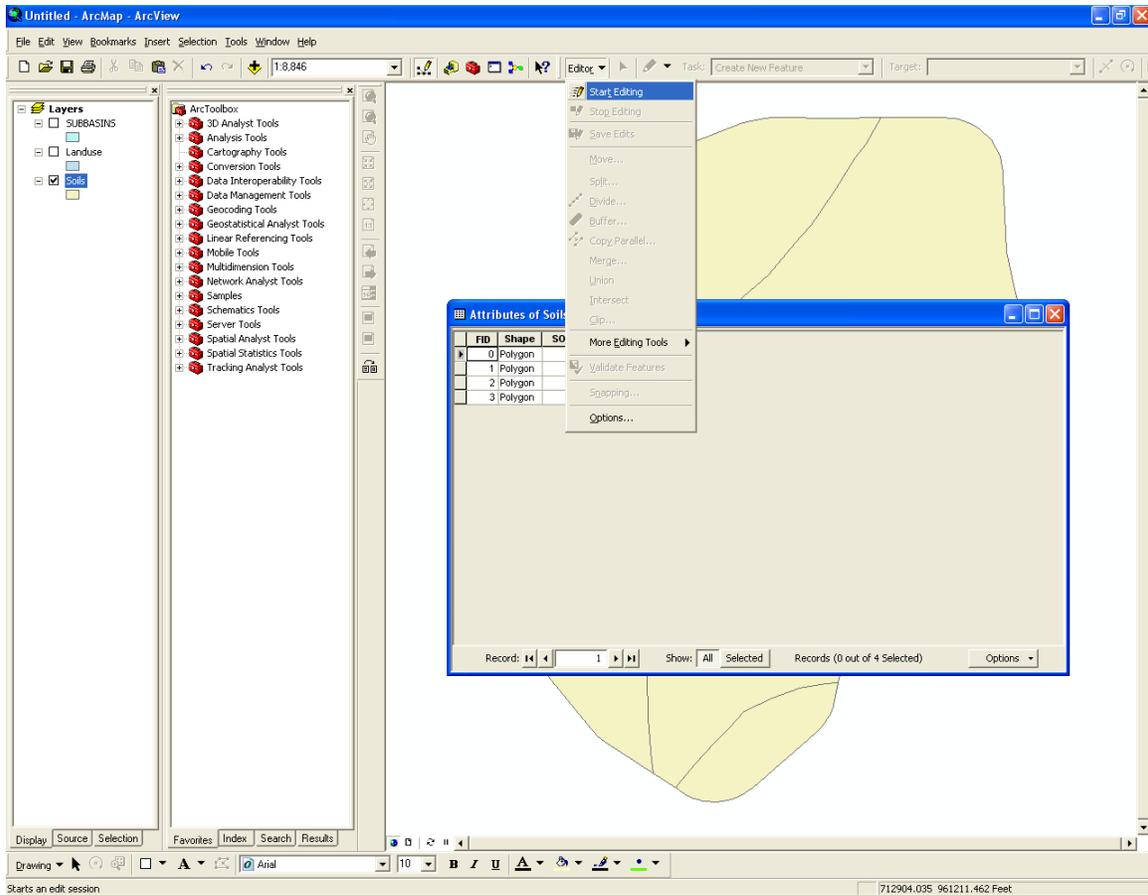
- Ensure that the shape file editing mode is off, otherwise the following cannot be performed
 - To determine if the editing mode is on:
 - Go to the *Editor tab*
 - If the *Start Editing* button can be clicked on then the editing mode is off
 - If the *Start Editing* button is not available then click the *Stop Editing* button to terminate the editing session
- Right click on the Soil shape file in the display list on the left of the screen in ArcMap
- Then select *Open Attribute Table* from the pull down menu
- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for SOIL_LID
 - In the **New Field** window enter SOIL_LID for the '**Name**'
 - Then select the data type as 'Double' from the pull down menu since the data type is 'Numeric' as can be seen in the table of Required Fields in Appendix A1
 - Since the length is 15 set the precision to 15
 - Set/leave the scale set to zero
 - Then click **OK** in the **New Field** window



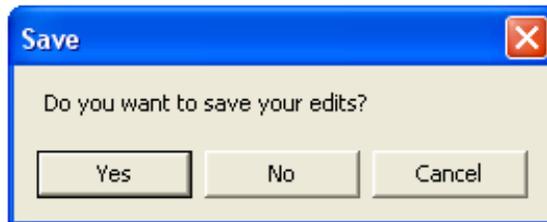


2.3.2 Entering Data

Before entering the applicable data, in the **Attribute** table of the shape file in ArcMap, that file must be selected for editing. To do this select the shape file by clicking on it, then go to the ArcMap *Editor* tab in the toolbar and select *Start Editing*. Data may now be entered into the **Attribute** table. It is important to remember the type of data that is required in the data fields, for example if the data type is 'Numeric' then the data must be a real number. The data that is entered into the Soil shape file must be in DDMSW Soil IDs see Appendix A3.2 for how to see defaults and create custom soil codes. After the data has been entered go back to the *Editor* tab and select *Stop Editing*. Some of the data fields that appear in the attribute table, such as FID, Shape, and Id, are built-in data fields that are created by the shape file when the shapes (polygons or polylines) are drawn. While entering data into the table, the user does not have to enter anything in these fields, they are filled automatically by the system.



Click Yes on the window that comes up to save the changes and continue.



2.4 Tc, Time of Concentration for Clark Unit Hydrograph (optional)

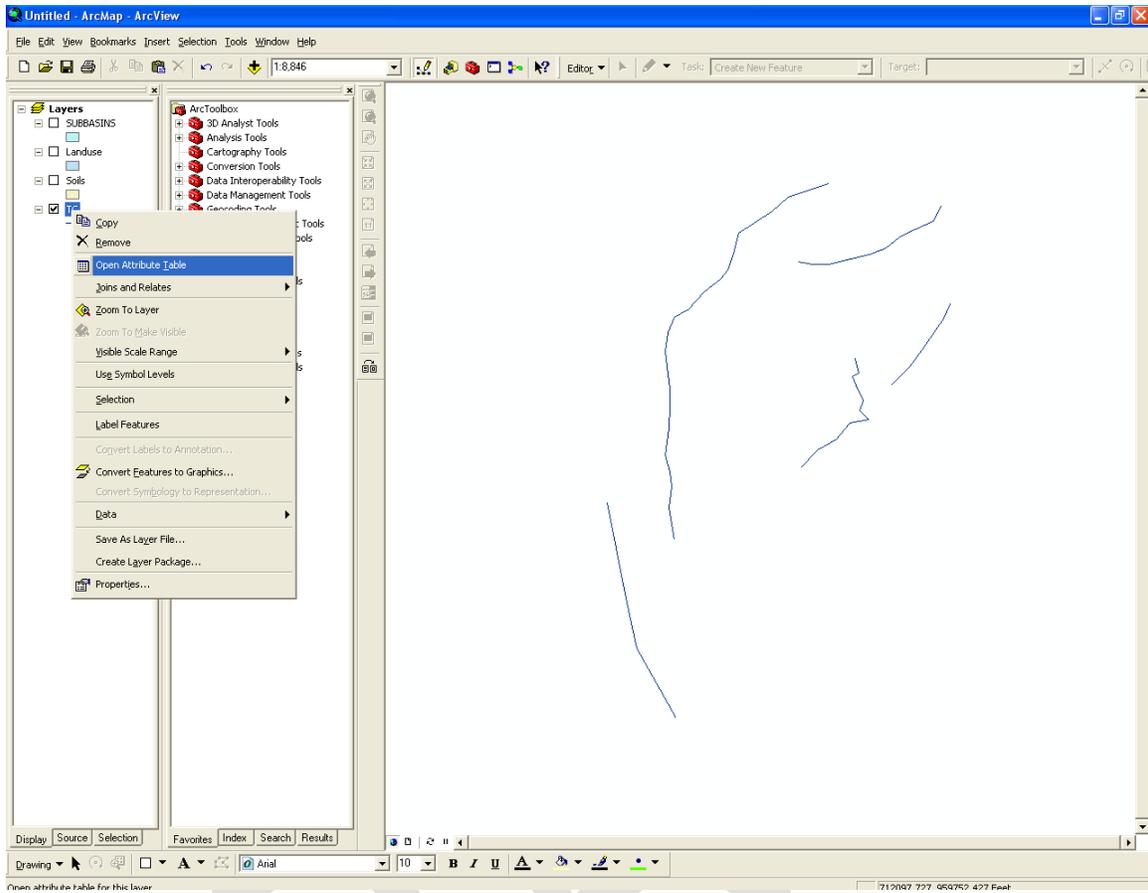
To begin creating the shape file for the Time of Concentration shape file (Tc) open ArcMap. The Tc shape file is a polyline. See Appendix A2.2 for help with creating polylines in ArcMap. This shape file is used to enter data if the Clark Unit Hydrograph is selected for the project.

2.4.1 Creating Fields

As can be seen in the Required Fields table in Appendix A1, the Tc shape file must have five fields: AREAID, BASINID, LENGTH, USGE, and DSGE.

To enter these into the Tc shape file:

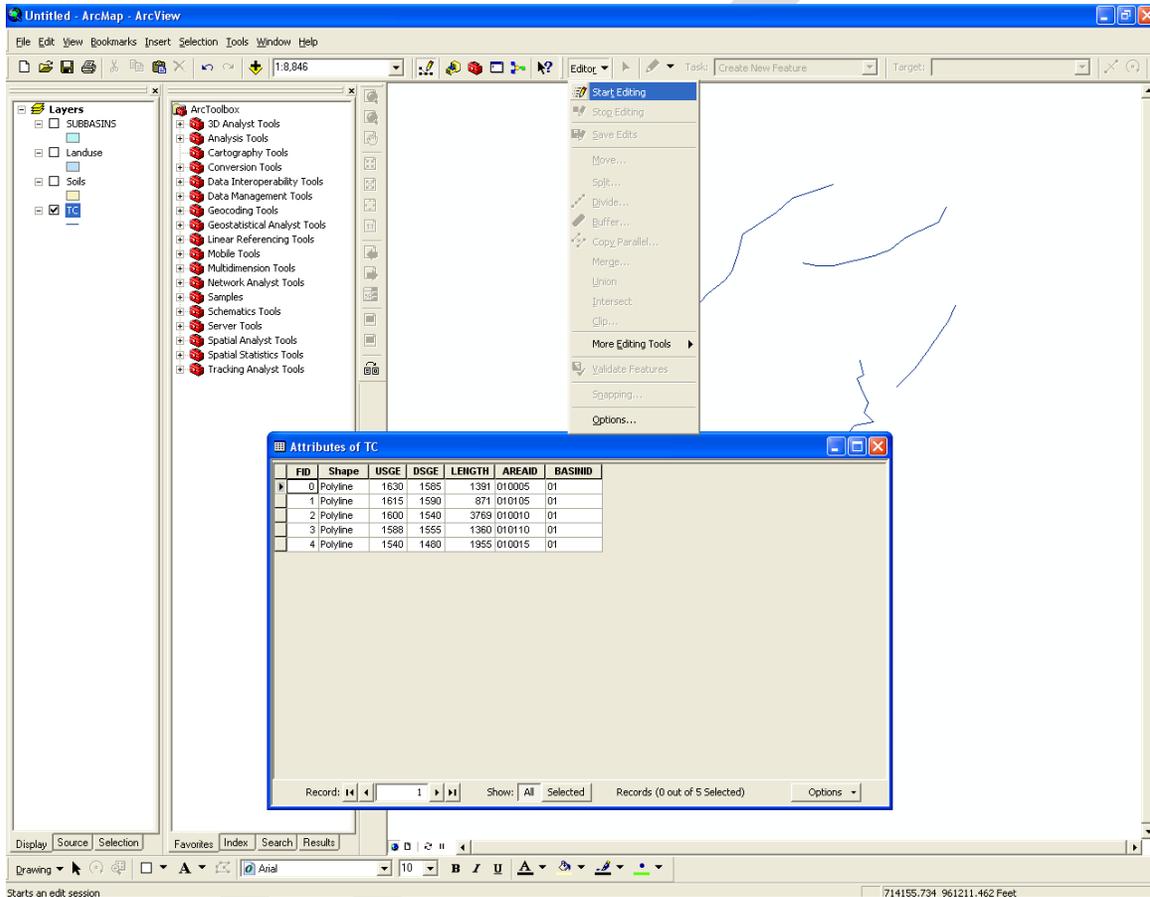
- Ensure that the shape file editing mode is off, otherwise the following cannot be performed
 - To determine if the editing mode is on:
 - Go to the *Editor tab*
 - If the *Start Editing* button can be clicked on then the editing mode is off
 - If the *Start Editing* button is not available then click the *Stop Editing* button to terminate the editing session
- Right click on the Tc shape file in the display list on the left of the screen in ArcMap
- Then select *Open Attribute Table* from the pull down menu
- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for AREAID
 - In the **New Field** window enter AREAID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since AREAID is specified as a 'Character' data type
 - Then change the length to 6 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the BASINID
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter BASINID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since BASINID is specified as a 'Character' data type
 - Then change the length to 2 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the LENGTH
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter LENGTH for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since LENGTH is specified as a 'Numeric' data type
 - Then change the precision to 12 as specified in the Table of Required Fields in Appendix A1
 - Set/leave the scale set to zero
 - Then click *OK* in the **New Field** window
- Enter the information for USGE
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter USGE for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since USGE is specified as a 'Numeric' data type
 - Then change the precision to 9 as specified in the Table of Required Fields in Appendix A1
 - Set the scale set to 2
 - Then click *OK* in the **New Field** window
- Enter the information for DSGE
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter DSGE for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since DSGE is specified as a 'Numeric' data type
 - Then change the precision to 9 as specified in the Table of Required Fields in Appendix A1
 - Set the scale set to 2
 - Then click *OK* in the **New Field** window



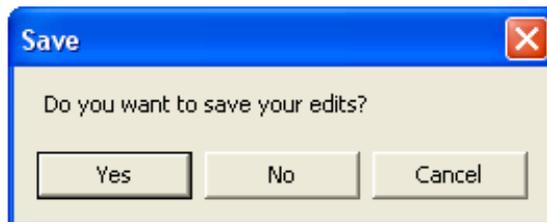
2.4.2 Entering Data

Before entering the applicable data, in the **Attribute** table of the shape file in ArcMap, that file must be selected for editing. To do this select the shape file by clicking on it, then go to the ArcMap *Editor* tab in the toolbar and select *Start Editing*. Data may now be entered into the **Attribute** table. It is important to follow the type of data that is required in the data fields. For example, if the data type is 'Numeric' then the data must be a real number. For the AREAID enter the same Sub Basin ID as in the Sub Basin shape file for the Sub Basin that contains the Tc line. The BASINID is the Major Basin ID of the Major Basin that the Tc line is in. There should be one Tc line for each Sub Basin. The LENGTH should be a numeric value. It is the length of the longest flow path in feet for each Sub Basin, this data can be

entered manually from field or other data or it can be measured in ArcMap using the 'Measure' tool as shown in Appendix A2.7. The Upstream Ground Elevation (USGE) is a numeric value. It is the elevation in feet of the upstream end of the time-of-concentration line. The Downstream Ground Elevation (DSGE) is also a numeric value. It is the elevation in feet of the channel bed at the end of the time-of-concentration line. After the data has been entered go back to the *Editor* tab and select *Stop Editing*. Some of the data fields that appear in the attribute table, such as FID, Shape, and Id, are built-in data fields that are created by the shape file when the shapes (polygons or polylines) are drawn. While entering data into the table, the user does not have to enter anything in these fields, they are filled automatically by the system.



Click **Yes** on the window that comes up to save the changes and continue.



2.5 L, Longest Watercourse Length for S-graph Unit Hydrograph (optional)

To begin creating the shape file for the Longest Watercourse Length (L), launch ArcMap. The L shape file is a polyline. See Appendix A2.2 for help with creating polylines in ArcMap. This shape file is used to enter data if the S-graph Unit Hydrograph is used.

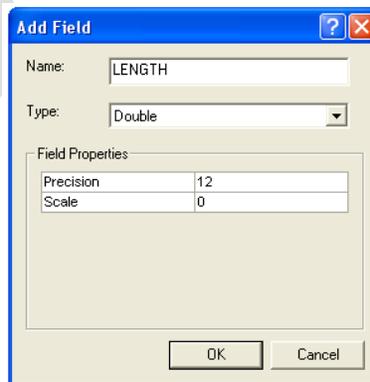
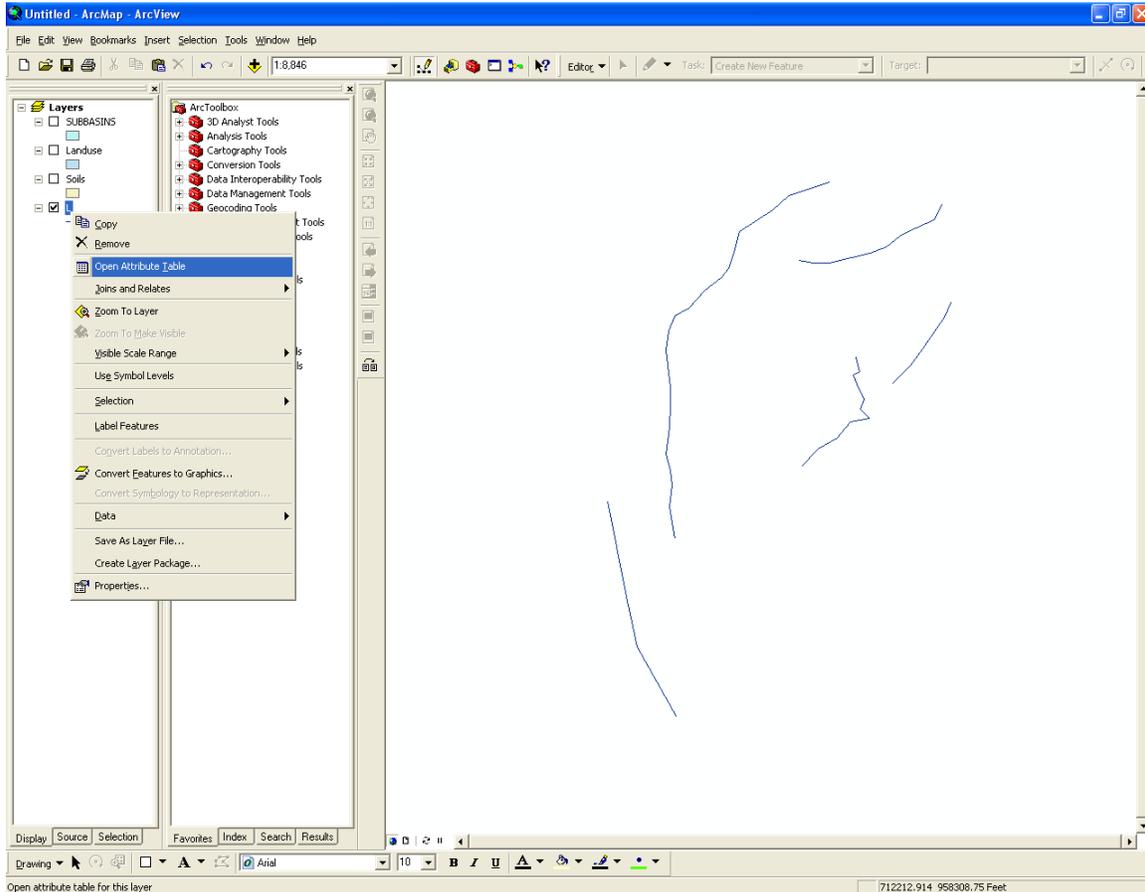
2.5.1 Creating Fields

As can be seen in the Required Fields table in Appendix A1, the L shape file must have five fields: AREAID, BASINID, LENGTH, USGE, and DSGE.

To enter these into the Longest Watercourse Length shape file:

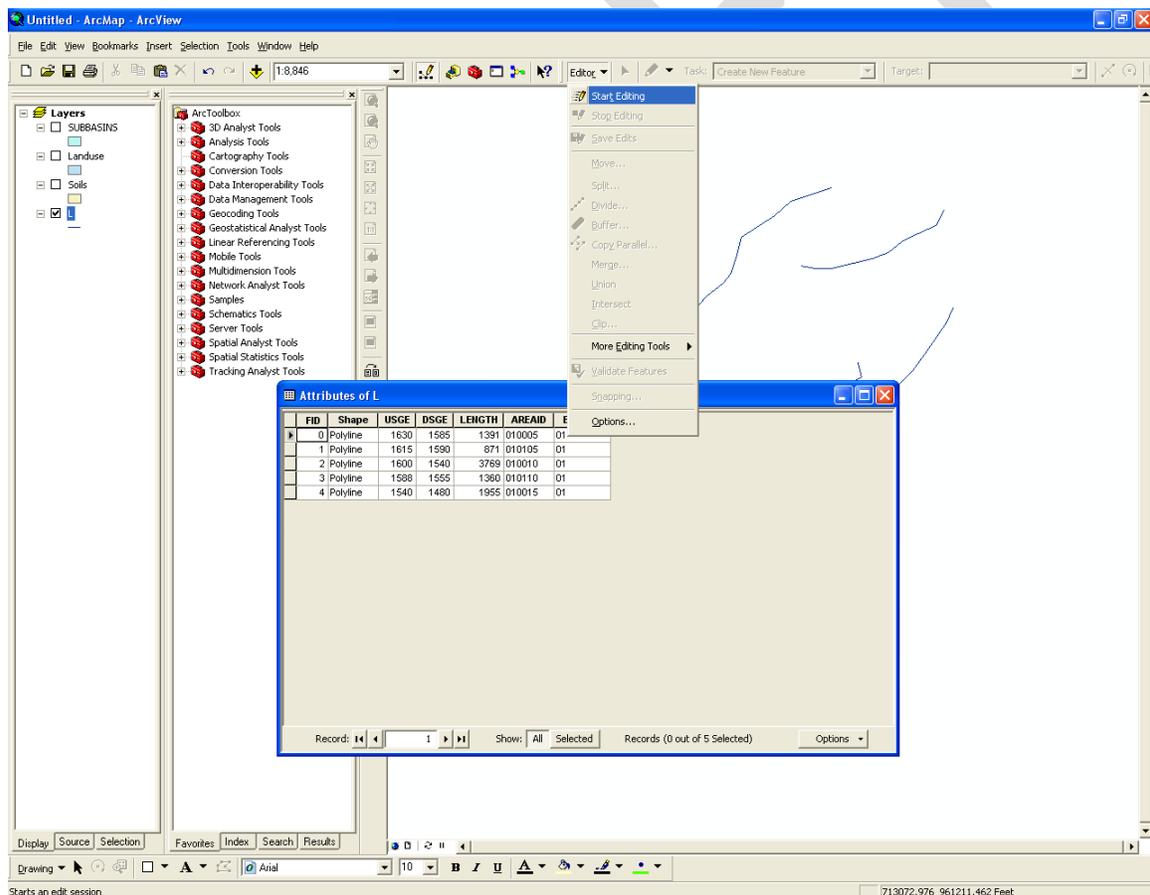
- Ensure that the shape file editing mode is off, otherwise the following cannot be performed
 - To determine if the editing mode is on:
 - Go to the *Editor tab*
 - If the *Start Editing* button can be clicked on then the editing mode is off
 - If the *Start Editing* button is not available then click the *Stop Editing* button to terminate the editing session
- Right click on the Sub Basin shape file in the display list on the left of the screen in ArcMap
- Then select *Open Attribute Table* from the pull down menu
- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for AREAID
 - In the **New Field** window enter AREAID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since AREAID is specified as a 'Character' data type
 - Then change the length to 6 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the BASINID
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter BASINID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since BASINID is specified as a 'Character' data type
 - Then change the length to 2 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the LENGTH
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter LENGTH for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since LENGTH is specified as a 'Numeric' data type
 - Then change the precision to 12 as specified in the Table of Required Fields in Appendix A1
 - Set/leave the scale set to zero
 - Then click *OK* in the **New Field** window
- Enter the information for USGE
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter USGE for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since USGE is specified as a 'Numeric' data type
 - Then change the precision to 9 as specified in the Table of Required Fields in Appendix A1
 - Set the scale set to 2
 - Then click *OK* in the **New Field** window

- Enter the information for DSGE
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter DSGE for the **'Name'**
 - Then select the type of data from the pull down menu as 'Double' since DSGE is specified as a 'Numeric' data type
 - Then change the precision to 9 as specified in the Table of Required Fields in Appendix A1
 - Set the scale set to 2
 - Then click **OK** in the **New Field** window

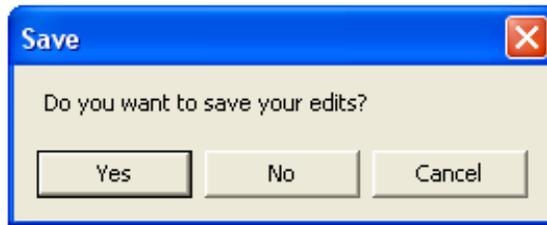


2.5.2 Entering Data

Before entering the applicable data, in the **Attribute** table of the shape file in ArcMap, that file must be selected for editing. To do this select the shape file by clicking on it, then go to the ArcMap *Editor* tab in the toolbar and select *Start Editing*. Data may now be entered into the **Attribute** table. It is important to follow the type of data that is required in the data fields. For example, if the data type is 'Numeric' then the data must be a real number. For the AREAID enter the same Sub Basin ID as in the Sub Basin shape file for the Sub Basin that contains the L line, each Sub Basin that the L line runs through should have a separate polyline. The BASINID is the Major Basin ID of the Major Basin that the L line is in. The LENGTH should be a numerical value. It is the length of the longest watercourse in feet, this data can be entered manually from field or other data or it can be measured in ArcMap using the *'Measure'* tool as shown in Appendix A2.7. The LENGTH should be the length of the water course in each Sub Basin. The Upstream Ground Elevation (USGE) is a numeric value. It is the elevation in feet of the upstream channel bed at the beginning of the watercourse. The Downstream Ground Elevation (DSGE) is also a numeric value. It is the elevation in feet of the downstream channel bed at the end of the watercourse. After the data has been entered go back to the ArcMap *Editor* tab and select *Stop Editing*. Some of the data fields that appear in the attribute table, such as FID, Shape, and Id, are built-in data fields that are created by the shape file when the shapes (polygons or polylines) are drawn. While entering data into the table, the user does not have to enter anything in these fields, they are filled automatically by the system.



Click Yes on the window that comes up to save the changes and continue.



2.6 Lca, Length to a Point Opposite Centroid for S-graph Unit Hydrograph (optional)

The Length to a Point Opposite Centroid shape file (Lca) is a polyline. See Appendix A2.2 for help creating polylines in ArcMap. The Lca shape file can be used to enter data when the S-graph Unit Hydrograph is selected for the project. The formal definition of the Lca is the length, from the concentration point, along the watercourse to a point opposite the centroid in feet, for DDMSW.

