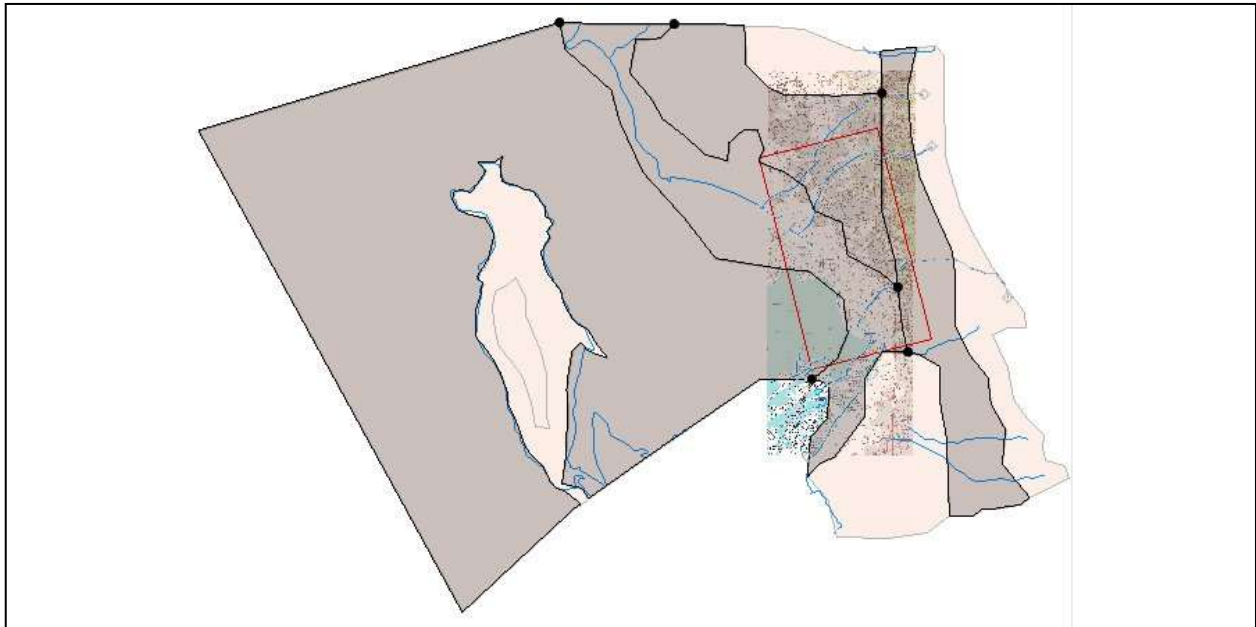


GMS 10.1 Tutorial

GIS Module

Importing, displaying, and converting shapefiles



Objectives

Learn how to import and display shapefiles with and without ArcObjects. Learn how to convert the shapefiles to GMS feature objects.

Prerequisite Tutorials

- Getting Started

Required Components

- GIS Module
- Map Module

Time

- 20-30 minutes



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1 Introduction and Getting Started

This tutorial introduces the GIS module, and is split into two parts. The first part shows the features available if the user doesn't have an active license of ArcObjects®. The GIS module can be used to display data from a GIS database directly in GMS without having to convert that data to GMS data types. Native GMS data such as grids and boreholes can be displayed along with the GIS data.

The GIS module can also be used to select a portion of the GIS data and convert it to GMS data types to be used in constructing a groundwater model. Currently, the GIS module can only be used for steady-state data. For a full list of the features available in the different modules, refer to GMS Help.

The second part shows the features available if the user has an active license of ArcObjects®. With an active license, many features available in ESRI® software (such as ArcMap®) become available in GMS. Those without an active license will not be able to complete the second part.

In this tutorial, the following topics are discussed:

- Opening a shapefile.
- Viewing the attribute table.
- Converting the shapefile to scatter points.
- Enabling ArcObjects® and importing layers and shapefiles.
- Converting the shapefile into feature objects.

To get started, do the following:

1. Launch GMS.


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

2 Part 1 – Without ESRI® ArcObjects®

First, it is necessary to import a point shapefile containing well data. This makes it possible to create scatter points from the shapefile points. Next, a GMS MODFLOW conceptual model will be created in the Map module, and a coverage with well attributes will be created. The shapefile will then be converted to GMS wells useful in building a model. This will illustrate how GIS data can be imported and converted to GMS data.

2.1 Importing the Shapefile

The first step is to import the shapefile by doing the following:

1. Click **Open**  to bring up the *Open* dialog.
2. Select “Shapefiles (*.shp)” from the *Files of type* drop-down.
3. Browse to the *Tutorials\GIS\gis* directory and select “arcmmap.shp”.
4. Click **Open** to import the shapefile and close the *Open* dialog.

