The Automated Geospatial Watershed Assessment Tool

Watershed Groups and the Land Cover Modification Tool

Introduction:	In this exercise you will use group watersheds and modified land cover to investigate potential impacts of a residential and commercial development.
Goal:	To familiarize yourself with using group watersheds to model a study area that overlaps several watersheds and to learn how to simulate proposed land cover changes.
Assignment:	Run the KINEROS2 model parameterized with both pre-development and post-development land cover on a group watershed consisting of 5 individual watersheds.

Introduction to the AGWA/KINEROS2 study of development near Benson, Arizona

Residential and commercial development is occurring with unprecedented speed throughout the American Southwest. It is projected that from 1995 to 2025, the population in the six Southwestern states of California, Nevada, Arizona, New Mexico, Utah and Colorado will increase by more than 50%, while the remainder of the country is projected to grow only 10 to 15%. This scale and rapid pace of development presents special challenges to the review and permitting process as required under Section 404 of the Clean Water Act (CWA) and the National Environmental Policy Act (NEPA). Many of the areas undergoing rapid development are in arid and semi-arid regions whose watersheds and associated streams exhibit ephemeral or intermittent flow. The standard process for CWA permitting associated with new development rarely considers the special attributes and circumstances encountered in these environments. In addition, rapid urbanization can present a challenge in assessing the cumulative impacts of development on watersheds and landscapes when permitting is conducted piecemeal over multiple parcels in the same region.

The U.S. Environmental Protection Agency's (EPA) 404(b)(1) Guidelines (Guidelines) are the substantive environmental criteria used in evaluating permit applications to the U.S. Army Corps of Engineers to discharge dredged or fill material into waters of the United States, including wetlands, under Section 404 of the Clean Water Act. No discharge of dredged or fill material shall be permitted if there is a practicable alternative which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

To determine the impact of a proposed project on the aquatic ecosystem, the Guidelines require an analysis of the direct, indirect, secondary and cumulative impacts to the aquatic ecosystem (40 CFR 230.11(g)(1)(h)). According to the Guidelines, "the terms aquatic environment and aquatic ecosystem mean waters of the United States, including wetlands, that serve as habitat for interrelated and interacting communities and populations of plants and animals" (Part 230.3(c)), and the definition of "waters of the United States" includes tributaries. The condition of an aquatic ecosystem may be better

understood by examining the hydrology of the watershed. For example, communities of plants and animals depend on the aquatic environment for nutrients and shelter. Changes to the hydrology of that environment, such as increases or decreases in flow or sediment volumes, can have serious impacts on the aquatic ecosystem and the health of those communities.

The Study Area

The San Pedro River is nationally known as being one of the last free-flowing rivers in the Southwest. It is a critical migration corridor for hundreds of bird species and serves as important habitat for many other regionally-declining species of plants, fish, and wildlife. In 1988, nearly 40 miles of the river were designated as the first RNCA (Riparian National Conservation Area) in the country, to protect the river and riparian area, and its biological, educational, recreational and cultural resources. Just a few miles downstream from the San Pedro Riparian National Conservation Area (SPRNCA) is a proposed 8,200 acre development. Although not federally protected as an RNCA, the San Pedro River downstream (north) of the study area also contains many of the same highly valued attributes and is critical to maintaining the ecological integrity of upstream areas.

In this study, AGWA was applied to the proposed development located near Benson, Arizona (**Figure 1**), and represents a preliminary, qualitative assessment of anticipated hydrologic change resulting from proposed development. Pre- and proposed post-development land cover conditions were simulated using KINEROS2 through the AGWA interface. Changes in runoff and sediment yield due to the proposed changes in land cover were computed for five watersheds encompassing the study area and extending to the main-stem of the San Pedro River.

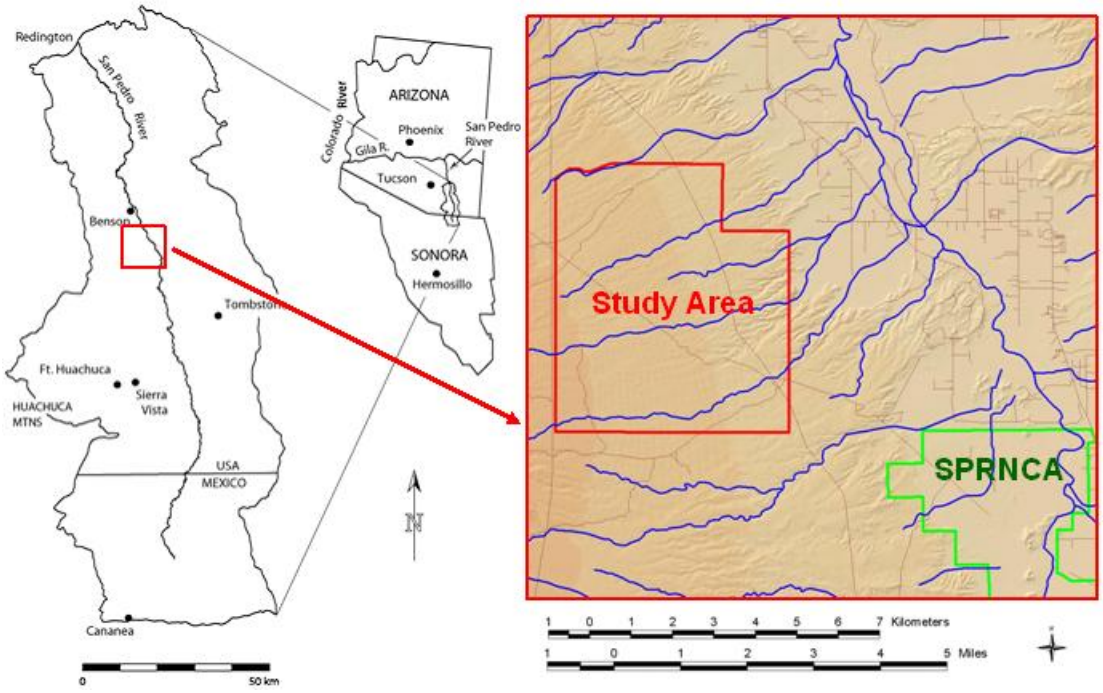


Figure 1. Location Map of the study area, near Benson, Arizona.

