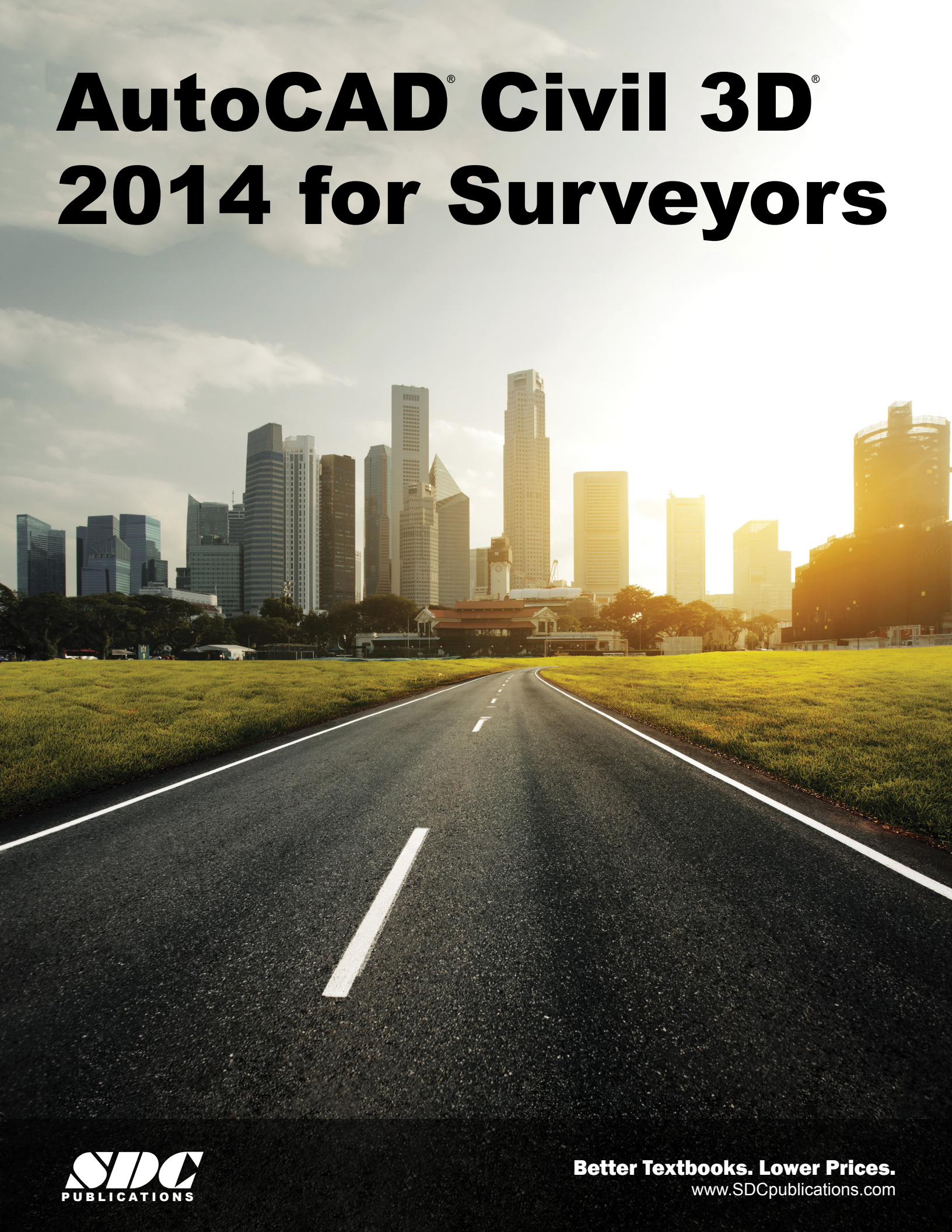
AutoCAD® Civil 3D® 2014 for Surveyors



SDC PUBLICATIONS

Better Textbooks. Lower Prices.
www.SDCpublications.com

Visit the following websites to learn more about this book:

Chapter 2

Connecting to Geospatial Data

In this chapter, you connect to existing geospatial data and create a surface from it to determine which data should be collected during the field survey.

This chapter contains the following topics:

- ✓**Introduction to the Planning and Analysis Workspace**
- ✓**Coordinate Systems**
- ✓**Geospatial Data Connection**
- ✓**Create a Surface from GIS Data**

2.1 Introduction to the Planning and Analysis Workspace

Learning Objective

Identify where tools are found within the Planning and Analysis Workspace.

The Planning and Analysis Workspace in the AutoCAD® Civil 3D® software contains tools that are also found in the AutoCAD® Map 3D® software. They help you to attach and analyze GIS data for more efficient planning of projects before starting a design.

Map Workflow

The following workflow is one of many workflows that can be used. It only covers a small portion of the AutoCAD Map 3D software capabilities.

1. Start a new drawing from a Civil 3D template that includes all of the necessary styles.
2. Assign a Coordinate System to the drawing file.
3. Attach Image and Digital Elevation Models (DEM) files using the **Data Connect** command.
4. Attach other source data using the **Data Connect** command.
5. Create AutoCAD Civil 3D surfaces from source data.
6. Style the layers for presentation or publication purposes.
7. Analyze the data.
8. Create labels and legends to annotate the drawing.

A typical workflow using the Planning and Analysis workspace includes setting up a drawing with the coordinates assigned, and then connecting to file-based data sources (.SHP or .SDF files) or to a database (Oracle or Microsoft SQL Server). Data can be queried as it is added to the drawing file to ensure that only the area of interest or items of interest are incorporated into the drawing file.

Once data is included in the drawing, it can be displayed using themes and symbols for proper representation of the entities. Analysis can be done on the entities to determine which entities are within a specific distance of another (buffer analysis) or which entities overlay another (overlay analysis).

The *Map Setup* tab>Coordinate System panel is used to assign a coordinate system to the drawing file, as shown in Figure 2–1.

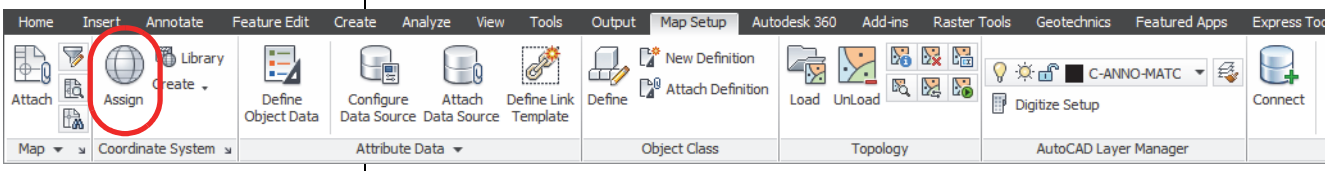


Figure 2–1

The *Home* tab>Data panel is used to connect to source data, such as images, file sources, and database sources, as shown in Figure 2–2.

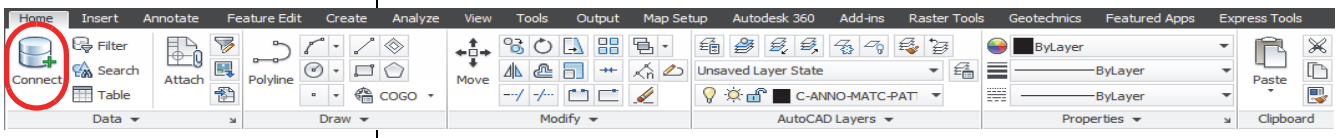


Figure 2–2

Creating a surface from source data is done using the Civil 3D workspace in the *Home* tab>Create Ground Data panel, as shown in Figure 2–3.

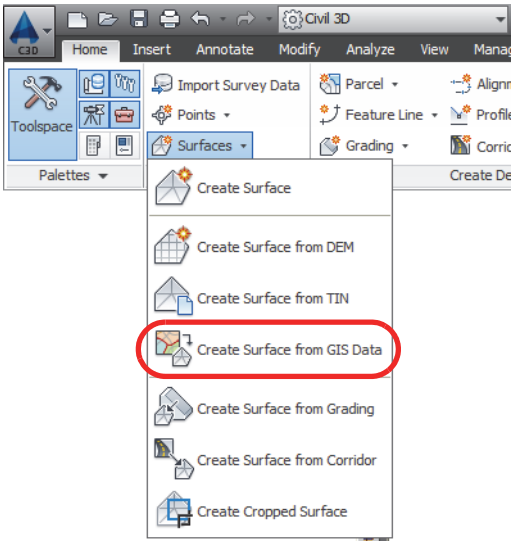


Figure 2–3

2.2 Coordinate Systems

Learning Objective

Set the drawing coordinate system for a new drawing.

Coordinate systems are used in engineering and mapping to uniquely identify the position of geographical elements. Different systems project elements differently to accommodate the curvature of the earth's surface. Therefore, it is vitally important to set the coordinate system for the drawing in which you plan to work.

Coordinate systems communicate to the computer where the project is located in the world, along with mathematical equations used to account for the curvature of the earth. Once the drawing coordinate system has been set, any GIS or Survey data that is connected to the drawing automatically re-projects and lines up properly in the current drawing.

