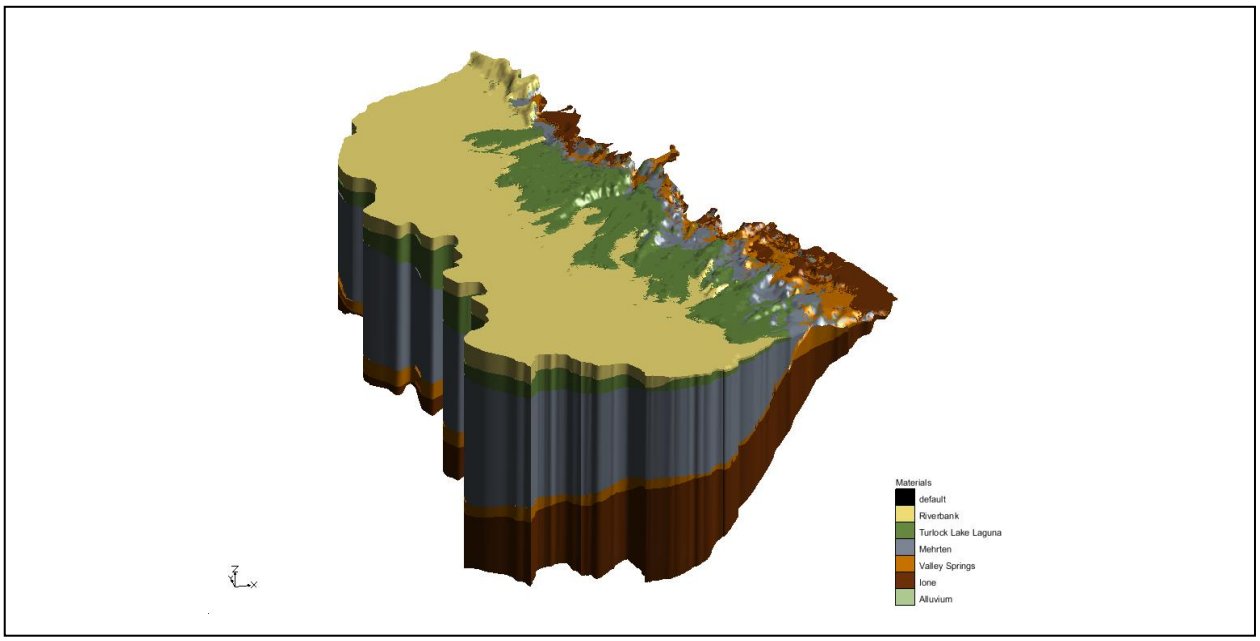
GMS v. 10.2

GMS 10.2 Tutorial

Stratigraphy Modeling—Horizons with Rasters

Create solids from rasters using the **Horizons** → **Solids** tool.



Objectives

Learn what a raster catalog is and how it can be used to create subsurface models.

Prerequisite Tutorials

- Stratigraphy Modeling—Horizons and Solids

Required Components

- Sub-surface Characterization
- Geostatistics
- Map Module
- GIS Module

Time

- 20–30 minutes

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1 Introduction

This tutorial builds on the concepts taught in the "Stratigraphy Modeling—Horizons and Solids" tutorial. In that tutorial, solids were created using horizons defined on boreholes and cross sections. In this tutorial, horizons will be assigned to rasters and then used to create solids. This tutorial will begin with a simple problem to illustrate the concepts involved in using rasters to create solids. Then this tutorial will apply the method to data from Sacramento, California, USA.

This tutorial will demonstrate the following:

1. Import a project with rasters.
2. Create a raster catalog and assign horizon IDs.
3. Create solids from the horizons.
4. Repeat these steps using data from the Sacramento, California region.

1.1 Getting Started

Do the following to get started:

1. If necessary, launch GMS.
2. If GMS is already running, select the *File* | **New** command to ensure that the program settings are restored to their default state.

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2 Importing the Project

The first step in the construction of the solid models is to import a set of borehole logs. Borehole data can be entered into GMS manually, or the data can be read from a file. In the interest of time, import a previously prepared file by doing the following:

1. Click **Open** to bring up the *Open* dialog.
2. Select "Project Files (*.gpr)" from the *Files of type* drop-down.
3. Browse to the *Tutorials\Stratigraphy_Modeling\Horizons_with_Rasters* directory and select "rasters.gpr".
4. Click **Open** to import the project and close the *Open* dialog.