This study examines the effects of development on the hydrology of a particular portion of the San Pedro River watershed. The results disclose changes to the hydrologic regime that are attributable to modifications in land cover. Changes include the impairment of water resources due to increases in stormwater runoff and sediment yield during frequent, small storm events. This study reveals change as a result of individual discharge and through the cumulative effect of numerous changes to the environment in multiple adjacent watersheds.

Getting Started

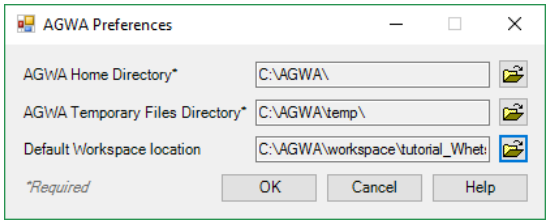
Start ArcMap with a new empty map. Save the empty map document as **tutorial_Whetstone** in the **C:\AGWA\workspace\tutorial_Whetstone** folder (the workspace location will need to be created by clicking on the ***Make New Folder*** button in the window that opens).

TIP Always use a meaningful name to help identify the map document. Map documents can be saved anywhere, but for project organization and to help navigate to the project workspace via the ArcCatalog window in ArcMap, we suggest saving the map document in the workspace location.

If the ***AGWA Toolbar*** is not visible, turn it on by selecting ***Customize > Toolbars > AGWA Toolbar*** on the ArcMap Main Menu bar. Once the map document is opened and saved, set the Home, Temp, and

Default Workspace directories by selecting the ***AGWA Tools > Other Options > AGWA Preferences*** on the ***AGWA Toolbar***.

- Home: **C:\AGWA**
- Temp: **C:\AGWA\temp**
- Default Workspace: **C\AGWA\workspace\tutorial_Whetstone**
  The default workspace location will need to be created by clicking on the ***Make New Folder*** button in the window that opens if you did not create it when saving the map document earlier.



The Home folder contains all of the look-up tables, datafiles, models, and documentation required for AGWA to run. If this is set improperly or you are missing any files, you will be presented with a warning that lists the missing folders or files that AGWA requires.

The Temp folder is where some temporary files created during various steps in AGWA will be placed. You may want to routinely delete files and folders in the Temp folder if you need to free up space or are interested in identifying the temporary files associated with your next AGWA use.

The Default Workspace folder is where delineation geodatabases will be stored by default. This can be a helpful timesaver during the navigation process if you have a deeply nested folder structure where you store AGWA outputs.

GIS Data

Before adding data to the map, connections to drives and folders where your data are stored must be established if they have not been already. To establish folder connections if they don't already exist, click on the ***Add Data*** button  below the menu bar at the top of the screen. In the Add Data form that opens, click the ***Connect To Folder*** button and select **OS (C:)**.

Once the folder connection is established, navigate to the **C:\AGWA\gisdata\tutorial_Whetstone** folder and add the following datasets and layers:

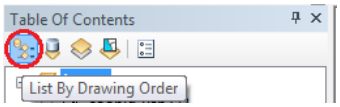
- **..\land cover types.gdb**
  - **Commercial_HighDensityResidential**
  - **GolfCourse**
  - **LowDensityResidential**
  - **MediumDensityResidential**
  - **Park_OpenSpace**
  - **School**
  - **WhetstoneRanchFootprint**
- **demf**
- **development.tif**

- **facg**
- **fdg**
- **hillshade**
- **nlcd2001**
- **outlets.shp**
- **San Pedro River.shp**
- **statsgo.shp**
- **streams**

You will also need to add the following database files from the **C:\AGWA\datafiles** folder:

- **lc_luts\mrlc2001_lut.dbf** – MRLC look-up table for 2001 and 2006 NLCD land cover
- **precip\dsgnstrm.dbf** – return period rainfall for KINEROS2

You may want to collapse the legends and rearrange the order of the layers to better see what is going on. Click on the minus box next to the layer name in the Table of Contents to collapse the legend, or right-click on the Layers dataframe and select ***Collapse All Layers***. Click and drag the layers by their names in Table of Contents to rearrange layer order. If you cannot rearrange the layer order, you may need to select the ***List By Drawing Order*** button in the ***Table Of Contents***.