How to: Set the Drawing Coordinate System in the Planning and Analysis Workspace

1. In the Quick Access Toolbar, change the workspace to **Planning and Analysis**, as shown in Figure 2–4.

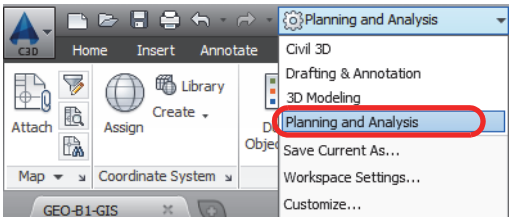


Figure 2–4

2. In the *Map Setup* tab>Coordinate System panel, click (Assign) to assign a coordinate system to the drawing file, as shown in Figure 2–5.

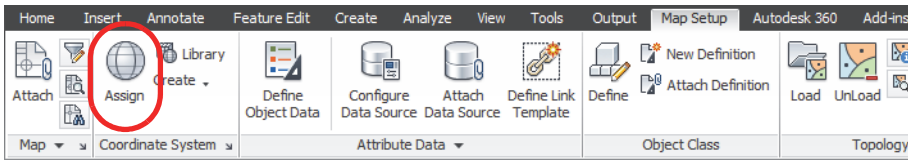


Figure 2–5

3. Search for the code required by your project and select it, as shown in Figure 2–6.

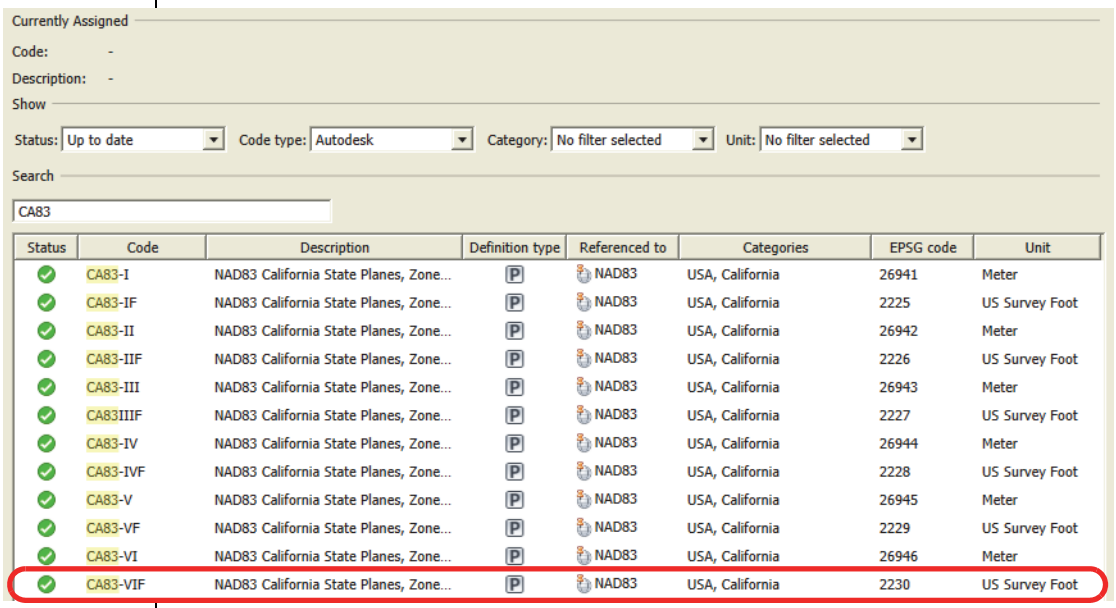
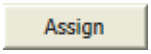


Figure 2–6

4. Click 

.

How to:

Set the Drawing Coordinate System in the Civil 3D Workspace

1. In the Quick Access Toolbar, change the workspace to **Civil 3D**, as shown in Figure 2–7.

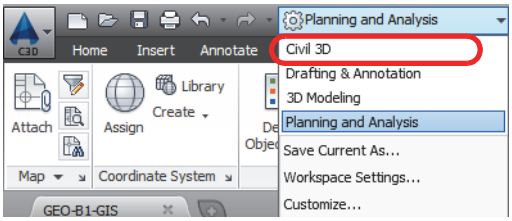


Figure 2–7

2. In the *Settings* tab in the Toolspace, right-click on the drawing name and select **Edit Drawing Settings**, as shown in Figure 2–8.

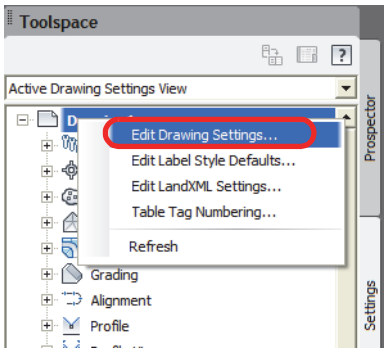


Figure 2–8

3. In the Drawing Setting dialog box, in the *Units and Zone* tab, select the category and coordinate system for the drawing, as shown in Figure 2–9. Click OK.

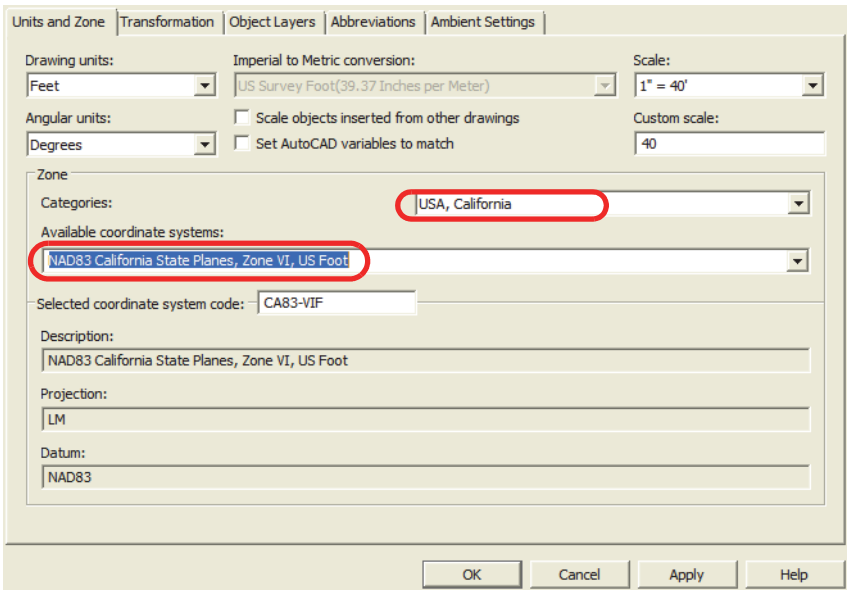


Figure 2–9

Practice 2a

Estimated time for completion: 5 minutes

Start a New Project

Learning Objective

Display the current conditions by connecting to GIS data.

In this practice, you will create a new drawing and assign a coordinate system to the drawing.

Task 1 - Start a new file.

1. Click (Application Menu) and select **New** to start an new drawing file.
2. Select **_AutoCAD Civil 3D (Imperial) NCS.dwt**, which ships with the software, as shown in Figure 2–10.

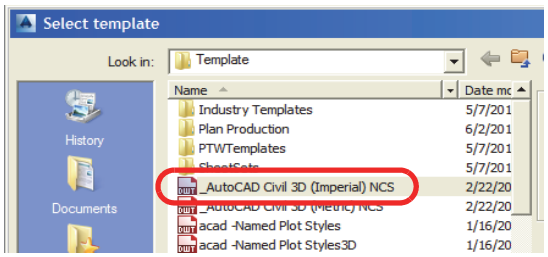


Figure 2–10

3. Click (Application Menu) and select **SaveAs**. Type **BaseMap** for the filename, browse to *C:\Civil 3D Projects\Civil3D-Training*, and click Save.

Task 2 - Set the drawing coordinates.

1. Continue working with the drawing from the previous task or open **GEO-A2-GIS.dwg.**
2. In the Quick Access Toolbar, change the workspace to **Planning and Analysis**, as shown in Figure 2–11.

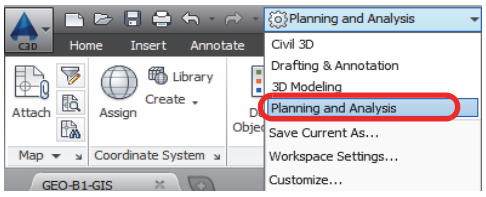


Figure 2–11

3. In the *Map Setup* tab>Coordinate System panel, click (Assign) to assign a coordinate system to the drawing file, as shown in Figure 2–12.

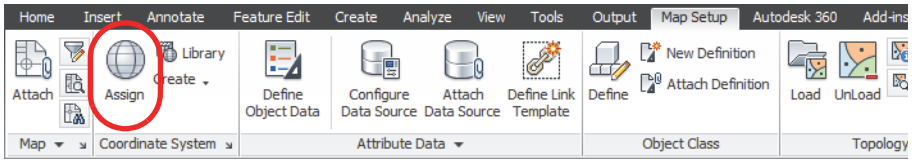


Figure 2–12

4. In the Search field, type **CA83** and select **CA83-VIF** from the list of code, as shown in Figure 2–13. Click Assign.