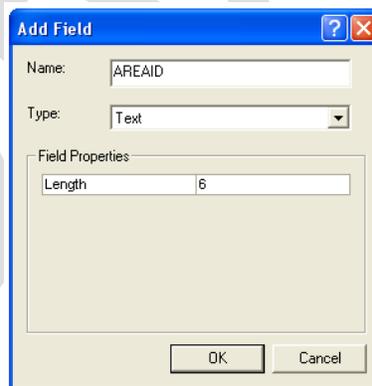
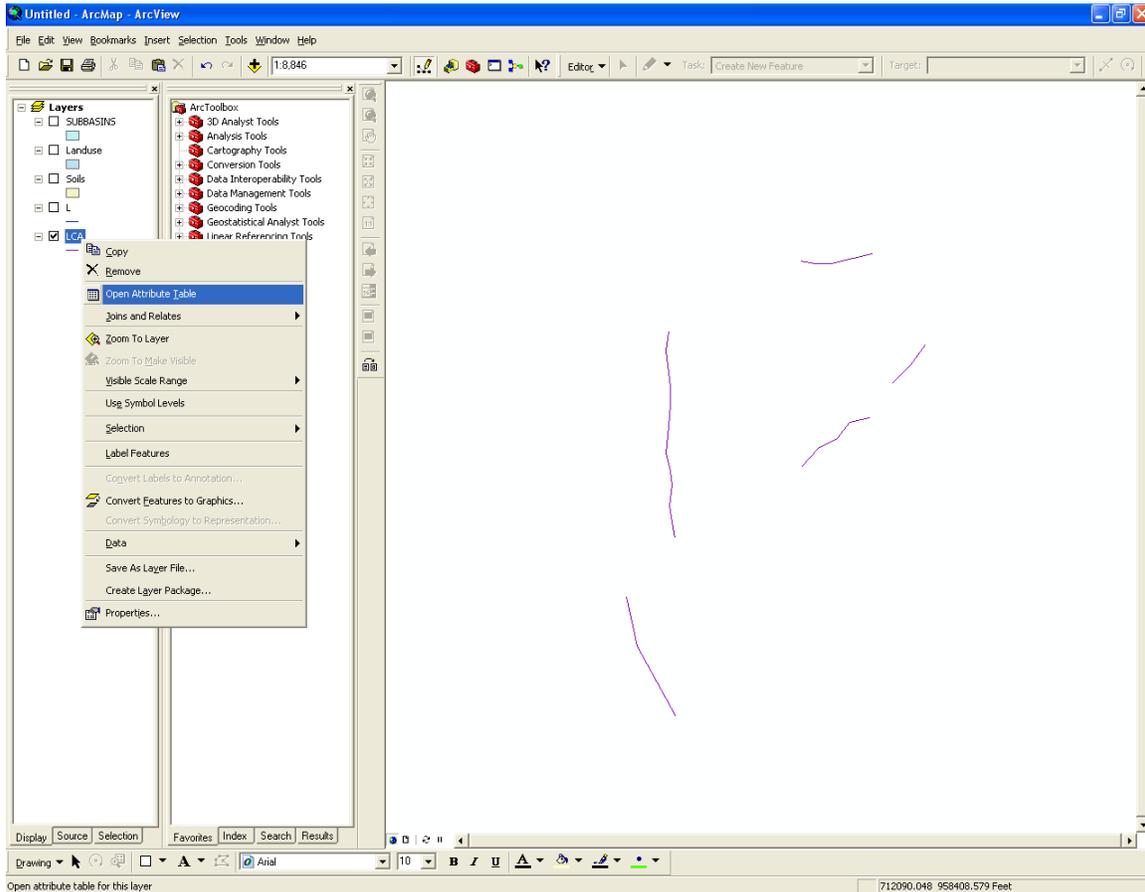
2.6.1 Creating Fields

As can be seen in the Required Fields table in Appendix A1, the Lca shape file must have three fields: AREAID, BASINID, and LENGTH.

To enter these into the Lca shape file:

- Ensure that the shape file editing mode is off, otherwise the following cannot be performed
 - To determine if the editing mode is on:
 - Go to the *Editor tab*
 - If the *Start Editing* button can be clicked on then the editing mode is off
 - If the *Start Editing* button is not available then click the *Stop Editing* button to terminate the editing session
- Right click on the Lca shape file in the display list on the left of the screen in ArcMap
- Then select *Open Attribute Table* from the pull down menu
- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for AREAID
 - In the **New Field** window enter AREAID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since AREAID is specified as a 'Character' data type
 - Then change the length to 6 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the BASINID
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter BASINID for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since BASINID is specified as a 'Character' data type
 - Then change the length to 2 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window
- Enter the information for the LENGTH
 - Select *Options* → *Add New Field...*
 - In the **New Field** window enter LENGTH for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since LENGTH is specified as a 'Numeric' data type
 - Then change the precision to 12 as specified in the Table of Required Fields in Appendix A1

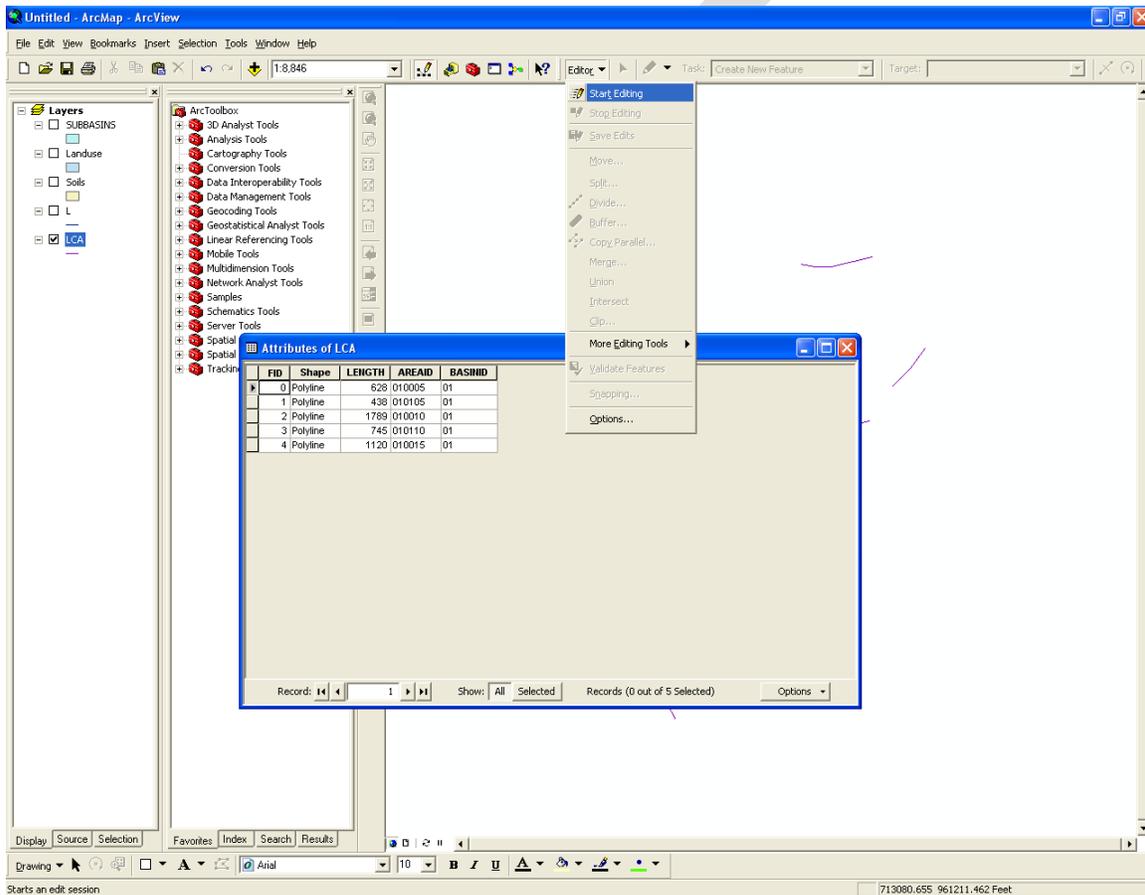
- Set/leave the scale set to zero
- Then click **OK** in the **New Field** window



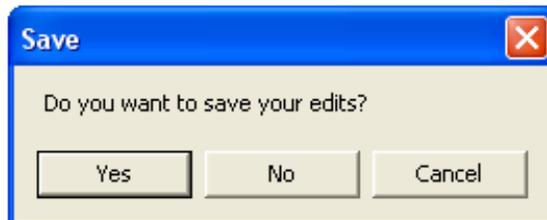
2.6.2 Entering Data

Before entering the applicable data, in the **Attribute** table of the shape file in ArcMap, that file must be selected for editing. To do this select the shape file by clicking on it, then go to the ArcMap *Editor* tab in the toolbar and select *Start Editing*. Data may now be entered into the **Attribute** table. It is important to remember the type of data that is required in the data fields, for example if the data type is 'Numeric' then

the data must be a real number. For the AREAID, the same AREAID should be entered as in the Sub Basin shape file for the applicable Sub Basin that the line is in. The BASINID is the Major Basin ID that the Lca line is in; there should be one Lca line for each Sub Basin. The LENGTH is a numeric value that denotes the length to the centroid. LENGTH should be measured in feet, this data can be entered manually from field data or previous studies or the 'Measure' tool can be used in ArcMap as shown in Appendix A2.7. The LENGTH refers to the length of Lca line in each Sub Basin. After the data has been entered go back to the *Editor* tab and select *Stop Editing*. Some of the data fields that appear in the attribute table, such as FID, Shape, and Id, are built-in data fields that are created by the shape file when the shapes (polygons or polylines) are drawn. While entering data into the table, the user does not have to enter anything in these fields, they are filled automatically by the system.



Click **Yes** on the window that comes up to save the changes and continue.



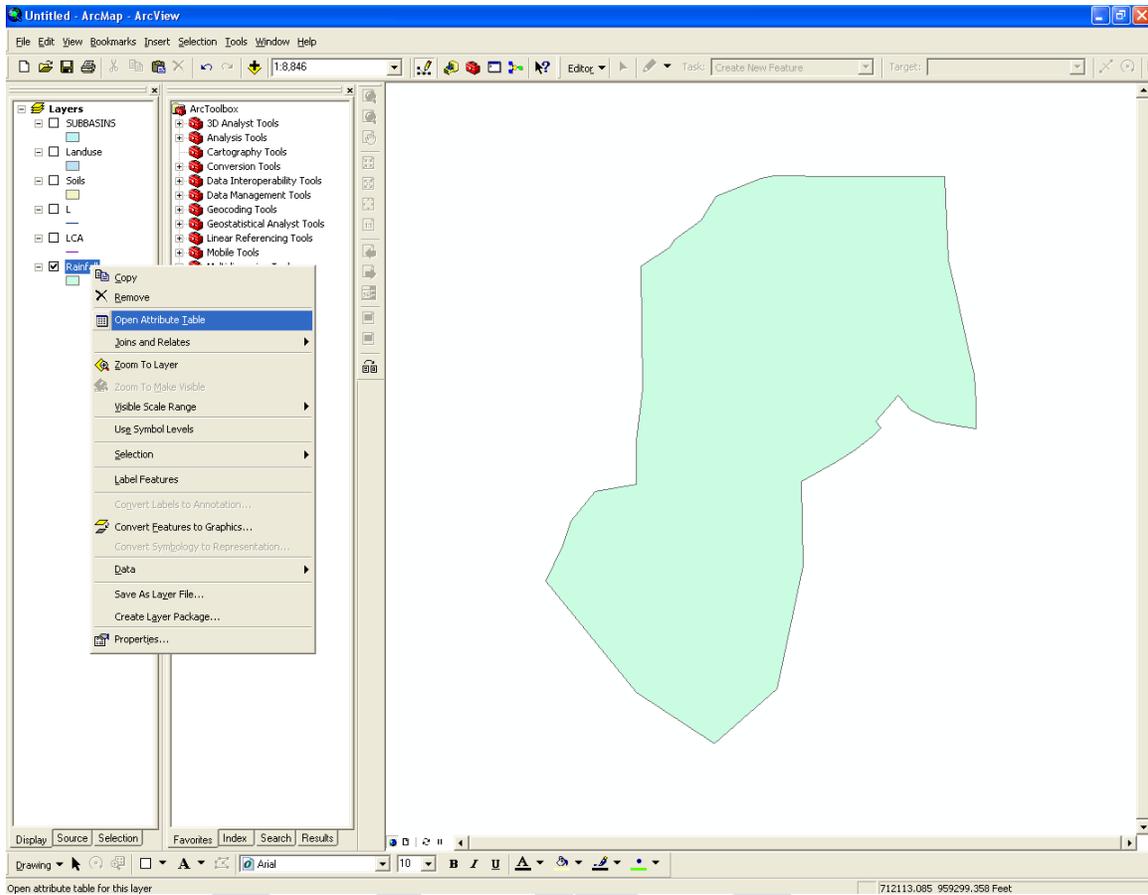
2.7 NOAA 14 Rainfall

The Rainfall shape file consists of a polygon (or polygons) that cover the entire study area, to begin open ArcMap and create the polygon. In most cases the Sub Basin shape file can be used for the Rainfall shape file since it contains the entire study area, all needed is to add the rainfall data to it. The following is a generic example using a separate Rainfall shape file. To use the Sub Basin shape file simply perform the same operations on the Sub Basin shape file.

2.7.1 Creating Fields

As can be seen in the Required Fields table in Appendix A1, the Rainfall shape file must have the field RAINID. To enter this into the Rainfall shape file:

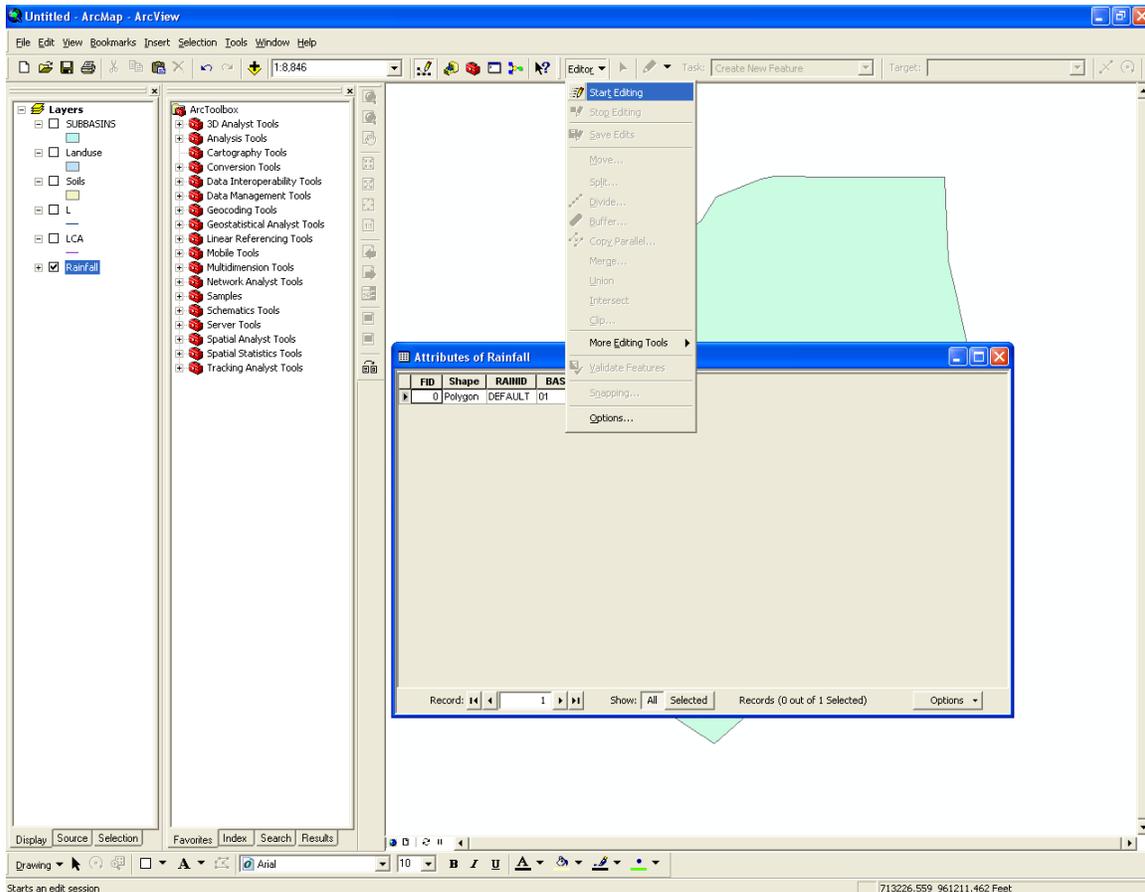
- Ensure that the shape file editing mode is off, otherwise the following cannot be performed
 - To determine if the editing mode is on:
 - Go to the *Editor tab*
 - If the *Start Editing* button can be clicked on then the editing mode is off
 - If the *Start Editing* button is not available then click the *Stop Editing* button to terminate the editing session
- Right click on the Rainfall shape file in the display list on the left of the screen in ArcMap
- Then select *Open Attribute Table* from the pull down menu
- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for RAINID
 - In the **New Field** window enter RAINID for the **'Name'**
 - Then select the type of data from the pull down menu as 'Text' since RAINID is specified as a 'Character' data type
 - Then change the length to 8 as specified in the Table of Required Fields in Appendix A1
 - Then click *OK* in the **New Field** window



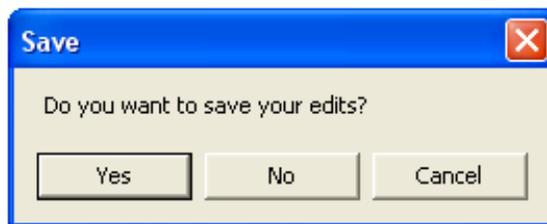
2.7.2 Entering Data

Before entering the applicable data, in the **Attribute** table of the shape file in ArcMap, that file must be selected for editing. To do this select the shape file by clicking on it, then go to the ArcMap *Editor* tab in the toolbar and select *Start Editing*. Data may now be entered into the **Attribute** table. For the Rainfall shape file the only field required is RAINID. RAINID is used to identify which of the Rainfall Ids found under *Hydrology* in DDMSW is being considered. DDMSW always begins each project with a Rainfall ID named DEFAULT. Thus in most cases DEFAULT is all that needs to be entered into the RAINID data field. If more complex analysis is desired multiple Rainfall Ids can be created, see Appendix A3.5 for instructions, and then the applicable Rainfall ID would need to be entered into the RAINID field. After the

data has been entered go back to the *Editor* tab and select *Stop Editing*. Some of the data fields that appear in the attribute table, such as FID, Shape, and Id, are built-in data fields that are created by the shape file when the shapes (polygons or polylines) are drawn. While entering data into the table, the user does not have to enter anything in these fields, they are filled automatically by the system.

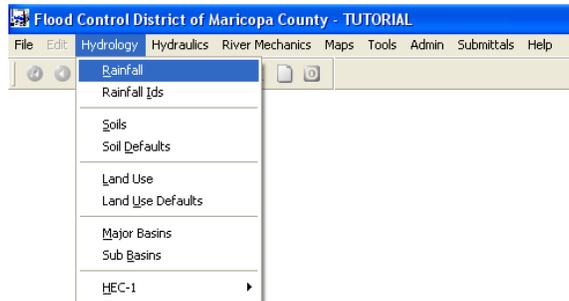


Click **Yes** on the window that comes up to save the changes and continue.

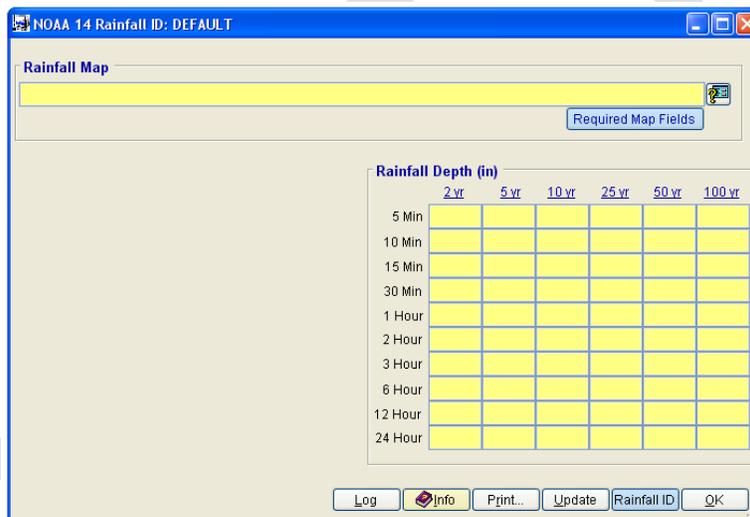


3 Loading ESRI GIS Shape Files into DDMSW *Rainfall*

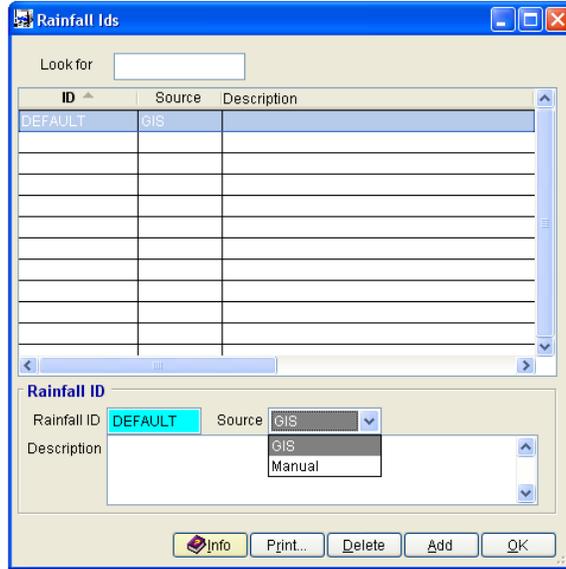
To update the Rainfall data in DDMSW go to *Hydrology* and select *Rainfall* from the pull down menu.



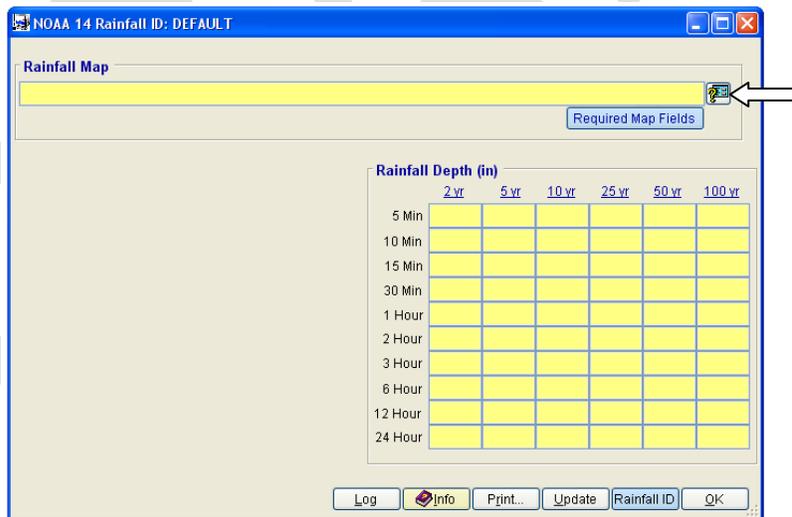
The default window that comes up in DDMSW 4.6.0 is for using shape files.



If this window does not come up, go to *Hydrology* and click on *Rainfall Ids*. That will open a new window that will allow the source of the Rainfall data to be chosen, select *GIS* to use a shape file. Then open the **Rainfall** window to load the shape file.



The shape file for the rainfall may now be loaded into DDMSW, to do this click on the indicated button in the **NOAA 14 Rainfall ID** window. This will bring up another window which allows navigation of the files on the computer, select the applicable file. After the file has been loaded click on the *Save* button at the bottom of the window, the Rainfall data is now ready to be updated.



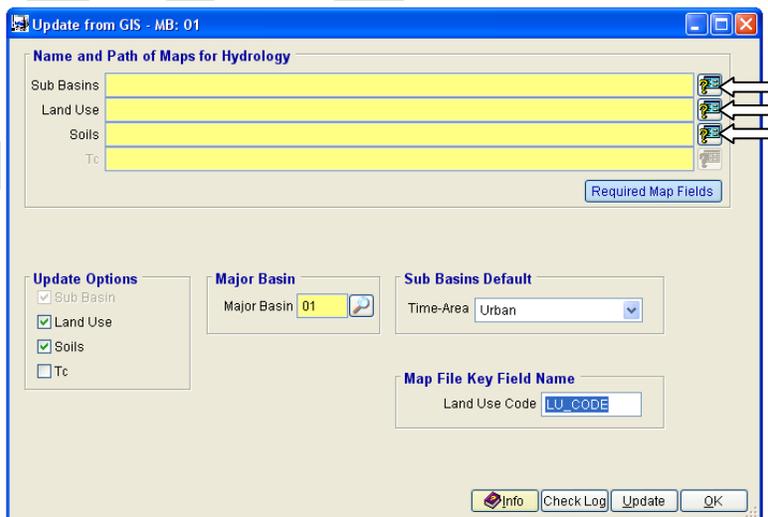
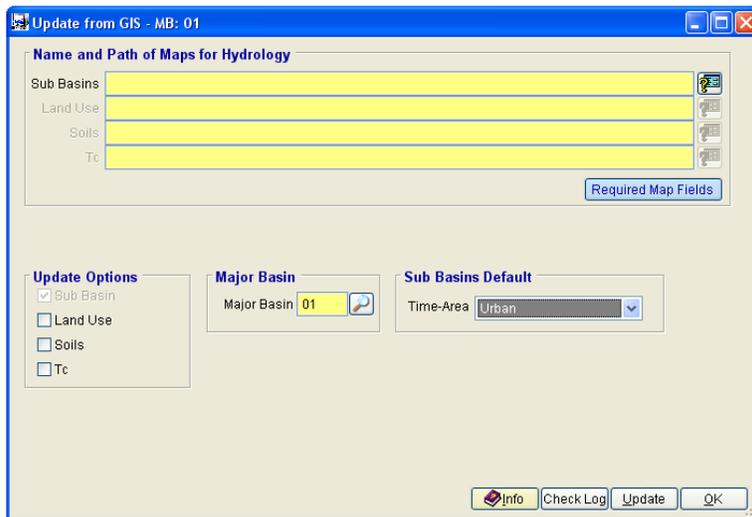
Hydrology

To update the Hydrology data in DDMSW, click on the *Maps* menu item on the menu bar and select *Update Hydrology* from the pull down menu.

