WMS 11.4 Tutorial
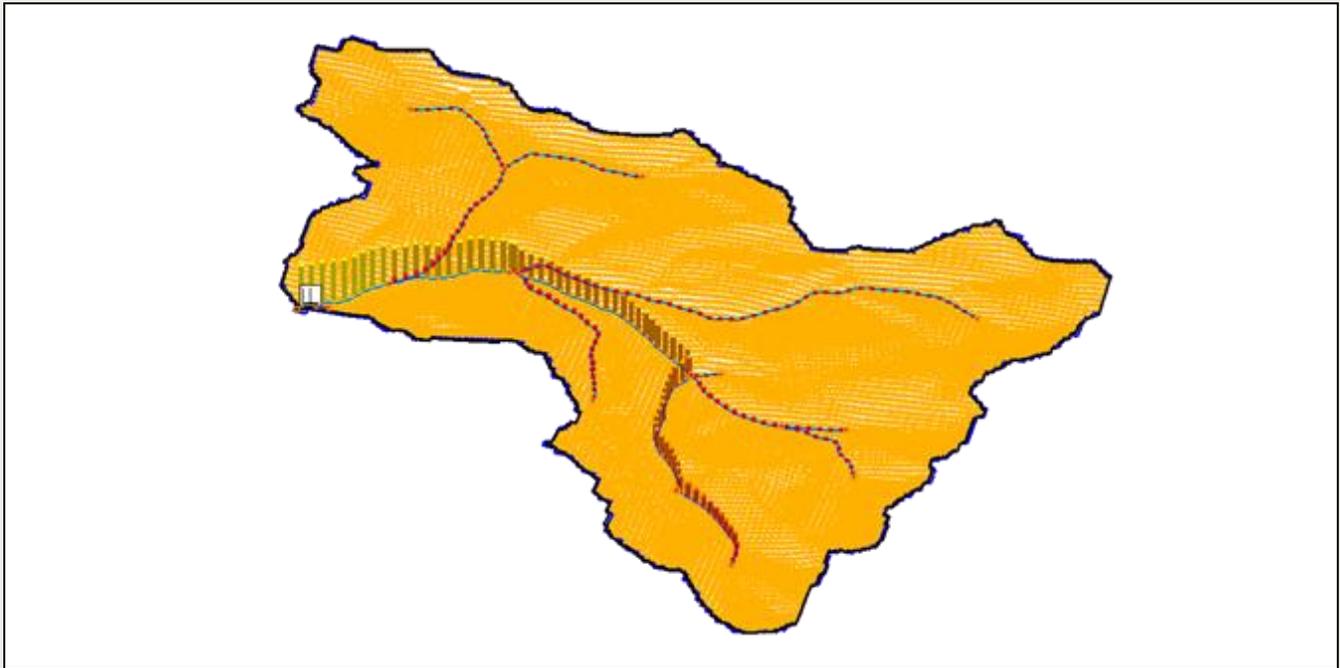
GSSHA Land Use Change – Residential Location

Model land use changes using GSSHA

Objectives

This tutorial demonstrates how to model and compare the effects of residential land use location changes using the GSSHA model.

Prerequisite Tutorials

- Developing a GSSHA Model Using the Hydrologic Modeling Wizard

Required Components

- WMS Core
- GSSHA Model

Time

- 20–30 minutes

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1   Introduction

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

The following will be demonstrated and discussed:

- Change a portion of land from its existing land use to a residential land use.

- Change the location of the residential area to determine the effects of the change.

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.

6. Click **Open** 📂 to bring up the *Open* dialog.

7. Browse to the *data files* folder for this tutorial and select "Aerial.jpg".

8. Click **Open** to import the image and exit the *Open* dialog.

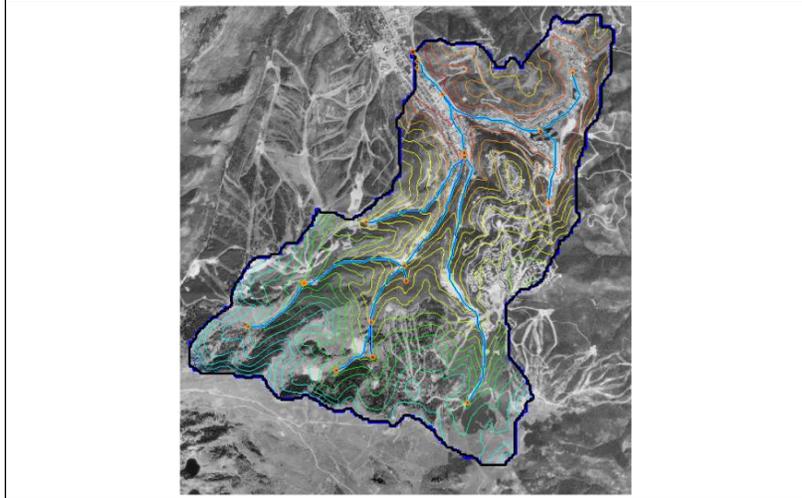After a few moments, the project should appear similar to Figure 1.