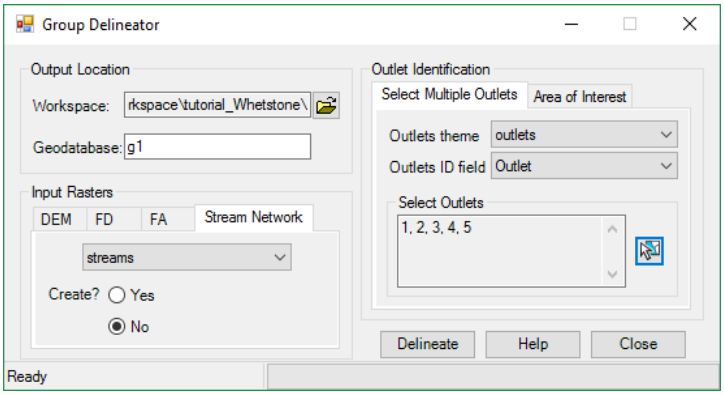


Part 1: Modeling Runoff in Study Area Using Existing Pre-Development Land Cover

Step 1: Delineating the watershed

In Part 1, the watersheds intersecting the study area will be delineated. The delineated group watershed will be discretized into model elements and those elements will be parameterized using the pre-development land cover. Following the initial parameterization, the model will be executed.

1. Perform the watershed delineation by selecting ***AGWA Tools*** > ***Delineation Options*** >***Delineate Group Watershed***
   - 1.1. ***Output Location*** box:
     - 1.1.1. ***Workspace*** textbox: navigate to and select/create **C:\AGWA\workspace\tutorial_Whetstone**
     - 1.1.2. ***Geodatabase*** textbox: enter **g1**
   - 1.2. ***Input Rasters*** box:
     - 1.2.1. ***DEM*** tab: select **demf** (do not click Fill)
     - 1.2.2. ***FD*** tab: select **fdg** (do not click Create)
     - 1.2.3. ***FA*** tab: select **facg** (do not click Create)
     - 1.2.4. ***Stream Network*** tab: select **streams** and the **No** radiobutton



1.3. ***Outlet Identification*** box:

1.3.1. ***Select Multiple Outlets*** tab:

1.3.1.1. ***Outlets theme***: select **outlets**

1.3.1.2. ***Outlets ID field***: select **Outlet**

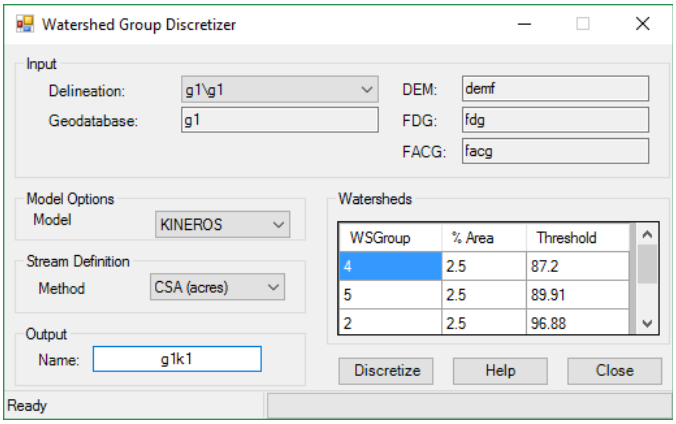
1.3.1.3. ***Select Outlets*** box: Click the ***Select Features*** tool and drag a box around the 5 points in the feature class. The textbox should be populated with Outlet numbers 1-5.

1.3.2. Click ***Delineate***.

1.3.3. Save the map document and continue to the next step.

Step 2: Discretizing or subdividing the watershed

2. Perform the group watershed discretization by selecting the ***AGWA Tools > Discretization Options > Discretize Group Watershed.***



2.1. ***Input*** box:

2.1.1. ***Delineation***: select **g1\g1**

2.2. ***Model Options*** box:

2.2.1. ***Model***: select **KINEROS**

2.3. ***Stream Definition*** box:

2.3.1. ***Method***: select **CSA (acres)**

2.4. ***Watersheds*** box:

2.4.1. ***% Area*** column: Leave the default of 2.5% Area for each watershed.

2.5. ***Output*** box

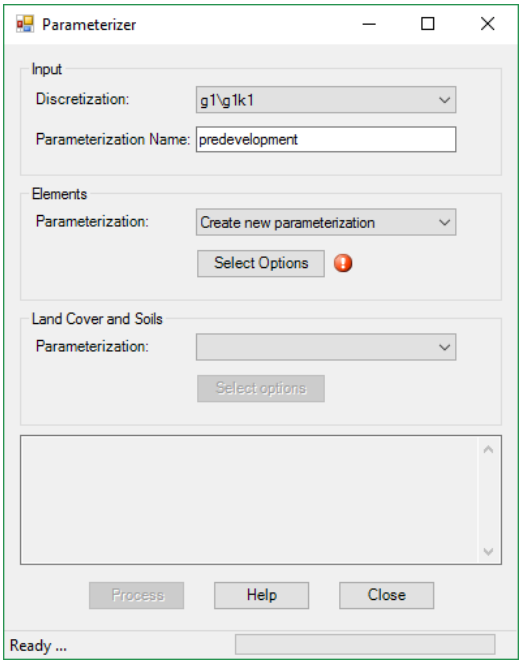
2.5.1. ***Name***: enter **g1k1**

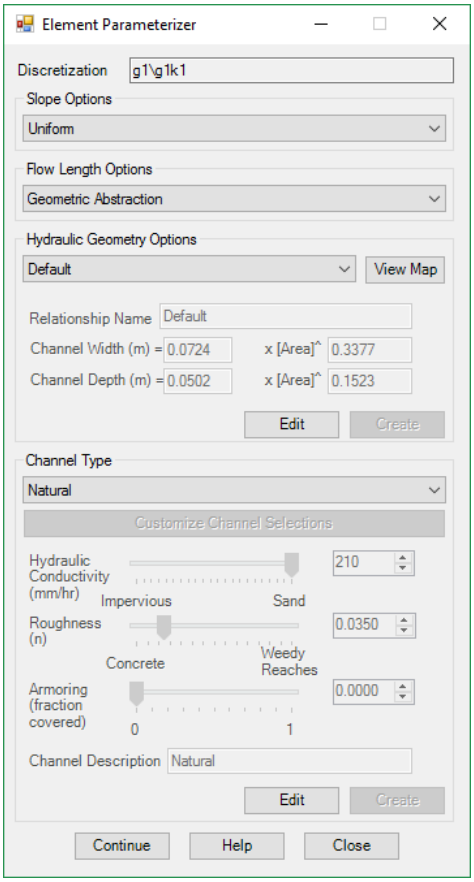
2.6. Click ***Discretize***.

