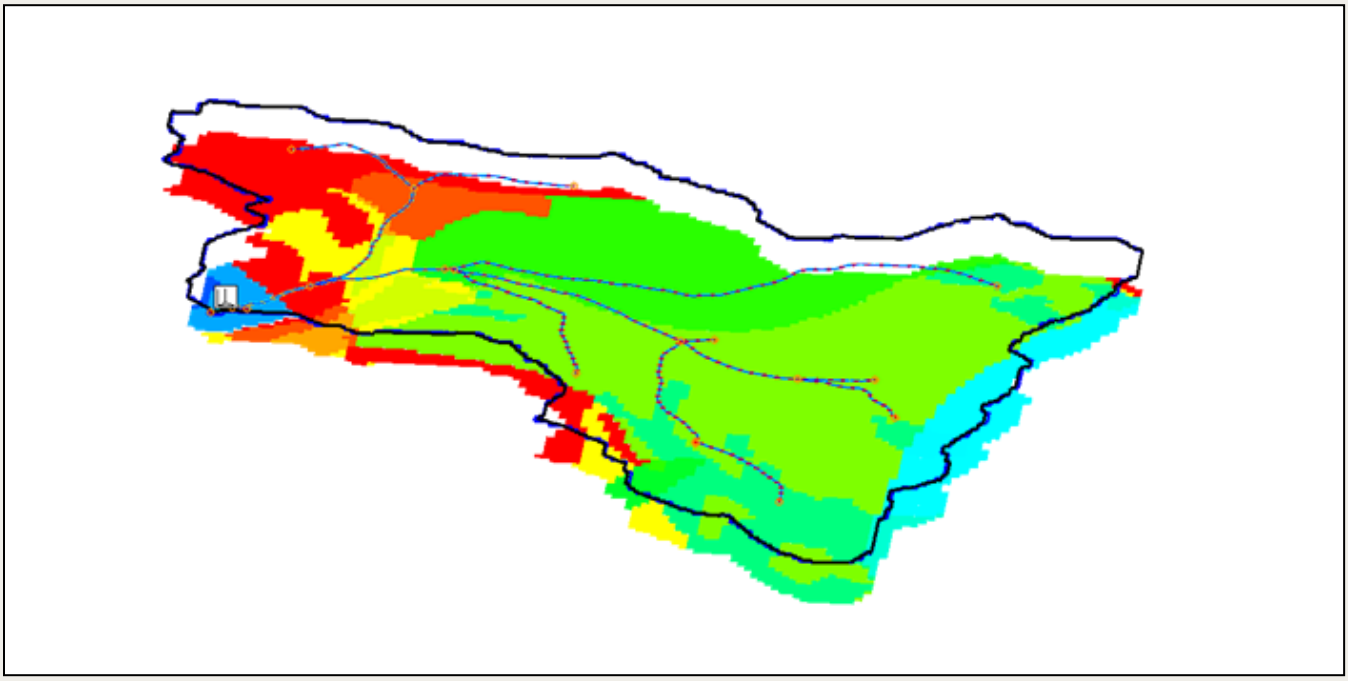
WMS 11.2 Tutorial

GSSHA Land Use Change – Industrial

Model land use changes using GSSHA



Objectives

This tutorial demonstrates how to model and compare the effects of changing land use from residential to industrial using the GSSHA model.

Prerequisite Tutorials

- Developing a GSSHA Model Using the Hydrologic Modeling Wizard

Required Components

- WMS Core
- GSSHA Model

Time

- 20–35 minutes

1 Introduction

This tutorial shows how changing land use from residential to industrial can be modeled in GSSHA. This scenario can then be used to compare pre-development and post-development watershed conditions.

1.1 Getting Started

Begin by opening an existing GSSHA model:

1. Open WMS, or click **New** to reset to the default settings and clear any existing data.
2. Switch to the **2-D Grid** module.
3. Select *GSSHA* | **Open Project File…** to bring up the *Open* dialog.
4. Browse to the *data files* folder for this tutorial and select “Residential_1_end.prj”.
5. Click **Open** to import the project and exit the *Open* dialog.

The project should appear similar to Figure 1.