A TIN and multiple rasters have been loaded into this GMS project (Figure 1).

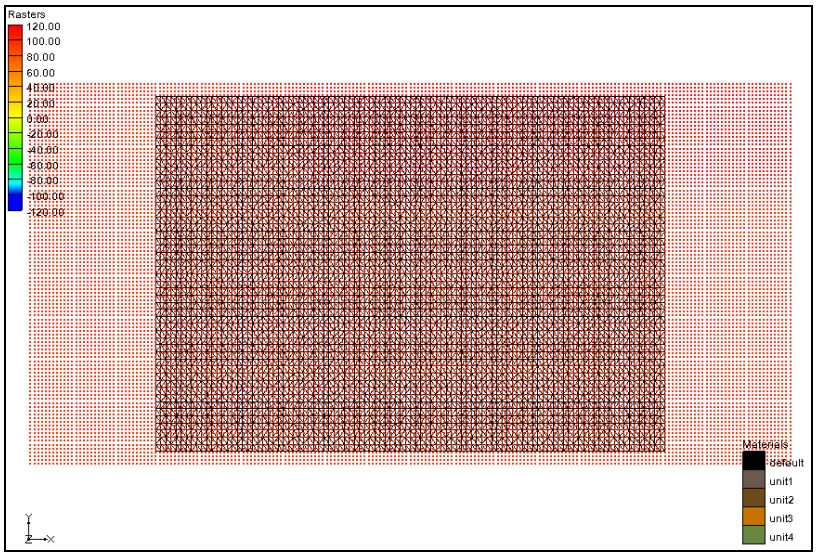

Figure 1 Tin and rasters displayed in the Graphics Window

3 Viewing Raster Elevations

The display options are currently set to view the rasters as points.

1. Switch to **Oblique View** .
2. **Frame** the project.

The two lower rasters slope upward toward the right of the image. The upper two rasters are at constant elevations (Figure 2).

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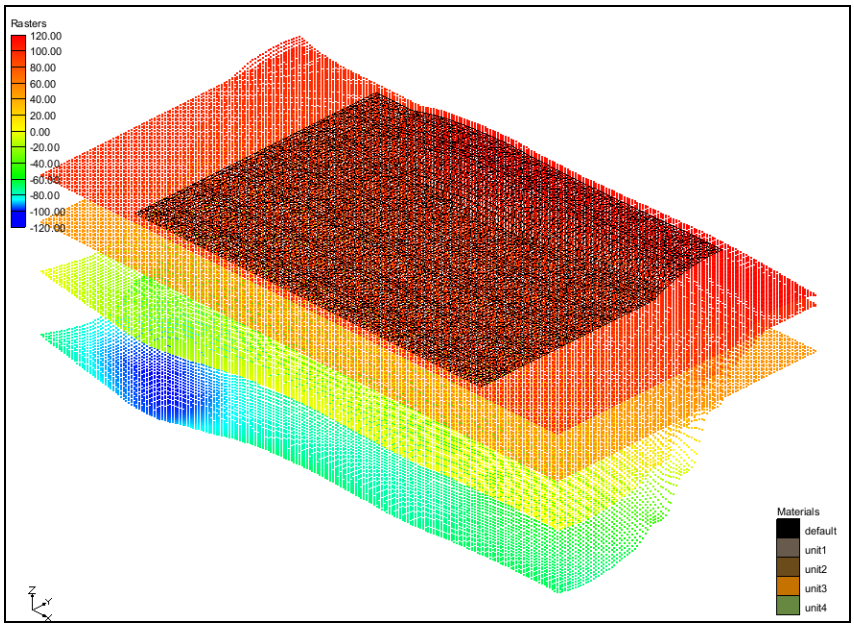

Figure 2 Raster surfaces

The next step is to change the display of the raster to background imagery.

1. Change to **Plan View** .
2. Right-click on the " GIS Layers" folder in the Project Explorer and select **Display Options…** to bring up the *Display Options* dialog. Notice that "GIS Data" is already selected in the list on the left.
3. On the *GIS* tab in the *Rasters* section, select *Display as 2D image* and click **OK** to exit the *Display Options* dialog.