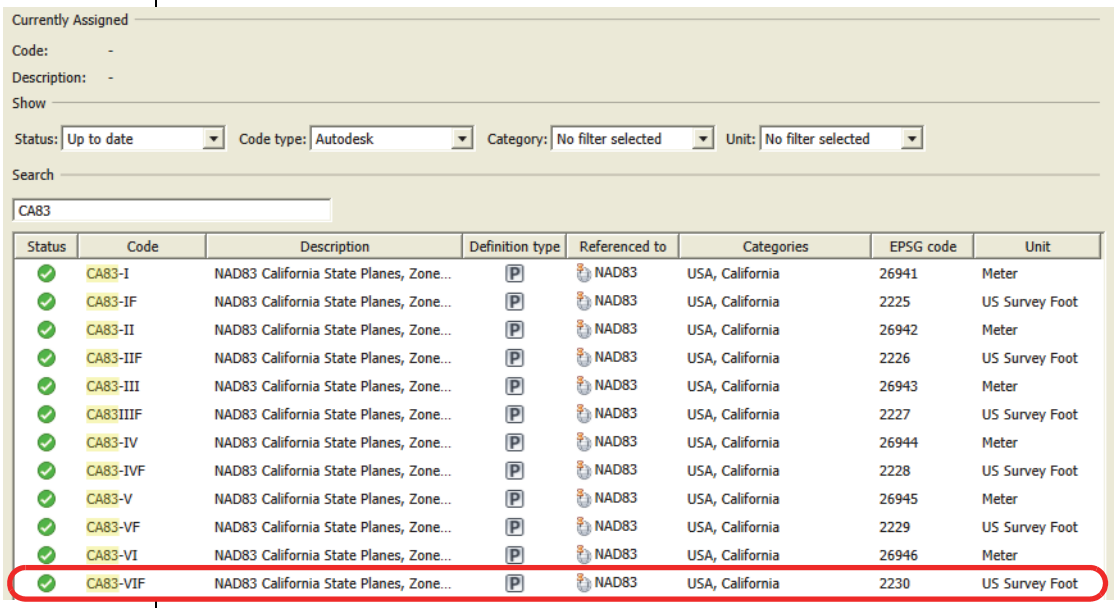


Figure 2–13

5. Save the drawing.

2.3 Geospatial Data Connection

Learning Objective

Display the current conditions by connecting to GIS data.

Geospatial data is collected and maintained by a large number of organizations using a variety of different software. The AutoCAD Civil 3D software can connect to many of these data sources using the Feature Data Object (FDO) connection in *Display Manager* tab>AutoCAD Map 3D Task pane or the *Home* tab in the Planning and Analysis workspace. The types of data that can be connected include: ArcSDE, Enterprise Industry Models, MySQL, ODBC, Oracle, PostgreSQL, Raster Image or Surface Connection, Spatial Data Files, ESRI Shape files, SQL Server Spatial, SQLite, WFS, WMS.

Connect to GIS Data

The process of connecting to GIS data is similar among data types. First you select the type of data to which to connect, and then you select the number of files that are going to connect at the same time. You can connect to one file at a time or to an entire directory of files at the same time. If a database connection is selected (such as Oracle or ArcSDE) you might need to input your login credentials, as shown in Figure 2–14.

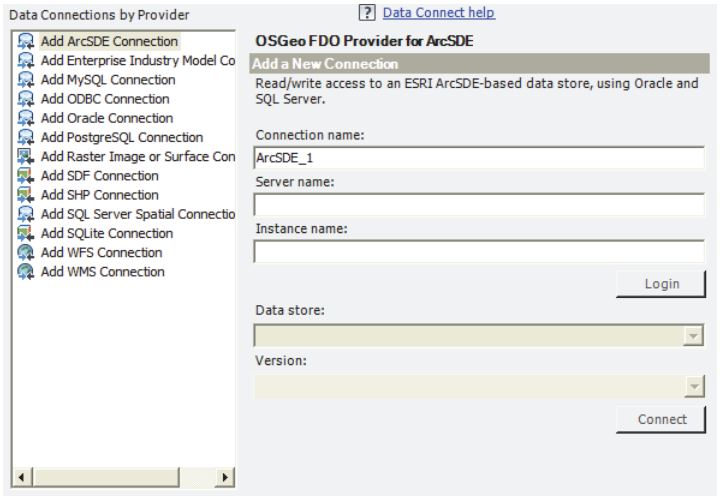


Figure 2–14

Finally, you need to ensure that the coordinate system of the source file registers as you connect to it. If the coordinate system for the source file is listed as <unknown> (as shown in Figure 2–15), it did not register properly. Therefore, you need to assign the source coordinate system manually so that it re-projects automatically in the drawing and displays in the correct location.

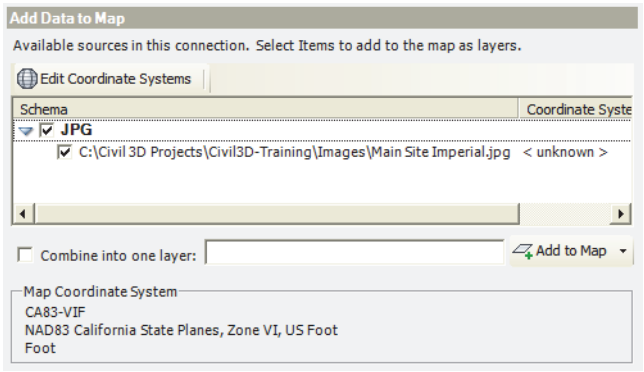


Figure 2–15

How to: Connect to GIS Data

There are multiple locations in which you can access the Data Connection palette. The first is the *Home* tab in the Planning and Analysis workspace, the second is in the Map Task pane.

1. In the *Home* tab>Data panel in the Planning and Analysis workspace, click (Connect), as shown in Figure 2–16.

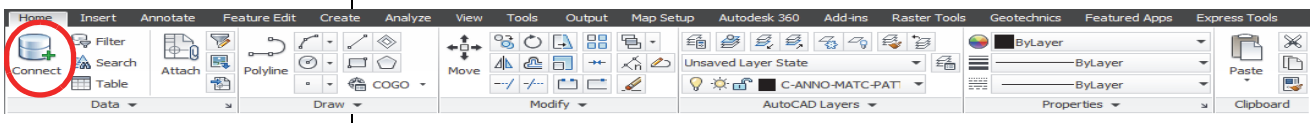


Figure 2–16

Alternatively, you can do the following:

1. In the *Home* tab>expanded Palettes panel in the Civil 3D workspace, click (Map Task Pane), as shown in Figure 2–17.

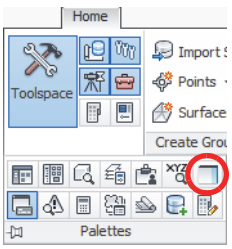


Figure 2–17

2. In the *Display Manager* tab in the Map Task Pane, click (Data) and select **Connect to Data**, as shown in Figure 2–18.

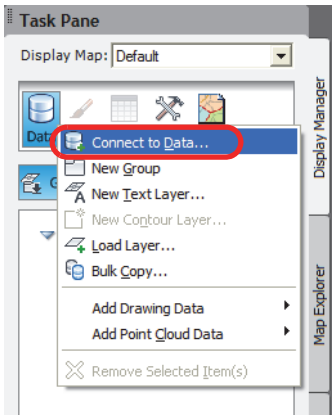


Figure 2–18

3. In the Data Connect palette, select the proper connect type.
4. Type a name for the connection and click (Browse for source file) or (Browse for source folder), as shown in Figure 2–19.

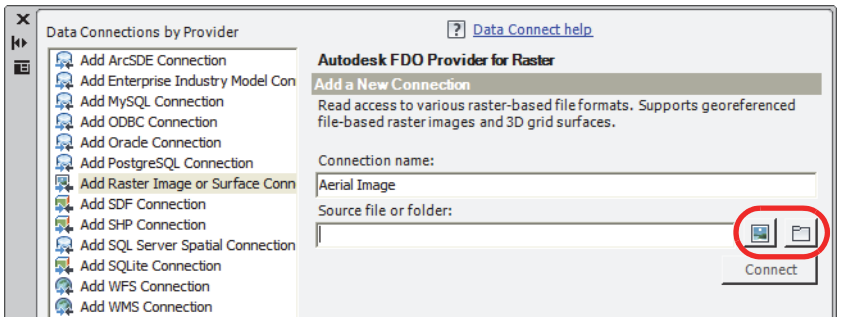


Figure 2–19

5. Select the file or folder and click Open.
6. In the Data Connect palette, click Connect.
7. In the *Coordinate System* column, double-click on <unknown> to edit the coordinate system that is registered with the source file, as shown in Figure 2–20.