Figure 1   Initial project

2   Creating a New GSSHA Coverage

Because GSSHA is a fully distributed model, changing the location of the residential area makes a significant difference. In the imported project file, the change in land use occurred close to the watershed outlet (Figure 2). In this tutorial, change the land use to residential at the far upstream location (Figure 3). The new residential land area will be approximately the same as the original area in the imported project file.

The land under consideration for the new location of the development is in the Park City, Utah watershed. To simulate the change in the development location, the existing residential area will be moved. This change impacts both infiltration and the overland roughness characteristics of the watershed. Inserting the residential area at a different location and re-running the model should show variation in the watershed response.

Figure 2   Current location of residential area

Figure 3   New location of residential area

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 "GSSHARes_2" and press *Enter* to set the new name.

3   Saving the Working Project

Before making further changes, save the new project.

1. Right-click on " Residential_1_end" and select **Duplicate** to create a new " Residential_1_end (2)" project.

2. Right-click on " Residential_1_end (2)" and select **Rename**.

3. Enter "Residential_2" and press *Enter* to set the new name.

There should now be two projects listed: " Residential_1_end" and " Residential_2".

4. Under " Residential_2", right-click on " GSSHARes_1" and select *Assign coverage* | **GSSHARes_2**.

The coverage should change from " GSSHARes_1" to " GSSHARes_2".

5. Select " Residential_2" to make it active.

6. Right-click on " Residential_2" and select **Save Project File…** to bring up the *Save GSSHA Project File* dialog.

7. Select "GSSHA Project File (*.prj)" from the *Save as type* drop-down.

8. Enter "Residential_2.prj" as the *File name*.

9. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.

4   Changing the Land Use Map

The next step is to modify the land use.

1. Under "📛 Coverages" in the Project Explorer, right-click on "🟢 Land Use" and select **Duplicate**.

2. Right-click on "🟢 Copy of Land Use" and select **Rename**.

3. Enter "LUResidential_2" and press *Enter* to set the new name.

4. Turn off all coverages except "🟢 GSSHARes_2" and "🟢 LUResidential_2".

5. Turn off "📒 2D Grid Data".

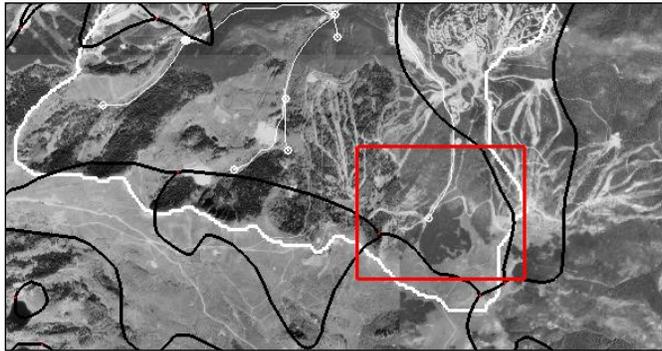6. **Zoom** in to the area near the bottom right, as shown in Figure 4.

Figure 4   Zoom into this area

7. Switch to the **Map** ✛ module.

Much of this area is evergreen forest (LUCode 42). After development, much of the area will become relatively impervious, similar to a residential area (LUCode 11).

8. Select "🟢 LUResidential_2" to make it active.

9. Using the **Select Feature Polygon** 📐 tool, double-click on the center of the forested area near the convergence of the roads to bring up the *Land use mapping* dialog.

In the *WMS landuse ID* section, notice that "Land ID 42" is selected. This is the code for evergreen forest, as indicated above.

10. Click **Close** to exit the *Land use mapping* dialog.

For convenience, a template background image has been created to allow easy creation of the new land use polygon.