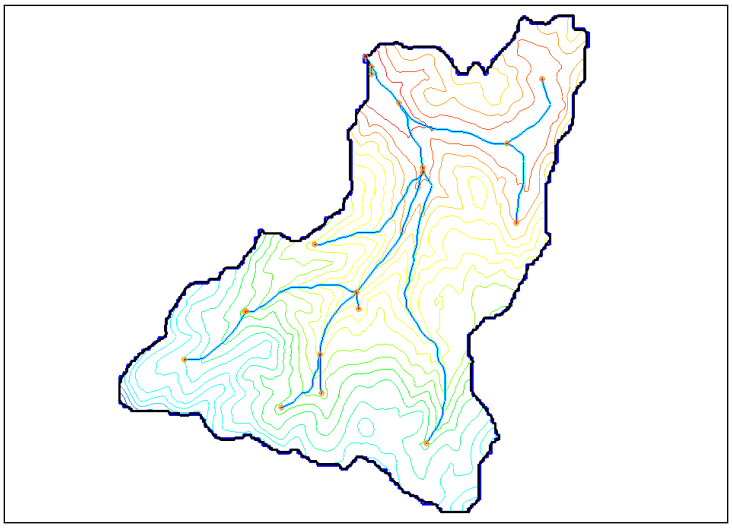


Figure 1 Initial project

2 Creating a New GSSHA Coverage

The land under consideration for industrial development is in the Park City, Utah watershed. To simulate the development, the existing residential land use will be converted to an industrial area. This change impacts both infiltration and the overland roughness characteristics of the watershed.

The first step is to create a new GSSHA coverage by doing the following:

1. Right-click on "GSSHARes_1" and select **Duplicate** to create a new "Copy of GSSHARes_1" coverage.
2. Right-click on "Copy of GSSHARes_1" and select **Rename**.
3. Enter "GSSHAIndust" and press *Enter* to set the new name.
4. Turn off all coverages except for "GSSHAIndust".
5. Select "GSSHAIndust" to make it active.
6. Right-click on "Residential_1_end" and select **Duplicate** to create a new "Residential_1_end(2)" project.
7. Right-click on "Residential_1_end(2)" and select **Rename**.
8. Enter "GSSHA_Industrial" and press *Enter* to set the new name.

There should now be "Residential_1_end" and "GSSHA_Industrial" projects in the Project Explorer.

9. Under "GSSHA_Industrial", right-click on "GSSHARes_1" and select *Assign coverage* | **GSSHAIndust**.

The coverage should change from "GSSHARes_1" to "GSSHAIndust".

3 Saving the Working Project

Before continuing, save the new GSSHA project by doing the following:

1. Right-click on "GSSHA_Industrial" and select **Save Project File…** to bring up the *Save GSSHA Project File* dialog.
2. Select "GSSHA Project File (*.prj)" from the *Save as type* drop-down.
3. Enter "GSSHA_Industrial.prj" as the *File name*.
4. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.

4 Creating the Modified Index Maps

The location where the land use is changing from residential to industrial is known, so it is not necessary to update the landuse coverage. Instead, update the index map directly by doing the following:

1. Right-click on "GSSHA_Industrial" and select **Maps…** to bring up the *GSSHA Maps* dialog.
2. In the *Compute index using data calculator (uniform map)* section, click **Data Calculator…** to bring up the *Data Calculator* dialog.

3. In the *Datasets* section, double-click on "d3. LUResidential_1" in the tree list. It may be necessary to expand "Index maps" to see it.

This adds "d3" to the *Expression* field.

4. Enter "LUIndustrial" as the *Result*.
5. Turn on *Index map*.
6. Click **Compute** to create a new "LUIndustrial" dataset.
7. In the *Dataset* section, double-click on "d4. ComboResidential_1" in the tree list.

This adds "d4" to the *Expression* field.