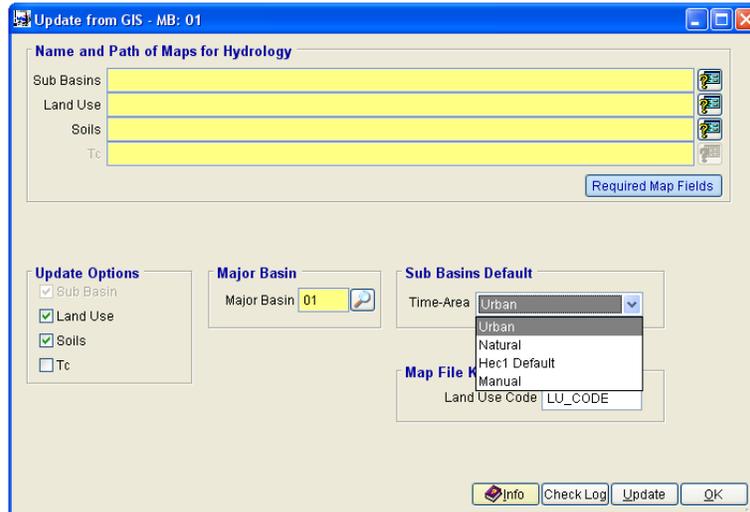
Then:

- The data that the user wishes to update must be selected from the **Update Options**

- Select the data to be updated by clicking on the applicable boxes
- Note that the Sub Basin is automatically available since it is required
- After the data that is going to be loaded has been selected the applicable shape files may be loaded
 - To load the shape files click on the 'Browse' icon indicated
 - This will open a window that allows the user to browse the files on the computer and select the correct shape file



- The field '**Land Use Code**' under **Map File Key Field Name** is a new feature that allows the user to choose the required field name for the land use code based on the field name used in the shape file
 - The field names LU_CODE and LUCODE are generally used by most agencies
 - DDMSW will recognize any name that is entered into the Land Use Code field, thus the Field Name can be anything that meets all of the requirements previously mentioned
 - Then the '**Time-Area**' type may be selected from the pull down menu



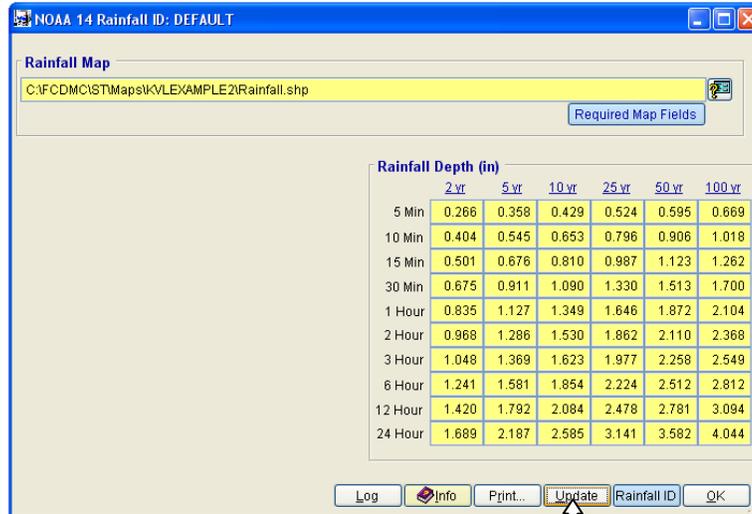
After the shape files have been loaded, the '**Land Use Code**' field name entered, and the '**Time-Area**' selected click Save. If there is only one Major Basin in the project, then DDMSW is ready to update the Hydrology data. If there are multiple Major Basins then click on the '*Magnifying Glass*' icon by the '**Major Basin**' field and select the other Major Basins. Repeat the process for the other Major Basins and update each. Note that if multiple Major Basins are used that the Major Basins must be created first in DDMSW, they are not automatically updated from the shape files.

4 Computing Hydrologic Parameters with ESRI GIS Shape Files

After the ESRI shape files have been loaded into DDMSW, the program is ready to compute the hydrologic parameters.

To have DDMSW calculate the Rainfall data do the following:

- Go to *Hydrology* → *Rainfall* to open the **Rainfall** window
- Ensure that the shape file has been loaded into the program
- Click on the *Update* button at the bottom of the window
- This will bring up a **Message** box, click Yes
- The program should then calculate the Rainfall data
- When the program returns to the **Rainfall** window the '**Rainfall Depth**' table should be populated



To calculate the Hydrology data perform the following:

- Go to *Maps* → *Update Hydrology* this should open the **Update from GIS** window
- Ensure that the required shape files have been loaded
- Click on the *Update* button at the bottom of the window
- This will bring up a **Message** box, click **Yes**
- DDMSW should then update the applicable fields from the loaded shape files
- After the update is complete the program should return to the **Update from GIS** window
- To check the data that was loaded from the shape files, go to *Hydrology* and select the following:
 - Soils – to view the soil data
 - Land Use – to view the land use data
 - Sub Basins – to view the sub basin data
 - Major Basins – to view the major basin data
 - Sometimes it is necessary to update the Major Basin data if the program did not do it automatically, to do this click on the update button at the bottom of the **Major Basin** window

Update from GIS - MB: 01

Name and Path of Maps for Hydrology

Sub Basins C:\FCDM\CIST\Maps\KVLEXAMPLE2\SubBasins.shp

Land Use C:\FCDM\CIST\Maps\KVLEXAMPLE2\Landuse.shp

Soils C:\FCDM\CIST\Maps\KVLEXAMPLE2\Soils.shp

Tc C:\FCDM\CIST\Maps\KVLEXAMPLE2\Tc.shp

Required Map Fields

Update Options

Sub Basin

Land Use

Soils

Tc

Major Basin

Major Basin 01

Sub Basins Default

Time-Area Urban

Map File Key Field Name

Land Use Code LU_CODE

Info Check Log Update OK

Question

This will update the Major Basin data for the Selected Updates as follows:

Sub Basin ID's will be updated in DDMSW.
 Land Use data will be deleted from DDMSW and replaced with GIS data.
 Soils data will be deleted from DDMSW and replaced with GIS data.
 Tc data will be updated in DDMSW.

Do you want to continue?

Yes No

Appendix

A1 Table of Required Fields for ESRI Shape files

The following is a key to the data type and length for the Required Fields table for ArcMap:

'Character' = 'Text' = 'String'
'Numeric' = 'Double'

For 'Text', the length is the number of characters that the field can contain. For 'Character' the data entered into the data field can be either alphabetical or numerical and the numeric input will be interpreted as a character. (It is important to note that ArcMap will not allow "special Characters" such as # or @ in a data field name and also that DDMSW requires that data fields do not begin with a numerical value.) If the data type required is Character 6 then select 'Text' and,

Length = 6

In the form of:

cccccc
Where c = any Character

Since the 'Numeric' is 'Double' there are two fields, '**Precision**' and '**Scale**'. For the length of a 'Double' data type the Precision is given by the number on the left of the decimal and the Scale is given by the number on the right of the decimal. The Precision is the total number of digits that the data contains and the Scale is the number of decimal places. As implied by the name, the 'Numeric' data type must contain only real numbers. For example if the data field requires a Numeric 9.2 then,

Precision = 9
Scale = 2

And the data entered will be in the form of:

xxxxxxx.xx
Where, x = any integer or digit

Map	Field Name	Type and Length	Description
	<i>Hydrology</i>		
Sub Basin	AREAID	Character 6	Unique ID
	BASINID	Character 2	Major Basin ID
	AREASF	Numeric 12.0	Area in square feet
Land Use	LU_CODE	Character 15	Land use Code (Field name can be changed by user)
Soils	SOIL_LID	Numeric 15.0	Soils code
Tc	AREAID	Character 6	Unique ID (same as sub basin)
	BASINID	Character 2	Major Basin ID

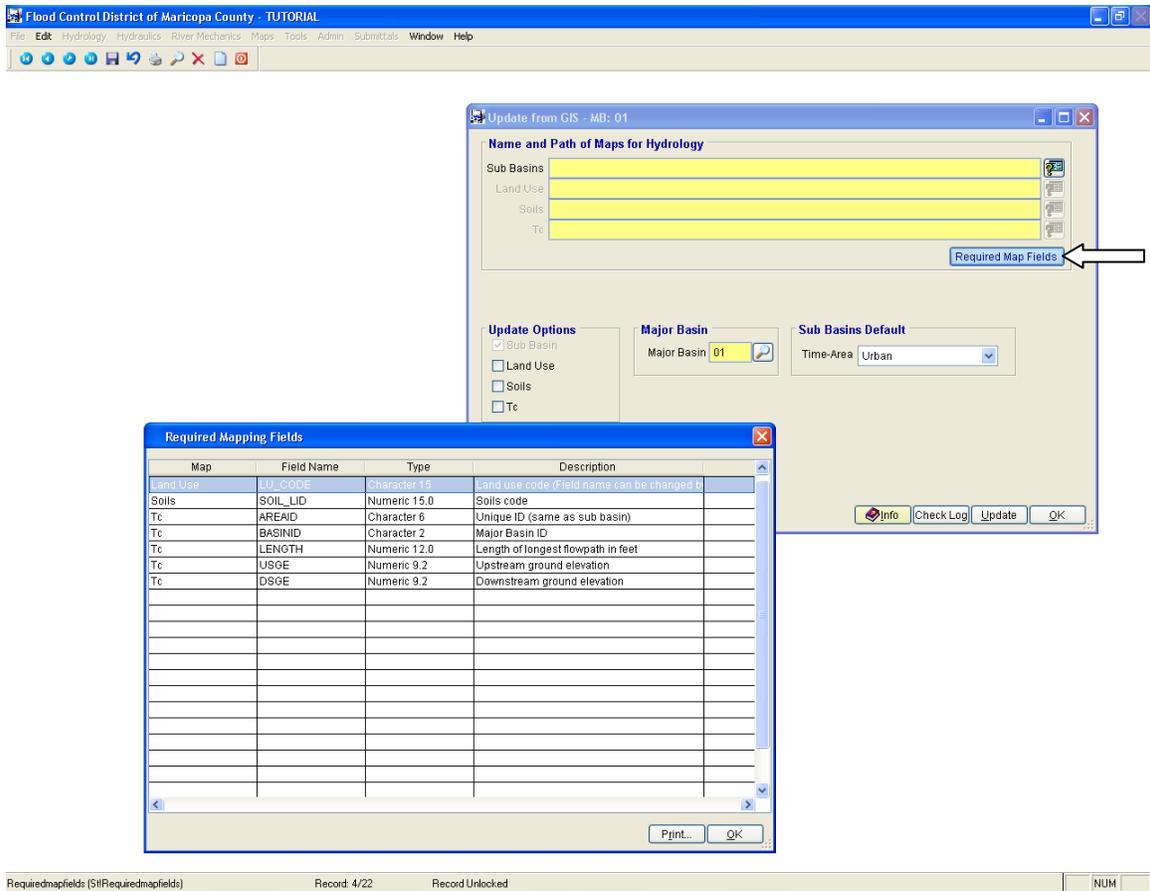
	LENGTH	Numeric 12.0	Length of longest flow path in feet
	USGE	Numeric 9.2	Upstream ground level
	DSGE	Numeric 9.2	Downstream ground level
L	AREAID	Character 6	Unique ID (same as sub basin)
	BASINID	Character 2	Major Basin ID
	LENGTH	Numeric 12.0	Length of longest watercourse in feet
	USGE	Numeric 9.2	Upstream ground level
	DSGE	Numeric 9.2	Downstream ground level
Lca	AREAID	Character 6	Unique ID (same as sub basin)
	BASINID	Character 2	Major Basin ID
	LENGTH	Numeric 12.0	Length to centroid in feet

Rainfall

Rainfall	RAINID	Character 8	Rainfall ID
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Map	Field Name	Type and Length	Description
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The Required Field information is always available in DDMSW by clicking on the *Required Map Fields* button in the **Hydrology** and **Rainfall** update windows.



The fields shown in the Required Fields tables must be included in the shape file being used for the program to function properly. Not only must the field name that DDMSW uses to identify the data be correct but also the type and length of the data must match the specified requirements.

A2 Useful ArcMap Tools and Tips

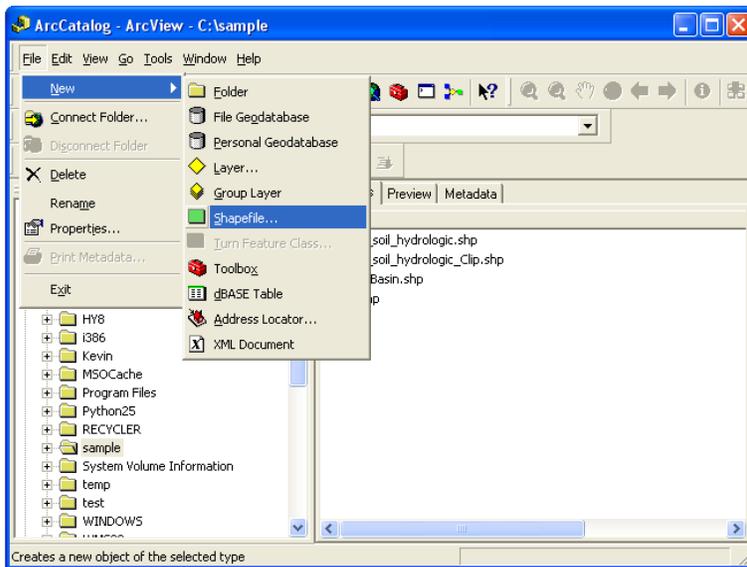
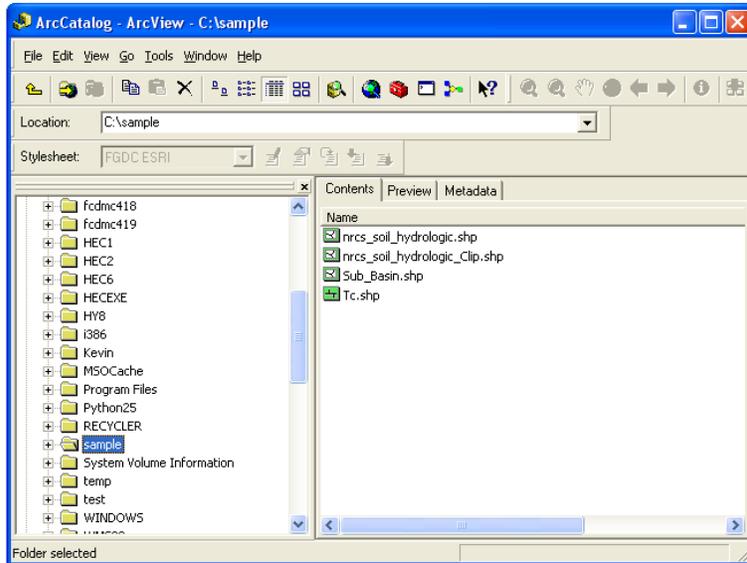
The following sections give instructions and illustrations for many of the useful tools in ArcMap for creating and preparing shape files to be loaded into DDMSW.

A2.1 Creating Polygons

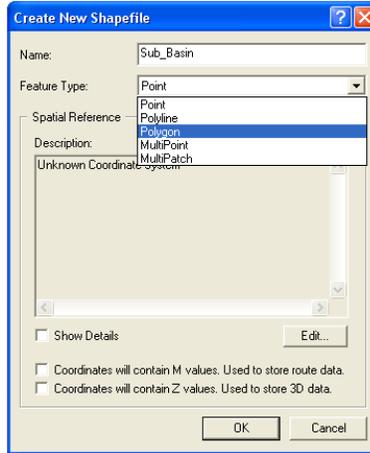
To begin creating a polygon open ArcMap. Open the *ArcCatalog* by clicking on the 'Yellow Drawer' icon indicated.



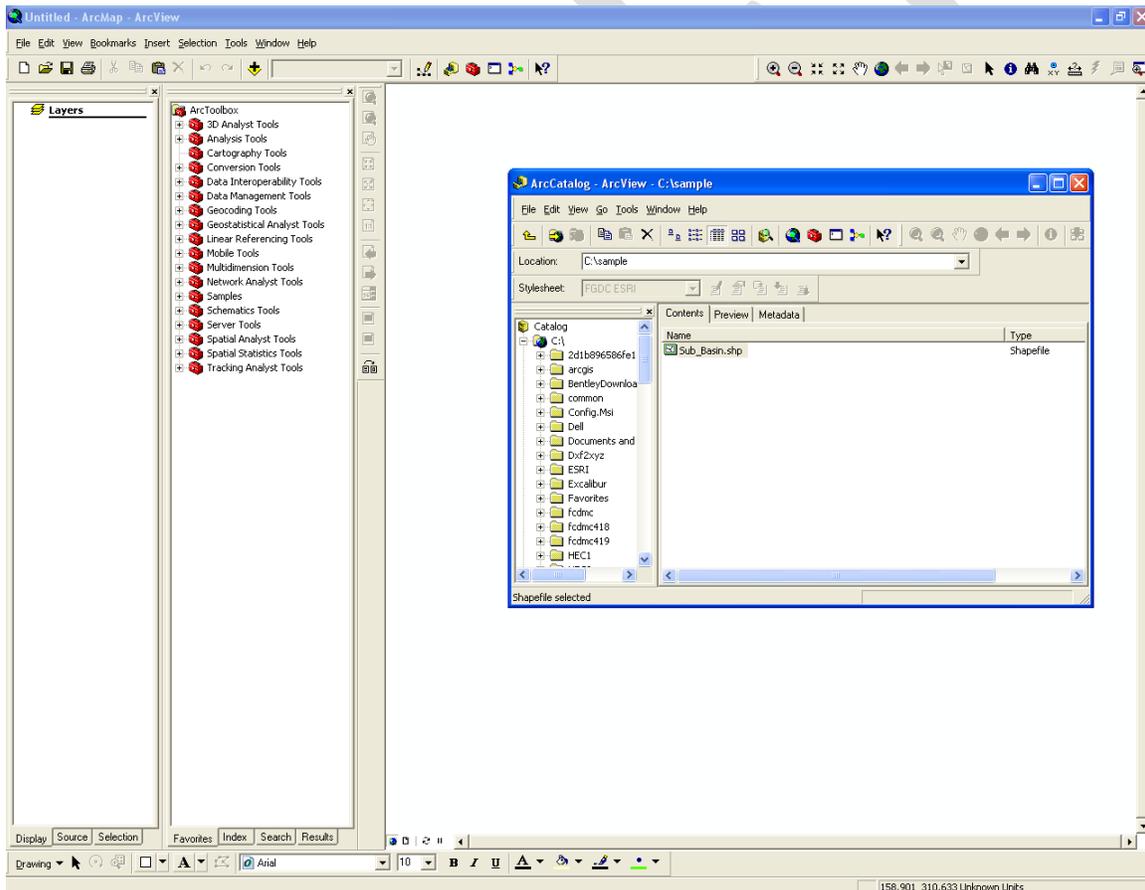
After the **ArcCatalog** is launched select a location from the Catalog Tree panel as is shown in the screen capture below to save the new shape file. When the destination folder has been selected, go to **File** → **New** → **Shapefile...** as shown below.



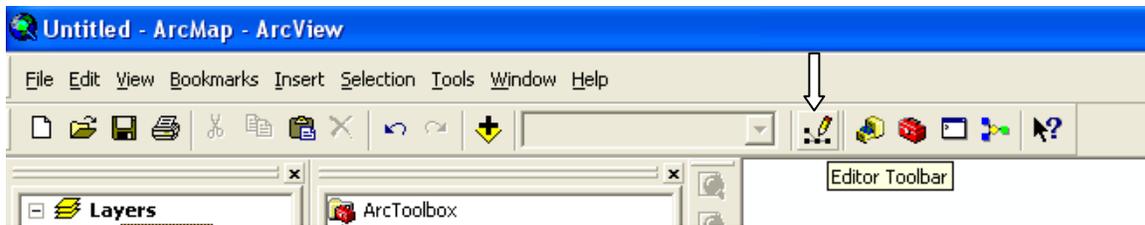
This will open the **Create New Shapefile** window.



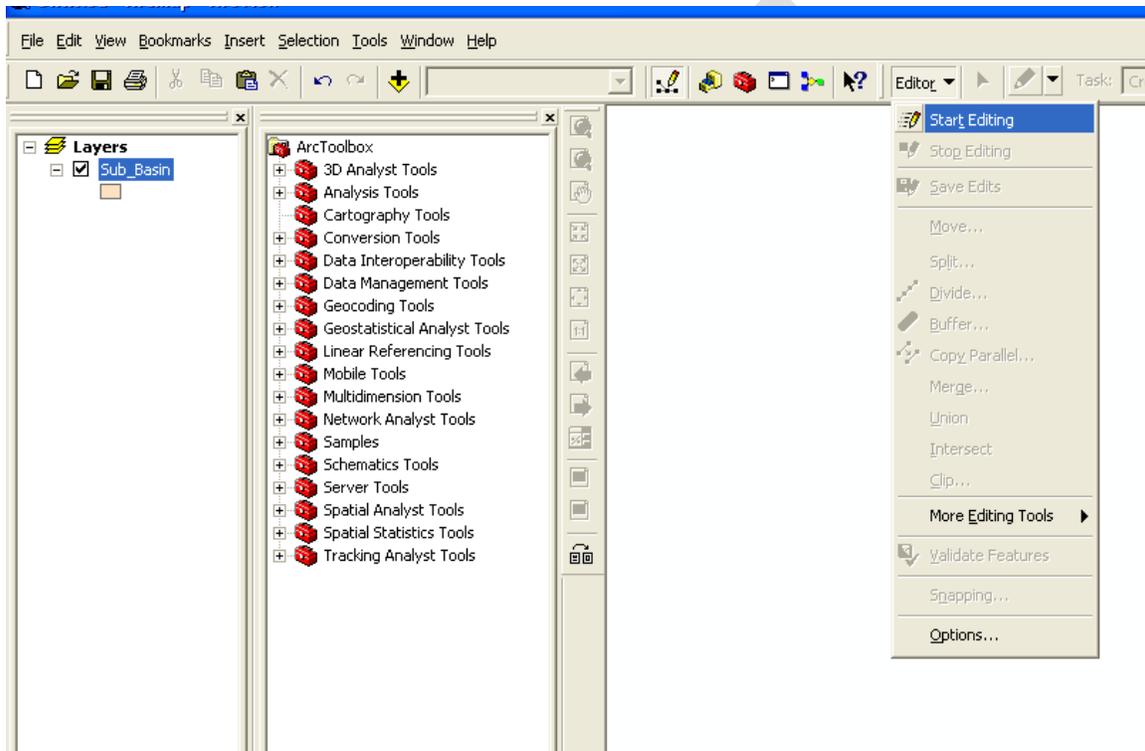
Type in the **'Name'** of the new shape file, in this example Sub Basin is used. Then select the **'Feature Type'** as *Polygon*, and then click **OK**. The shape file has now been created. Now select the shape file in **ArcCatalog** and drag it into the **ArcMap** display on the left side of the screen.



The next step is to create the actual polygon. To do this click on the *'Pencil'* icon indicated.

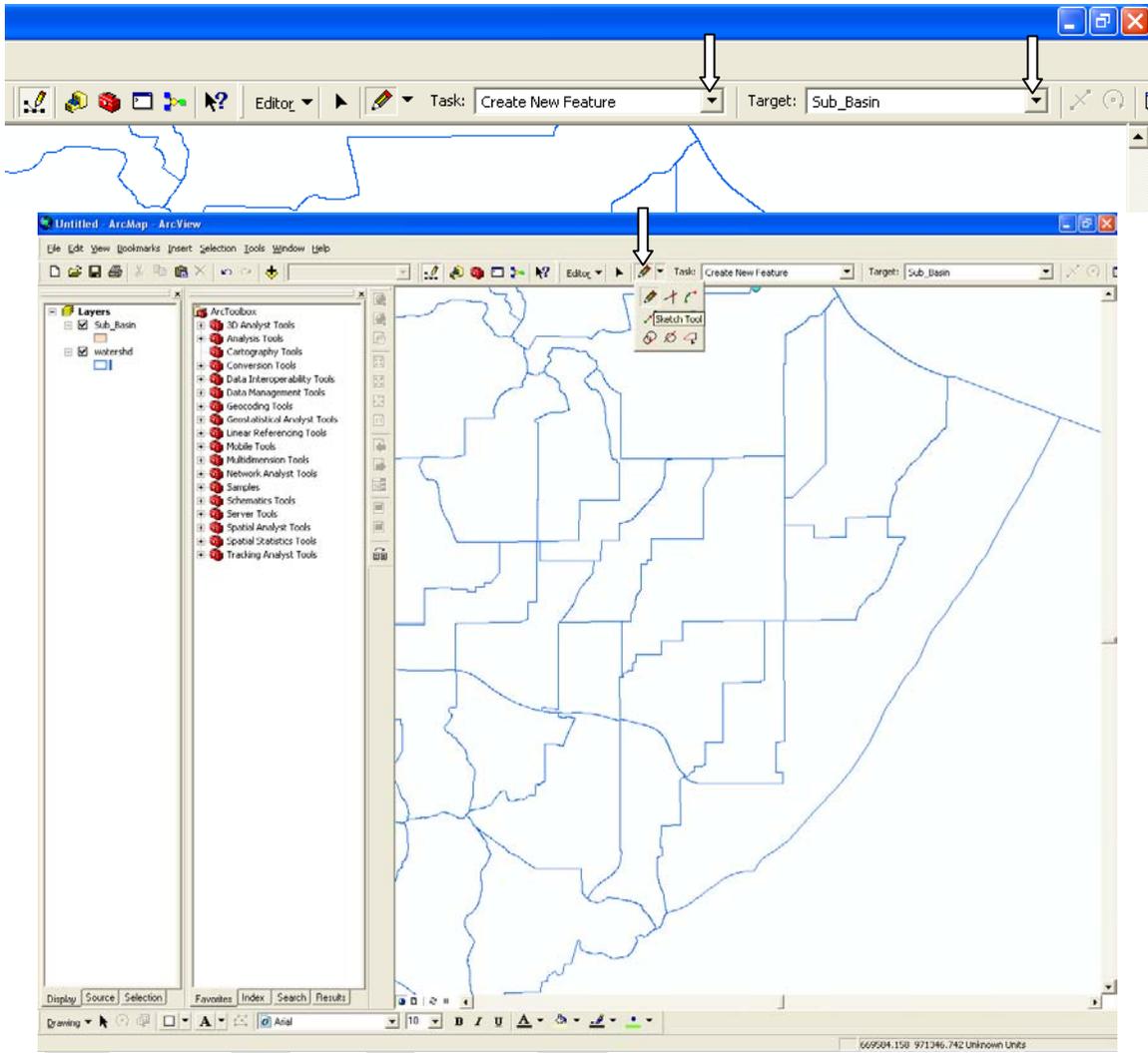


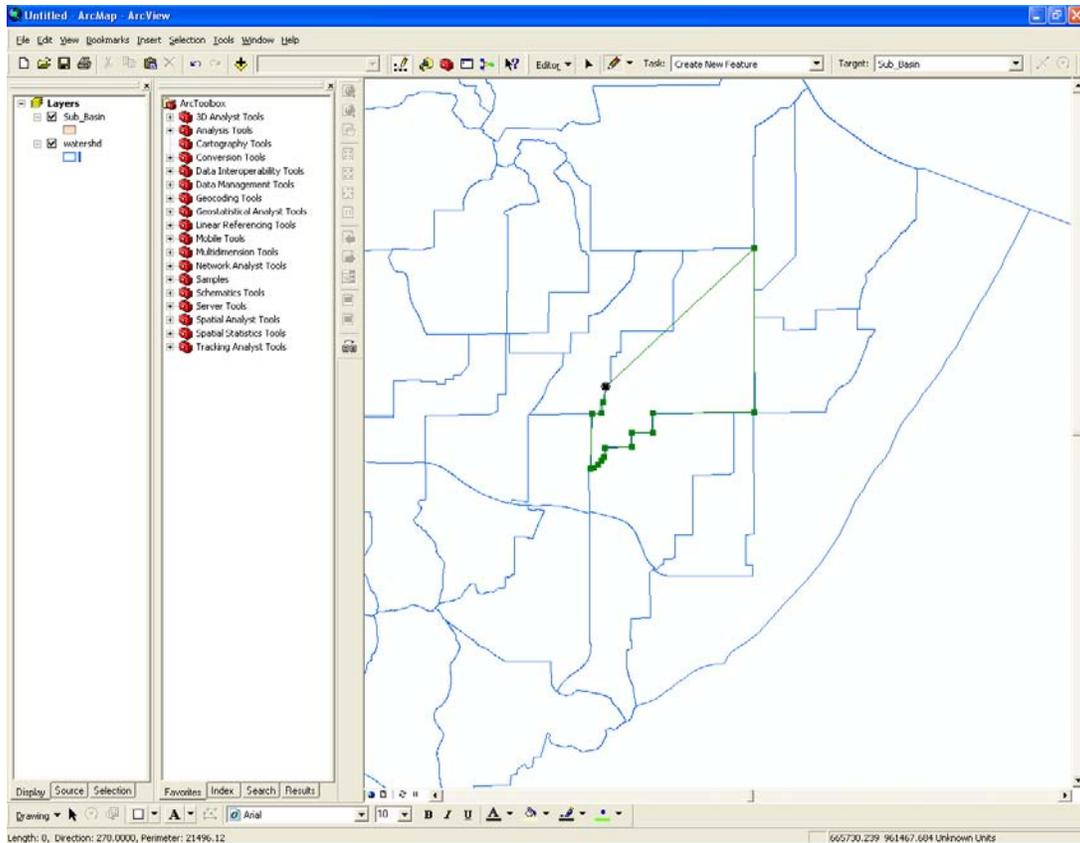
This opens up the **ArcMap Editor Toolbar** as shown. From this toolbar select *Editor* → *Start Editing*, this then displays more icons in the Editor Toolbar.