2.7. Save the map document and continue to the next step.

Step 3: Parameterizing the watershed elements for KINEROS2 with the pre-development land cover

3. Perform the element, land cover, and soils parameterization of the group watershed by selecting ***AGWA Tools*** > ***Parameterization Options*** > ***Parameterize***.





3.1. ***Input*** box:

3.1.1. ***Discretization***: select **g1\g1k1**

3.1.2. ***Parameterization Name***: enter **predevelopment**

3.2. ***Elements*** box:

3.2.1. ***Parameterization:*** select **Create new parameterization**

3.2.2. Click ***Select Options***. The ***Element Parameterizer*** form opens.

3.3. In the ***Element Parameterizer*** form:

3.3.1. ***Slope Options:*** select **Uniform**

3.3.2. ***Flow Length Options:*** select **Geometric Abstraction**

3.3.3. ***Hydraulic Geometry Options*** box: select **Default**

3.3.4. ***Channel Type*** box: select **Natural**

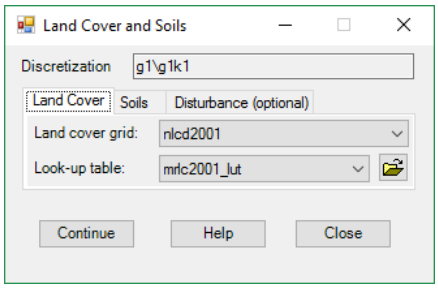
3.3.5. Click ***Continue***. You will be returned to the ***Parameterizer*** form to create the Land Cover and Soils Parameterization.

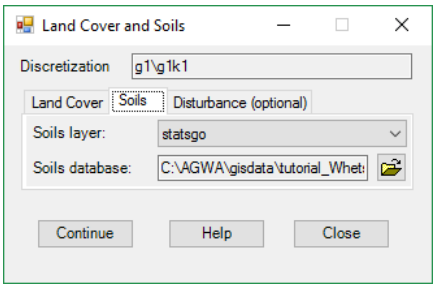
3.4. Back in the ***Land Cover and Soils*** box of the ***Parameterizer*** form

3.4.1. ***Parameterization:*** **Create new parameterization**

3.4.2. Click ***Select Options***. The ***Land Cover and Soils*** form opens.

3.5. In the ***Land Cover and Soils*** form:





3.5.1. ***Land Cover*** tab:

3.5.1.1. ***Land cover grid:*** select **nlcd2001**

3.5.1.2. ***Look-up table:*** select **mrlc2001_lut**

3.5.2. ***Soils*** tab:

3.5.2.1. ***Soils Layer***: select **statsgo**

3.5.2.2. ***Soils database:*** navigate to and select **C:\AGWA\gisdata\tutorials\tutorial_Whetstone\soildb_US_2002.mdb**

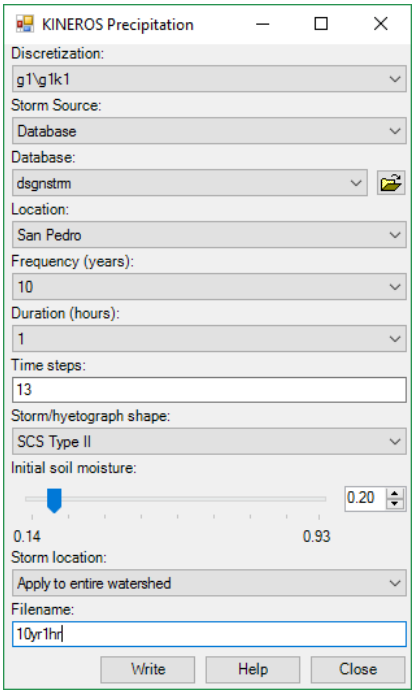
3.5.3. Click ***Continue***. You will be returned to the ***Parameterizer*** form where the ***Process*** button will now be enabled.

3.6. Click ***Process***.

Step 4: Preparing rainfall files

4. Write the KINEROS2 precipitation file for the group watershed by selecting ***AGWA Tools > Precipitation Options > Write KINEROS Precipitation***.

4.1. ***KINEROS Precipitation*** form:



4.1.1. ***Discretization:*** select **g1\g1k1**

4.1.2. ***Storm source:*** select **Database**

4.1.3. ***Database:*** select **dsgnstrm**

4.1.4. ***Location:*** select **San Pedro**

4.1.5. ***Frequency (years):*** select **10**

4.1.6. ***Duration (hours):*** select **1**

4.1.7. ***Time steps:*** enter **13**

4.1.8. ***Storm/hyetograph shape:*** select **SCS Type II**

4.1.9. ***Initial soil moisture:*** select **0.2**

4.1.10. ***Storm location:*** select **Apply to entire watershed**

4.1.11. ***Filename:*** enter **10yr1hr**

4.1.12. Click ***Write***.

4.1.13. ***AGWA KINEROS Precipitation*** window: Click ***Yes***

Step 5: Writing KINEROS2 input files for the pre-development scenario

5. Write the KINEROS2 simulation input files for the group watershed by selecting ***AGWA Tools > Simulation Options > KINEROS Options > Write KINEROS Input Files***.