8. Enter "ComboIndustrial" as the *Result*.
9. Turn on *Index map*.
10. Click **Compute** to create a new "ComboIndustrial" dataset.
11. Click **Done** to close the *Data Calculator* dialog.
12. Click **Done** to close the *GSSHA Maps* dialog.
13. Notice the new "LUIndustrial" and "ComboIndustrial" index maps in the Project Explorer.
14. Right-click on "LUResidential_1" under the "Index Maps" folder under "GSSHA_Industrial" and select **Remove**.
15. Repeat step 14 for "ComboResidential_1" in the same location.

5 Modifying the Index Maps

Land that was originally converted to residential is now being converted to industrial. This means the two new duplicated index maps, "LUIndustrial" and "ComboIndustrial", need to be modified to match the new industrial usage. Because they were duplicated from existing image maps, they only require slight modification.

Changing the parameters for LU11 (the "residential" land use code) will change parameters for all LU11 grid cells, so the new industrial cells should instead be assigned new cell IDs.

5.1 Modifying the Land Use Index Map

First, modify the land use index map by doing the following:

1. In the Project Explorer, turn off all coverages except "GSSHAIndust".
2. Select "GSSHAIndust" to make it active.
3. **Frame** the project.
4. **Zoom** into the area to be converted from residential to industrial usage (Figure 2).

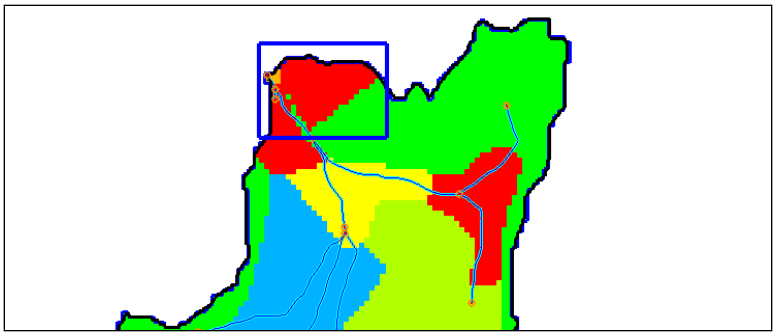


Figure 2 Zoom area (encircled)

5. Click **Display Options** to bring up the *Display Options* dialog.
6. Select "2D Grid Data" from the list on the left.
7. On the *2D Grid* tab, turn on *Cells* and select *Blocked*.
8. Click **OK** to close the *Display Options* dialog.
9. Select "GSSHA_Industrial" to make it active.
10. Under "Index Maps" under that project, select "LUIndustrial".
11. Select the **Select Grid Cell** tool.
12. Select *Edit* | **Select With Polygon** to bring up the *Polygon Selection Options* dialog.
13. Select "Enter a polygon interactively" from the drop-down.
14. Click **OK** to close the *Polygon Selection Options* dialog.
15. Trace a polygon enclosing the group of cells shown with centroids in Figure 3. Double-click at the end point.
16. Without clicking anywhere else in the Graphics Window, enter "15" and press *Enter* in the *Index Map ID* field in the Properties section of the WMS window.

The cells should change color (in this example, they change from red to yellow, as shown in Figure 3).

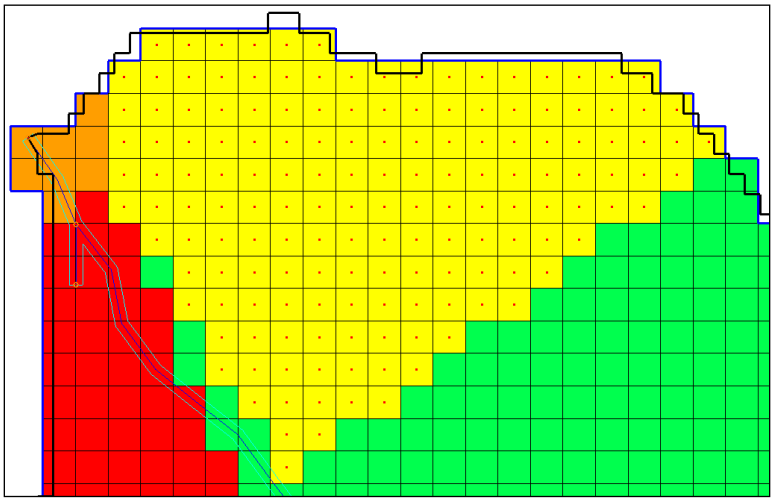


Figure 3 Cells converted from residential (LU11) to industrial (LU15)