From these icons that are now visible select the icon indicated (this is usually by default a *'Pencil'* but if the user has already used this tool it will display whatever tool was used last). The polygon can then be drawn using the cursor. The technique being used in this example is to use an existing watershed shape file as the base to trace out the basins from it.

Before starting to draw the polyline it is important to ensure that the right feature is selected to be changed and that the desired operation will be performed on it. To do this check the **'Target'** field in the *Editor Toolbar* to see which feature is selected, if the right feature is already selected then proceed. If the desired feature is not selected then click on the button indicated to open the pull down menu and select the desired feature. To ensure that the correct operation will be performed check the **'Task'** field to ensure that Create New Feature is selected, if this is not selected then click on the indicated button to open the pull down menu and select Create New Feature. If there is only one shape file in ArcMap this is not a problem but if there are multiple shape files the user should ensure that they are editing the correct one.

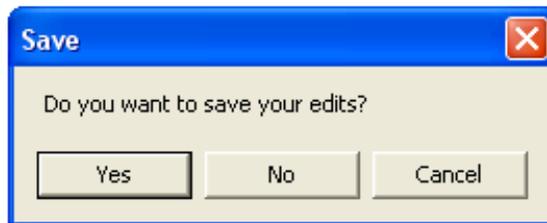




To use the cursor to draw the polygon:

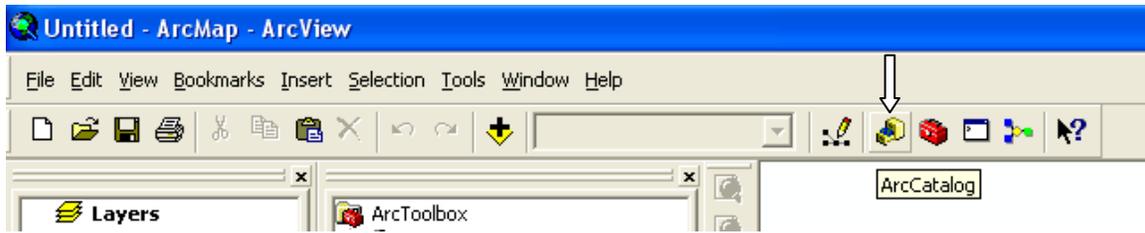
- Select the starting point and click once
- Then proceed to the next point and click again to complete the segment
 - Basically each vertex should be a point
 - These vertices are connected by line segments completing the polygon
- Double click on the last point in the polygon to finish drawing

After one polygon has been drawn others can be added by creating more points in the same shape file. When all the need polygons have been drawn go back to the **ArcMap Editor Toolbar** and select *Editor* → *Stop Editing*. Click Yes on the window that comes up to save the changes and continue.

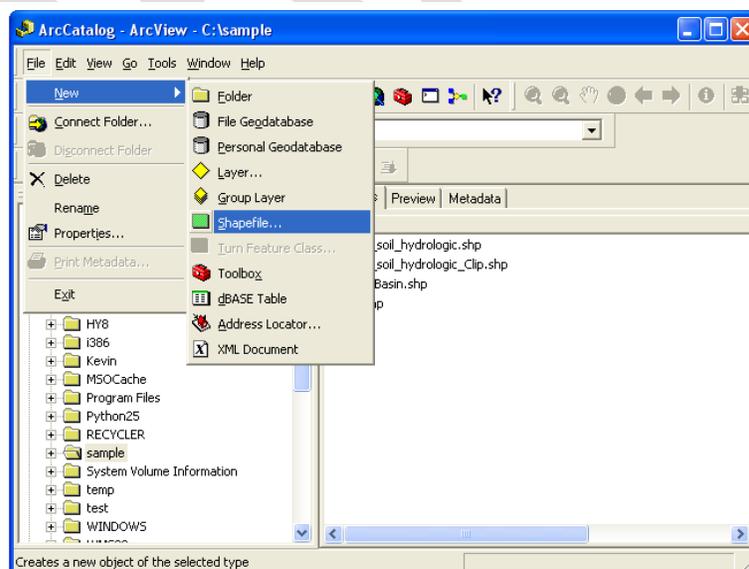
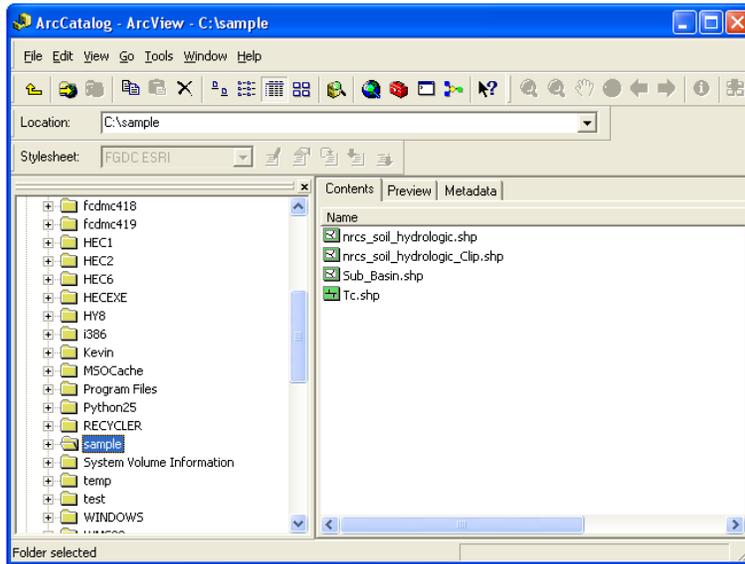


A2.2 Creating Polylines

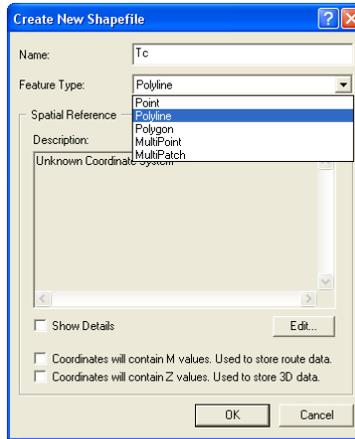
To begin creating a polyline launch ArcMap. Open the **ArcCatalog** by clicking on the yellow drawer icon indicated.



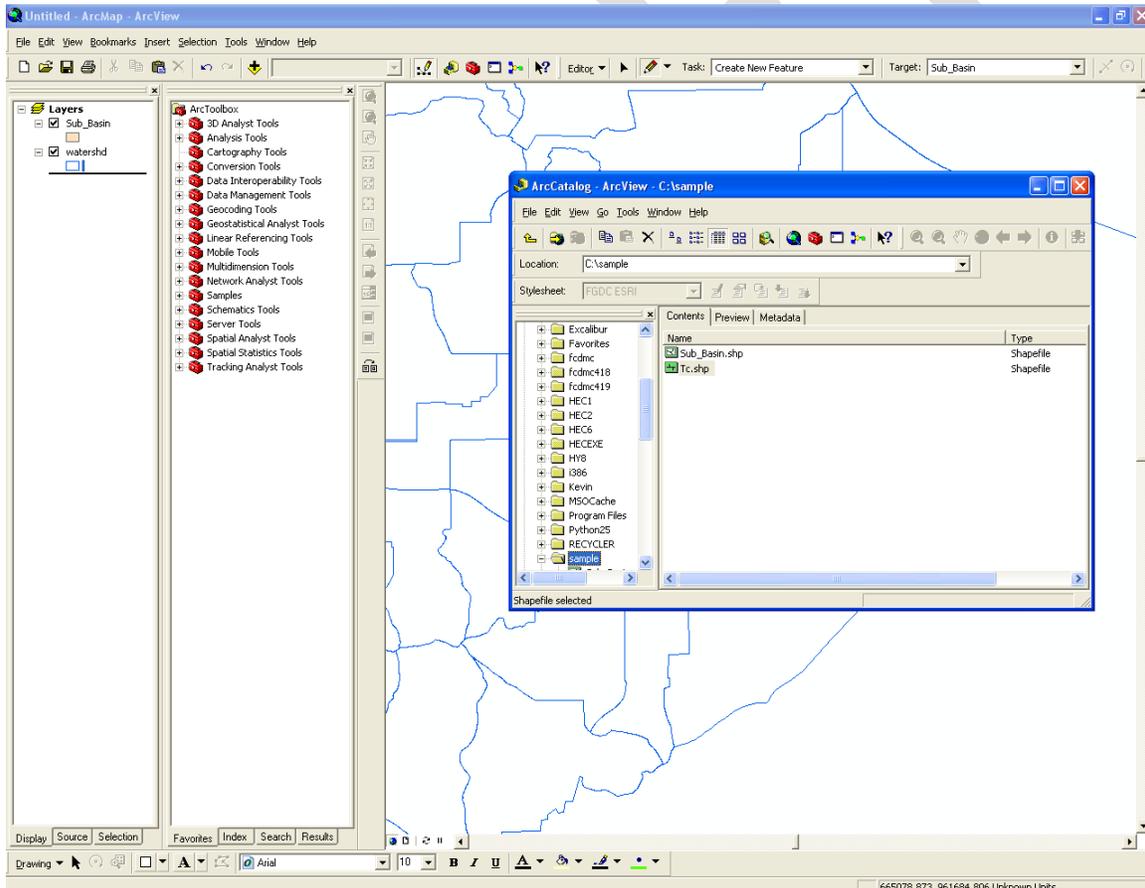
After the **ArcCatalog** is open select a location from the Catalog Tree panel as is shown in the screen capture below to save the new shape file. When the folder that is going to be used has been opened, select *File* → *New* → *Shapefile...* as shown below.



This will open the **Create New Shapefile** window.



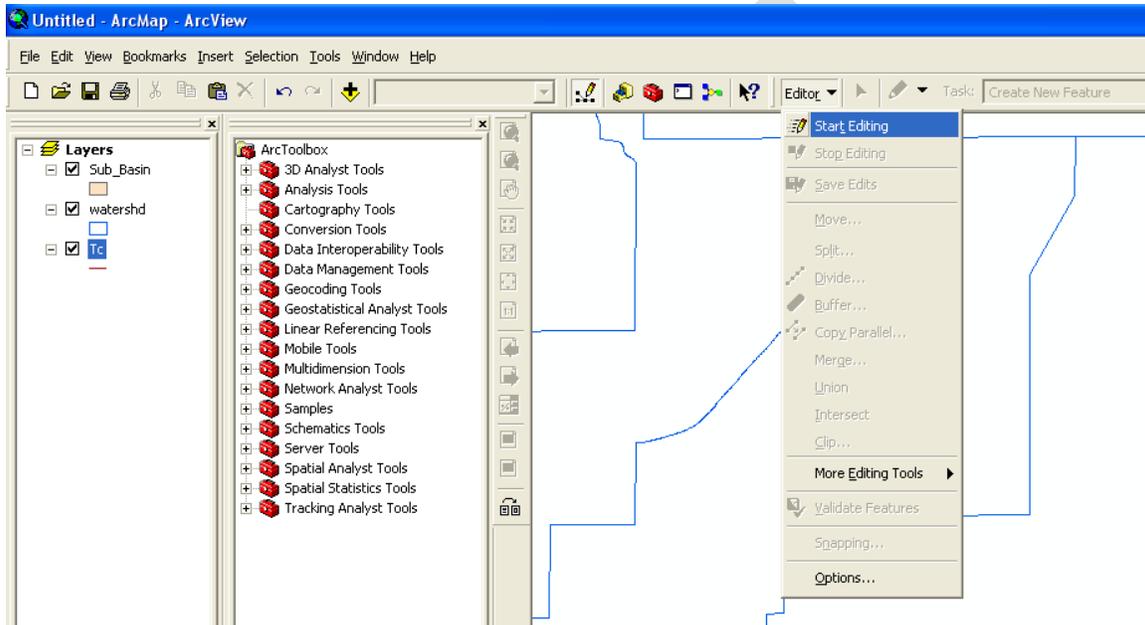
Then type in the **'Name'** of the new shape file, in this example Tc is used for the **'Name'** of the shape file. The **'Feature Type'** may be selected from the pull down menu, select *Polyline* then click **OK**. Now select the new shape file in **ArcCatalog** and drag it into the **ArcMap** display on the left of the screen.



The next step is to create the actual polyline. To do this click on the *'Pencil'* icon indicated.

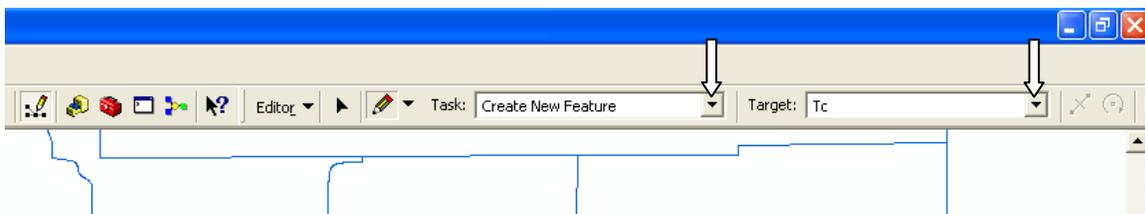


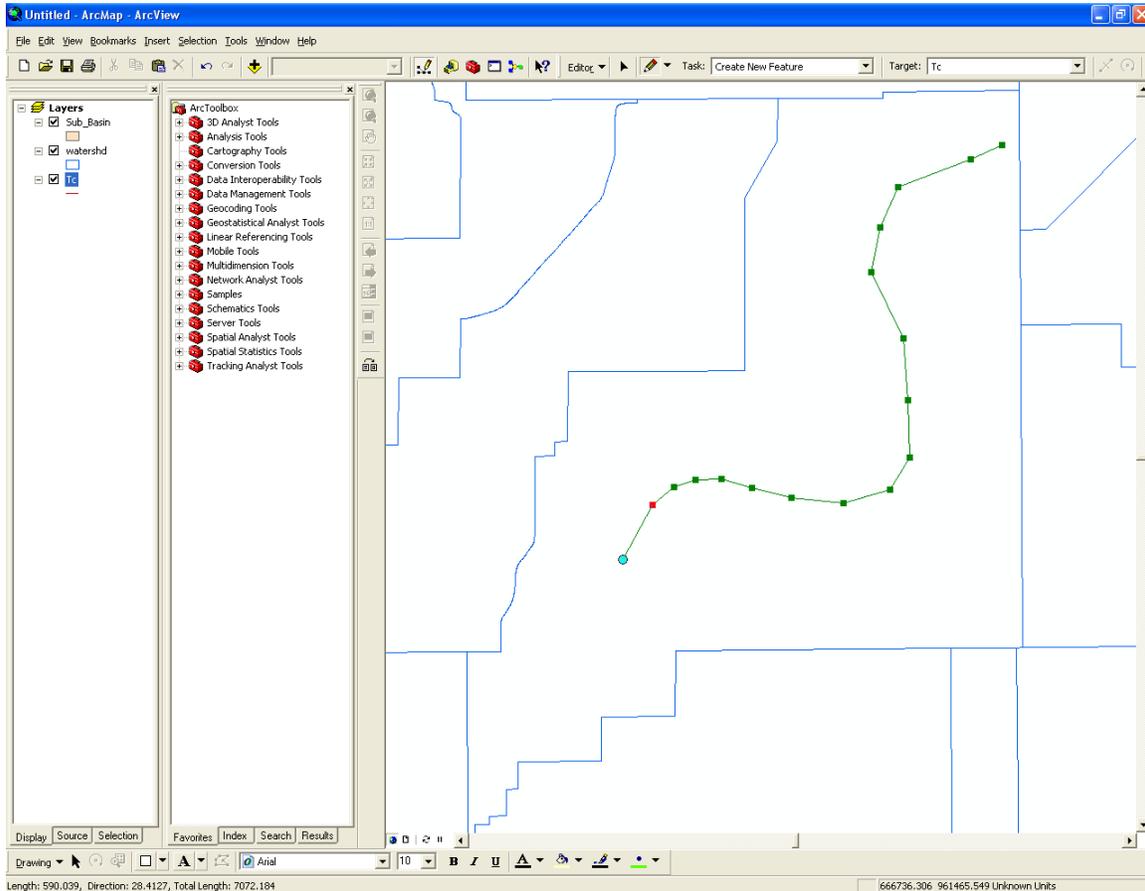
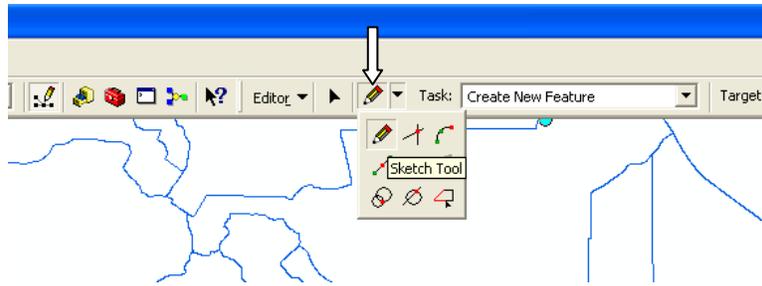
This opens up the ArcMap Editor Toolbar as shown. From this toolbar select *Editor* → *Start Editing*, this then displays more icons in the **Editor Toolbar**.



From these icons that are now visible select the icon indicated (this is usually by default a 'Pencil' but if the user has already used this tool it will display whatever tool was used last). The polyline can then be drawn using the cursor as shown.

Before starting to draw the polyline it is important to ensure that the right feature is selected to be changed and that the desired operation will be performed on it. To do this check the 'Target' field in the *Editor Toolbar* to see which feature is selected, if the right feature is already selected then proceed. If the desired feature is not selected then click on the button indicated to open the pull down menu and select the desired feature. To ensure that the correct operation will be performed check the 'Task' field to ensure that Create New Feature is selected, if this is not selected then click on the indicated button to open the pull down menu and select Create New Feature. If there is only one shape file in ArcMap this is not a problem but if there are multiple shape files the user should ensure that they are editing the correct one.

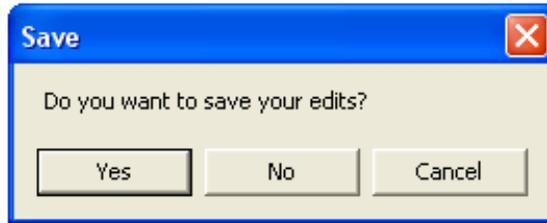




To use the cursor to draw the polyline:

- Select the starting point and click once
- Then proceed to the next point and click again to complete the segment
 - Basically each vertex should be a point
 - These vertices are connected by line segments completing the polyline
- Double click on the last point in the polyline to finish drawing

After one polyline has been drawn others can be added to the shape file by creating more points. When all the need polylines have been drawn go back to the **ArcMap Editor Toolbar** a select *Editor* → *Stop Editing*. Click Yes on the window that comes up to save the changes and continue.

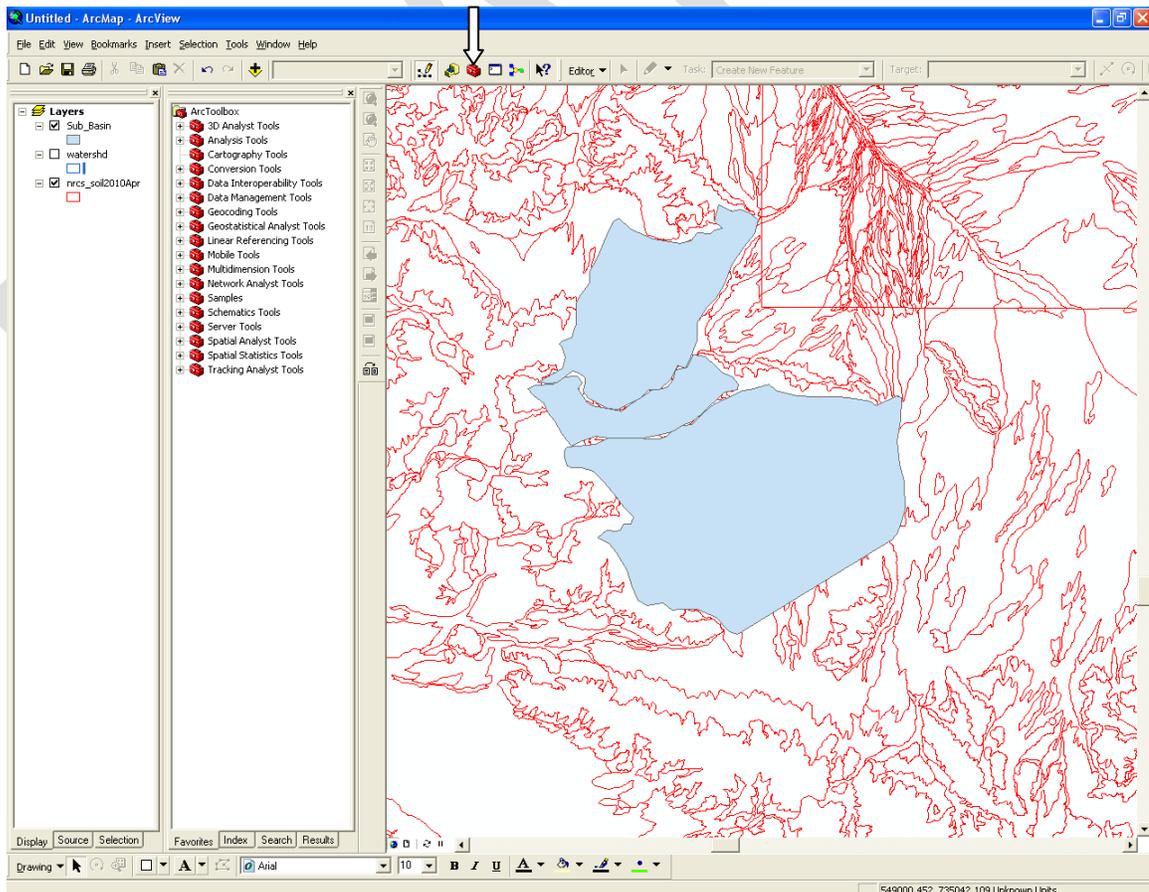


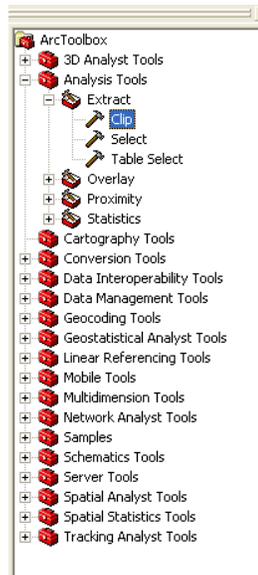
A2.3 Data Extraction by Polygon Clip

The 'Clip' tool in ArcMap is very useful if the user has Soil or Land Use shape files for the entire county. These shape files already contain the required data they are just much larger than the study area. The 'Clip' tool "clips" the data where two polygons overlap.

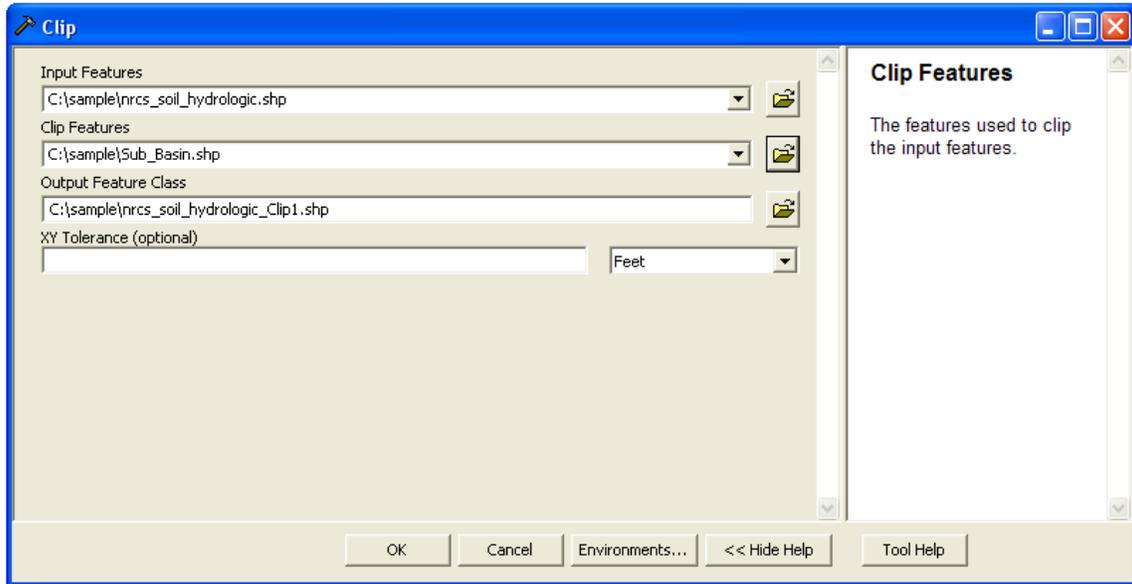
Execute the following steps to 'Clip' data from an existing shape file:

- Launch ArcMap
- Create or load a polygon of the study area (e.g. the Sub Basin shape file) in ArcMap
- Open the existing shape file (this example will use the Soil shape file)
- Open the **ArcToolbox** if it is not open already, click on the 'Red Toolbox' icon indicated
- Select **Analysis Tools** → **Extract** → **Clip** from the **ArcToolbox**

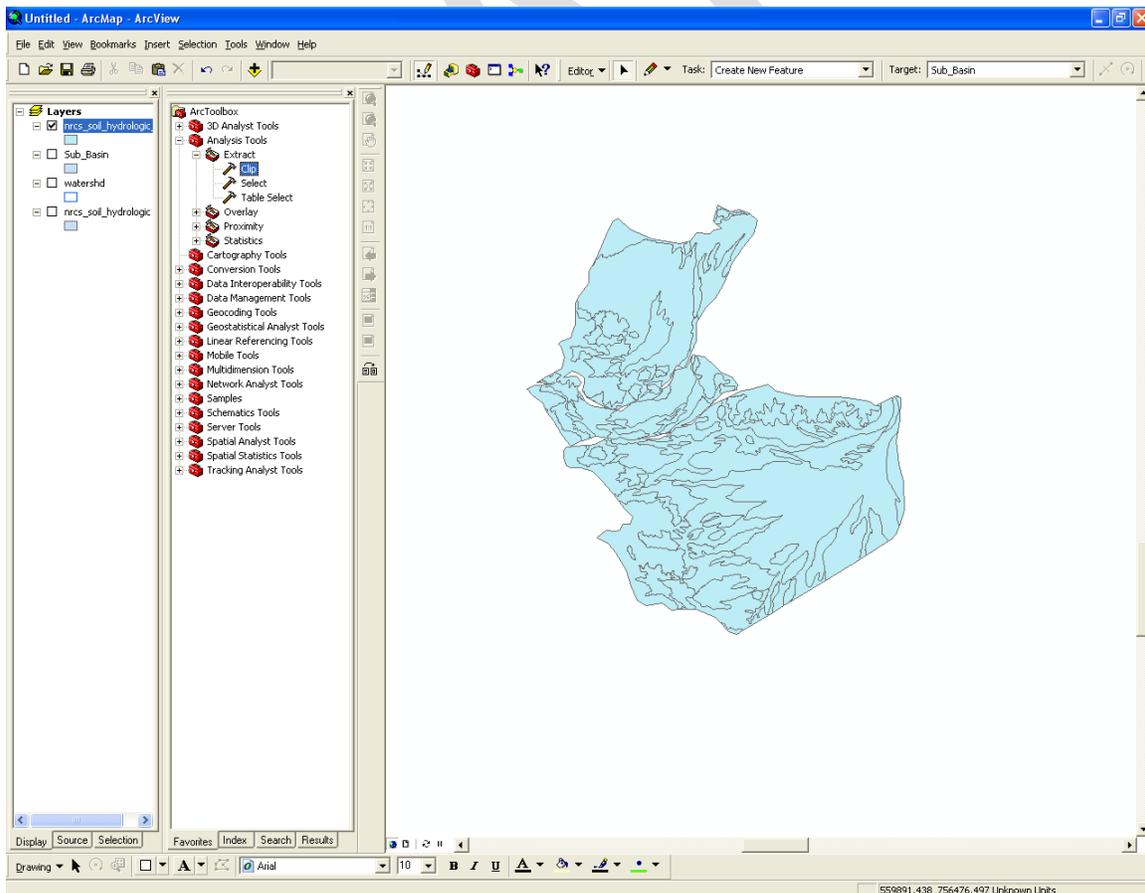




- This opens the **Clip** window, fill in the required fields
 - The **'Input Features'** is the shape file that is going to be "clipped", in this case the Soil shape file
 - This can be selected from the pull down menu which has all of the shape files currently being used by ArcMap or by clicking on the folder any shape file on the computer can be selected
 - The **'Clip Features'** is the shape file that is doing the "clipping", in this case the Sub Basin shape file
 - This can be selected from the pull down menu which has all of the shape files currently being used by ArcMap or by clicking on the folder any shape file on the computer can be selected
 - The **'Output Feature Class'** is where the file is saved to and what its name is
 - The Output Feature Class is the output of the tool, it is the new shape file that is created by "clipping" the other shape files
 - The location and file name can be selected by clicking on the *'Folder'*



- After all the required fields have been filled in (note that 'XY Tolerance' is not required) click **OK**
- This will create a new shape file that appears in ArcMap when it is completed



This new shape file now contains whatever data the **'Input Features'** had but is in the shape and location of the **'Clip Features'**. As long as the original shape file had the correct data this new file is now ready to be loaded into DDMSW. This tool basically is like a cutter that cuts or clips out a copy of the original in the shape of the cutter but with the properties of the original. A simple analogy is that the original shape file (the **'Input Features'**) is like a big piece of cookie dough and the other shape file that is used to "clip" (the **'Clip Features'**) the original is like a cookie cutter. So when the cutter is used it cuts a piece of the cookie dough in its shape but has all of the ingredients or properties of the original big piece of cookie dough (the **'Output Features'**).