5.1. ***Basic Info*** tab:

5.1.1. ***Select the discretization***: **g1\g1k1**

5.1.2. ***Select the parameterization***: **predevelopment**

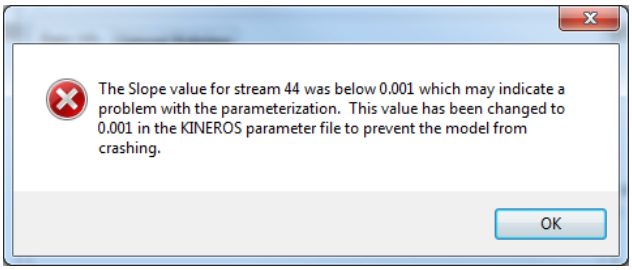
5.1.3. ***Select the precipitation file***: **10yr1hr.pre**

5.1.4. ***Select the multiplier file***: leave blank

5.1.5. ***Select a name for the simulation***: **predevelopment_10yr1hr**

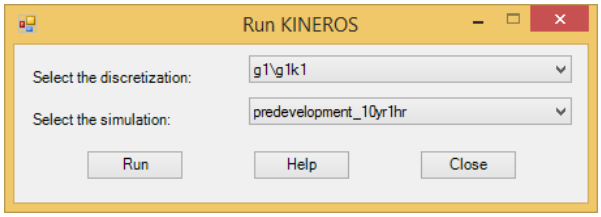
5.2. Click ***Write***.

Where the watersheds meet the San Pedro River, the topography becomes very flat, and combined with the resolution, accuracy, and precision of the DEM, several stream reaches have calculated slopes of zero. A warning message in AGWA is shown when this occurs and informs you that a nominal slope value will be used to prevent the model from crashing. Although not the case in this example, the warnings could indicate an underlying problem with the discretization, a particularly flat study area not well-suited to the application of AGWA, or a large sink feature in the DEM that when filled created a large low slope area.



Step 6: Executing the KINEROS2 model for the pre-development scenario

6. Run the KINEROS2 model for the group watershed by selecting ***AGWA Tools*** > ***Simulation Options*** > ***KINEROS Options*** > ***Execute KINEROS Model***.



6.1. ***Select the discretization***: select **g1\g1k1**

6.2. ***Select the simulation***: select **predevelopment_10yr1hr**

6.3. Click ***Run***.

The command window will stay open for each watershed in the group so that successful completion can be verified. Enter each command window and press any key to continue.

6.4. Close the ***Run KINEROS*** form.

At this point, pre-development conditions have been simulated; post-development land cover will be created in Part 2 and then simulated in Part 3 so that the analysis can be performed in Part 4.

Part 2: Create Post-Development Land Cover

In Part 2, the pre-development land cover will be used along with polygons representing the proposed development to create a post-development land cover product that matches the provided development map.

Step 7: Convert polygon to Developed, High Intensity land cover

7. Perform the land cover modification for the proposed schools by selecting ***AGWA Tools > Other Options > Land Cover Modification Tool***.
   - 7.1. ***Input Land Cover*** tab:
     - 7.1.1. ***Land cover grid***: select **nlcd2001**
     - 7.1.2. ***Look-up table***: select **mrlc2001_lut**
   - 7.2. ***Output Land Cover*** tab:
     - 7.2.1. ***Output folder***: navigate to and select **C:\AGWA\workspace\tutorial_Whetstone**
     - 7.2.2. ***New land cover name***: enter **step1**
   - 7.3. ***Polygon Definition*** tab:
     - 7.3.1. ***Polygon feature class***: select **School**
     - 7.3.2. ***Create?*** radiobuttons: select **No**
     - 7.3.3. Select the ***Select Features*** tool  and drag a box around the features in the selected feature class.
   - 7.4. ***Modification Scenario*** box:
     - 7.4.1. ***Single Change*** tab:
       - 7.4.1.1. Select the **Change entire polygon** radiobutton
       - 7.4.1.2. ***To type***: select **Developed, High Intensity**
   - 7.5. Click ***Process***.
   - 7.6. Save the map and continue to the next step.

Step 8, 9, 10 11, & 12: Combine modifications into one land cover grid

8. Repeat Part 2: Step 7 for the proposed parks and open spaces.
   - 8.1. ***Input Land Cover*** tab:
     - 8.1.1. ***Land cover grid***: select **step1**
     - 8.1.2. ***Look-up table***: select **mrlc2001_lut**
   - 8.2. ***Output Land Cover*** tab:
     - 8.2.1. ***Output folder***: navigate to and select **C:\AGWA\workspace\tutorial_Whetstone**
     - 8.2.2. ***New land cover name***: enter **step2**
   - 8.3. ***Polygon Definition*** tab:
     - 8.3.1. ***Polygon feature class***: select **Park_OpenSpace**
     - 8.3.2. ***Create?*** radiobuttons: select **No**
     - 8.3.3. Select the ***Select Features*** tool  and drag a box around the features in the selected feature class.
   - 8.4. ***Modification Scenario*** box:
     - 8.4.1. ***Single Change*** tab:
       - 8.4.1.1. Select **Change entire polygon** radiobutton
       - 8.4.1.2. ***To type***: select **Grasslands/Herbaceous**
   - 8.5. Click ***Process***.
   - 8.6. Save the map and continue to the next step.
9. Repeat Part 2: Step 7 for the medium density residential areas.