The Graphics Window should now appear similar to Figure 3.

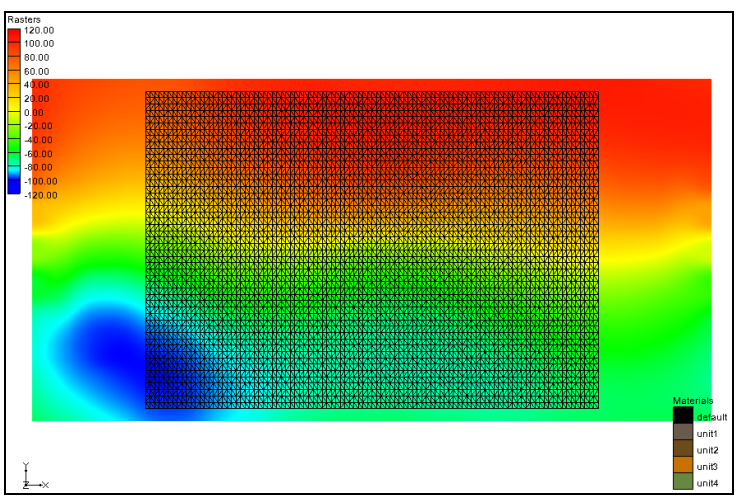

Figure 3 Rasters displayed as background imagery

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4 Creating the Raster Catalog

A raster catalog is a table that allows assigning attributes to rasters. In this case, it is necessary to assign horizon IDs to the rasters.

1. Expand the "GIS Layers" folder in the Project Explorer and select "unit1.tif" raster.
2. While holding down the *Shift* key, select the "unit4.tif" raster. This should select all four rasters.
3. Right-click on the selected rasters and select **New Raster Catalog…** to bring up the *Raster Catalog* dialog (Figure 4).

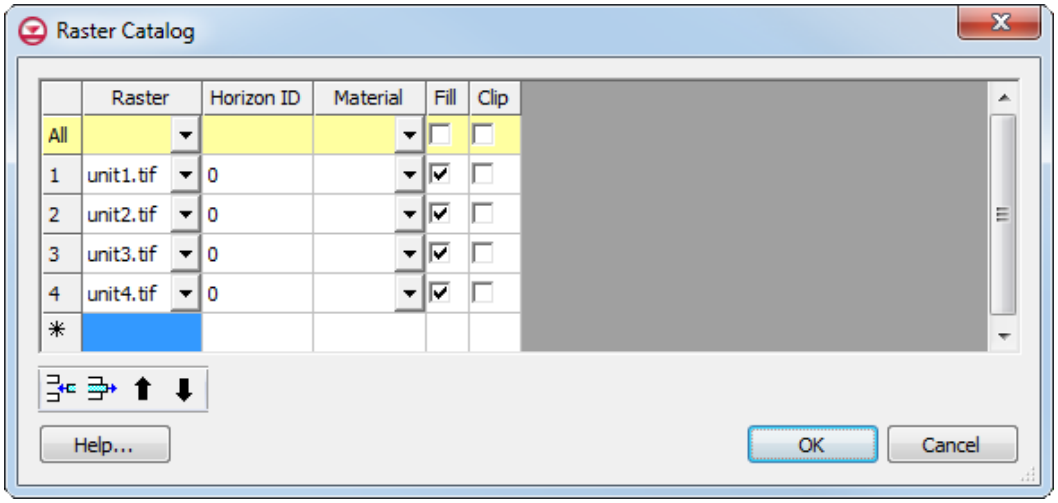

Figure 4 Raster catalog

This dialog allows associating properties with a raster. First, it is necessary to assign horizon IDs and materials to each raster.

4. Enter values from the table below into the *Horizon ID* and *Material* fields for each raster.

Raster	Horizon ID	Material
unit1.tif	1	unit1
unit2.tif	2	unit2
unit3.tif	3	unit3
unit4.tif	4	unit4

5. Make certain the *Fill* column for each of the four entries is on.
6. Select **OK** to exit the *Raster Catalog* dialog.