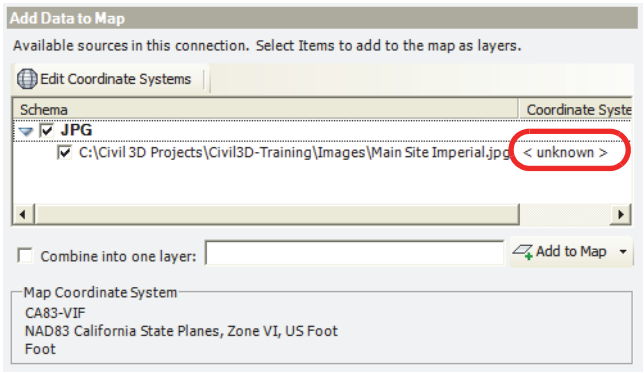


Figure 2–20

8. In the Edit Spatial Contexts dialog box, select **<unknown>** and click Edit..., as shown in Figure 2–21.

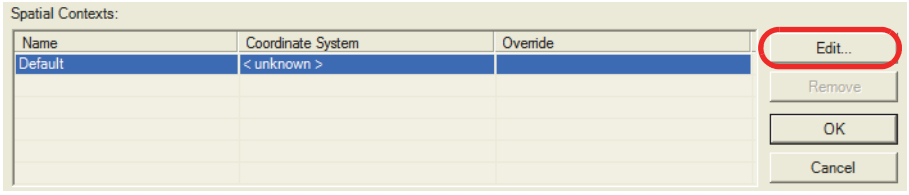


Figure 2–21

9. Select the required coordinate system from the list of codes, as shown in Figure 2–22. Click Select. Click OK.

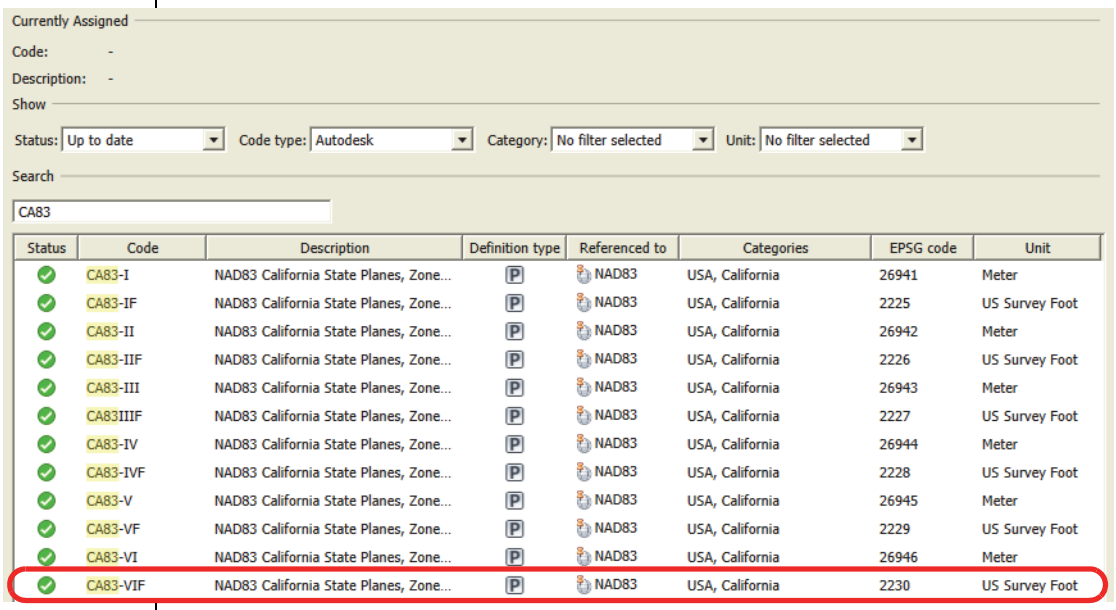


Figure 2–22

10. In the Data Connect palette, click Add to Map.
11. Continue adding data sources as required.

Stylize GIS Data

The available styles for a GIS layer depend on the type of GIS data being displayed. Point features (such as points of interest within a city) can use block symbols as the point style while linear features (such as roads) use linetypes and linewidths to communicate differences between feature types. If an area feature (such as a city boundary or parcel) is used, both hatch patterns and linetypes/linewidths are used to communicate differences between feature types, as shown in Figure 2–23.

Figure 2–23

How to: Modify an Area Style

1. In the *View* tab>Palettes panel, click (Map Task Pane) as shown in Figure 2–24.

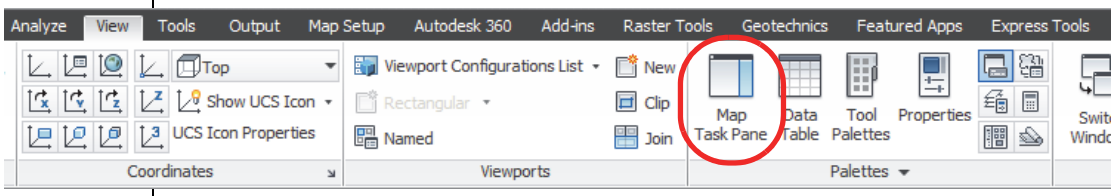


Figure 2–24

2. In the Task Pane, in the *Display Manager* tab, double-click on the area layer.
3. In the Style Editor palette, in the *Style* column, click (Browse) as shown in Figure 2–25.

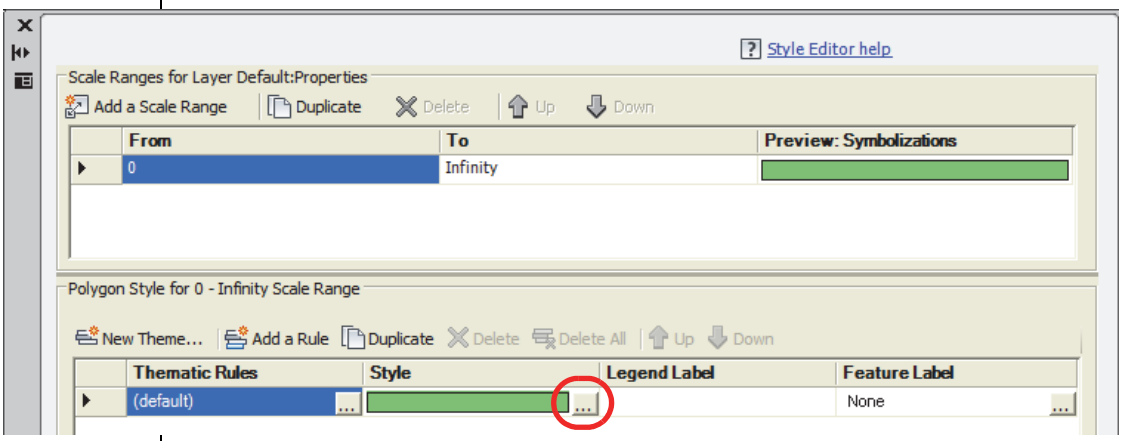


Figure 2–25

4. In the Style Polygon dialog box, change the border color and fill color or add additional borders and fills as required, as shown in Figure 2–26. Click Apply and close the Style Polygon dialog box and Style Editor palette.

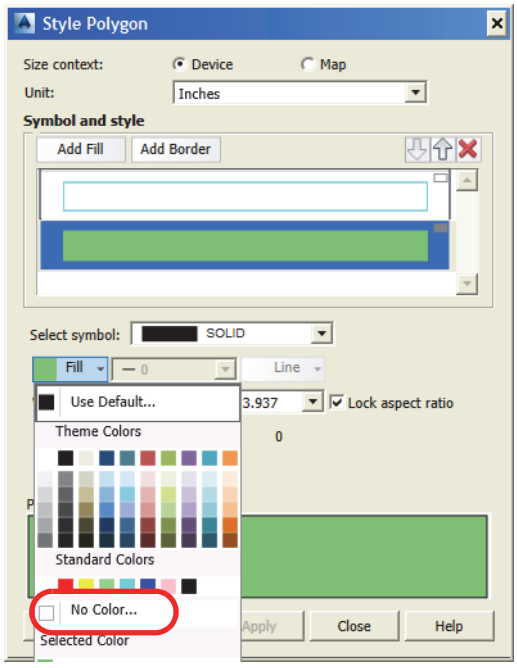


Figure 2–26

Draw Order

Setting the drawing order of the layer determines which layer is displayed on top of another. If an aerial photograph or other raster file is displayed, it is useful to move it to the background so that other layers are visible.

How to:

Change the Draw Order of GIS Layers

1. In the Task Pane, in the *Display Manager* tab, select **Draw Order** and drag the layers above or below the others to ensure that they all display, as shown in Figure 2–27.

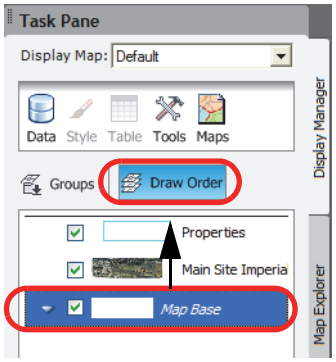


Figure 2–27

2. In the Draw Order dialog box that opens, select **Continue action and allow Draw Order to control layer position from now on**.