5.2 Modifying Combined Index map

The next step is modifying the grid cell IDs for the ComboIndustrial index map. This time, there will be two different grid cell IDs used. Proceed by doing the following:

1. Under the "GSSHA_Industrial" project's "Index Maps" folder, select "ComboIndustrial".
2. Select the **Select Grid Cell** tool.
3. Select *Edit* | **Select With Polygon** to bring up the *Polygon Selection Options* dialog.
4. Select "Enter a polygon interactively" from the drop-down.
5. Click **OK** to close the *Polygon Selection Options* dialog.
6. Trace a polygon enclosing the group of cells shown with centroids in Figure 4. Double-click at the end point.
7. Without clicking anywhere else in the Graphics Window, enter "102" and press *Enter* in the *Index Map ID* field in the Properties section of the WMS window.

The cells should change color (in this example, they change from yellow to blue, as shown in Figure 4).

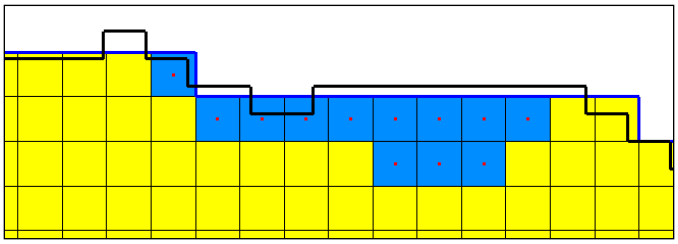


Figure 4 Cells changed to ID 102

8. Repeat steps 2–7, selecting the group of cells shown with the centroid in Figure 5, and entering "101" as the *Index Map ID*.

The cells should change color (in this example, from yellow to cyan).

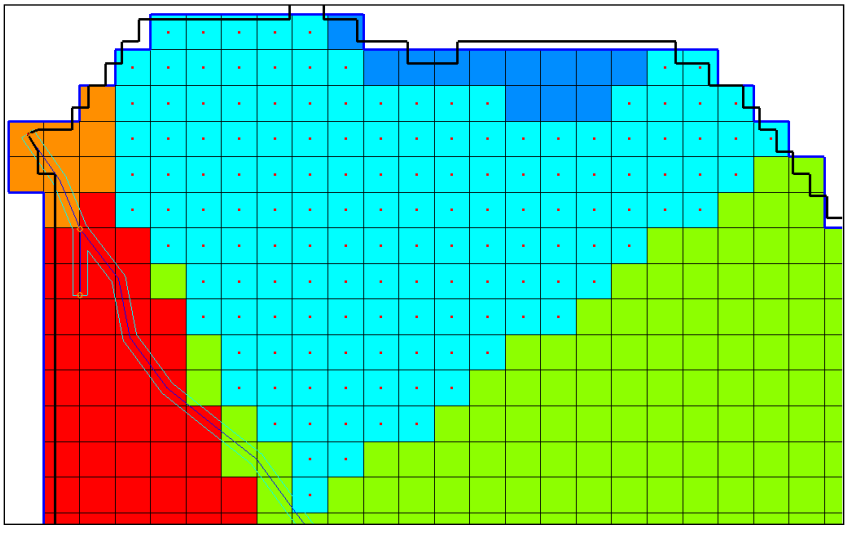


Figure 5 Cells changed to ID 101

6 Changing the Roughness and Infiltration Parameters

The last step prior to running GSSHA is to adjust parameters, including roughness and infiltration, by doing the following:

1. Right-click "GSSHA_Industrial" and select **Map Tables…** to bring up the *GSSHA Map Table Editor* dialog.
2. On the *Roughness* tab, select "LUIndustrial" from the *Using index map* drop-down.
3. Click **Generate IDs**, clicking **No** when asked to delete the existing IDs.

A new column should appear in the spreadsheet. It may appear at the far right, so scroll to the right if needed.

4. On the *Surface Roughness* row in column *15*, enter "0.01".
5. The remaining columns should already be defined as shown in the following table. Correct any that differs from the table.