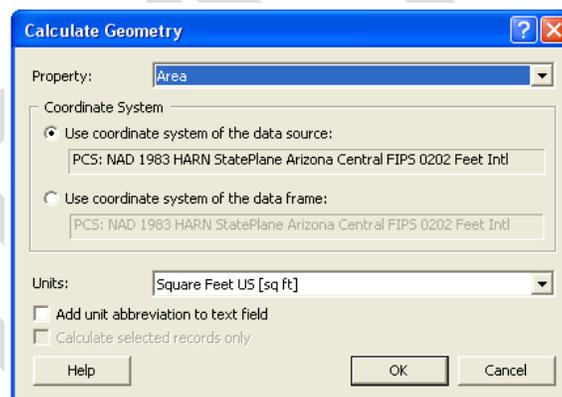
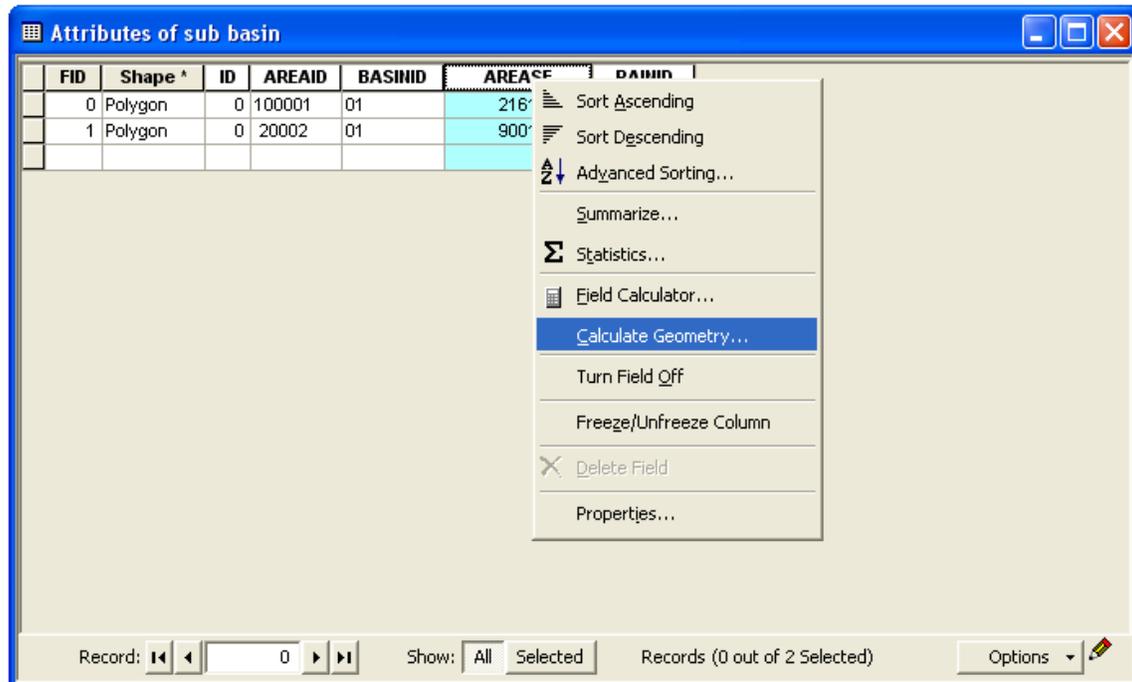
A2.4 Geometry Calculator

ArcMap has a built-in function to calculate the area of the polygons created. This is necessary for the Sub Basins shape file for the field AREASF.

To have ArcMap populate this field:

- Open the **Attribute** table
 - To open the **Attribute** table right click on the shape file in the ArcMap display on the left of the screen
- Create the field AREASF with the required properties
 - To create a new field:
 - In the **Attribute** table click on the *Options* button in the lower right hand corner
 - Select *Add New Field...* from the pull down menu
 - Enter the applicable data into the fields, see the Sub Basin section for more information
- Right-click on the field AREASF after it has been created, this opens a pull down menu
- Select *Calculate Geometry* from the pull down menu
- In the window that comes up select the **'Property'** to calculate as *Area* from the pull down menu
- If possible select the **'Units'** as *Square Feet US [sq ft]*
- Regardless of whether it was possible to select units
- Click *OK*

The field AREASF should then be populated with the area of the polygons in square feet.

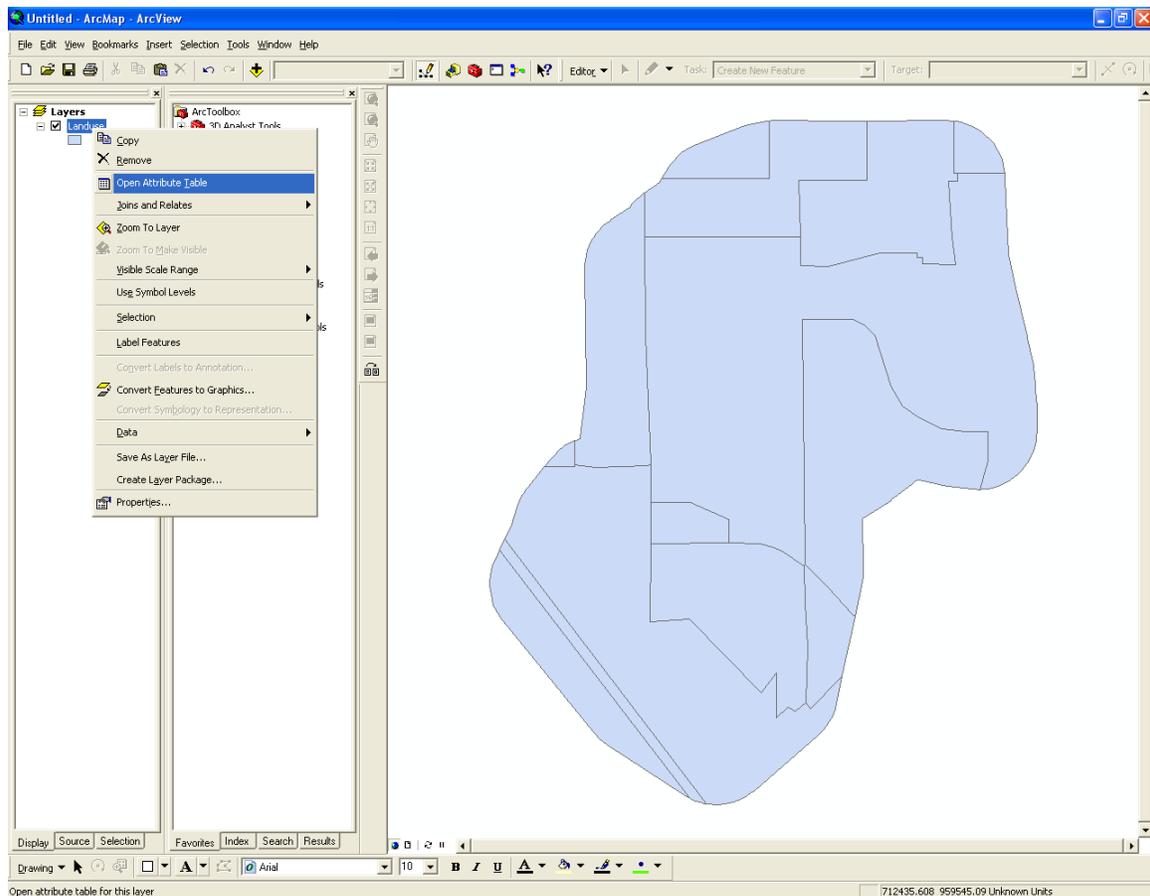


A2.5 Field Calculator

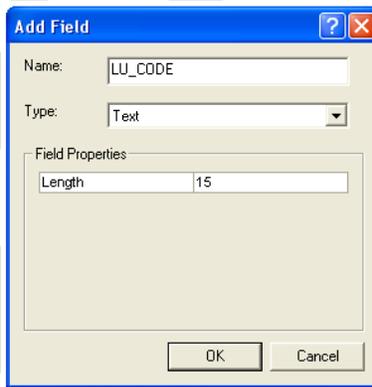
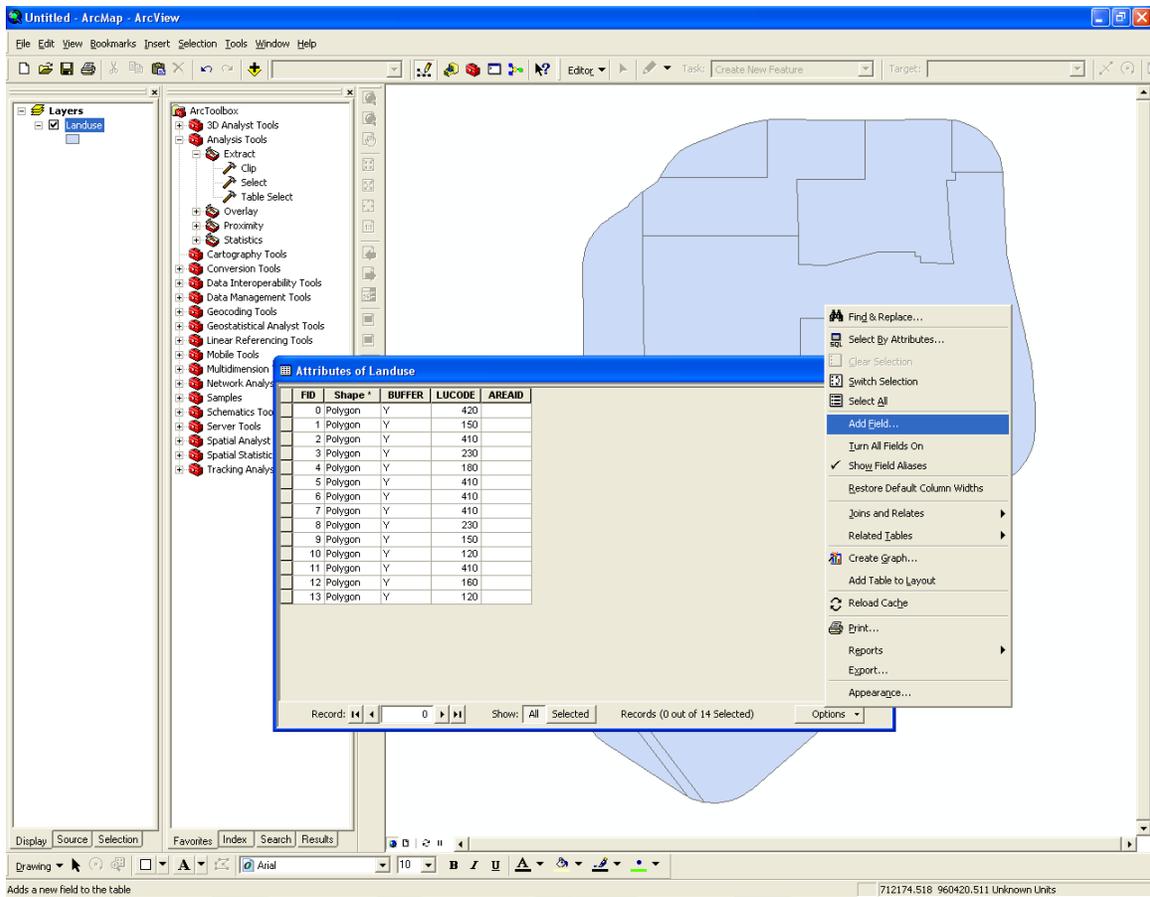
The *'Field Calculator'* is a useful tool if the data contained in the **Attribute** table of a shape file has the correct data but either the wrong data type or wrong Field Name. The *'Field Calculator'* allows for calculations to be made between data fields in the **Attribute** table. The following procedure will use the Land Use shape file as an example to show how the field calculation tool is used. The Land Use shape file contains the Land Use Code LUCODE but the Land Use Code LU_CODE is needed. So the *'Field Calculator'* tool will be used to copy the data from LUCODE field into LU_CODE field.

To use the Field Calculator perform the following:

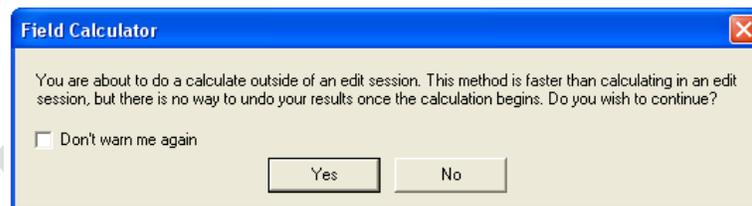
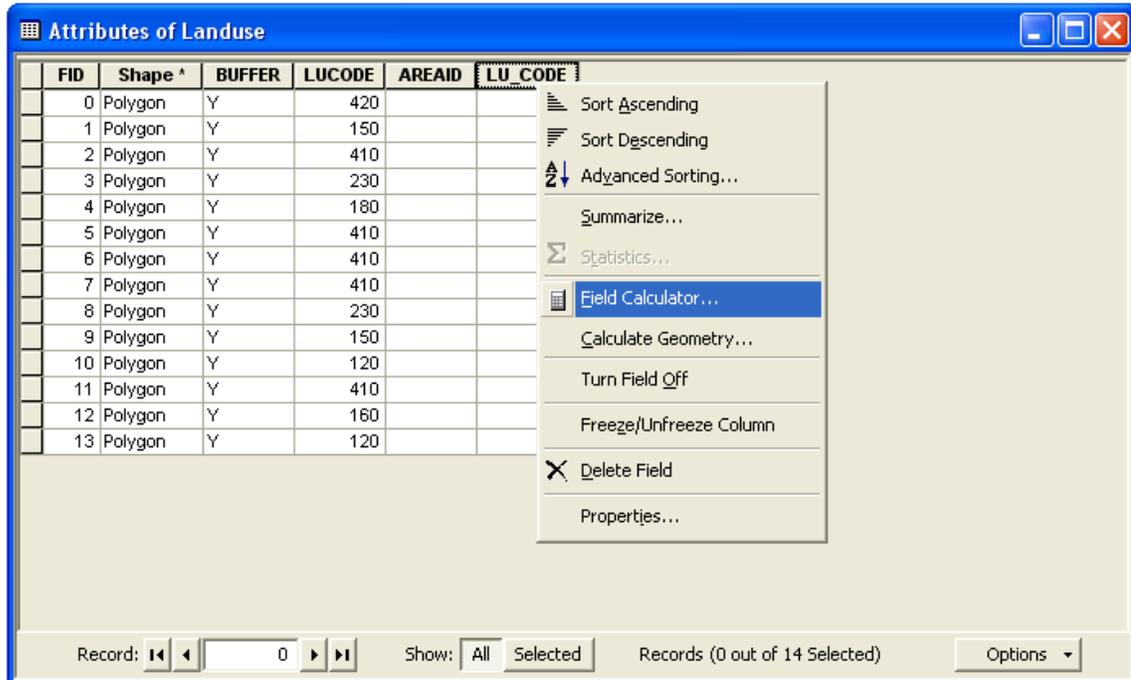
- Launch ArcMap
- Open the shape file that needs to be changed
- Open the **Attribute** table, to open the **Attribute** table:
 - Right click on the Land Use shape file in the display list on the left of the screen
 - Then select *Open Attribute Table* from the pull down menu



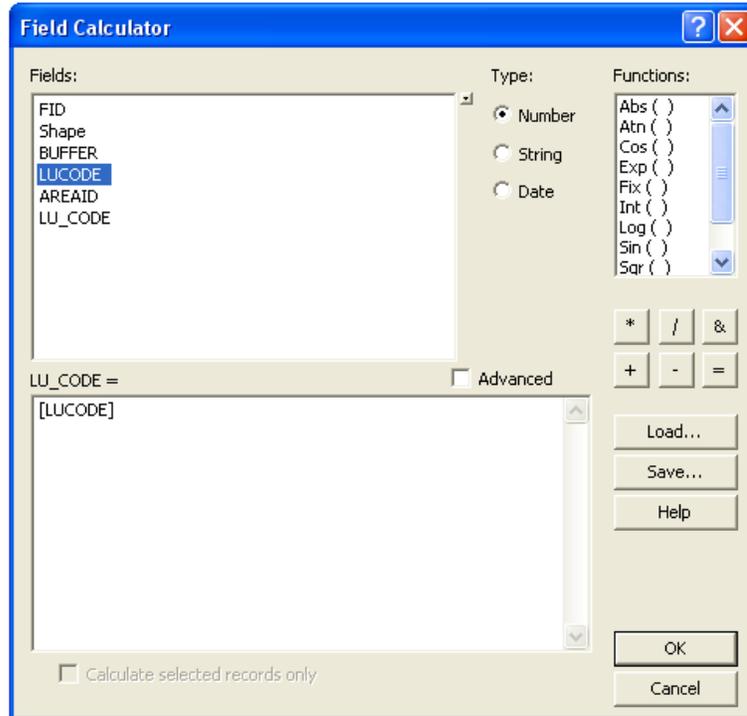
- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for LU_CODE
 - In the **New Field** window enter LU_CODE for the '**Name**'
 - Then select the type of data from the pull down menu as 'Text' since LU_CODE is specified as a 'Character' data type
 - Then change the length to 15 as specified in the Table of Required Fields
 - Click **OK** to close the **New Field** window



- Right click on the new field named LU_CODE
- Select 'Field Calculator' from the pull down menu
- Click Yes on the **Field Calculator** warning window that appears



- The **Field Calculator** window allows for the selection of all the fields in the **Attribute** table
- Select LUCODE
- Click **OK** in the **Field Calculator** window
- The LU_CODE data field should now be populated
- Save the shape file
- The shape file is now ready to be loaded into DDMSW

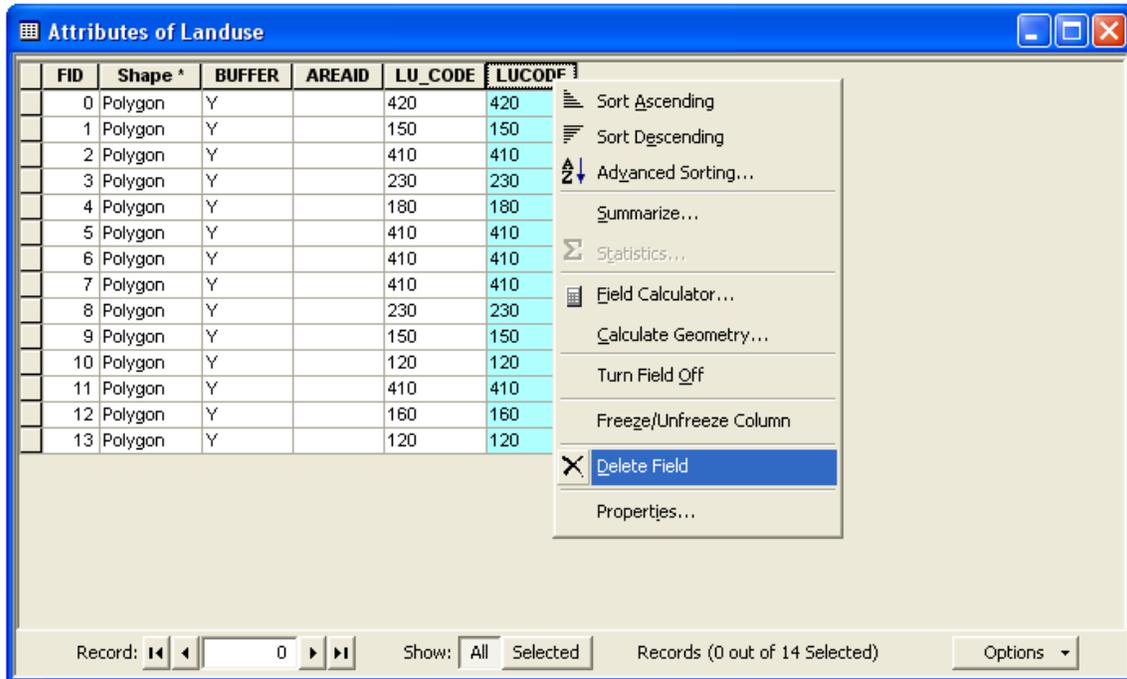


FID	Shape *	BUFFER	LUCODE	AREAID	LU_CODE
0	Polygon	Y	420		420
1	Polygon	Y	150		150
2	Polygon	Y	410		410
3	Polygon	Y	230		230
4	Polygon	Y	180		180
5	Polygon	Y	410		410
6	Polygon	Y	410		410
7	Polygon	Y	410		410
8	Polygon	Y	230		230
9	Polygon	Y	150		150
10	Polygon	Y	120		120
11	Polygon	Y	410		410
12	Polygon	Y	160		160
13	Polygon	Y	120		120

The Field Calculator can also be used if the field name is correct but the data type is wrong. To do this:

- Create a new field that does not have the same 'Name' as any existing fields
- Use the 'Field Calculator' to move the data to this new field

- Delete the original field
- To delete an existing field in the **Attribute** table:
 - Open the **Attribute** table, to open the **Attribute** table:
 - Right click on the Land Use shape file in the display list on the left of the screen
 - Then select *Open Attribute Table* from the pull down menu
 - Right click on the field that needs to be deleted
 - For this example LUCODE is used
 - Select Delete Field from the pull down menu
 - Click Yes on the **Message** box that appears

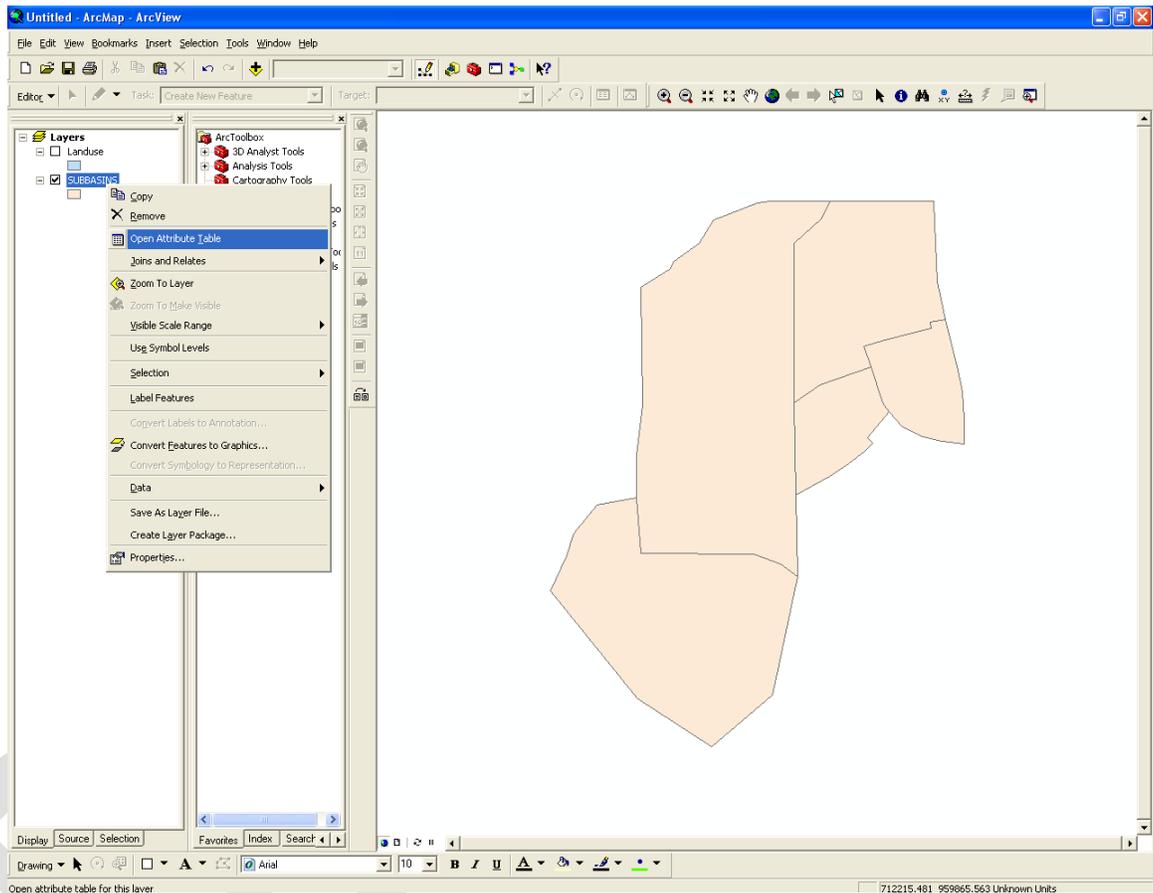


- Create another new field
- This time with the correct name, data type, and length
- Use the field calculator to transfer the data to the new field with the correct parameters

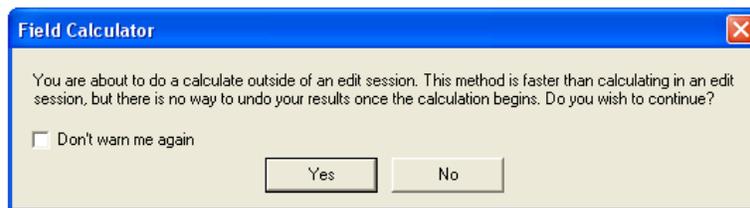
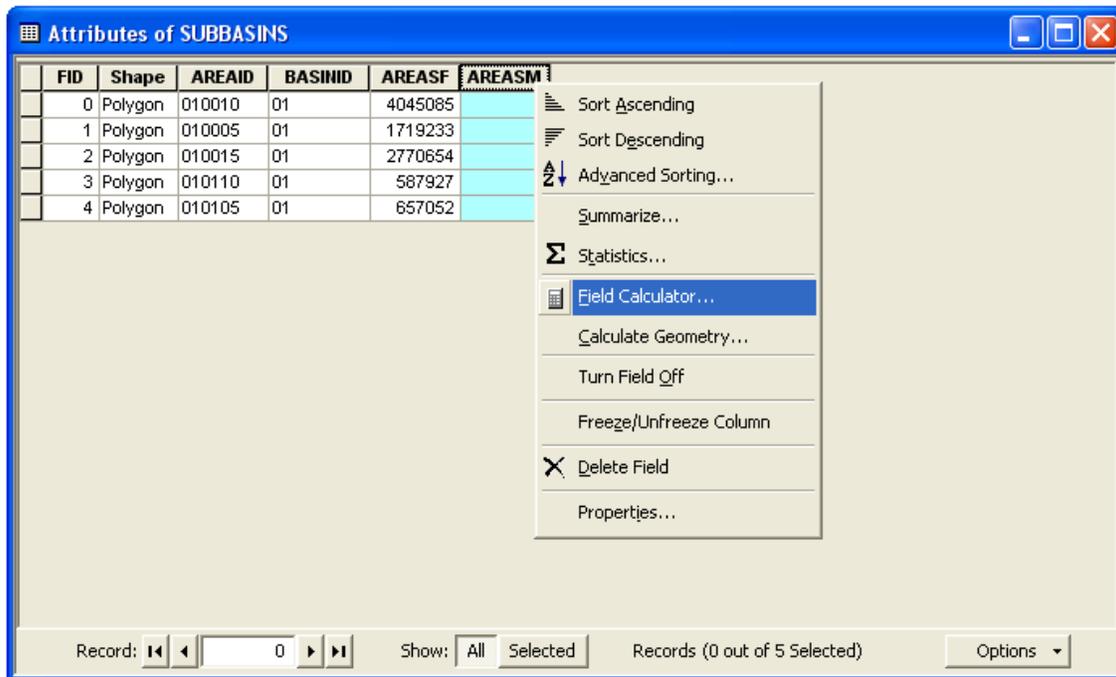
Another built-in function of the Field Calculator is that it can do basic mathematical operations. This feature is useful if the data in the table has to be converted to different units for example (note that usually unit conversions can be done using the 'Calculate Geometry' tool but in some cases this cannot be done and there other applications where the ability to manipulate the data in the **Attribute** table mathematically is useful). The following example will show how to use this feature to change the area of a polygon in the Sub Basin shape file from square feet to square miles; this field will be labeled AREASM.