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5 Creating Solids

It is now possible to create solids using the raster catalog. The **Horizons → Solids** command allows using any combination of borehole, TIN, conceptual model, and raster data to create solids. In this example, only the raster catalog will be used to define the horizon elevations.

1. Select and right-click on "Raster Catalog" in the Project Explorer and select **Horizons → Solids…** to bring up the *Horizon Elevations* page of the *Horizons to Solids* dialog.
2. In the *Raster Catalog* section, select "Project\GIS Layers\Raster Catalog" from the drop-down.
3. Click **Next** to close the *Horizon Elevations* page and open the *Top and Bottom Elevations* page of the *Horizons to Solids* dialog.

There is only one TIN in this project and it will be used as the primary TIN. Additionally, it is necessary to use this TIN's elevations as the top of the solids and to use a constant elevation of "-145.0" as the bottom elevation of the solids.

4. In the *Top elevation* section, select *TIN elevations* and "tin (1)" from the tree list below that.
5. In the *Bottom elevation* section, select *Constant elevation* and enter "-145.0" in the field below that.
6. Click **Next** to close the *Top and Bottom Elevations* page and open the *Build Solids* page of the *Horizons to Solids* dialog.
7. In the *Solids* section, turn on *Minimum solid thickness* and set the value to be "1.0".
8. Click **Finish** to close the *Horizons to Solids* dialog.

5.1 Viewing the Solids

The **Horizons → Solids** process should complete quickly, and a new folder of solids should appear in the Project Explorer.

1. Switch to **Oblique View** .

The solids should look similar to Figure 5. Notice how the lower two layers extend upward on the left side of the solids and cut off the upper two layers.

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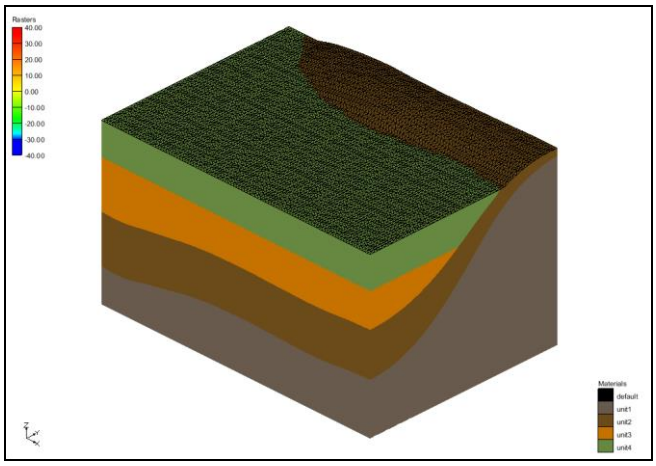

Figure 5 Solids created from raster catalog

6 Changing the Fill and Clip Fields

Now see the effect of changing the *Fill* and *Clip* fields in the raster catalog. When the raster catalog was first created and the dialog appeared, the check boxes for the *Fill* field were on by default. The *Fill* field indicates to use the raster to create a solid. It means the **Horizons → Solids** operation will *Fill* between this raster and the lower surfaces. If the *Fill* field is turned off, then it will not create a solid that is associated with the particular raster. The *Clip* field is used to indicate a surface that "Clips" or truncates any lower surfaces. This process is best illustrated by the following steps:

1. Double-click on the "Raster Catalog" item in the Project Explorer to open the *Raster Catalog* dialog.
2. Uncheck the check box in the *Fill* field for "unit3".
3. Select **OK** to exit the *Raster Catalog* dialog.
4. Right-click on the "Raster Catalog" item and select the **Horizons → Solids** command to open the *Horizons to Solids* dialog again.
5. Select the **Finish** button to close the *Horizons to Solids* dialog and generate a new set of solids.

6.1 Viewing the Solids

When the **Horizons → Solids** command is finished, multiple solids will have been created in the same location. The next step is to turn off the first set of solids that were created.

1. Uncheck the "solids" folder under the "Solid Data" item in the Project Explorer.

The solids should look like Figure 6 below. Notice that no solid was created for "unit3".