Practice 2b

Estimated time for completion: 10 minutes

Connect to GIS Data

Learning Objective

Connect to an aerial image file using AutoCAD Map 3D tools.

In this practice, you will create a new drawing and assign a coordinate system to the drawing.

Task 1 - Connect to an image file.

1. Continue working with the drawing from the previous practice or open **GEO-B1-GIS.dwg.**

2. In the *Home* tab>Data panel, click (Connect), as shown in Figure 2–28.

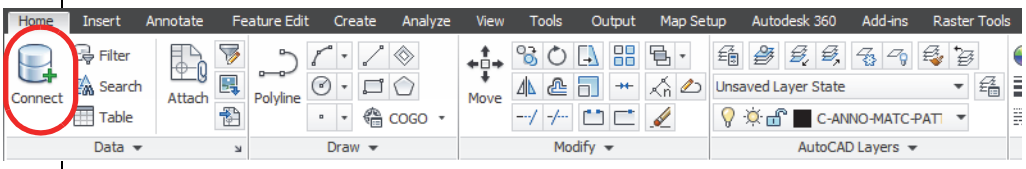


Figure 2–28

3. In the Data Connect palette, select **Add Raster Image or Surface Connection**, for *Connection name*, type **Aerial Image**, and click (browse for image file), as shown in Figure 2–29.

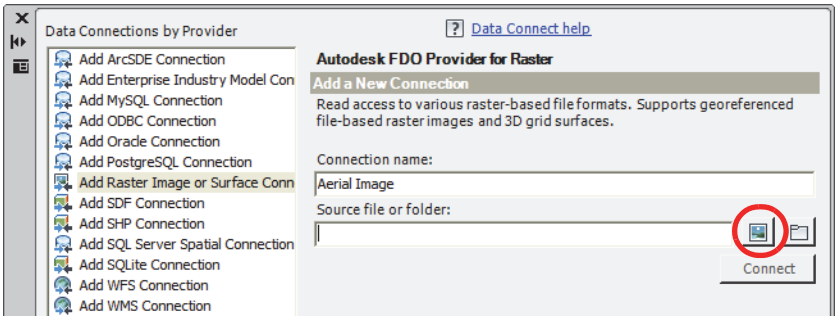


Figure 2–29

4. Select the **Main Site Imperial.jpg** in *C:\Civil 3D Projects\Civil3D-Training\Images*. Click Open.

5. In the Data Connect palette, click Connect.

6. In the *Coordinate System* column, double-click on <unknown> to edit the coordinate system that is registered with the image file.

7. In the Edit Spatial Contexts dialog box, select **<unknown>** and click Edit..., as shown in Figure 2–30.

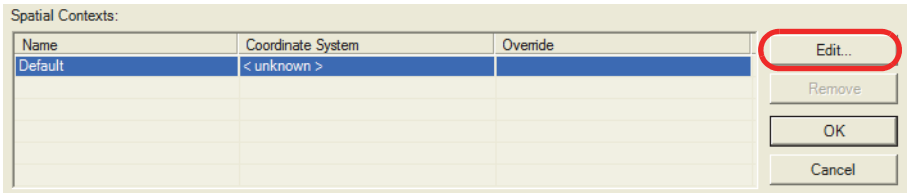


Figure 2–30

8. In the *Search* field, type **CA83**, and in the list of code, select **CA83-VIF**, as shown in Figure 2–31. Click Select. Click OK.

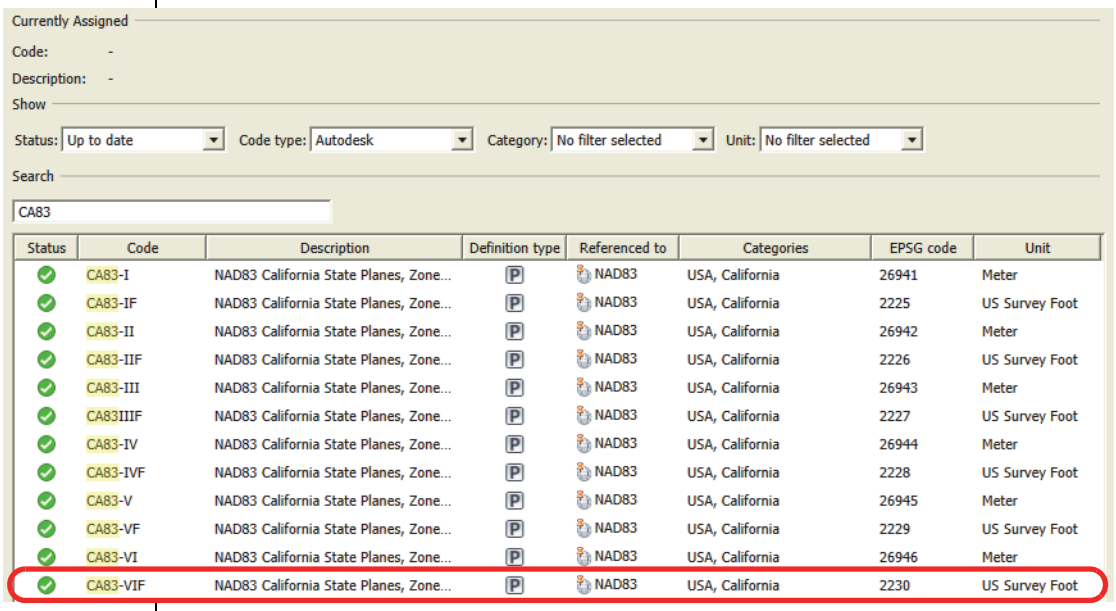


Figure 2–31

9. In the Data Connect palette, click Add to Map, close the Data Connect palette, and save the drawing.

Task 2 - Connect to a Shape file.

1. Continue working with the drawing from the previous task or open **GEO-B2-GIS.dwg.**

2. In the *Home* tab>Data panel, click (Connect), as shown in Figure 2–32.

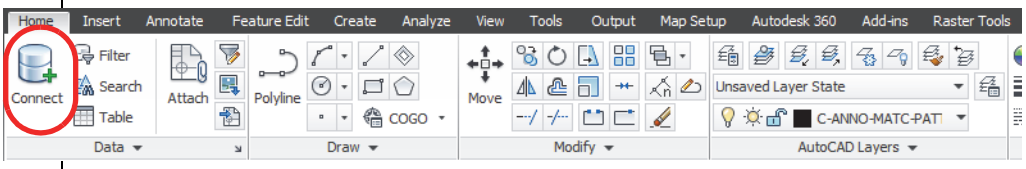


Figure 2–32

3. In the Data Connect palette, select **Add SHP Connection**. For the *Connection name*, type **Parcels**, and click (Browse for shp file), as shown in Figure 2–33.

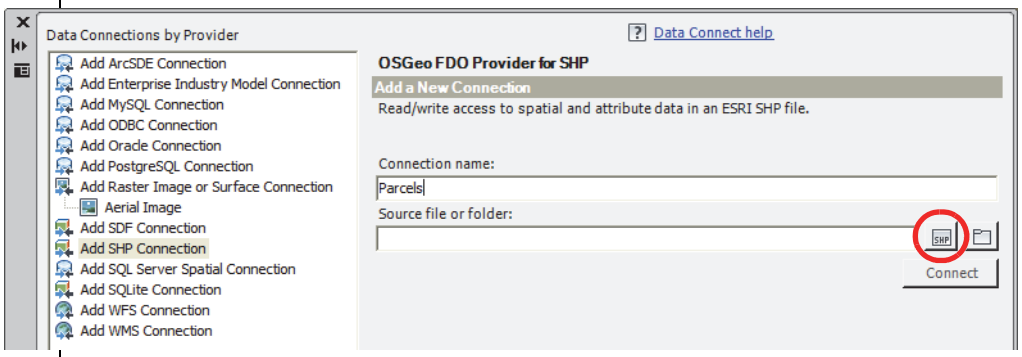


Figure 2–33

4. Select the **Properties.shp** in *C:\Civil 3D Projects\Civil3D-Training\Geospatial*. Click Open.

5. In the Data Connect palette, click Connect.

6. In the Data Connect palette, click Add to Map. Close the Data Connect palette and save the drawing.

7. If the Map Task Pane is not displayed, click (Map Task Pane) in the *View* tab>Palettes panel, as shown in Figure 2–34.