To use the 'Fields Calculator' for mathematical operation:

- Launch ArcMap
- Open the shape file that needs to be changed
- Open the **Attribute** table, to open the **Attribute** table:
 - Right click on the Sub Basin shape file in the display list on the left of the screen
 - Then select *Open Attribute Table* from the pull down menu

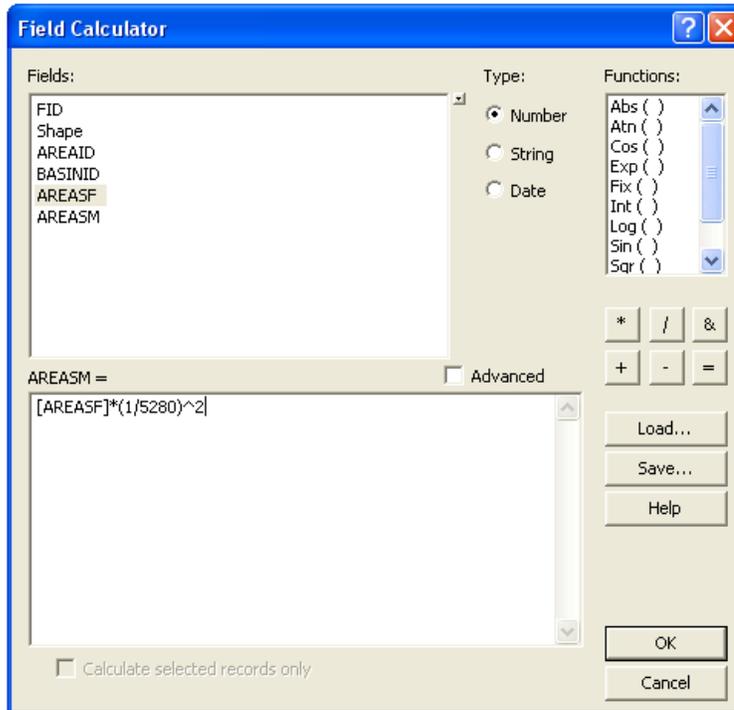


- In the **Attribute** table window select *Options* → *Add New Field...*
- Enter the information for AREASM
 - In the **New Field** window enter AREASM for the '**Name**'
 - Then select the type of data from the pull down menu as 'Double' since this should be a numerical value
 - Set the precision to 5
 - Set the scale to 3
 - Note that this precision and scale have no real bearing on loading files into DDMSW but are simply used in this example to demonstrate how this function works in ArcMap
 - Click *OK* to close the **New Field** window
- Right click on the new field named AREASM
- Select '*Field Calculator*' from the pull down menu
- Click *Yes* on the **Field Calculator** warning window that appears



- In the **Field Calculator** window select the data field AREASF by double clicking on it
- Then multiply it by the conversion factor from square feet to square miles by typing:

$*(1/5280)^2$



- Then click **OK** to have ArcMap do the calculation
- The data field **AREASM** in the Sub Basin **Attribute** table should then be populated with the area of each polygon in square miles

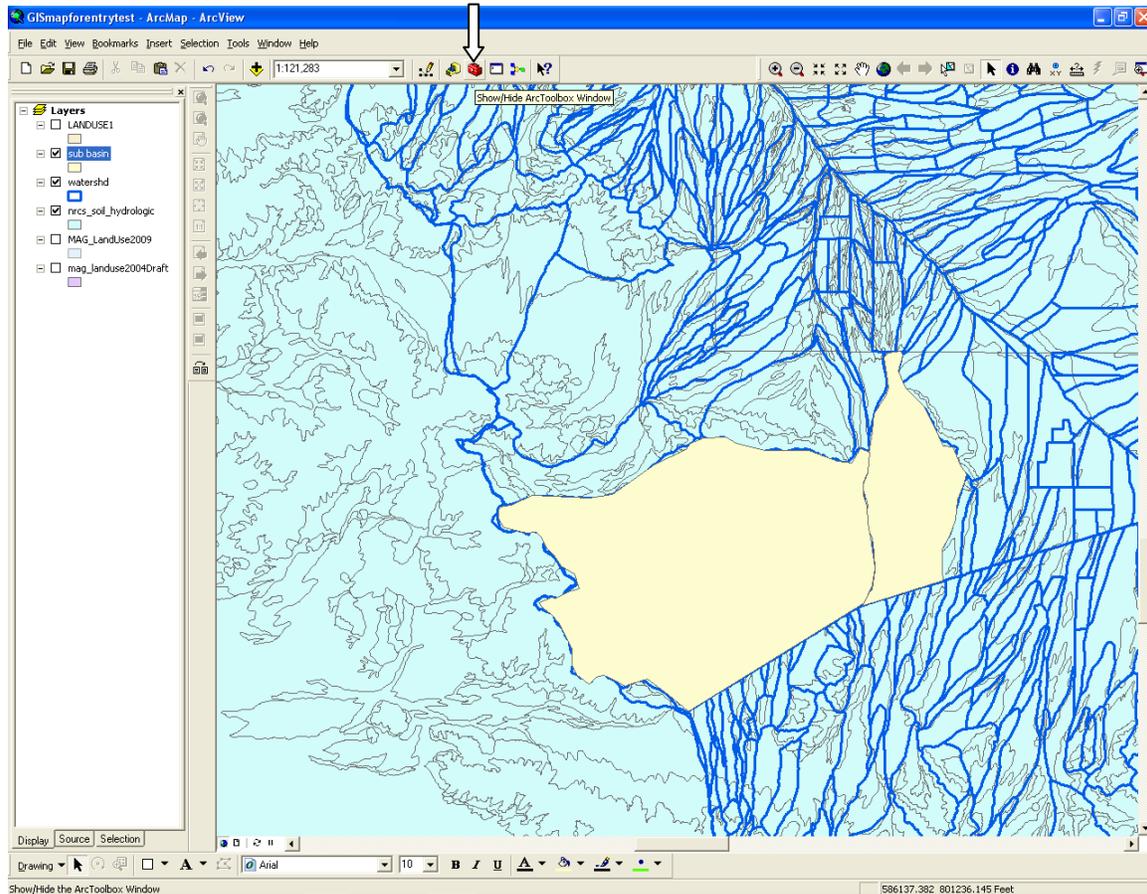
FID	Shape	AREAID	BASINID	AREASF	AREASM
0	Polygon	010010	01	4045085	0.145
1	Polygon	010005	01	1719233	0.062
2	Polygon	010015	01	2770654	0.099
3	Polygon	010110	01	587927	0.021
4	Polygon	010105	01	657052	0.024

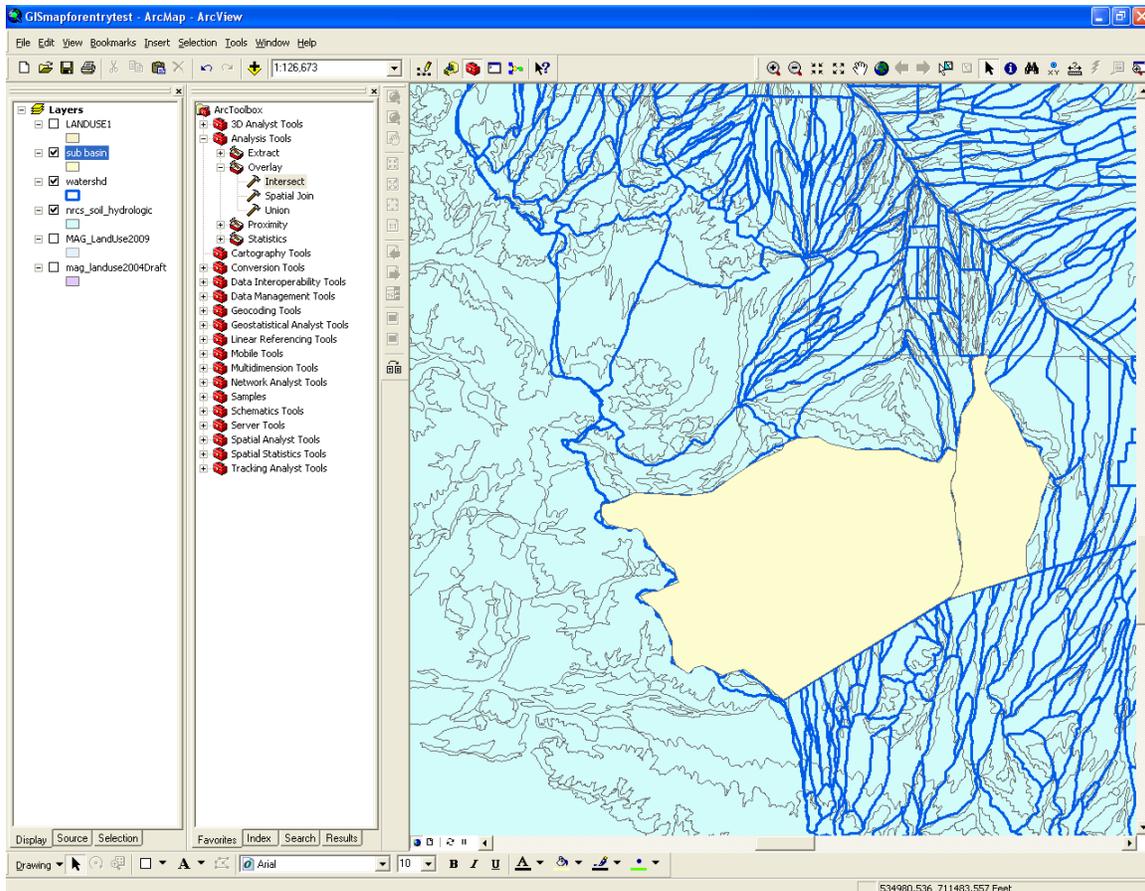
A2.6 Polygon Intersection

The *'Intersect'* tool in ArcMap is very useful if the user has Soil or Land Use shape files for the entire County. These shape files already contain the required data they are just much larger than the study area. The *'Intersect'* tool copies the data and shapes from where 2 shapes intersect. This allows the user to transfer data from the county wide shape file into a shape file of the Sub Basins or of the Sub Basins and the surrounding area. For the Land Use and Soil shape files it is acceptable to have a shape file that is either the exactly same or larger than the Sub Basins shape file. The following example uses the Soil shape file to show how the *'Intersect'* tool works.

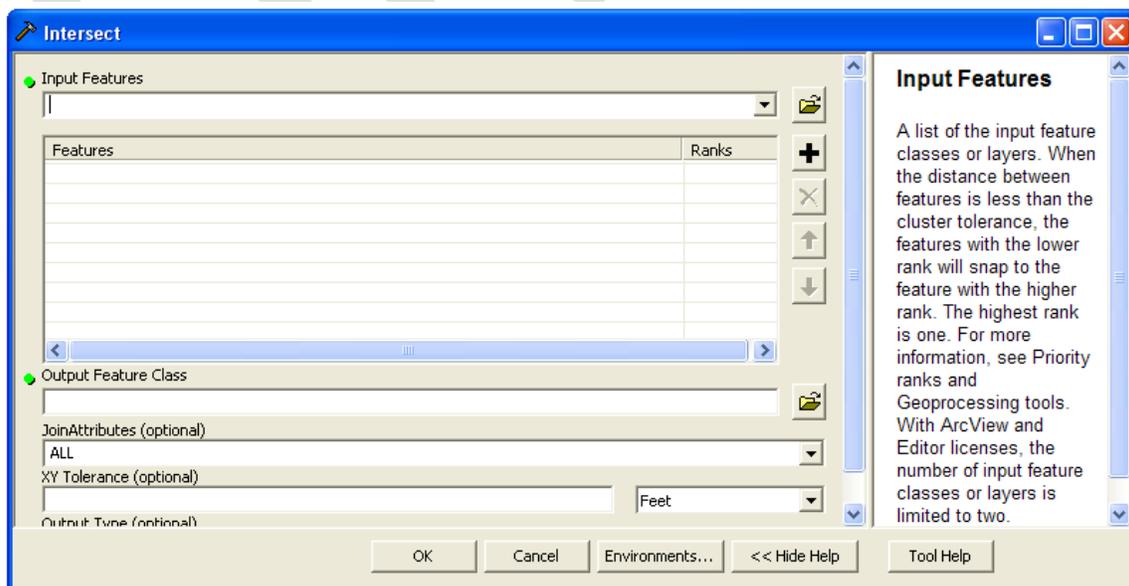
To use the 'Intersect' tool:

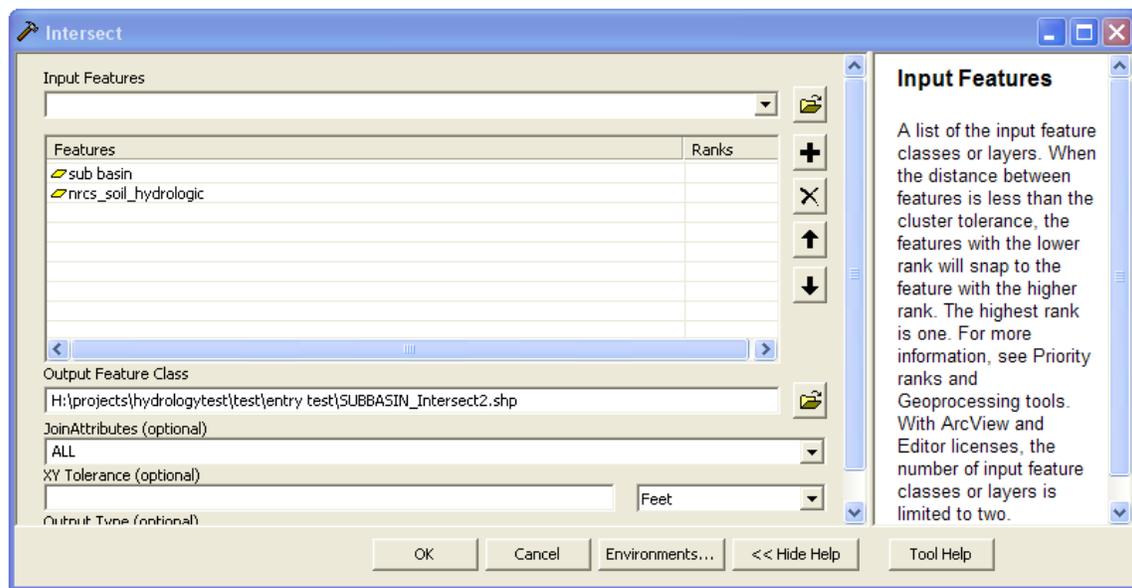
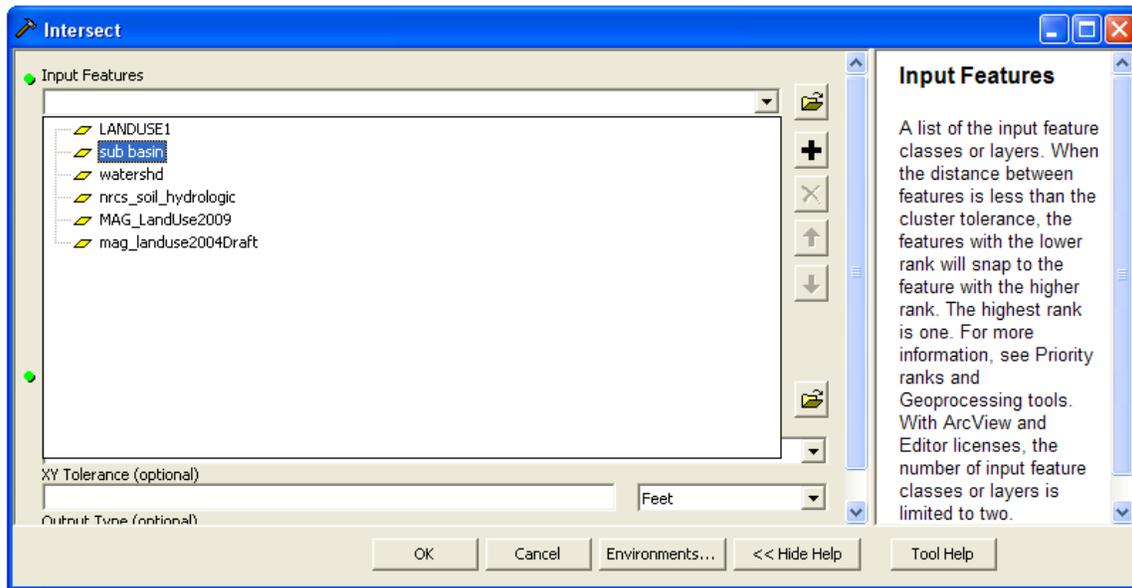
- Launch ArcMap
- Load the applicable shape files into ArcMap
- Click on the 'Red Toolbox' icon if the **ArcToolbox** is not already open
- Then from the list in the **ArcToolbox** select *Analysis Tools* → *Overlay* → 'Intersect'



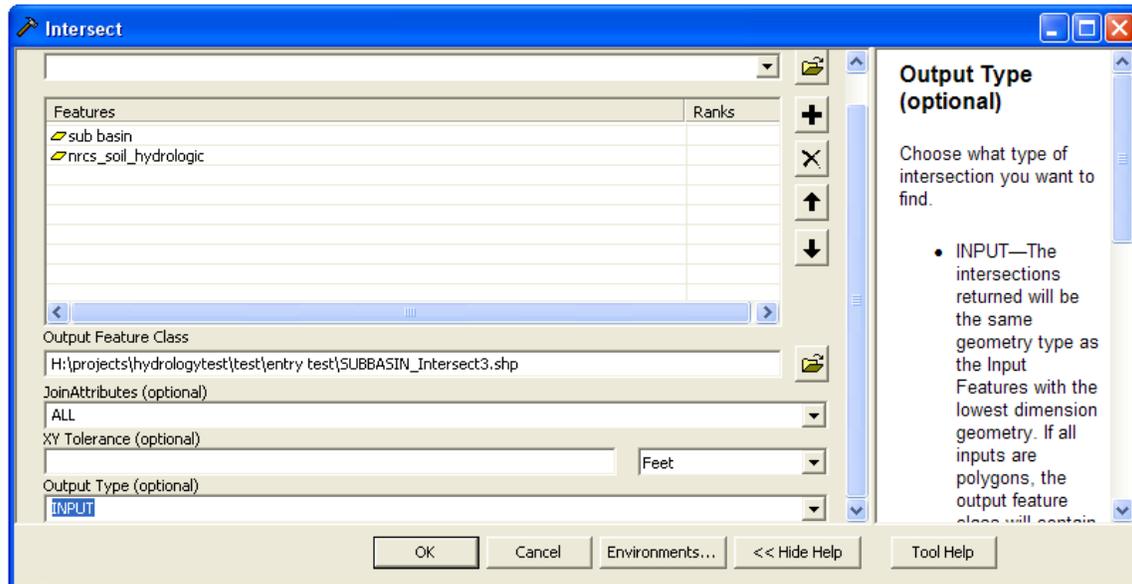


- This will bring up the **Intersect** window
- For the '**Input Features**' either the pull down menu or the folder may be used
 - For the '**Input Features**', select the shape file that the data needs to be copied into first
 - Then select the shape file that the data needs to be copied from

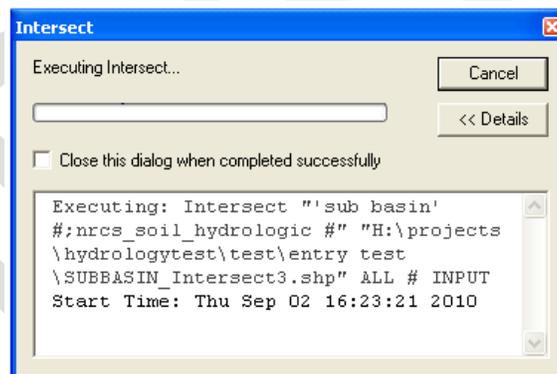




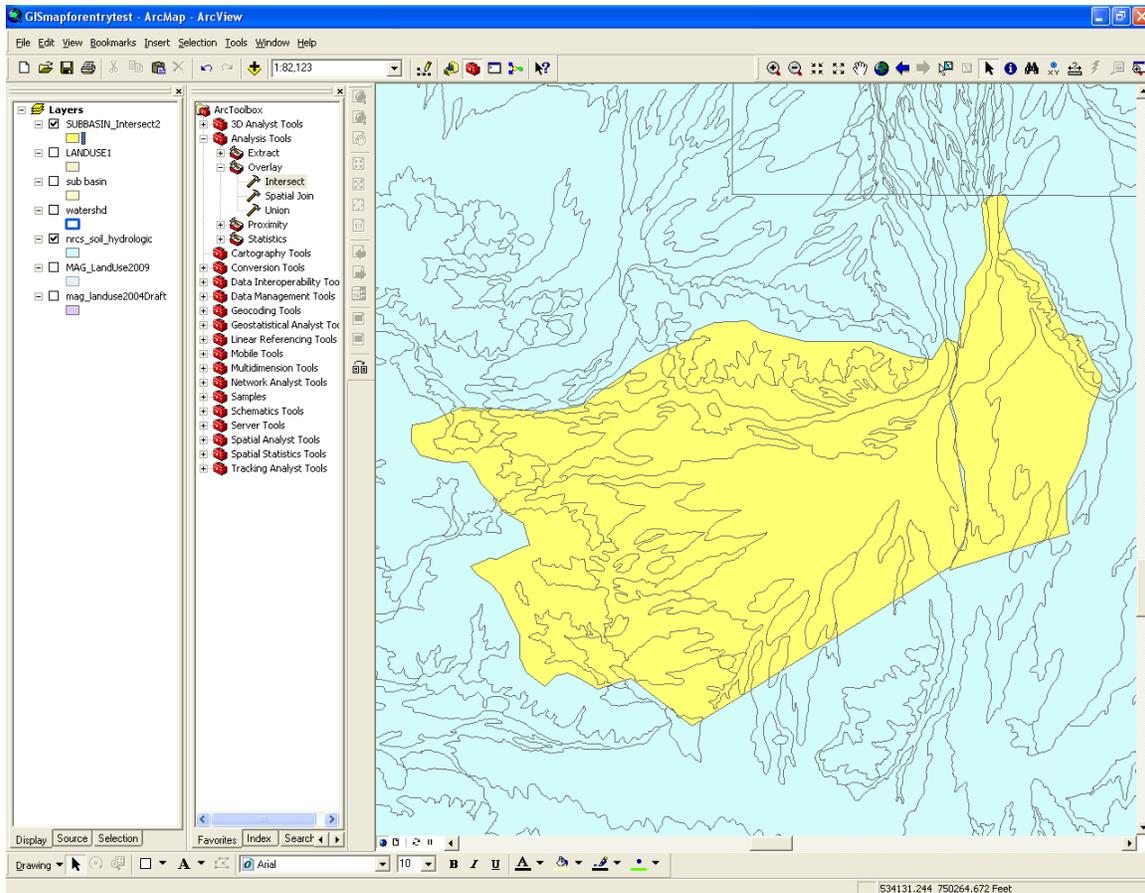
- For the '**Output Feature Class**', either the default given by ArcMap can be used or the user may select their own location to save the shape file by clicking on the '*Folder*' icon
- The '**XY Tolerance**' is optional, so it is not used in this example
- The '**Output Type**' is also optional, but it is important that it be set to *INPUT* so that the tool creates a polygon and not a polyline or point (the *INPUT* will only give the same type as was put into it, so this is only true if polygons are input into the '**Input Features**')



- After all of these have been entered, check to ensure that the shape file that the data needs to be copied into is ranked first and that the one that contains the data is below it
- Then click **OK**
- A window should come that informs the user of the status of the operation



- When the '*Intersect*' has been completed close the window
- ArcMap should now display the new shape file

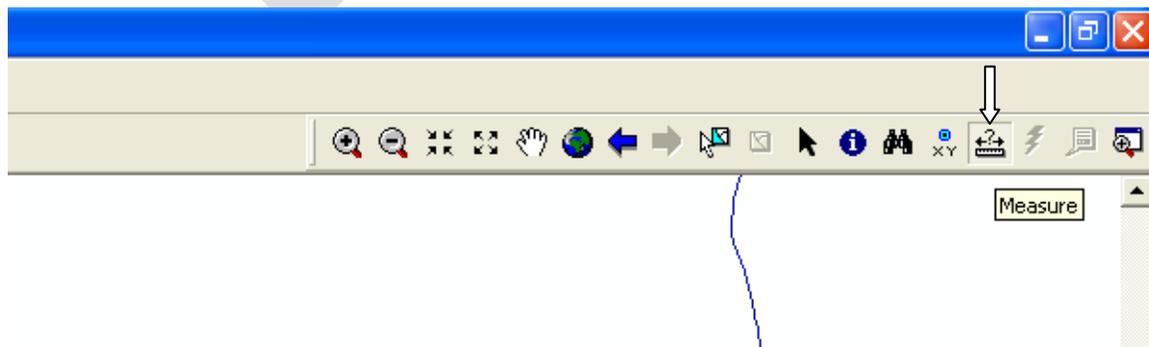


A2.7 Measurement

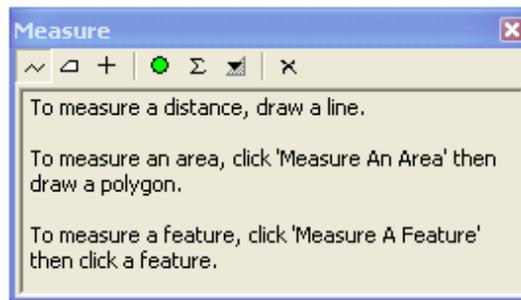
ArcMap has a tool built into it that allows the user to find the distance between points. This measurement can be in a straight line or can follow any path that the user chooses. The following instructions are for finding the length of a wash that runs through a Sub Basin in the study area. But the same process can be used in many applications.