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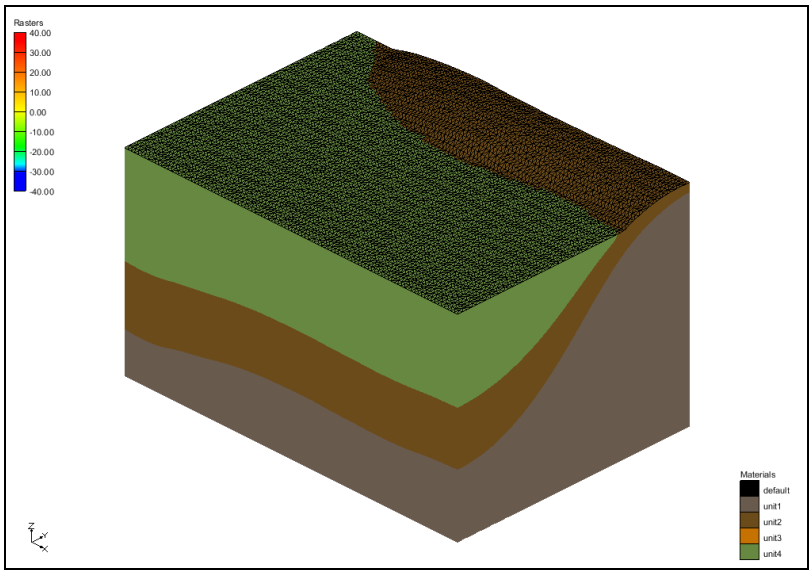

Figure 6 Solids created with the "Fill" field off for the unit3 raster

6.2 Changing the Clip Field

Now it is possible to change the *Clip* field for the "unit3" raster and view the effect.

1. Double-click on the "Raster Catalog" item in the Project Explorer to open the *Raster Catalog* dialog.
2. Check the check box in the *Clip* field for "unit3".
3. Select **OK** to exit the *Raster Catalog* dialog.
4. Right-click on the "Raster Catalog" item and select the **Horizons → Solids** command to open the *Horizons to Solids* dialog again.
5. Select the **Finish** button to close the *Horizons to Solids* dialog and generate a new set of solids.

6.3 Viewing the Solids

1. Uncheck the "solids (2)" folder under the "Solid Data" item in the Project Explorer.

The solids should look like Figure 7 below. Notice that while no solid was created for unit3, the raster was used to "clip" or truncate the units as seen in Figure 7.

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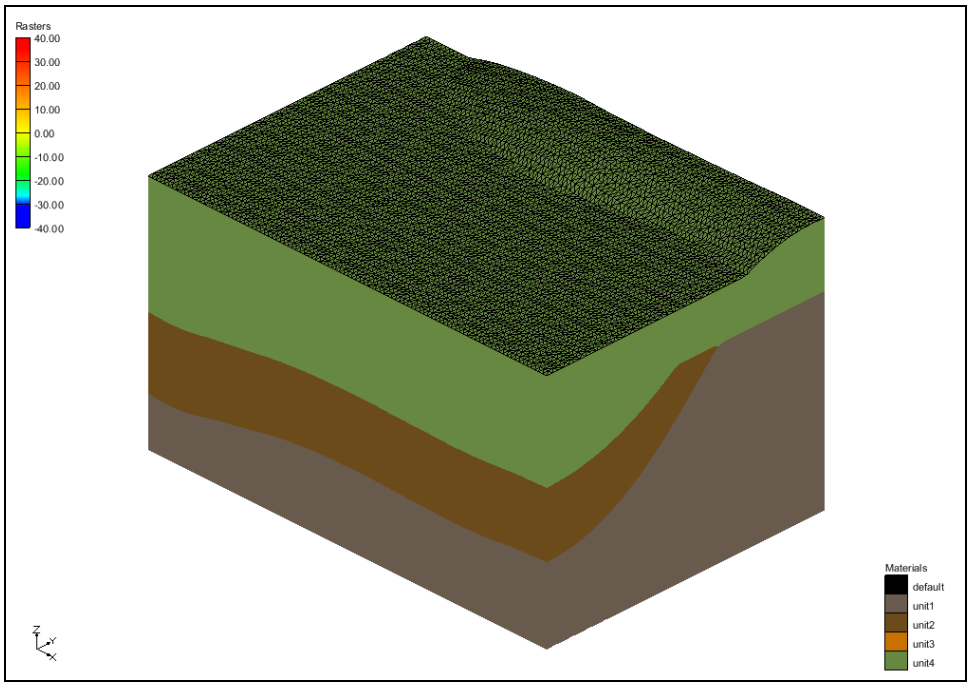

Figure 7 Solids created with the "Clip" field on for the unit3 raster

7 Sacramento Data

It is now possible to use what has been learned to create solids of data from the Sacramento Valley.