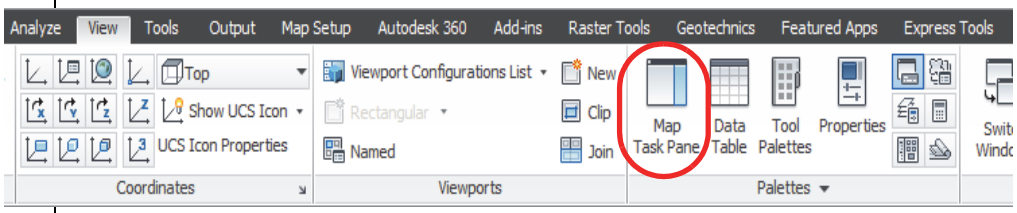


Figure 2–34

8. In the Task Pane, in the *Display Manager* tab, double-click on the **Properties** layer.

9. In the Style Editor palette, in the *Style* column, click … (Browse) as shown in Figure 2–35.

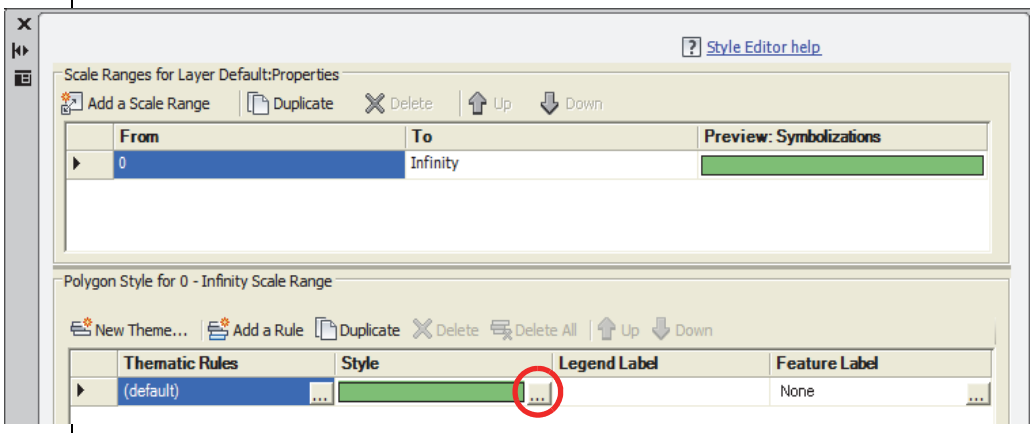


Figure 2–35

10. In the Style Polygon dialog box, change the *border color* to **Cyan** and the *fill color* to **No Color**, as shown in Figure 2–36.

Click Apply and close the Style Polygon dialog box and Style Editor palette.

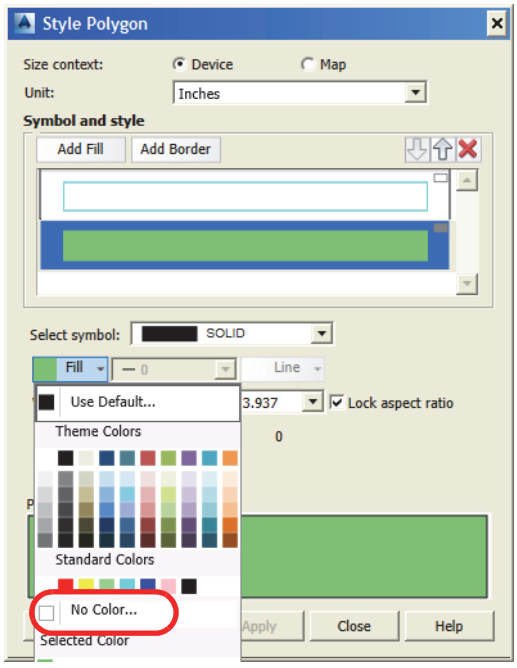


Figure 2–36

11. In the Task Pane, in the *Display Manager* tab, select **Draw Order** and then drag the **Map Base** layer above the **Properties** layer, as shown in Figure 2–37.

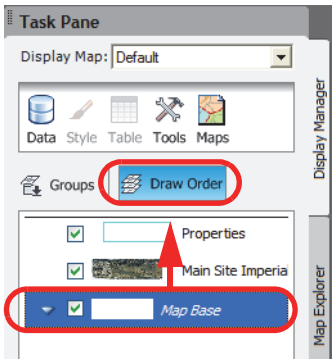


Figure 2–37

12. In the Draw Order dialog box that opens, select **Continue action and allow Draw Order to control layer position from now on**.

13. Save the drawing.

2.4 Create a Surface from GIS Data

Learning Objective

Create a surface from a shape file containing elevation data.

An AutoCAD Civil 3D surface can be created from GIS data. Once created, the surface can be used to create surface profiles and act as a target for corridor models and grading groups. It is recommended that you request any available metadata when obtaining GIS layers that could be used for creating a 3D surface model. The metadata should indicate how accurate the data is and whether it can be used in detailed design drawings. GIS surfaces are not often used for detailed design because they are typically mapping grade rather than survey grade, but that is changing rapidly. Having a surface from GIS data can be useful in the project planning phase of a project, even if it is not survey grade. Data source types that can be used to create a surface include: ArcSDE, Oracle, and ESRI Shape Files

How to: Create an AutoCAD Civil 3D Surface from SHP files

1. In the Quick Access Toolbar, select **Civil 3D** for the workspace.
2. In the *Home* tab>Create Ground Data panel, expand the Surfaces drop-down list and click (Create Surface from GIS Data), as shown in Figure 2–38.

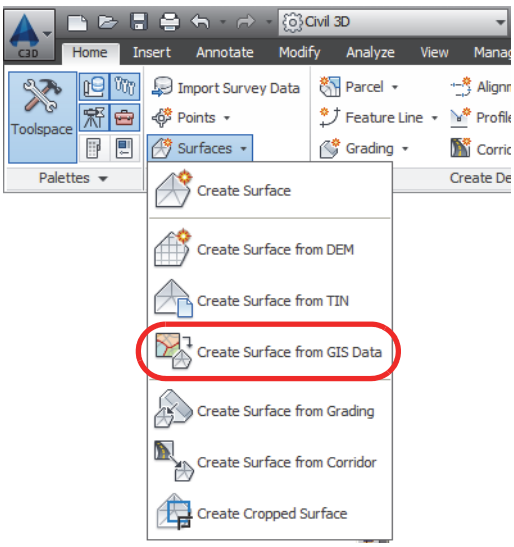


Figure 2–38

3. In the Object Options page, for the *Civil 3D object type*, select **Surface**. Type a name and select the required styles for displaying the surface, as shown in Figure 2–39. Click Next >.

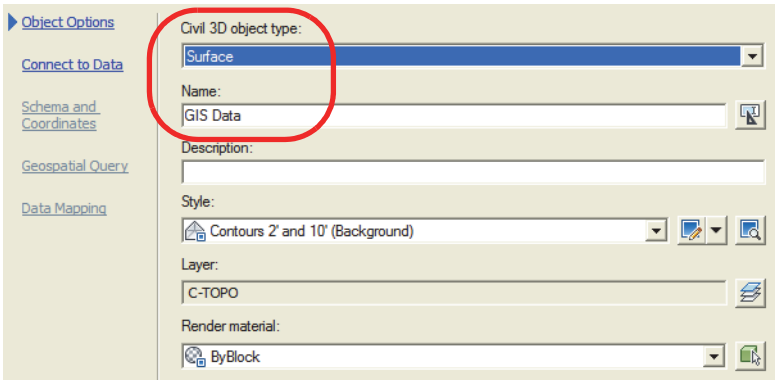


Figure 2–39

4. In the Connect to Data page, for the Data source type, select **SHP**, click ... (Browse for file) and select a shape file that includes vector data for the contours and elevation data in the database file, as shown in Figure 2–40. Click Open and click Login.

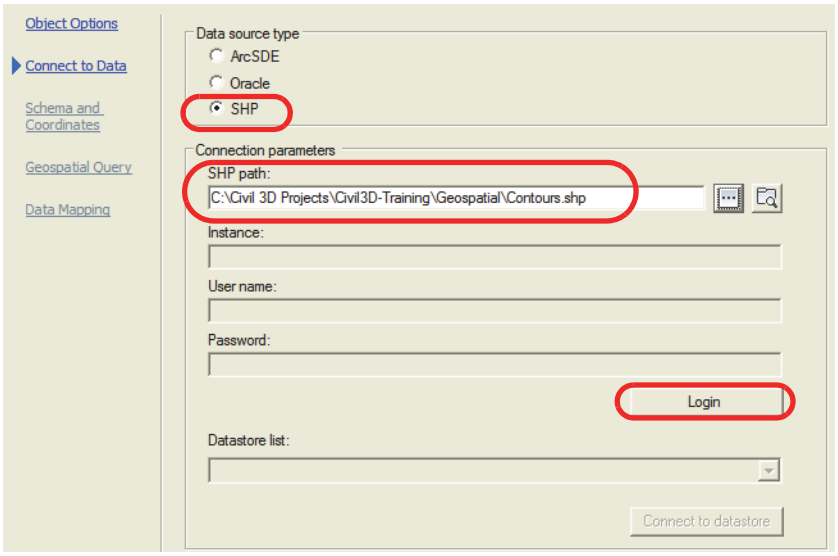


Figure 2–40

5. In the Schema and Coordinates page, select the **Contours** feature class and ensure that the *Contours Coordinate system* is set, as shown in Figure 2–41. Click Next >.