2.2 Viewing the Shapefile




A number of points representing wells are now visible in the Graphics Window (Figure 1). These are contained in the “ arcmmap.shp” shapefile listed in the “ GIS Layers” folder in the Project Explorer. Without ESRI® ArcObjects®, users have only a limited set of options for displaying the shapefile.



Figure 1 Well points imported from the arcmmap shapefile

1. Select the “GIS Layers” folder in the Project Explorer.
2. Click the **Display Options**  macro to bring up the *Display Options* dialog.
3. Select “GIS Data” from the list on the left.
4. On the *GIS* tab, click the wide button to the right of *Points* to bring up the *Point Properties* dialog.
5. Enter “10” in the *Radius* field.
6. From the down-arrow menu for *Color*, select “Red”.
7. Click **OK** to close the *Point Properties* dialog.
8. Click **OK** to close the *Display Options* dialog.

Notice that the size and color of the points have changed (Figure 2).

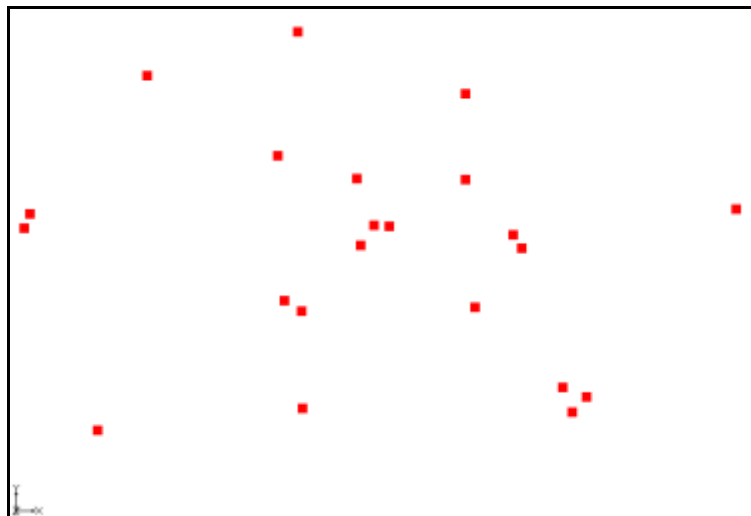


Figure 2 Well points now colored red

2.3 Viewing the Attribute Table

The shapefile has a number of attributes associated with each point. To view these attributes, do the following:

1. In the Project Explorer, right-click on “arcmmap.shp” and select **Attribute Table...** to bring up the *Attributes* dialog.
2. Resize the *Attributes* dialog by dragging the bottom right corner out so that more of the data is visible.

A number of attributes (columns) are associated with each point. Notice the data is not editable here.

3. Click **OK** to close the *Attributes* dialog.

2.4 Converting a Shapefile to 2D Scatter Points

The GIS data can be converted to 2D scatter points that can be used to perform interpolations.

1. In the Project Explorer, right-click on “arcmap.shp” and select *Convert To | 2D Scatter Points*. This converts the shapefile points to 2D scatter points which appear on top of the shapefile points (Figure 3).
2. If necessary, expand the “2D Scatter Data” folder and the “arcmap.shp” dataset.

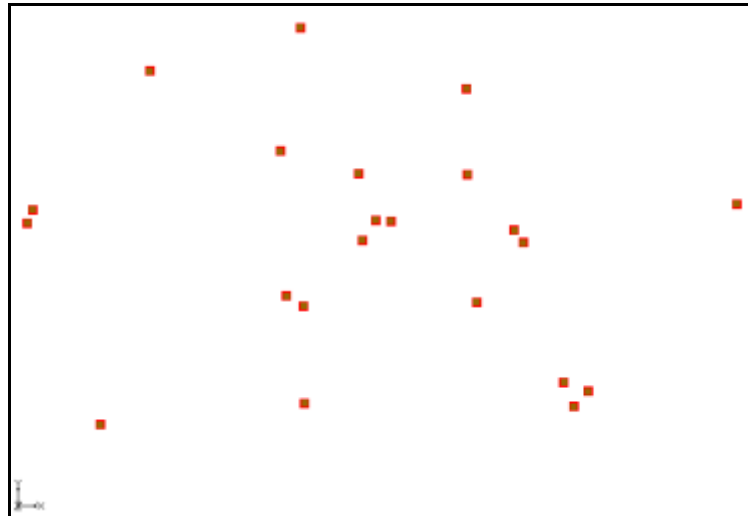


Figure 3 Well points converted to scatter points

Notice that GMS automatically created a dataset from each numeric attribute in the attribute table. This procedure can be used to create scatter points and then interpolate from the scatter points to a grid. Using water level information for each point, for example, a starting head dataset could be created for the model.