9.1. ***Input Land Cover*** tab:
  9.1.1. ***Land cover grid***: select **step2**
  9.1.2. ***Look-up table***: select **mrlc2001_lut**
9.2. ***Output Land Cover*** tab
  9.2.1. ***Output folder***: navigate to and select **C:\AGWA\workspace\tutorial_Whetstone**
  9.2.2. ***New land cover name***: enter **step3**
9.3. ***Polygon Definition*** tab
  9.3.1. ***Polygon feature class***: select **MediumDensityResidential**
  9.3.2. ***Create?*** radiobuttons: select **No**
  9.3.3. Select the ***Select Features*** tool  and drag a box around the features in the selected feature class.
9.4. ***Modification Scenario*** box
  9.4.1. ***Single Change*** tab
    9.4.1.1. Select **Change entire polygon** radiobutton
    9.4.1.2. To type: select **Developed, Medium Intensity**
9.5. Click ***Process***.
9.6. Save the map and continue to the next step.

10. Repeat Part 2: Step 7 for the low density residential areas.
10.1. ***Input Land Cover*** tab
  10.1.1. ***Land cover grid***: select **step3**
  10.1.2. ***Look-up table***: select **mrlc2001_lut**
10.2. ***Output Land Cover*** tab
  10.2.1. ***Output folder***: navigate to and select **C:\AGWA\workspace\tutorial_Whetstone**
  10.2.2. ***New land cover name***: enter **step4**
10.3. ***Polygon Definition*** tab
  10.3.1. ***Polygon feature class***: select **LowDensityResidential**
  10.3.2. ***Create?*** radiobuttons: Select **No**
  10.3.3. Select the ***Select Features*** tool  and drag a box around the features in the selected feature class.
10.4. ***Modification Scenario*** box
  10.4.1. ***Single Change*** tab
    10.4.1.1. Select ***Change entire polygon*** radiobutton
    10.4.1.2. ***To type***: select **Developed, Low Intensity**
10.5. Click ***Process***.
10.6. Save the map and continue to the next step.

11. Repeat Part 2: Step 7 for the golf course.
11.1. ***Input Land Cover*** tab
  11.1.1. ***Land cover grid***: select **step4**
  11.1.2. ***Look-up table***: select **mrlc2001_lut**
11.2. ***Output Land Cover*** tab
  11.2.1. ***Output folder***: navigate to and select **C:\AGWA\workspace\tutorial_Whetstone**

11.2.2. ***New land cover name***: enter **step5**

11.3. ***Polygon Definition*** tab

11.3.1. ***Polygon feature class***: select **GolfCourse**

11.3.2. ***Create?*** radiobuttons: select **No**

11.3.3. Select the ***Select Features*** tool and drag a box around the features in the selected feature class.

11.4. ***Modification Scenario*** box

11.4.1. ***Single Change*** tab

11.4.1.1. Select ***Change entire polygon*** radiobutton

11.4.1.2. ***To type***: select **Developed, Open Space**

11.5. Click ***Process***.

11.6. Save the map and continue to the next step.

12. Repeat Part 2: Step 7 for the commercial and high density residential areas.

12.1. ***Input Land Cover*** tab

12.1.1. ***Land cover grid***: select **step5**

12.1.2. ***Look-up table***: select **mrlc2001_lut**

12.2. ***Output Land Cover*** tab

12.2.1. ***Output folder***: navigate to and select **C:\AGWA\workspace\tutorial_Whetstone**

12.2.2. ***New land cover name***: enter **finalLC**

12.3. ***Polygon Definition*** tab

12.3.1. ***Polygon feature class***: select **Commercial_HighDensityResidential**

12.3.2. ***Create?*** radiobuttons: select **No**

12.3.3. Select the ***Select Features*** tool and drag a box around the features in the selected feature class.

12.4. ***Modification Scenario*** box

12.4.1. ***Single Change*** tab

12.4.1.1. Select ***Change entire polygon*** radiobutton

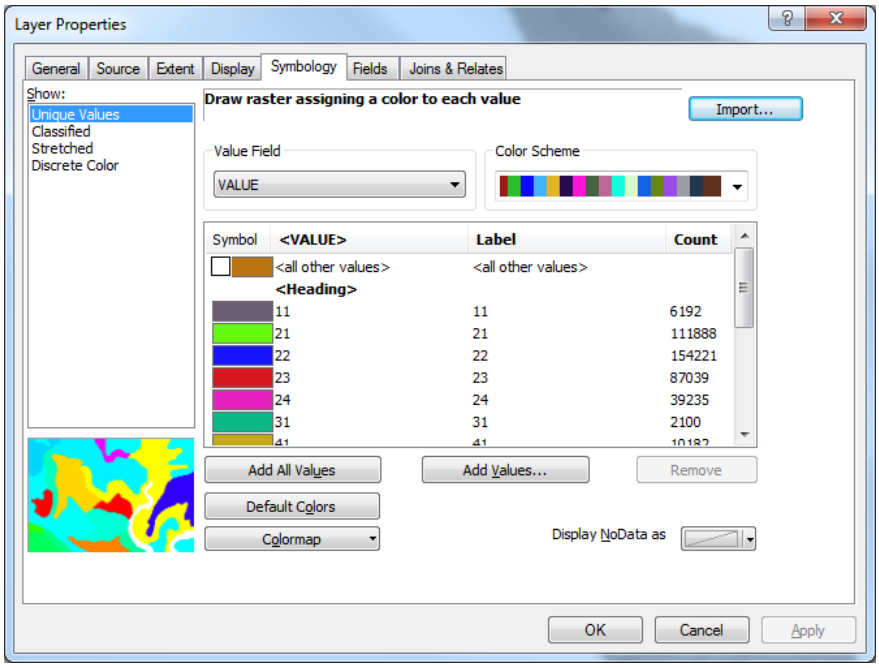
12.4.1.2. ***To type***: select **Developed, High Intensity**

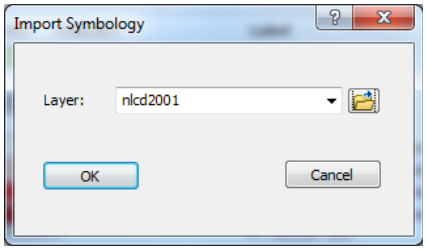
12.5. Click ***Process***.