11. Click **Open** 📂 to bring up the *Open* dialog.

12. Browse to the *data files* folder for this tutorial and select "Residential2.jpg".

13. Click **Open** to close the *Open* dialog and import "Residential2.jpg".

14. Once it finishes loading, right-click on "🗺 Residential2.jpg" and select **Zoom To Extents**.

15. **Zoom** 🔍 in to the area around the arc marked "Trace this arc".
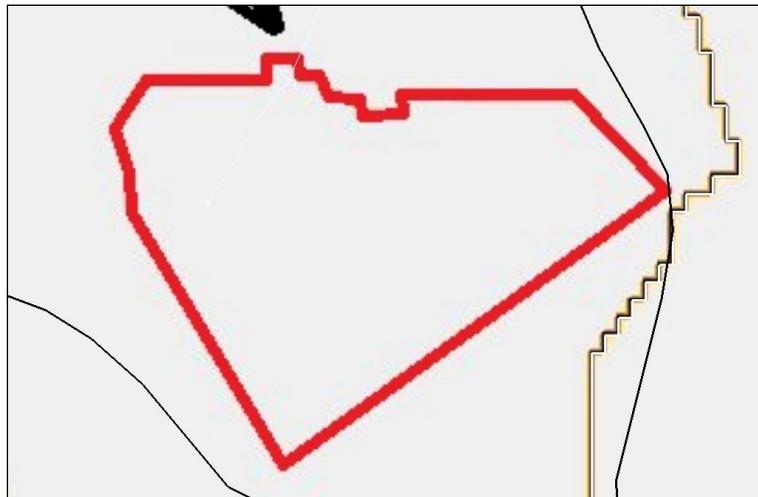
The project should appear similar to Figure 5.

Figure 5   Zoomed in to the arc template

16. Select "⬙ LUResidential_2" to make it active.

17. Using the **Create Feature Arc** ⌇ tool, beginning and ending where the arc template intersects with the existing land use polygon border on the right (circled in Figure 6), create an enclosed arc as shown in Figure 6.
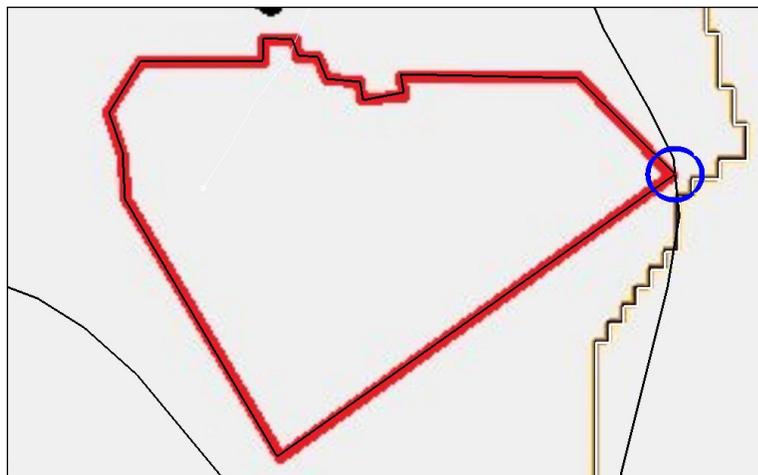

Figure 6   Enclosed arc with beginning/end circled

18. Select *Feature Objects* | **Build Polygon**, clicking **OK** when asked to use all arcs.

19. Using the **Select Feature Polygon** ⬩ tool, double-click inside the new polygon to bring up the *Land use mapping* dialog.

20. In the *WMS landuse ID* section, select "Land ID 11" from the list.

This indicates the land use is now residential.

21. Click **Apply** to exit the *Land use mapping* dialog.

22. Select "⬙ GSSHARes_2" to make it active.

23. Turn off "🖼 Residential2.jpg", "🖼 Aerial.jpg", and "⬙ LUResidential_2".

24. **Frame** 🔍 the project.

5   Creating the Modified Index Maps

With the change in land use coverage, the index maps that use "⬤ Land Use" need to be updated as well. First, create a new land use index map by doing the following:

1. Right-click "Ⓜ Residential_2" and select **Maps…** to bring up the *GSSHA Maps* dialog.

2. On the *Index - Grid* tab, in the *Compute index using WMS coverages* section, select "LUResidential_2" from the *Input coverage (1)* drop-down.

3. Select "Id" from the *Coverage attribute* drop-down.

4. Enter "LUResidential_2" as the *Index map name*.

5. Click **Coverages→Index Map** to map the coverage to a new "📋 LUResidential_2" index map.

Next, create a new index map which is a combination of soil type data and the modified land use data by doing the following:

6. Select "LUResidential_2" from the *Input coverage (1)* drop-down.

7. Select "Id" from the *Coverage attribute* drop-down.

8. Turn on *Input coverage (2)* and select "Soil Type" from the drop-down.

9. Select "Texture" from the *Coverage attribute* drop-down below that.

10. Enter "ComboResidential_2" as the *Index map name*.

11. Click **Coverages→Index Map** to map the coverages to a new "📋 ComboResidential_2" index map.

12. Click **Done** to close the *GSSHA Maps* dialog.

13. Turn on "📦 2D Grid Data" and select "📋 LUResidential_2" to make it active.

The project should appear similar to Figure 7.