This tutorial won't do anything more with the scatter points, so it's time to delete them.

3. In the Project Explorer, right-click on “2D Scatter Data” and select **Delete**.


Now it is possible to convert the GIS data to GMS feature objects that could be used to build a conceptual model. The first step is to create a default conceptual model and coverage with the appropriate attributes.

Creating the Conceptual Model



1. Right-click on an empty space in the Project Explorer and select *New / Conceptual Model* to bring up the *Conceptual Model Properties* dialog.
2. Enter “Model1” in the *Name* field.
3. Select “MODFLOW” from the *Type* drop-down.

4. Click **OK** to close the *Conceptual Model Properties* dialog.
5. In the Project Explorer, right-click on “ Model1” under Map Data and select **New Coverage...** to bring up the *Coverage Setup* dialog.
6. Enter “coverage1” in the *Coverage name* field.
7. Toggle on *Wells* in the list of *Sources/Sinks/BCs*.
8. Click **OK** to close the *Coverage Setup* dialog.

Mapping the GIS Data

1. Select the “ GIS Layers” folder in the Project Explorer to make it active.
2. Select *GIS / Shapes* → **Feature Objects** command.
3. Click **Yes** to confirm the use of all visible shapefiles and bring up the *GIS to Feature Objects Wizard* dialog.
4. Click **Next** to bring up the *GIS to Feature Objects Wizard – Step 1 of 2* page of the dialog.
5. In the *WELLNAME* column, select “Name” from the *Mapping* drop-down.
6. In the *PUMPRATE* column, select “Flow rate” from the *Mapping* drop-down.
7. Click **Next** to bring up the *GIS to Feature Objects Wizard – Step 2 of 2 (Finished)* page of the dialog.
8. Click **Finish** to close the *GIS to Feature Objects Wizard – Step 2 of 2 (Finished)* dialog.

This creates feature points in the same location as the GIS shapefile points. Depending on the settings, they may or may not be visible.

9. Uncheck “ arcmap.shp” in the Project Explorer. This hides the shapefile points in the Graphics Window.
10. In the Project Explorer, right-click on “ coverage1” and select **Attribute Table...** to bring up the *Attribute Table* dialog.

This dialog shows the properties of all the feature points in the coverage. Notice that the names and flow rates were transferred from the GIS attributes, just as specified. However, the type for all points is “NONE.” It is necessary to make them into wells.

11. Select “well” from the drop-down in the *Type* column of the *All* row. Since this is the *All* row, all of the points are changed to wells.
12. Click **OK** to close the *Attribute Table* dialog. All of the feature points are now wells.

2.5 Part 1 Conclusion



At this point, the well points could be used to construct a MODFLOW conceptual model. This topic is discussed more thoroughly in the tutorial entitled “MODFLOW – Conceptual Model Approach” and will not be discussed further here.

3 Part 2 – With ESRI® ArcObjects®

Many more features in the GIS module are available if an active license of ArcObjects® is installed. This part of the tutorial introduces those features. If an active license of ArcObjects® is installed (for instance, if ArcGIS® is installed), this part of the tutorial may be completed. This tutorial will cover how to determine if an active license is on the computer being used.

3.1 Enabling ArcObjects


First, it is necessary to delete everything that has been done so far and enable ArcObjects®.

1. Click the **New**  macro and click **No** when prompted to save changes.
2. Switch to the **GIS**  module.
3. Select **GIS / Enable ArcObjects** and GMS will determine if an active license is available.

If a check mark appears next to the **GIS / Enable ArcObjects** menu command, then an active license for ArcObjects® is installed and the tutorial may be completed. If an active license is not found, please contact ESRI® at <http://www.esri.com/> for further assistance.



3.2 Reading the Data

The first step is to import the required data


1. Select **GIS / Add Data...** to bring up the *Select Data* dialog.
2. Click the  **Connect to Folder** macro to bring up the *Connect to Folder* dialog.
3. Browse to the *Tutorials\GIS\gis* directory click **OK** to close the *Connect to Folder* dialog.
4. Select the following files while holding down the *Shift* key: “streams.shp”, “recharge.shp”, “area_interest.shp”, and “Davis.jpg”.
5. Click **Add** to import the files and close the *Select Data* dialog.