12.6. Save the map and continue to the next step.

At this point, the **finalLC** raster represents the post-development land cover. Load a legend into the **nlcd2001** and **finalLC** datasets to better visualize the changes. Right click the layer name of the **nlcd2001** dataset in the ***Table of Contents*** and select ***Properties*** from the context menu that appears. Select the ***Symbology*** tab from the form that opens. In the ***Show*** box on the left side of the form, select ***Unique Values*** and click the ***Import*** button on the right. Click the file browser button , navigate to and select **C:\AGWA\datafiles\renderers\nlcd2001.lyr**, and click ***OK*** to apply the symbology and exit the ***Import Symbology*** form. Repeat the procedure for the **finalLC** dataset.

To check that the **finalLC** dataset matches the provided development map (**development.tif**), turn all the layers in the Table of Contents off except for **nlcd2001**, **development.tif**, and **finalLC** by unchecking the checkbox next to the layer names. Toggle these three layers on and off and drag them above or below each other to see how the pre-development land cover has been modified to match the development map. After you're satisfied, you can rearrange the order of the layers and turn them on/off to your liking.



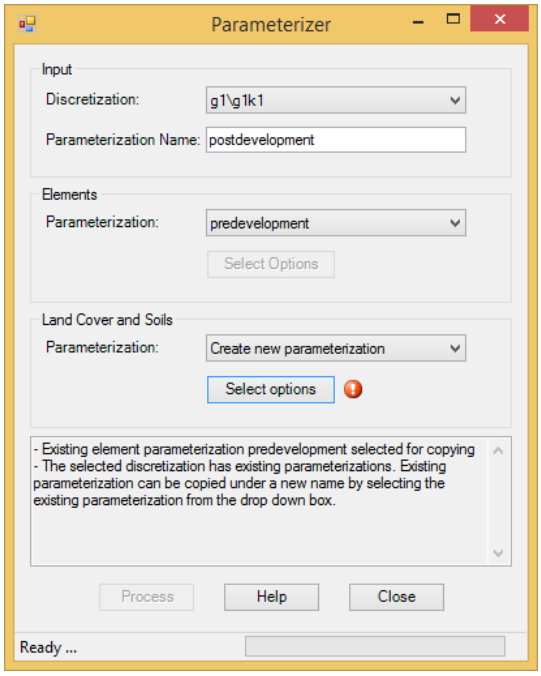


Part 3: Modeling Runoff in Study Area Using Proposed Post-Development Land Cover

In Part 3, the initial land cover and soils parameterization of the watershed will be overwritten by the post-development land cover dataset created in Part 2. The new parameterization will be used to write a different set of model input files to execute the model.

Step 13: Parameterizing the watershed elements for KINEROS2 with the post-development land cover

13. Perform a new land cover and soils parameterization of the group watershed by selecting ***AGWA Tools -> Parameterization Options > Parameterize***.



13.1. ***Input*** box:

13.1.1. ***Discretization***: select **g1\g1k1**

13.1.2. ***Parameterization Name***: enter **postdevelopment**

13.2. ***Elements*** box:

13.2.1. ***Parameterization:*** select **predevelopment**

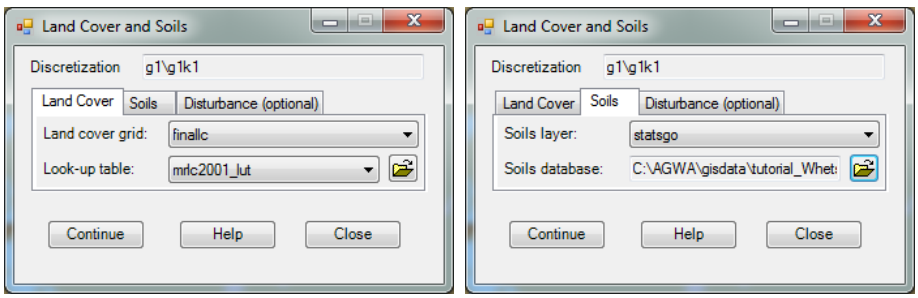
Land cover change is the emphasis of this exercise and no other changes will be made; because no other options are changing, the element parameterization parameters can be copied from an existing parameterization.