1. Select the *File* | **New** command.
2. Select **No** at the prompt to remove the existing data
3. Select the **Open** button to bring up the *Open* dialog.
4. Select "Project Files (*.gpr)" from the *Files of type* drop-down.
5. Browse to the directory entitled *Tutorials\Stratigraphy_Modeling\Horizons_with_Rasters* and select the file named "sacramento.gpr".
6. Click **Open** to import the project and close the *Open* dialog.

The Figure 8 image should be visible in the GMS graphics window. This project contains two TINs to define the top and bottom of the solids, a map coverage with the surface geology, multiple rasters to define top elevations for stratigraphic units, and an aerial photo of the Sacramento region.

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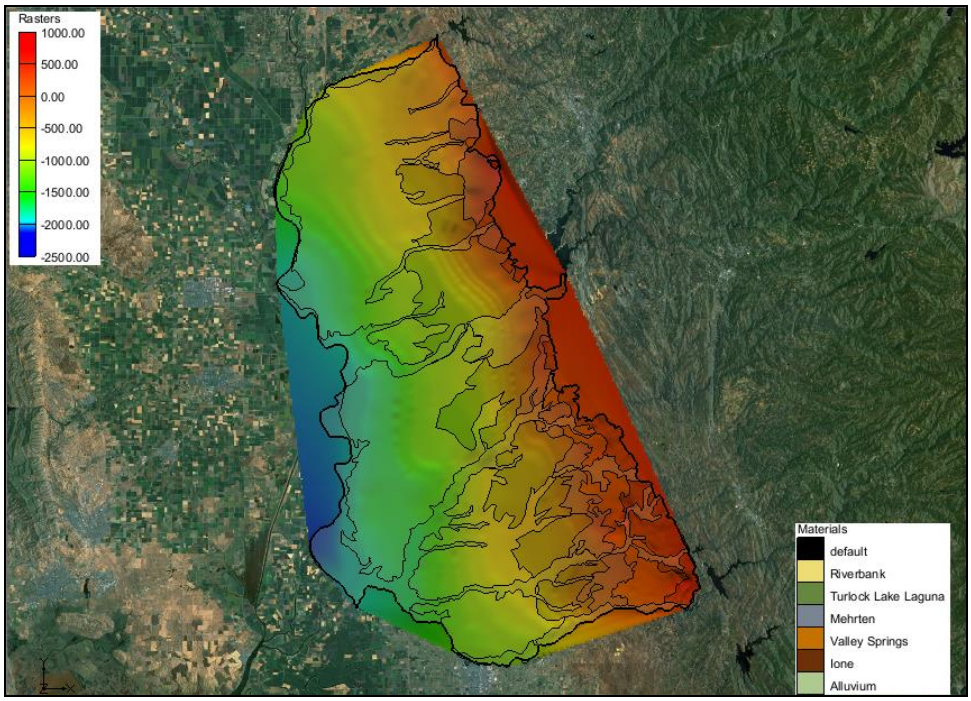

Figure 8 Map view of Sacramento Region Data

7.1 Creating the Raster Catalog

It is now possible to create a raster catalog and assign horizon IDs to the rasters.

1. Expand the "GIS Layers" item in the Project Explorer.
2. Select the "TOP7.bil" raster in the Project Explorer.
3. Hold down the *Shift* key and select the "TOP1.bil" raster in the Project Explorer.

All five rasters should now be selected.

4. Right-click on the selected rasters and select the **New Raster Catalog** command to bring up the *Raster Catalog* dialog.
5. Fill in the *Horizon ID* and *Material* fields as shown in table below.