ID	11	12	**15**	16	17	32	33	41	42
Surface Roughness	0.011	0.012	**0.01**	0.011	0.011	0.05	0.04	0.1	0.15

6. On the *Infiltration* tab, select "ComboIndustrial" from the *Using index map* drop-down.
7. Click **Generate IDs**, clicking **No** when asked to delete the existing IDs.

Two new columns (*101* and *102*) should appear in the spreadsheet. They may appear at the far right, so scroll to the right if needed.

8. Enter the following values for these IDs:

Parameter	**101**	**102**
Hydraulic conductivity	0.01	0.03
Capillary head	35.44	32.28
Porosity	0.464	0.464
Pore distribution index	0.242	0.242
Residual saturation	0.075	0.075
Field capacity	0.318	0.318
Wilting point	0.1	0.1

9. Click **Done** to close the *GSSHA Map Table Editor* dialog.

7 Running GSSHA

Before running GSSHA, the project file should be saved.

1. Right-click on "GSSHA_Industrial" and select **Save Project File…** to bring up the *Save GSSHA Project File* dialog.
2. Select "GSSHA Project File (*.prj)" from the *Save as type* drop-down.
3. Enter "GSSHA_Industrial.prj" as the *File name*.
4. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.

5. Right-click on "GSSHA_Industrial" and select **Run GSSHA** to bring up the *GSSHA Run Options* dialog.
6. Click **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
7. When GSSHA finishes, turn on *Read solution on exit* and click **Close** to exit the *Model Wrapper* dialog.
8. Click **Yes** if prompted to replace the existing file.

8 Visualizing the Results

Because the values are very small overall, the display options need to be adjusted in order to make the results visible.

1. Select "Stream flow" in the Project Explorer.
2. Click **Display Options** to bring up the *Display Options* dialog.
3. Select "2D Scatter Data" from the list on the left.
4. On the *Scatter Point* tab, turn on *Contours*.
5. Enter "20" as the *Radius* and "200.0" as the *Z magnification*.
6. Click **Options…** to bring up the *Stream flow Contour Options* dialog.
7. In the *Contour Method* section, select "Normal Linear" from the first drop-down.
8. Click **OK** to close the *Stream flow Contour Options* dialog.
9. Click **OK** to close the *Display Options* dialog.
10. Select "07/01/2010 10:10:00 AM" from the list of time steps in the *Properties* section of the Graphics Window.
11. Using the **Rotate** tool, rotate the project to appear as in Figure 6.

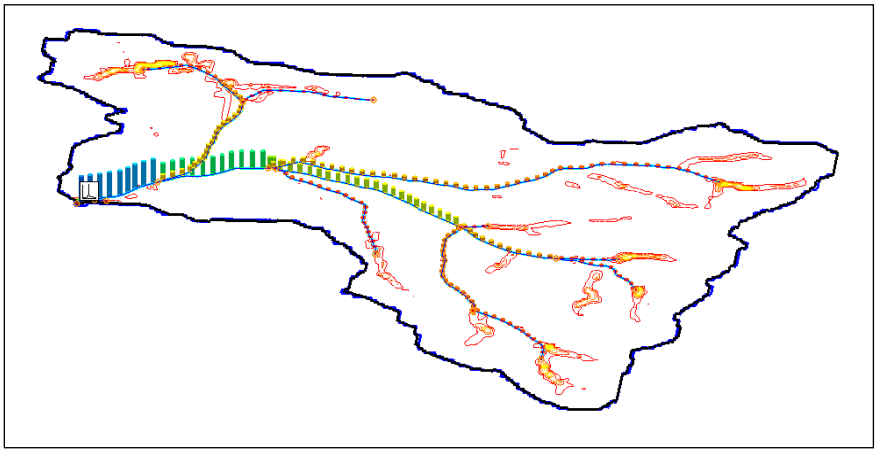


Figure 6 Rotated view showing stream flow

There are many additional ways to visualize the results. Feel free to experiment with other visualization options.

9 Conclusion

This concludes the “GSSHA Land Use Change – Industrial” tutorial. Feel free to continue experimenting, or exit the program.