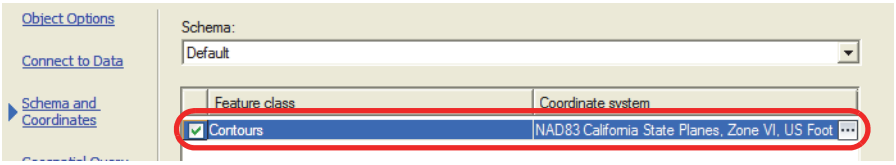


Figure 2–41

6. In the Geospatial Query page, clear the **Define area of interest** option so that the entire Contours shape file is used to create a surface, as shown in Figure 2–42. Click Next >.

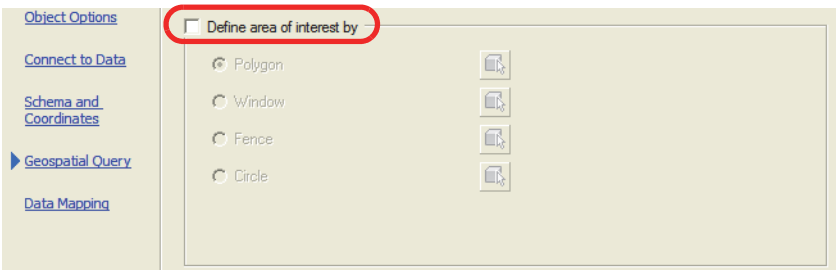


Figure 2–42

7. In the Data Mapping page, expand the drop-down list and select the field that holds the surface elevation values, as shown in Figure 2–43. Click Finish.

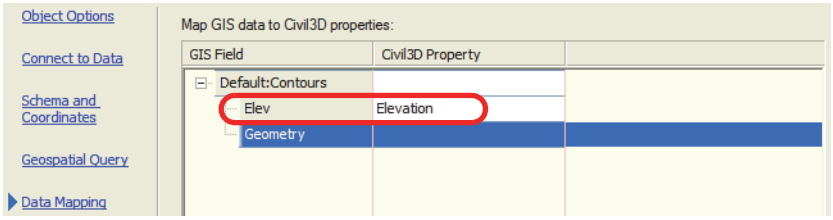


Figure 2–43

Contour data is available from many sources. Large sites are often surveyed using aerial photogrammetry, which provides contour polylines and spot elevations. When contour data is used from other GIS data types, the AutoCAD Civil 3D software interprets the imported linework as polylines with elevations.

In the AutoCAD Civil 3D software, polylines with elevation are useful as custom contour objects. Whether using polylines or other GIS contour objects, the AutoCAD Civil 3D software builds a surface by triangulating between contours. The end of each triangle side connects to a vertex of two different contours.

Contour Issues

Note the following issues when working with contour data: bays and peninsulas within the contours and the lack of high and low point elevations. These issues affect triangulation and the quality of a surface.

Bays and peninsulas within contours represent gullies or isolated high points on a surface. As long as there is data to work with, the AutoCAD Civil 3D software builds a surface by triangulating between contours of different elevations. When the software cannot triangulate between different contours, the triangulation switches to connecting vertices on the same contour.

The **Minimize Flat Faces** command helps mitigate this situation by forcing the triangulation to target different contours, as shown in Figure 2–44. However, this method, similar to the edge swap method, does not correct every problem on a contour surface.

- To launch the **Minimize Flat Faces** command, right-click on the *Edits* heading in the *Definition* collection of a surface and select the command.

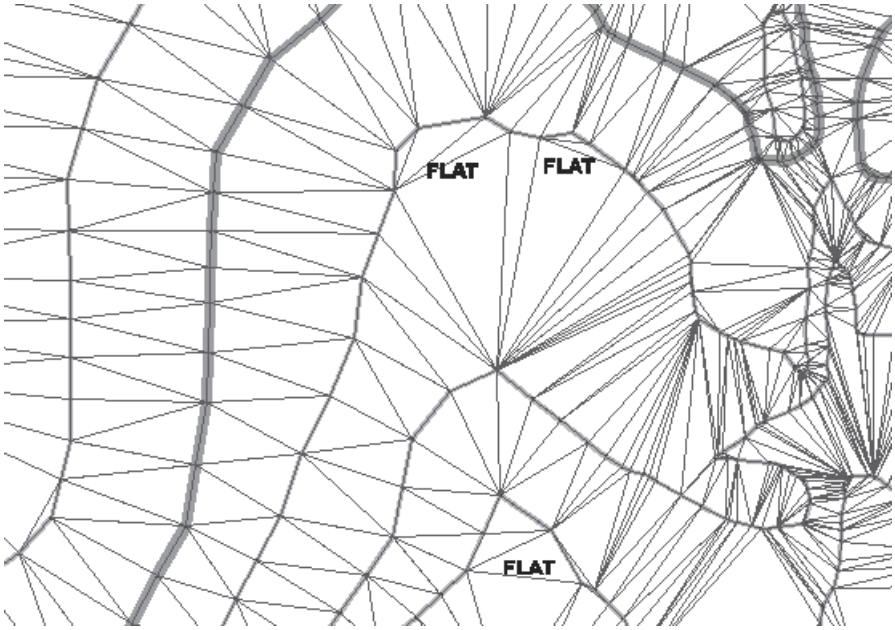


Figure 2–44

The second issue with contour data regards the loss of high and low points. Contours represent an elevation interval (120, 122, 123, etc.). However, the top of a hill could be 123.04 or 136.92 and the only contours present are for the elevations of 123 or 136. Spot elevations are needed in the surface data to help correctly resolve the high and low spots of a surface.

- Flat spots and the loss of high and low points affect the calculation of volumes for earthworks, as shown in Figure 2–45.

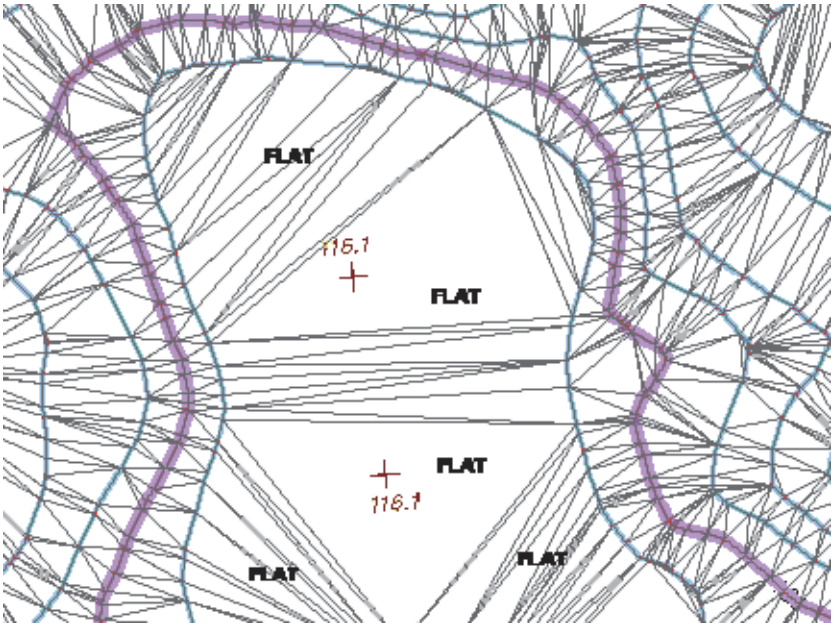


Figure 2–45

Minimizing Flat Triangle Strategies

By default, the **Minimize flat areas by:** options shown in Figure 2–46 are selected in the Add Contour Data dialog box.

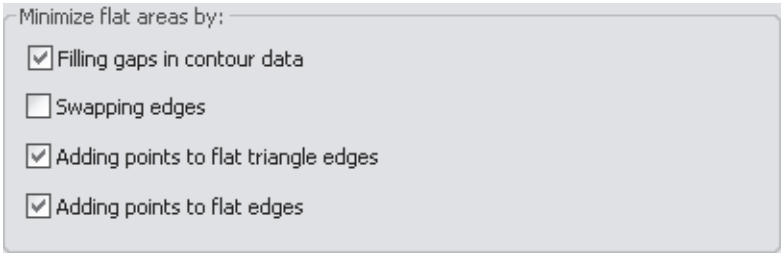


Figure 2–46

Together, these three methods attempt to detect and resolve peninsulas, bays, and other issues by adding additional points and filling in gaps based on surface trends. Generally, these provide the most expected results. The **Swapping edges** option is provided as a way of emulating how other terrain modeling software (such as AutoCAD Land Desktop) traditionally approached minimizing flat areas. The AutoCAD Civil 3D software automatically applies three of the four Minimize flat area options as it creates the surface from GIS data.

Draping Images On a Surface

Images and other 2D linework can be draped on a surface. Draping a 2D image on a surface gives it the appearance of being 3D and provides a better visualization of what is happening on the project site.

How to:

Drape an Image on an AutoCAD Civil 3D Surface

1. In Model Space, select the **GIS Data** surface. In the contextual *Surface* tab>Surface Tools panel, click (Drape Image), as shown in Figure 2–47.