To measure the length in ArcMap:

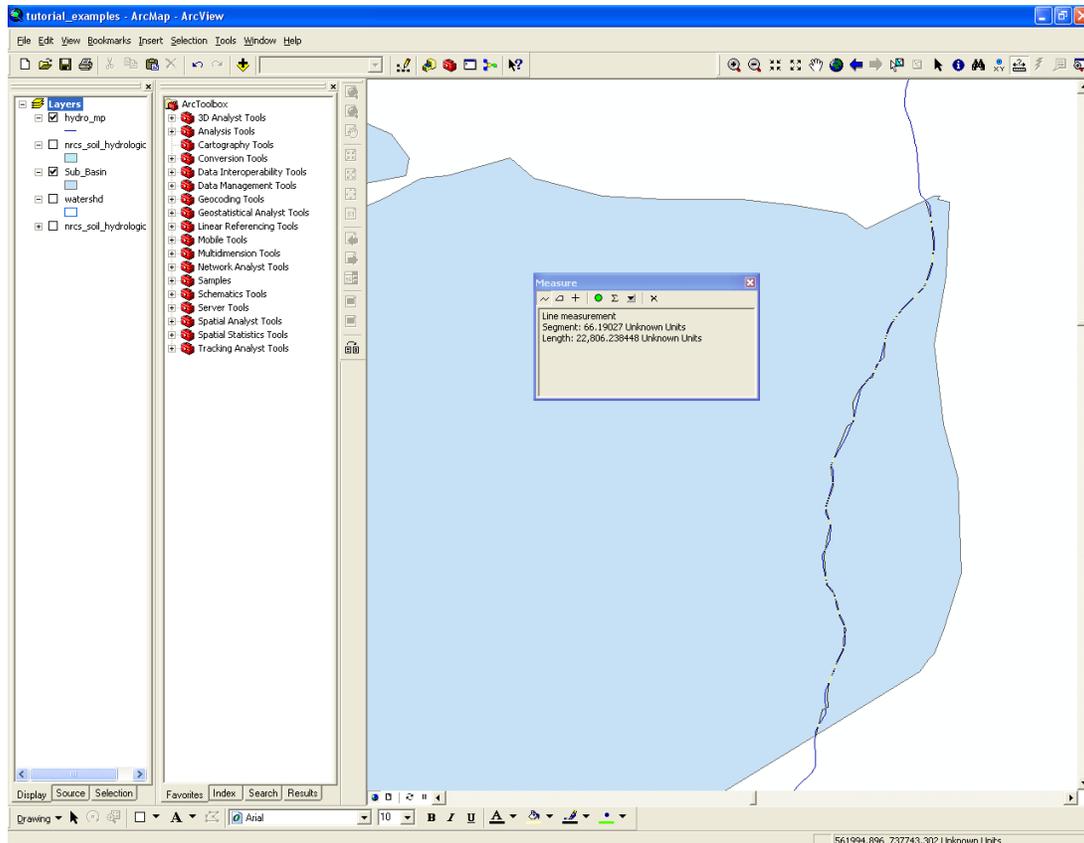
- Open ArcMap
- Load the applicable files that are need for reference of the measurement
- Then go to the upper right hand corner of the window and select the 'Ruler' icon indicated



- This opens the **Measure** window
 - The **Measure** window allows the selection of many options, they are from left to right:
 - *Measure Line*, this allows the measurement of distances between points of interest
 - *Measure An Area*, this allows the user to create polygons and gives the area of the polygon and the perimeter
 - *Measure A Feature*, this finds the Length if the feature is a polyline or the area and perimeter if the feature is polygon
 - The next tab turns the *Snap* feature in ArcMap on and off, this is helpful for when the user wants to snap to existing features
 - The *Sum* option is next, it turns the sum feature of the Measure tool on and off
 - The next tab allows the user to select the *Units* used for the measurements
 - The last tab is used to *Clear* and *Reset* the '*Measure*' tool



- After the type of measurement is selected in the **Measure** window, use the cursor to select the points of interest



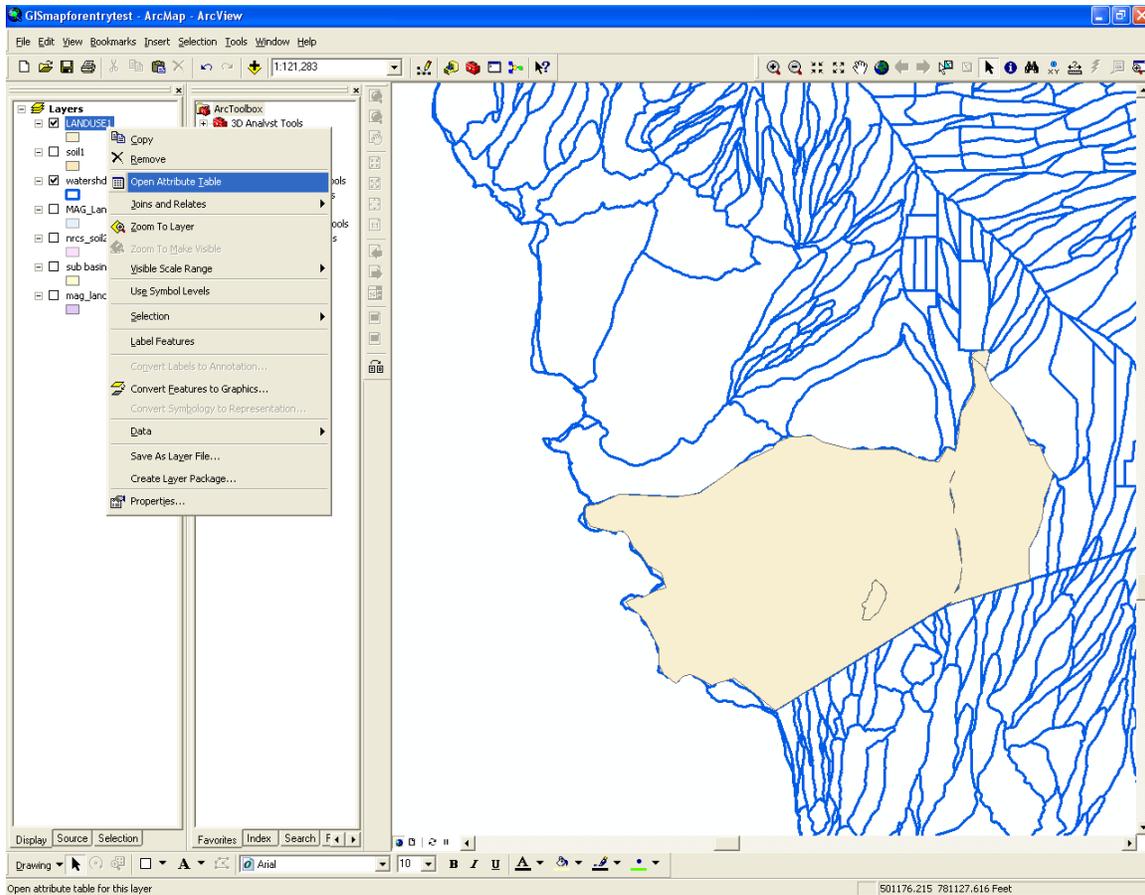
If a quick approximation is needed this is a good method to use if field or other data is not available. Note that the 'Measure' tool does not load the data into the applicable data field; it must be recorded by the user then entered manually into the **Attribute** table of the shape file.

A2.8 Checking the Properties of shape files in ArcMap

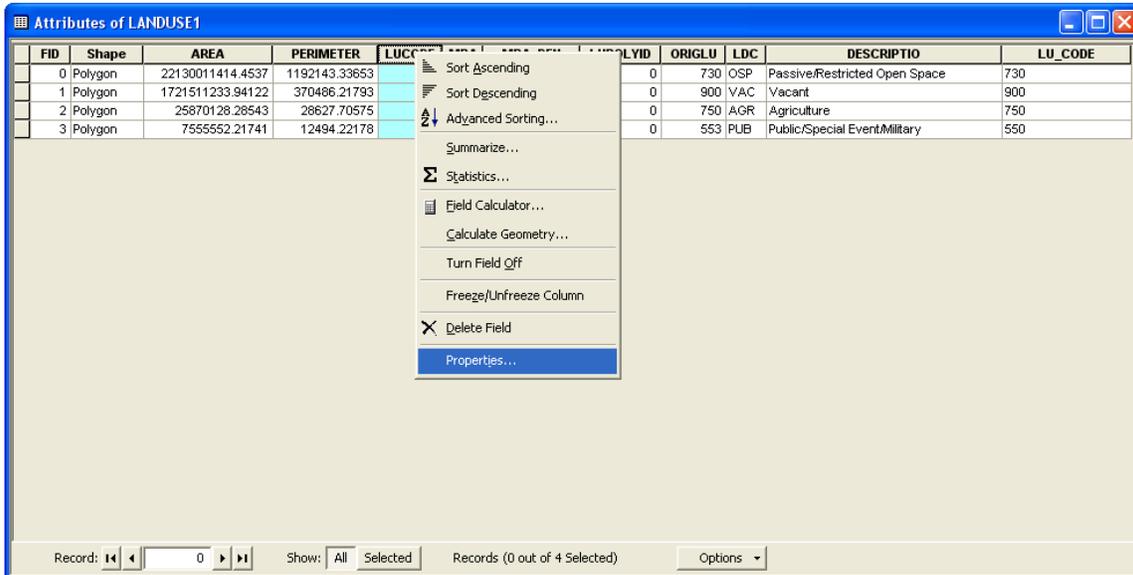
It is always good practice to check the data that is contained in the shape files before loading them into DDMSW or if DDMSW is reporting an error because of the shape files this is a quick way to try and find the problem. By checking the properties the user is able to see if the data type and length are correct. In the following example dealing with a Land Use shape file that contains fields named LUCODE and LU_CODE where the user needs to try to determine if the either or both fields contain the correct data type.

To check the properties of a data field in the **Attribute** table:

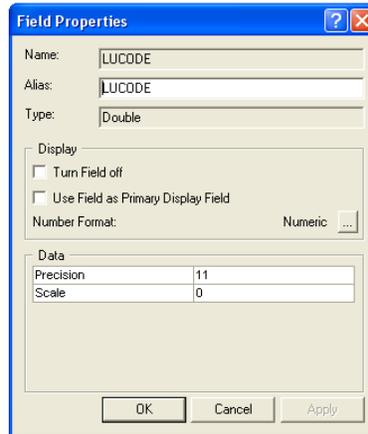
- Open ArcMap
- Load the applicable file
- Right click on the shape file in ArcMap
- Select *Open Attribute Table*



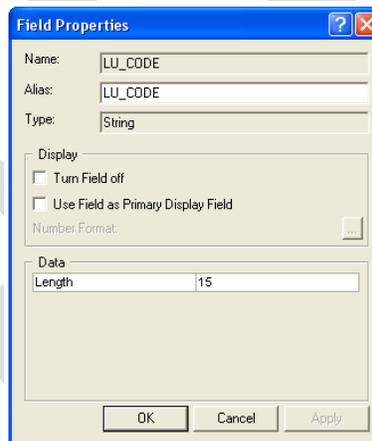
- This should open a new window that contains the **Attribute** table
- Find the data field in question and right click on it
- Select *Properties* at the bottom of the pull down menu



- This opens another window that shows the field's properties



As can be seen the data contained in the field is not correct for the Land Use Code required for DDMSW since it is 'Double', so it is a numerical value, and it is 11 long instead of 15. By doing the same procedure for LU_CODE it can be seen that the data contain in the LU_CODE field is in the correct format.



The user should note that no changes can be made to the field's properties, this method only allows for review of the properties. If a problem is found where a new field must be created then the section for Entering Data for that shape file and the *'Field Calculator'* tool in Appendix A2.5 should be consulted.

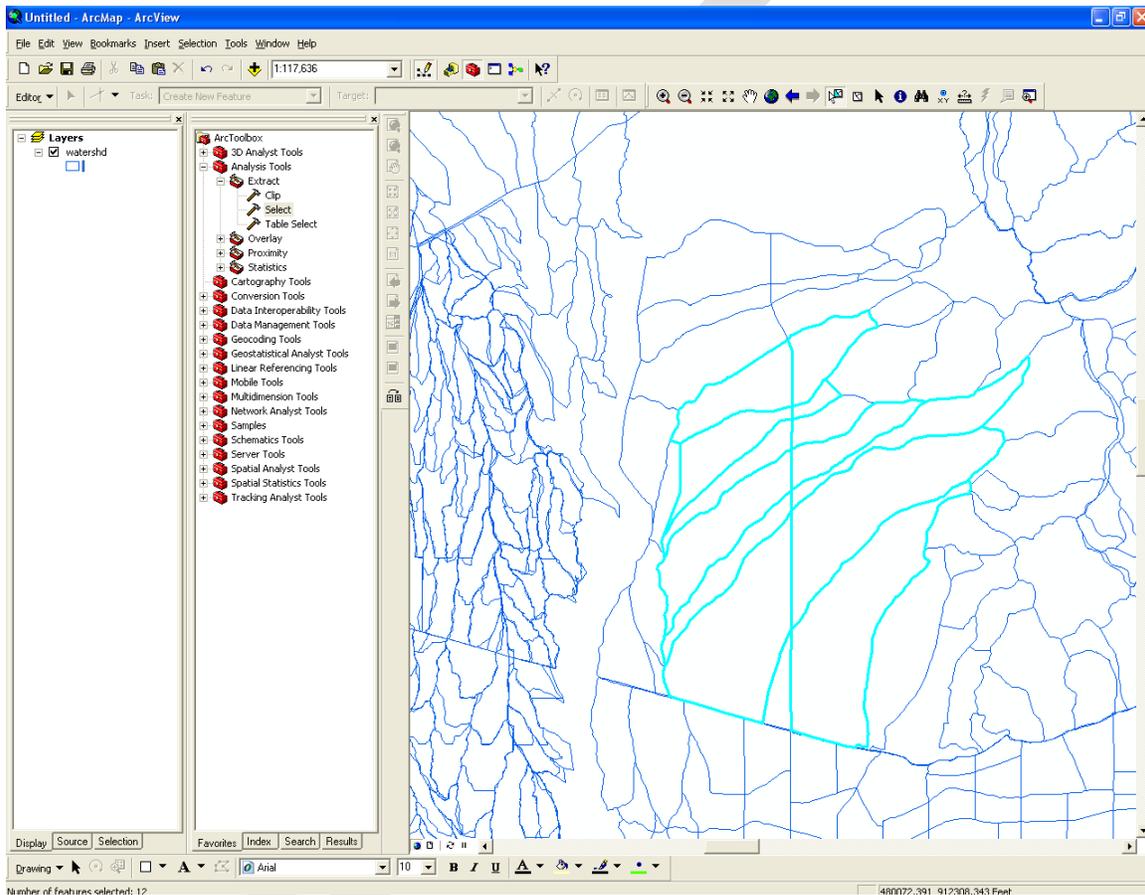
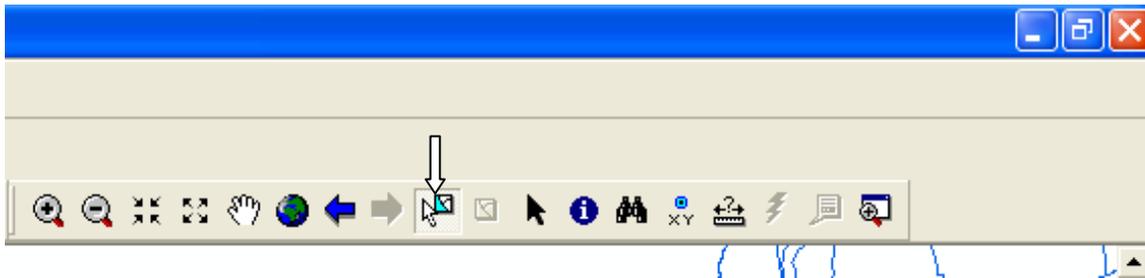
A2.9 Select Extraction

The *'Select'* tool is used to extract only selected polygons from a shape file containing many polygons. This is useful in many cases, for example creating Sub Basins for a project from a County watershed shape file. The watersheds in the study area can easily be extracted.

To use the *'Select'* extraction tool:

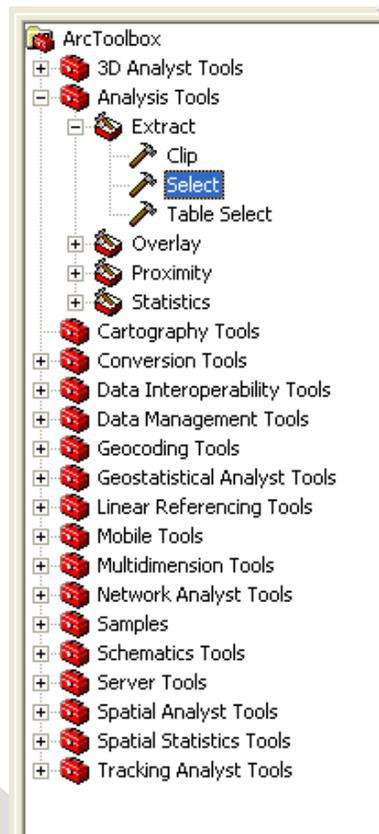
- Launch ArcMap
- Load the applicable shape file that contains the polygons that need to be extracted
- The polygons that need to be extracted must then be selected:
 - Go to the toolbar and select the icon indicated
 - Then click on the applicable polygons to select them

- Hold down the Shift key to select multiple polygons

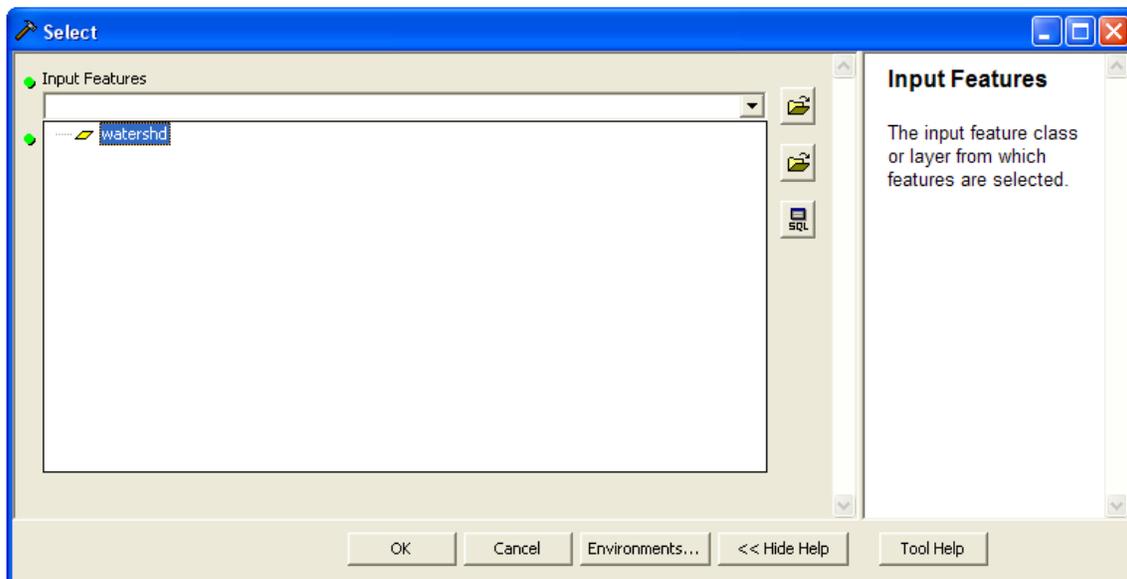


- After all the applicable polygons have been selected
- Open the **ArcToolbox** by clicking on the 'Red Toolbox'
- Go to **Analysis Tools** → **Extract** → **Select**

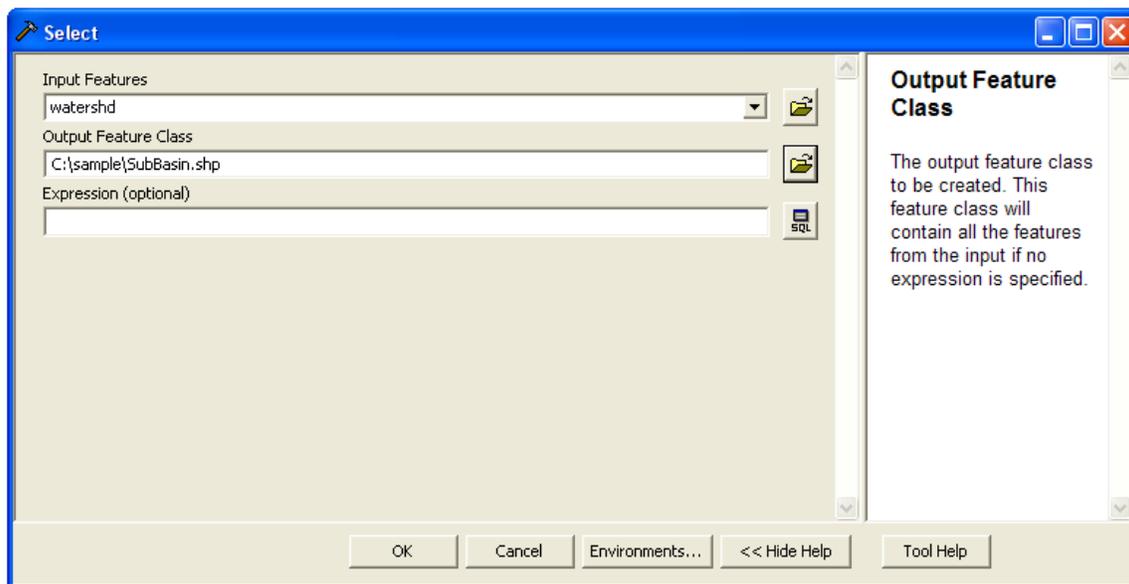
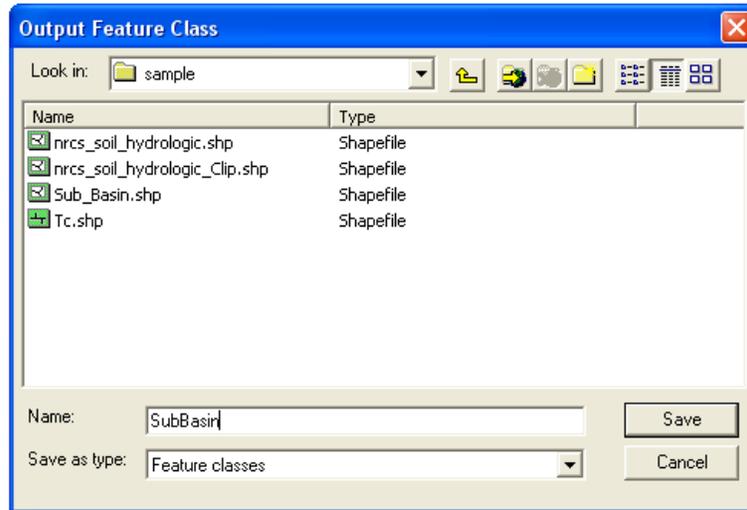




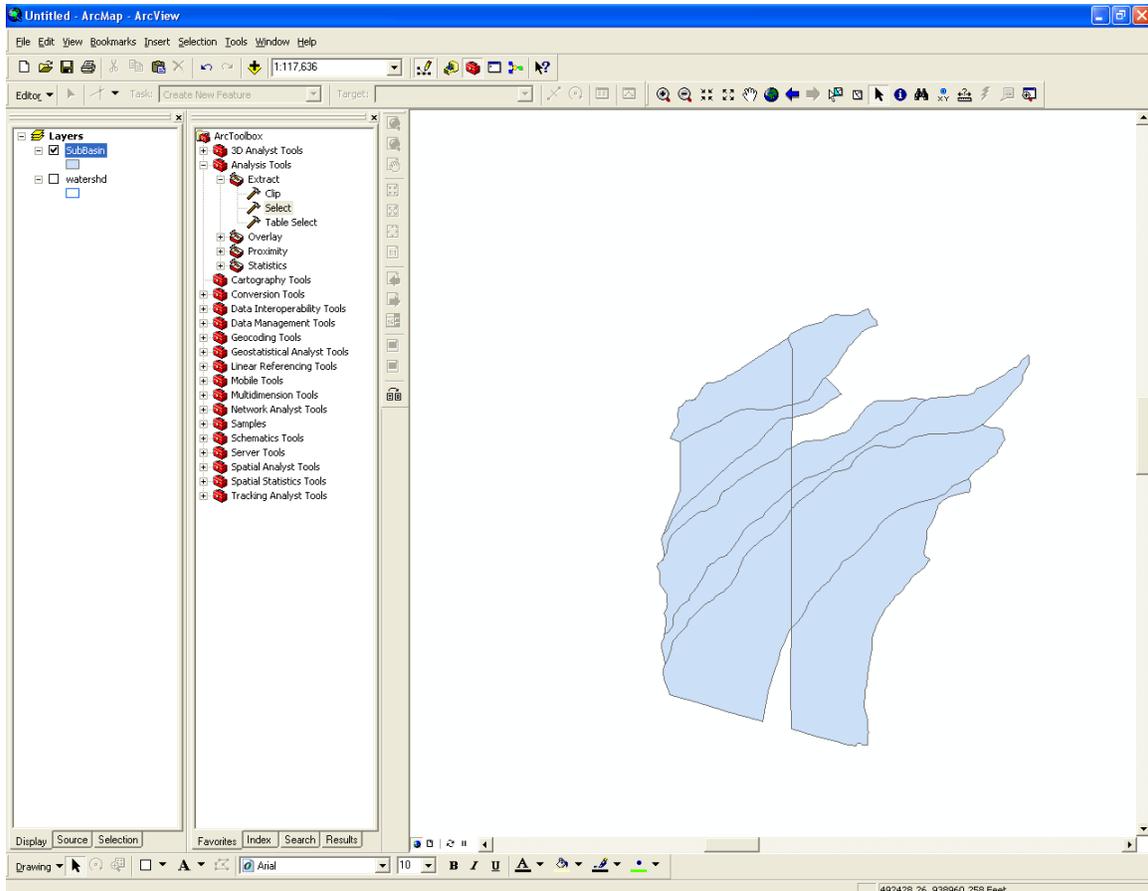
- This will open the **Select** window
- Select the shape file that contains the polygons being extracted from the pull down menu or 'Folder' in the 'Input Features' field



- Then select the location and name of the new shape file using the 'Folder' in the 'Output Features' or use the default provided by ArcMap
 - If the 'Folder' is selected it will bring up this window to select the location to store the results
 - After the name and location have been selected click Save



- Click OK to execute
- ArcMap will create the new shape file containing the polygons selected



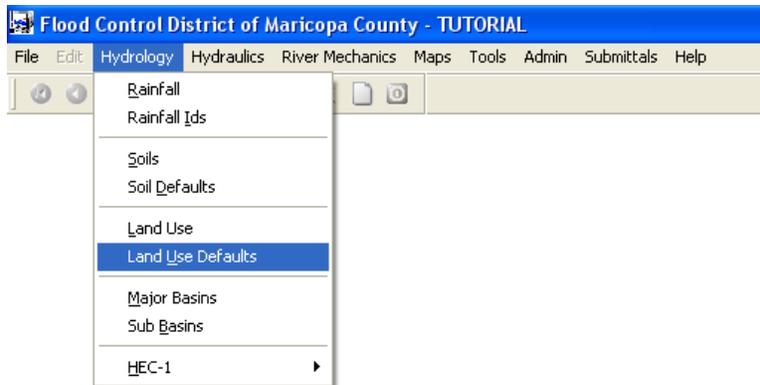
A3 Tips for Useful DDMSW Features

The following sections show some of the useful features that are built into DDMSW. Some of the features such as viewing the Land Use and Soil defaults are useful in the normal use of DDMSW and the others are mainly used for special or more sophisticated analysis.