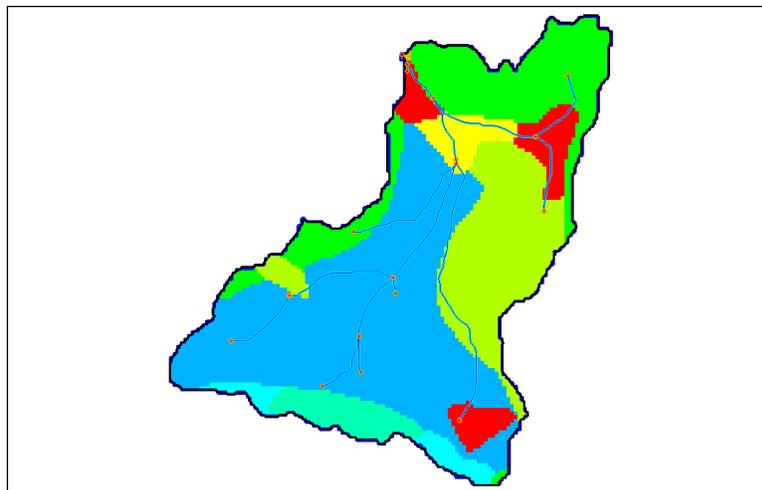*Figure 7   Notice new residential location in bottom right corner*

6   Assigning New Index Maps and Updating Parameters

Now assign the new index maps and update the parameters prior to running GSSHA.

1. Under " M Residential_2", under the " Index Maps" folder, right-click on " LUResidential_1" and select **Remove**.

2. Repeat step 1 for " ComboResidential_1".

The " Index Maps" folder should now contain only " ST", " LUResidential_2", and " ComboResidential_2" index maps.

Now update the mapping tables:

3. Right-click on " M Residential_2" and select **Map Tables…** to bring up the *GSSHA Map Table Editor* dialog.

4. On the *Roughness* tab, select "LUResidential_2" from the *Using index map* drop-down.

5. Click **Generate IDs**, clicking **No** when asked to delete existing IDs.

No new fields were added because ID 11 already exists. The only changes are the numbers of cells using ID 11 and ID 42.

6. On the *Infiltration* tab, select "ComboResidential_2" from the *Using index map* drop-down.

7. Click **Generate IDs**, clicking **No** when asked to delete existing IDs.

Again, no new fields were added.

8. Click **Done** to exit the *GSSHA Map Table Editor* dialog.

7   Running GSSHA

Before running GSSHA, it is recommended to save the project files.

1. Right-click on " M Residential_2" 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 "Residential_2_end.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 " M Residential_2_end" 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 10:05:00 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 8.
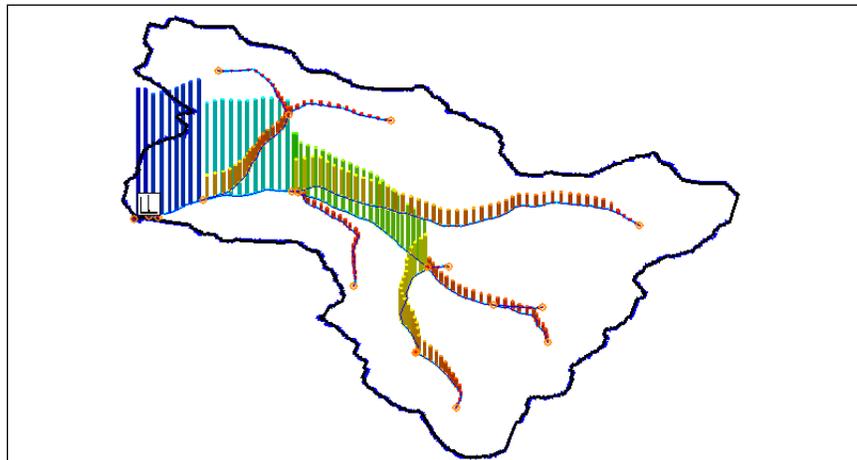

Figure 8   Rotated view showing stream flow

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 – Residential Location" tutorial. Feel free to continue experimenting, or exit the program.