3.3 Viewing the Shapefile



The display order of the different layers is controlled by the order of the items in the Project Explorer. Now it is possible to arrange the data so that it can be viewed easily.

1. In the Project Explorer, expand the “GIS Layers”  folder if necessary.
2. In the Project Explorer, right-click on “ area_interest” and select **Zoom To Layer**.
3. In the Project Explorer, arrange the GIS layers in the order shown below:
 - streams
 - area_interest
 - recharge
 - Davis.jpg

With ESRI® ArcObjects®, an expanded set of options is available for display. First, it is necessary to change the display of the stream layer.

4. In the Project Explorer, right-click on “ streams” and select **Properties...** to bring up the *Layer Properties* dialog.
5. On the *Symbology* tab in the *Symbol* section, click the large unlabeled button on the left to bring up the *Symbol Selector* dialog.
6. In the *ESRI* section, select “River” and click **OK** to close the *Symbol Selector* dialog.
7. Click **OK** to close the *Layer Properties* dialog.

To better see the background images, increase the transparency of the recharge layer and turn off the fill color for the interest layer area:



8. In the Project Explorer, right-click on “ recharge” and select **Set Layer Transparency...** to bring up the *Layer Transparency* dialog.
9. Use the slider to set the transparency to “50%” and click **OK** to close the *Layer Transparency* dialog.
10. In the Project Explorer, right-click on “ area_interset” and select **Properties** to bring up the *Layer Properties* dialog.
11. On the *Symbology* tab in the *Symbol* section, click the large unlabeled button on the left to bring up the *Symbol Selector* dialog.
12. In the *ESRI* section, select “Hollow”.
13. In the *Current Symbol* section, select “Mars Red” from the *Outline Color* drop-down.

14. Click **OK** to close the *Symbol Selector* dialog.
15. Click **OK** to close the *Layer Properties* dialog.

3.4 Converting a Shapefile to Feature Objects



Now the GIS data can be converted to GMS feature objects used to build a conceptual model. To do so, it is necessary to create a default conceptual model and coverages with the appropriate attributes.

Creating the Conceptual Model

1. In the Project Explorer, right-click on the empty space and select *New / Conceptual Model...* to bring up the *Conceptual Model Properties* dialog.
2. Enter “Model1” in the *Name* field.
3. Select “MODFLOW” from the *Type* drop-down.
4. Click **OK** to close the *Conceptual Model Properties* dialog.
5. Right-click on “ Model1” and select **New Coverage** to bring up the *Coverage Setup* dialog.
6. Enter “Rivers” in the *Coverage name* field.
7. Toggle on “River” in the list of *Sources/Sinks/BCs* and click **OK** to close the *Coverage Setup* dialog.
8. Right-click on “ Model1” and select **New Coverage** to bring up the *Coverage Setup* dialog.
9. Enter “Recharge” in the *Coverage name* field.
10. Toggle on “Recharge rate” in the list of *Areal Properties* and click **OK** to close the *Coverage Setup* dialog.

Mapping the GIS Data

The “streams” shapefile must now be mapped to the “Rivers” coverage. Only objects within the area of interest will be mapped by selecting items to map by their location.

1. Select “ Rivers” in the Project Explorer to make it active.
2. Select “ GIS Layers” in the Project Explorer to make it active.
3. Select *GIS | Selection / Select By Location...* to bring up the *Select By Location* dialog.
4. Select “select features from” in the *I want to* drop-down.

5. Toggle on *streams* in the *following layers* list.
6. Select “are within a distance of” from the *that* drop-down.
7. Select “area_interest” from the *features in this layer* drop-down.
8. Toggle off *Use selected features* and *Apply a buffer to the features in area_interest*.
9. Click **Apply**. Several of the rivers should be highlighted as in Figure 4.