A3.1 View Land Use defaults

To view the default Land Use Codes that are built into DDMSW:

- Open DDMSW
- Go to *Hydrology* → *Land Use Defaults*



- This opens a new window that contains all of the codes that are currently in DDMSW

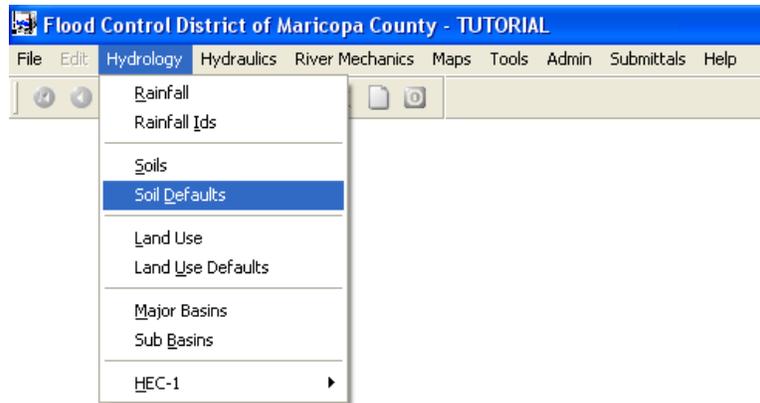
Sort	Code	Group	IA	Rtime	Cover	Dtheta	Kb	Description
10	120	Residential	0.30	5	30.0	NORMAL	MIN	Estate Residential (1/5 du per acr
20	140	Residential	0.25	30	50.0	NORMAL	MIN	Medium Lot Residential - Single Fa
30	150	Residential	0.25	30	50.0	NORMAL	MIN	Small Lot Residential - Single Fam
40	170	Residential	0.25	45	50.0	NORMAL	MIN	Medium Density Residential - Multi
50	180	Residential	0.25	45	50.0	NORMAL	MIN	High Density Residential - Multi Fa
60	190	Residential	0.25	45	50.0	NORMAL	MIN	Very High Density Residential - M
70	200	Commercial	0.10	80	60.0	NORMAL	MIN	General Commercial (Commercial
80	220	Commercial	0.10	80	65.0	NORMAL	MIN	Neighborhood Commercial (50,000
90	230	Commercial	0.10	80	75.0	NORMAL	MIN	Community Commercial (100,000
100	240	Commercial	0.10	80	65.0	NORMAL	MIN	Regional Commercial (500,000 to
110	250	Commercial	0.10	80	70.0	NORMAL	MIN	Super-Regional Commercial (>= 1
120	300	Industrial	0.15	55	60.0	NORMAL	MIN	General Industrial (Industrial where
130	310	Industrial	0.10	80	75.0	NORMAL	MIN	Warehouse/Distribution Centers
140	320	Industrial	0.15	55	60.0	NORMAL	MIN	Industrial
150	400	Office	0.10	80	75.0	NORMAL	MIN	Office General (Office where no d
160	420	Office	0.10	80	75.0	NORMAL	MIN	Office Mid Rise (5-12 stories)
170	430	Office	0.10	80	75.0	NORMAL	MIN	Office High Rise (13 stories or mo

As can be seen, this window contains the codes in the second column and a description of the land use type in the last column. The applicable data in the second column is what should be entered into the Land Use Code field in the ESRI shape file **Attribute** table. The other columns contain data that is used in the hydrologic calculations.

A3.2 View Soil defaults

To view the default Soil IDs that are built into DDMSW:

- Open DDMSW
- Go to *Hydrology* → *Soil Defaults*



- This will open a new window that contains a table with the Soil IDs currently in DDMSW

Soil ID	Book	Map Unit	XKSAT	Rock Pct	Description
6451	645	1	0.41	0.00	Antho sandy loams
6452	645	2	0.41	0.00	Antho gravelly sandy loams
6453	645	3	0.58	0.00	Antho-Carrizo-Maripo complex
6454	645	4	0.58	0.00	Antho-Carrizo-Maripo complex, low precipitation
6455	645	5	0.43	0.00	Anthony sandy loam
6456	645	6	0.62	0.00	Anthony-Arizo complex
6457	645	7	0.62	0.00	Anthony-Arizo complex, low precipitation
6458	645	8	0.96	0.00	Arizo cobbly sandy loam
6459	645	9	0.27	0.00	Beeline-Cipriano complex, 3 to 45 percent slopes
6531	653	1	0.00	0.00	Agualt and Ripley soils
6532	653	2	0.00	0.00	Agualt and Ripley soils, saline-sodic
6533	653	3	0.66	0.00	Ajo-Gunsight-Pompeii complex, 3 to 25 percent slopes
6534	653	4	0.00	0.00	Akela-Rock outcrop complex, 15 to 65 percent slopes
6535	653	5	0.82	0.00	Carrizo-Dateland complex, 0 to 3 percent slopes
6536	653	6	1.20	0.00	Carrizo-Momoli complex, 0 to 3 percent slopes
6537	653	7	0.40	0.00	Cherioni very cobbly fine sandy loam, 3 to 10 percent slopes

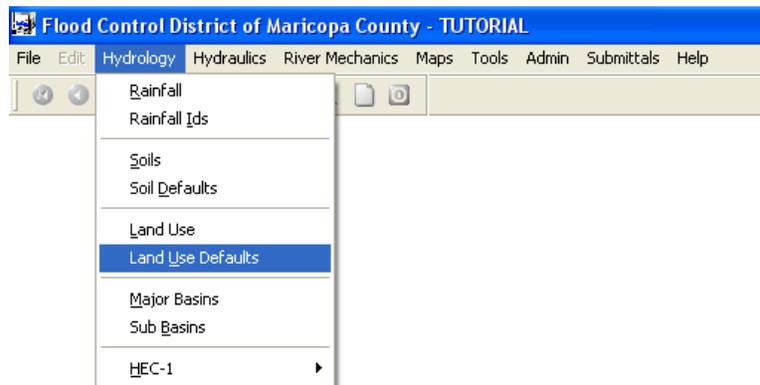
As can be seen, the first column contains the Soil ID for each soil type; this is what should be entered into the SOIL_LID data field in the ESRI shape files **Attribute** table. The last column contains a description of the soil and the other columns contain data that is used in hydrologic calculations or for reference.

A3.3 Customizing Land Use Default

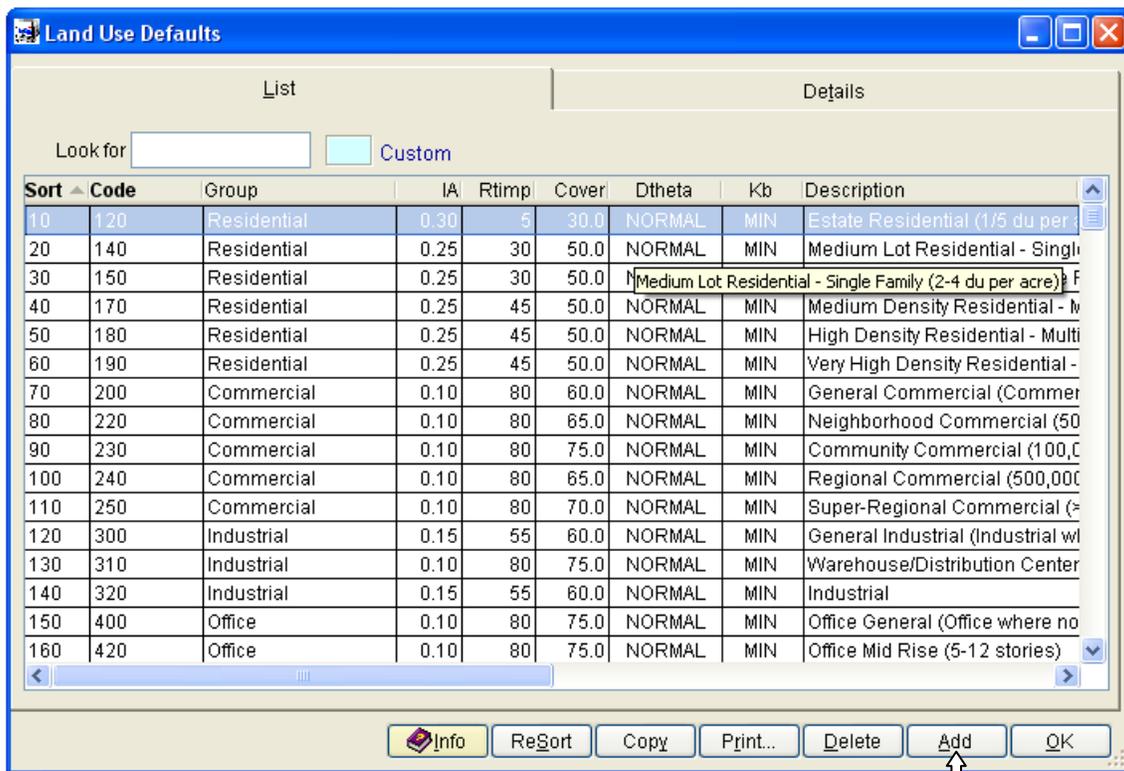
In some cases it may be necessary to add custom data to the Land Use Default if there is a new Land Use type or if the current Land Use Codes do not correctly model a situation.

To add Custom Land Use Codes:

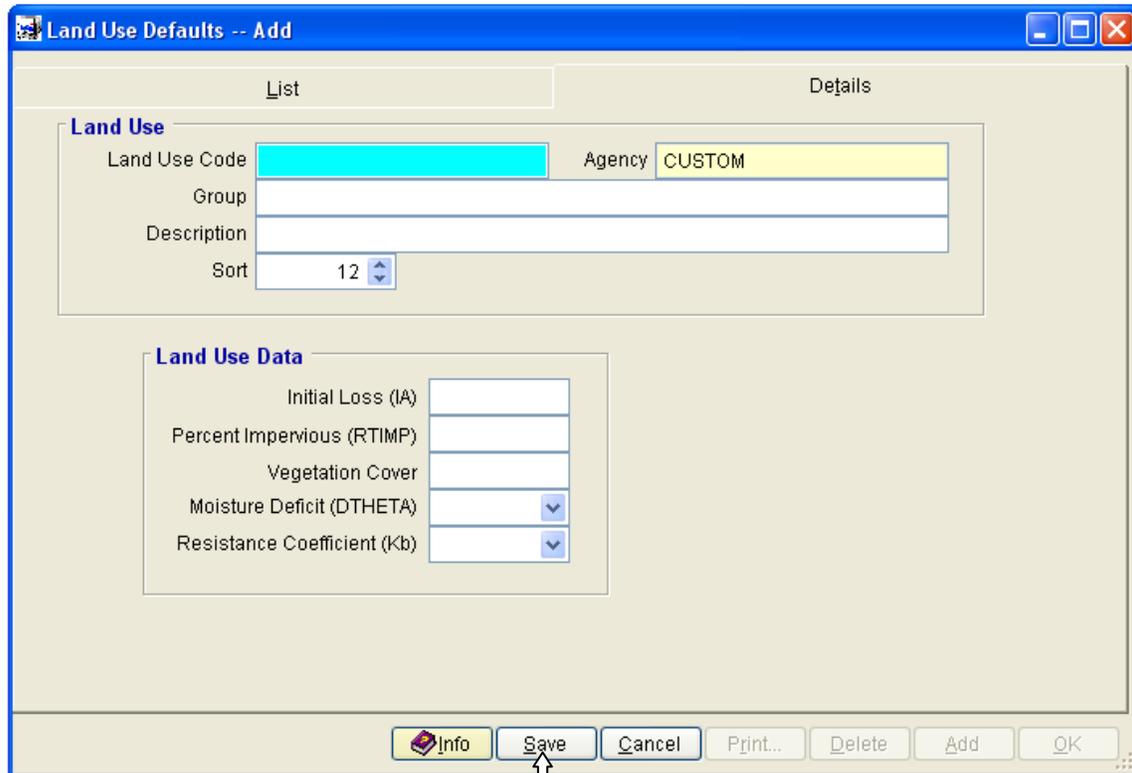
- Open DDMSW
- Go to *Hydrology* → *Land Use Defaults*



- This opens a new window that contains all of the codes that are currently in DDMSW
- Click on the *Add* button on the bottom right of the window as indicated



- This leads to another window where the new data may be entered into the program.



- Add the applicable data for the Custom Land Use code
- Click Save to save the Custom data entered

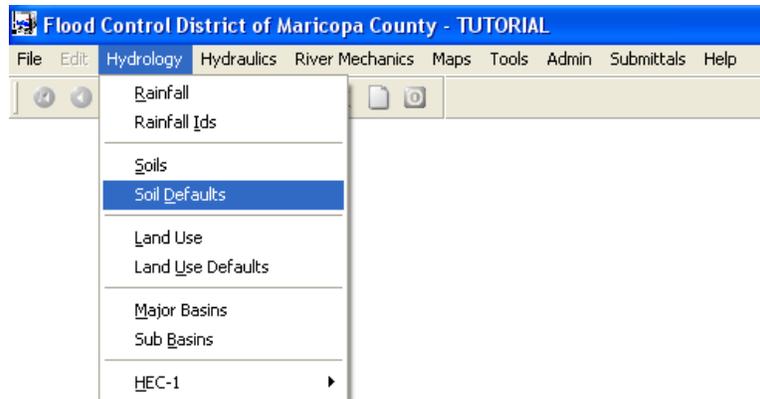
After Custom data has been entered it is important to remember that updating the Land Use Defaults will delete any Custom data.

A3.4 Customizing Soil Default

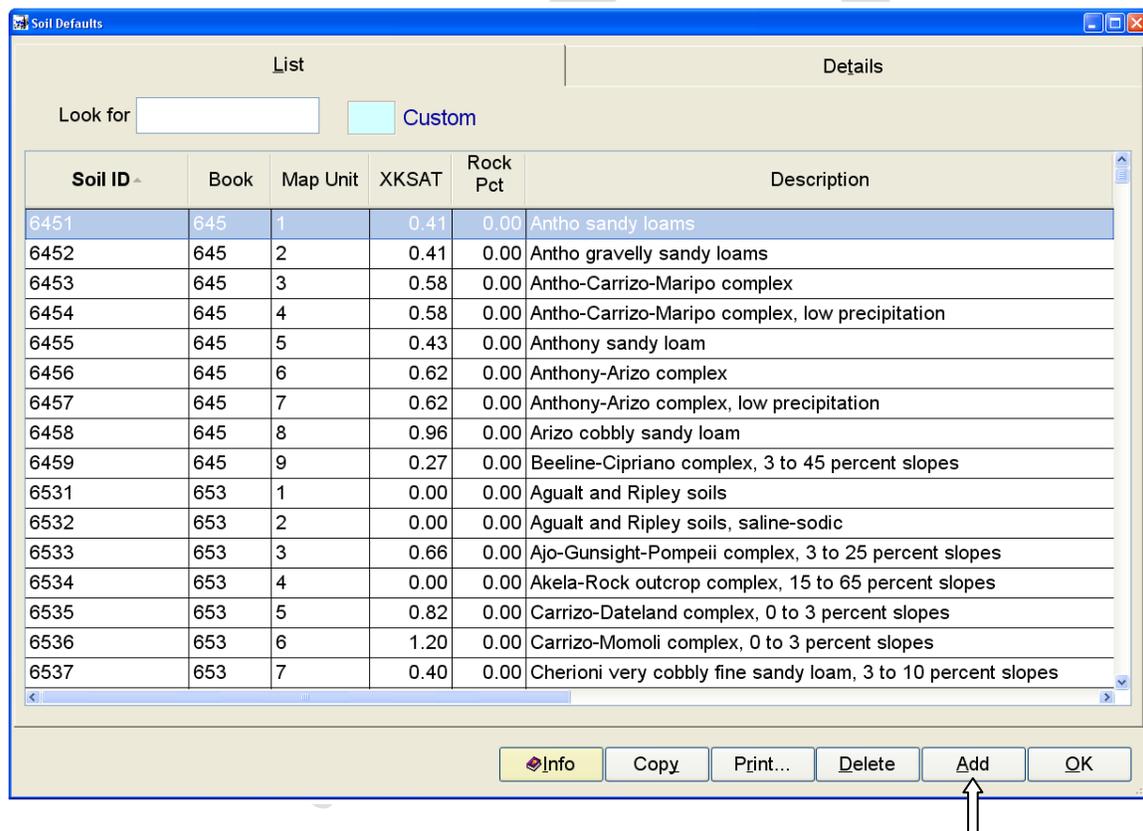
In some cases it is necessary to create Custom Soil IDs if the ones available in DDMSW do not correctly model the situation.

To add Custom Soil IDs:

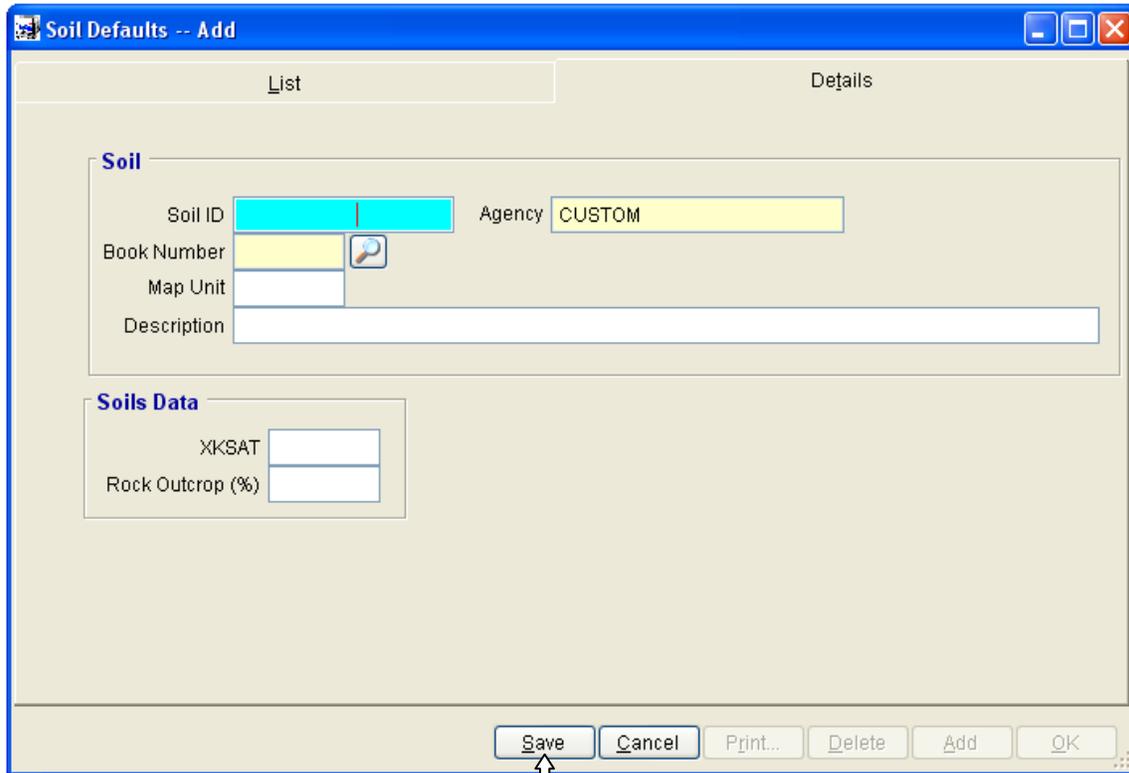
- Open DDMSW
- Go to *Hydrology* → *Soil Defaults*



- This will open a new window that contains a table with the Soil IDs currently in DDMSW
- Click on the *Add* button on the bottom right of the window as indicated



- This leads to another window where the applicable data may be entered



- Enter the applicable data for the Custom Soil ID
- Click Save after the data has been entered to save the Custom data

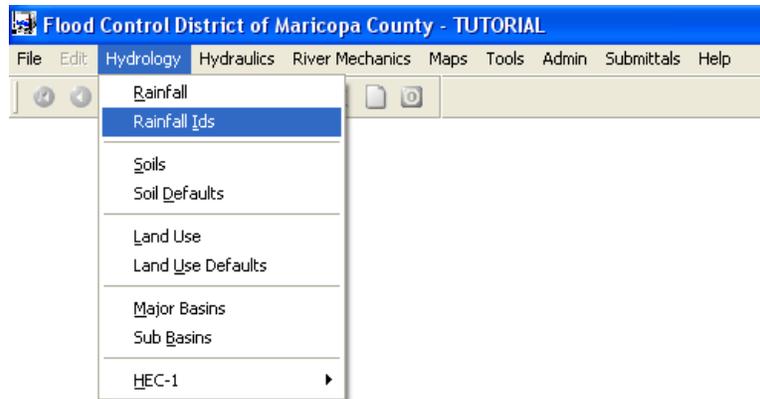
It is important to remember that any Custom data entered into the Soil Defaults in DDMSW will be deleted if the Soil Defaults are updated.

A3.5 Adding Rainfall Ids

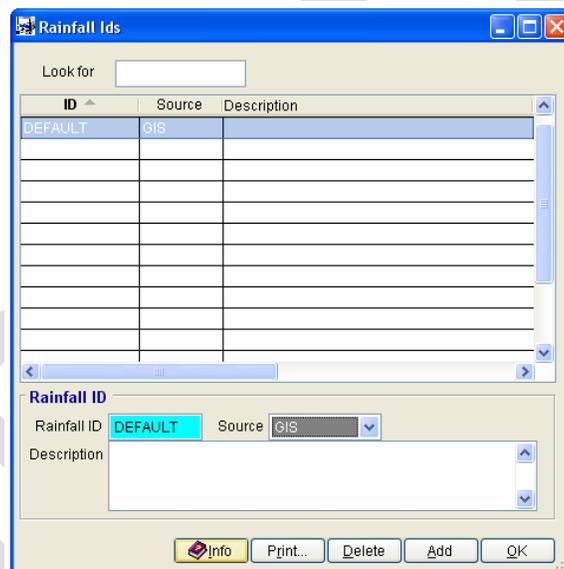
By using additional Rainfall Ids a more detailed analysis can be achieved. An example of this would be, when considering two sub basins, if: one is a fairly steep mountain side and the other is a fairly flat plain. This procedure allows the user to use one Rainfall ID for the mountain and a different one for the plain since they will likely be affected differently by the rainfall.

To add rainfall Ids:

- Open DDMSW
- Open the project file in DDMSW
- Select *Hydrology* → *Rainfall Ids*



- This will open the window for the **Rainfall Ids**



- To create a new Rainfall Ids click on *Add*

A4 Key

To be clear in this tutorial the following Key will be used to help clarify what exactly is being referred to in the text.

In this tutorial “shape file” will denote the file that is created in ESRI ArcMap and is loaded into DDMSW to update data in DDMSW. “ESRI GIS shape file” is the proper name of the shape files exclusively used in this tutorial. It is important to note that DDMSW refers to these shape files as “Maps” in some cases; this is because ArcMap creates maps, one part of which are shape files. It is the shape files specifically that store the data used by DDMSW. For clarity, only the name “shape file” will be used in this tutorial. “Map” will not be used unless it is referencing a specific tab or button named “Map”. DDMSW also uses “GIS” in the same context as shape files because the shape files are created in a GIS program. In this tutorial GIS will only be used to refer to a specific button or location that is named “GIS”, otherwise shape file will be used instead.

Any data type will be denoted by ‘single quotes’, for example a Numeric data type will appear as ‘Numeric’.

A button or tab will be shown by having the name *italicized*, for example the instruction to click on the File tab would appear, click on the *File* tab.

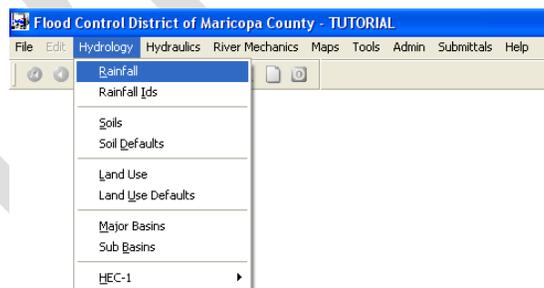
To denote a tool or icon the name or description will appear *‘italicized with single quotes’*, for example the Clip tool would be referred to as the *‘Clip’* tool.

New windows that are opened/pop-up will be **Bolded**, for example the New Field window would appear as the **New Field** window in the text.

A field name will be shown by **‘Bolded letters with single quotes’**, for example the field called Name will be referred to as the **‘Name’** field.

The use of “double quotes” will be used in the same context as they are usually used in the English language, to denote, rename or imply.

In this tutorial the symbol → will signify to click on the tab named on the left then select the next tab named on the right. For example the operation shown in the screen capture below would be denoted by *Hydrology* → *Rainfall*.



The following arrows will be used in conjunction with the screen captures to indicate an icon or other location that needs to be selected/clicked on.