Raster	Horizon ID	Material
TOP7.bil	1	Ione
TOP6.bil	2	Valley Springs
TOP4.bil	3	Mehrten
TOP2.bil	4	Turlock Lake Laguna
TOP1.bil	5	Riverbank

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6. Select **OK** to close the *Raster Catalog* dialog.

7.2 Creating Solids

Do the following to create solids from the rasters:

1. Right-click on the "Raster Catalog" item and select the **Horizons → Solids** command to open the *Horizons to Solids* dialog.
2. Select the "Project\GIS Layers\Raster Catalog" item in the drop down list in the *Raster Catalog* section of the dialog (upper right).
3. Click **Next** to close the *Horizon Elevations* page and open the *Top and Bottom Elevations* page of the *Horizons to Solids* dialog.
4. Ensure that *Tin elevations* is the selected option for *Top elevation* (middle section of the dialog) and that "top" is the selected TIN.
5. Ensure that *Tin elevations* is the selected option for *Bottom elevation* (right section of the dialog) and that "bottom" is the selected TIN.
6. Click **Next** to close the *Top and Bottom Elevations* page and open the *Build Solids* page of the *Horizons to Solids* dialog.
7. Make sure that the *Minimun solid thickness* option is on and that a value "1.0" has been entered.
8. Select the **Finish** button to close the *Horizons to Solids* dialog.

7.3 Viewing the Solids

The **Horizons → Solids** process should complete quickly and a new folder of solids should appear in the Project Explorer.

1. Select the **Oblique View** button.

The solids should appear like Figure 9 below.

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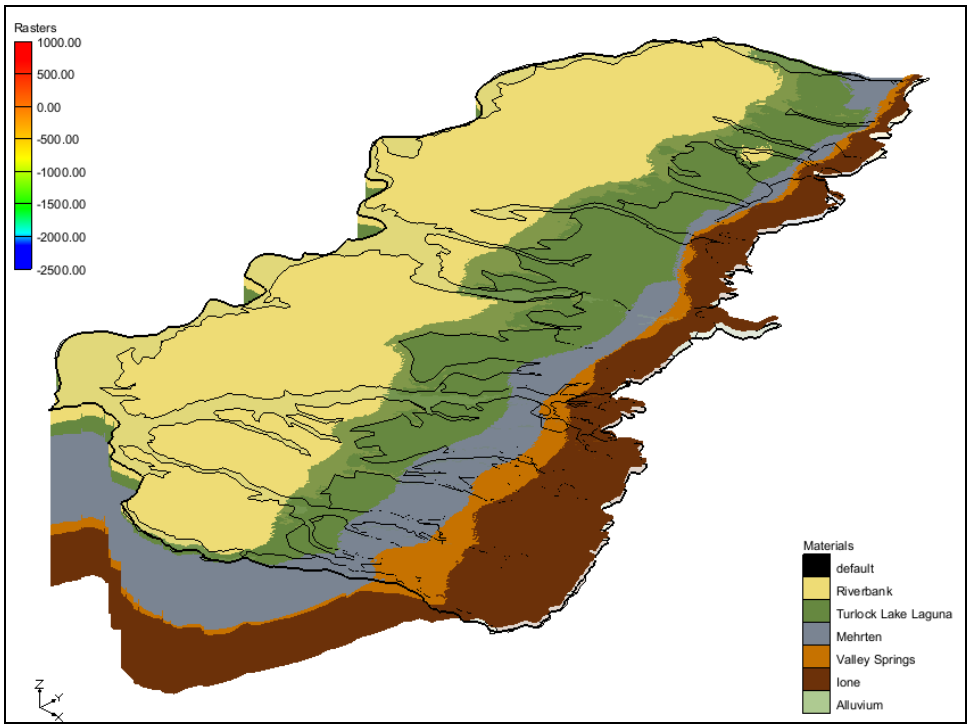

Figure 9 Solids of the Sacramento Valley

If desire, rotate the view, apply lighting, or cut cross sections through the solids.

8 Conclusion

This concludes the tutorial. Here are some of the key concepts in this tutorial:

- Rasters can be used to create solids.
- To use rasters with the horizons method, it is necessary to create a raster catalog and assign horizon IDs to the rasters.
- Rasters can be combined with any combination of boreholes, cross sections, TINs, and conceptual model data to create solids using the horizons method.

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