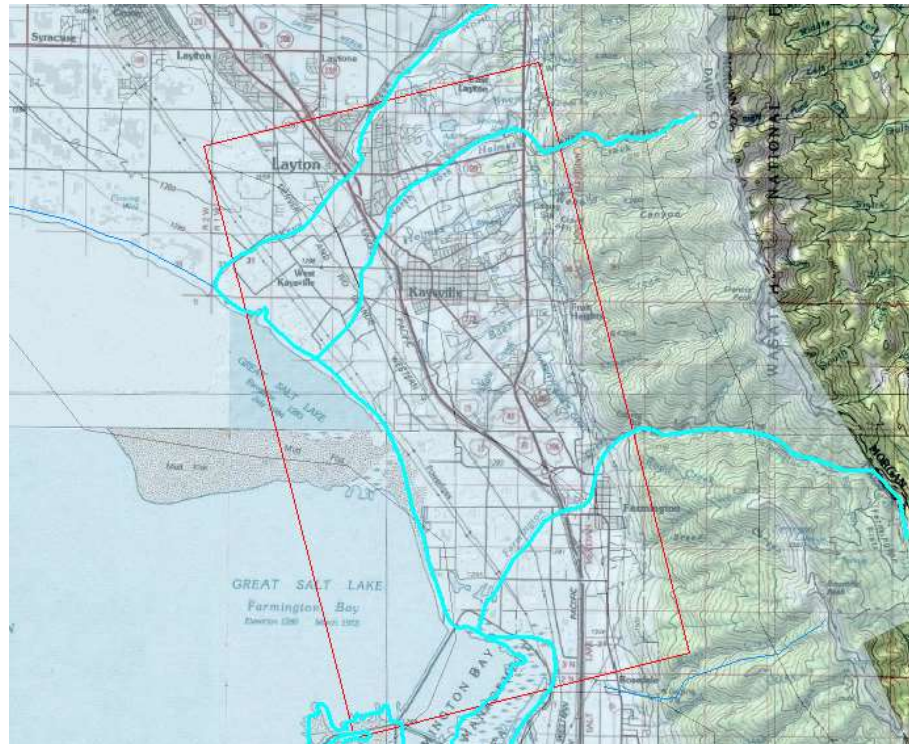


Figure 4 Rivers highlighted in cyan



10. Click **Close** to close the *Select By Location* dialog.

To convert the ArcObjects to feature objects, do the following:



1. Select *GIS / ArcObjects* → **Feature Objects** to bring up the *GIS to Feature Objects Wizard* dialog.
2. Click **Next** to go to the *GIS to Feature Objects Wizard – Step 1 of 2* page of the dialog.
3. In the *Mapping preview* section in the *TYPE* column, select “Type” from the drop-down in the *Mapping* row.
4. In the *NAME* column, select “Name” from the drop-down in the *Mapping* row.
5. Click **Next** to go to the *GIS to Feature Objects Wizard – Step 2 of 2* page of the dialog.

6. Click **Finish** to close the *GIS to Feature Objects Wizard* dialog.

Feature arcs now exist that represent the rivers in the same location as the GIS arcs. The “recharge” shapefile now needs to be mapped to the “Recharge” coverage.

1. Select “ Recharge” in the Project Explorer to make it active.
2. Select “ GIS Layers” in the Project Explorer to make it active.
3. Select *GIS | Selection | Select By Location...* to bring up the *Select By Location* dialog.
4. Select “select features from” in the *I want to* drop-down.
5. Toggle on *recharge* in the *following layers* list.
6. Select “are within a distance of” from the *that* drop-down.
7. Select “area_interest” from the *the features in this layer* drop-down.
8. Toggle off *Use selected features* and *Apply a buffer to the features in area_interest*.
9. Click **Apply**. Several polygons should be highlighted.

To create feature polygons from the polygons just created, do the following:

1. Select *GIS / ArcObjects* → **Feature Objects** to bring up the *GIS to Feature Objects Wizard* dialog.
2. Click **Next** to go to the *GIS to Feature Objects Wizard – Step 1 of 2* page of the dialog.
3. In the *Mapping preview* section in the *RECH_RATE* column, select “Recharge rate” from the drop-down in the *Mapping* row.
4. Click **Next** to go to the *GIS to Feature Objects Wizard – Step 2 of 2* page of the dialog.
5. Click **Finish** to close the *GIS to Feature Objects Wizard* dialog. Feature polygons now exist in the same location as the GIS polygons. The polygons should now be gray as in Figure 5.
6. Uncheck the “ GIS Layers” folder in the Project Explorer.
7. Right-click on “ Recharge” and select **Attribute Table...** to bring up the *Attribute Table* dialog.
8. Select “Polygons” from the *Feature type* drop-down.

This dialog shows the properties of all the feature polygons in the coverage. Notice that the recharge rates were transferred from the GIS attributes, just as specified.

9. Click **OK** to close the *Attribute Table* dialog.



Figure 5 Feature polygons highlighted in gray

The river arcs and recharge polygons could be used in further constructing a MODFLOW conceptual model. This topic is discussed in depth in the tutorial entitled “MODFLOW – Conceptual Model Approach” and will not be discussed further here.

4 Conclusion

This concludes the “GIS Module” tutorial. The following topics were covered:

- Importing ArcView® shapefiles into GMS without having an active ArcView® license.
- Converting shapefile data to GMS scatter points or feature objects.
- Using the powerful GIS tools available with an active ArcObjects® license.