13.3. ***Land Cover and Soils*** box

13.3.1. ***Parameterization***: select **Create new parameterization**

13.3.2. Click ***Select Options***. The ***Land Cover and Soils*** form opens.

13.4. In the ***Land Cover and Soils*** form:



13.4.1. ***Land Cover*** tab:

13.4.1.1. ***Land cover grid:*** select **finalLC**

13.4.1.2. ***Look-up table:*** select **mrlc2001_lut**

13.4.2. ***Soils*** tab:

13.4.2.1. ***Soils Layer***: select **statsgo**

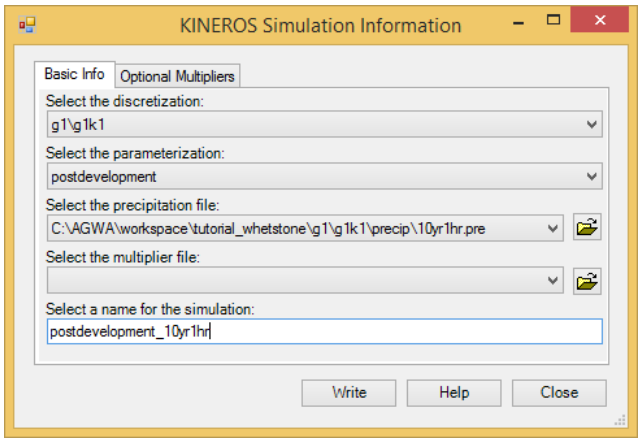
13.4.2.2. ***Soils database:*** navigate to and select **C:\AGWA\gisdata\tutorials\tutorial_Whetstone\soildb_US_2002.mdb**

13.4.3. Click ***Continue***. You will be returned to the ***Parameterizer*** form where the ***Process*** button will now be enabled.

13.5. Click ***Process***.

Step 14: Writing KINEROS2 input files for the post-development scenario

14. Write the KINEROS2 simulation input files for the group watershed by selecting the ***Write KINEROS Input Files*** menu item from the ***AGWA Tools -> Simulation Options -> KINEROS Options*** menu.



14.1. ***Basic Info*** tab:

14.1.1. ***Select the discretization***: **g1\g1k1**

14.1.2. ***Select the parameterization***: **postdevelopment**

14.1.3. ***Select the precipitation file***: **10yr1hr.pre**

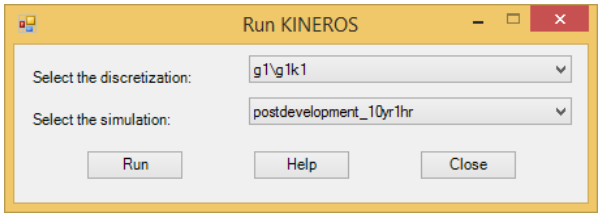
14.1.4. ***Select the multiplier file***: leave blank

14.1.5. ***Select a name for the simulation***: **postdevelopment_10yr1hr**

14.2. Click ***Write***.

Step 15: Executing the KINEROS2 model for the post-development scenario

15. Run the KINEROS2 model for the group watershed by selecting the ***Execute KINEROS Model*** menu item from the ***AGWA Tools -> Simulation Options -> KINEROS Options*** menu.



15.1. ***Select the discretization***: select **g1\g1k1**

15.2. ***Select the simulation***: select **predevelopment_10yr1hr**

15.3. Click ***Run***.

The command window will stay open for each watershed in the group so that successful completion can be verified. Enter each command window and press any key to continue.

15.4. Close the ***Run KINEROS*** form.

Part 4: Comparing Results from Pre- and Post-Development Scenarios

In Part 4, the results from the **predevelopment** and **postdevelopment** simulations will be imported into AGWA. These results will then be differenced to visually see how the proposed development affects the hydrology of the watersheds in the study area.

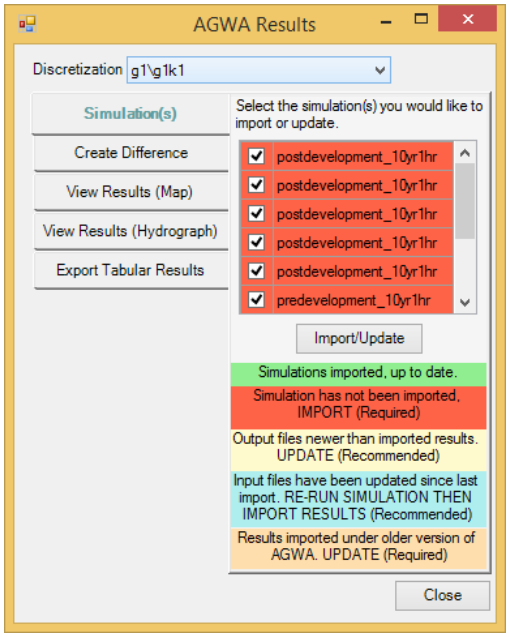
16. Import the KINEROS2 results from the ***predevelopment_10yr1hr*** and ***postdevelopment_10yr1hr*** simulations by selecting ***AGWA Tools > View Results > KINEROS Results > View KINEROS Results***.

16.1. ***Discretization***: select **g1\g1k1**

16.2. ***Simulation*** tab:

16.2.1. Check the boxes for all the simulations.

16.2.2. Click ***Import/Update***



16.3. Difference the ***predevelopment_10yr1hr*** and ***postdevelopment_10yr1hr*** simulation results.

16.3.1. ***Create Difference*** tab

16.3.1.1. ***Base Simulation***: select **predevelopment**

16.3.1.2. ***Alternative Simulation***: select **postdevelopment**

16.3.1.3. ***Change type***: Select **Absolute**

16.3.1.4. ***New Name***: enter **post-pre_abs**

16.3.1.5. Click ***Create***

16.4. View the differenced results.

16.4.1. ***View Results (Map)*** box

16.4.1.1. ***Simulation***: select **post-pre_abs**

16.4.1.2. ***Units:*** select **Metric**

16.4.1.3. ***Output:*** select **Runoff (mm)**

16.4.1.4. Click ***View***.

Your map should look similar to the figure below.