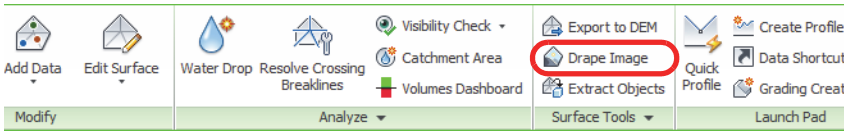


Figure 2–47

2. In the Drape Image dialog box, ensure that the **Main Site Imperial** image is selected and that the GIS Data surface is selected, as shown in Figure 2–48. Click OK.

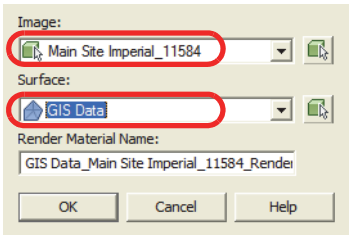


Figure 2–48

Practice 2c

Estimated time for completion: 5 minutes

Create a Surface from a Shape File

Learning Objective

Create a surface from a shape file containing elevation data.

In this practice, you will create a new drawing and assign a coordinate system to the drawing.

Task 1 - Create a surface from a Shape file.

1. Continue working with the drawing from the previous practice or open **GEO-C1-GIS.dwg.**
2. In the Quick Access Toolbar, for the workspace, select **Civil 3D**.
3. In the *Home* tab>Create Ground Data panel, expand the Surfaces drop-down list and click (Create Surface from GIS Data), as shown in Figure 2–49.

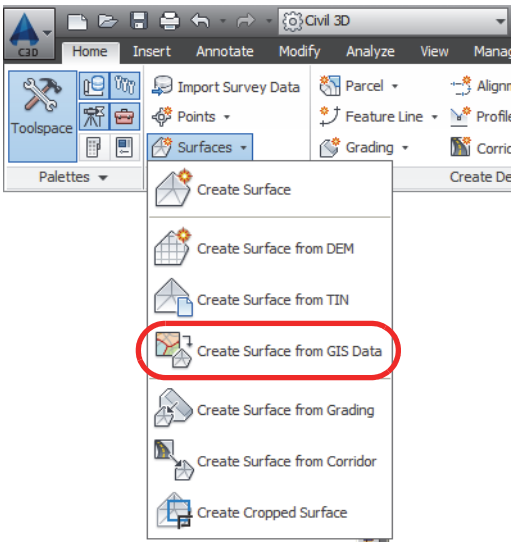


Figure 2–49

4. In the Object Options page, for the *Name*, type **GIS Data**. Leave all of the other settings as their defaults, as shown in Figure 2–50. Click Next >.

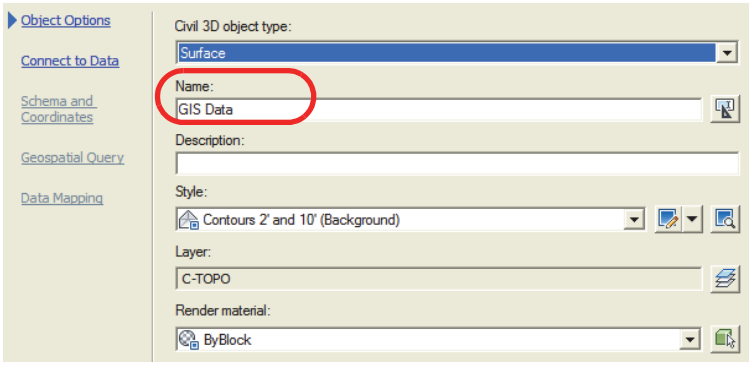


Figure 2–50

5. In the Connect to Data page, for the *Data source type*, select **SHP**. Click ... (Browse for file) and select **Contours.shp** in *C:\Civil 3D Projects\Civil3D-Training\Geospatial*, as shown in Figure 2–51. Click Open. Then click Login.

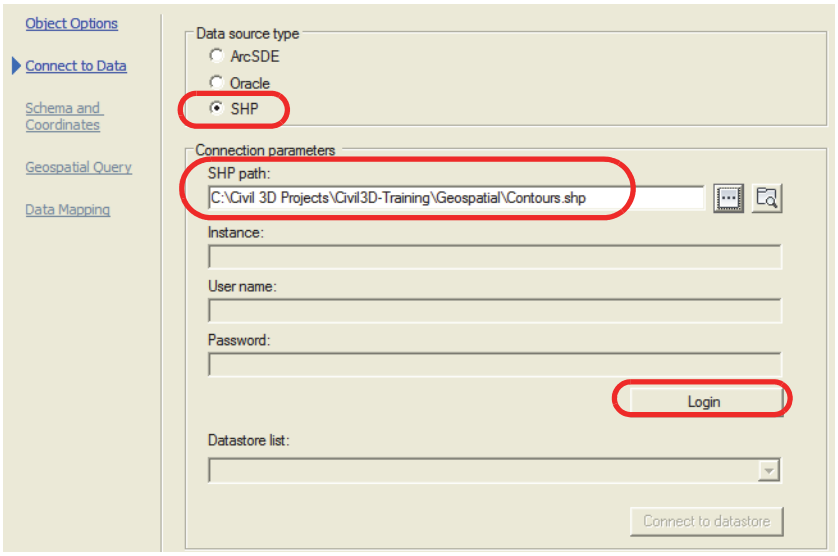


Figure 2–51

6. On the Schema and Coordinates page, select the **Contours** feature class and ensure that the *Contours Coordinate system* is set to **NAD83 California State Planes, Zone VI, US Foot**, as shown in Figure 2–52. Click Next >.

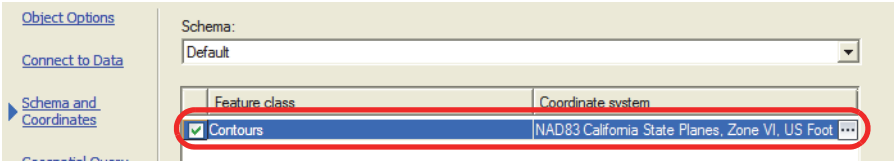


Figure 2–52

7. In the Geospatial Query page, clear the **Define area of interest** option so that the entire Contours shape file is used to create a surface, as shown in Figure 2–53. Click Next >.

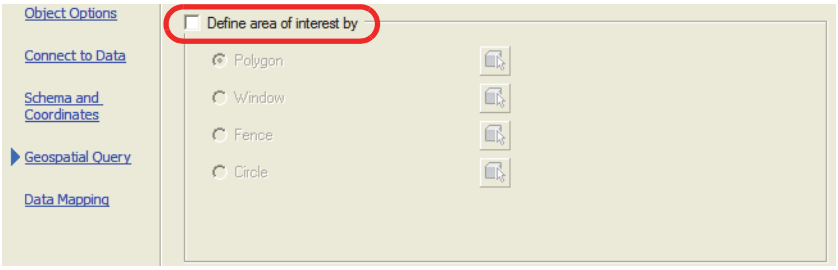


Figure 2–53

8. In the Data Mapping page, expand the Elev drop-down list and select **Elevation**, as shown in Figure 2–54. Click Finish.

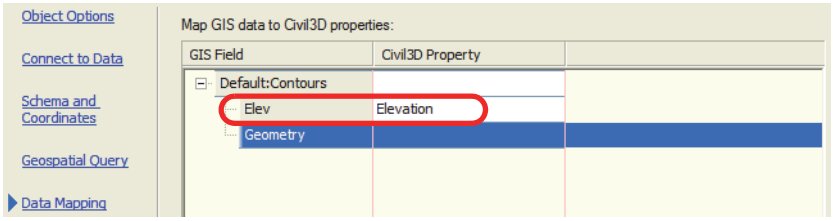


Figure 2–54

9. Save the drawing.

Task 2 - Drape an image on the surface.

1. Continue working with the drawing from the previous task or open **GEO-C2-GIS.dwg.**

2. In Model Space, select the **GIS Data** surface. In the contextual *Surface* tab>Surface Tools panel, click (Drape Image), as shown in Figure 2–55.

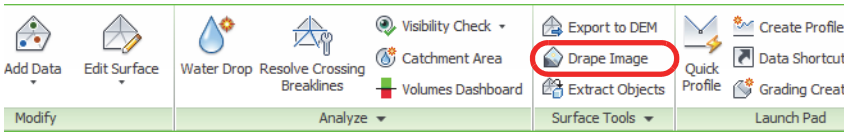


Figure 2–55

3. In the Drape Image dialog box, ensure that the **Main Site Imperial** image is selected and that the GIS Data surface is selected, as shown in Figure 2–56. Click OK.

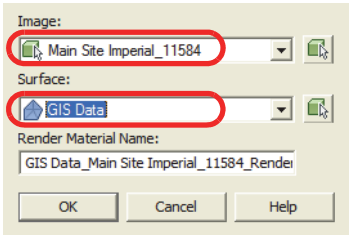


Figure 2–56

*The image might not look the same in the object view. Use **3D Orbit** to display the results of draping an image.*

4. In the *View* tab>Navigate 2D panel, click (Orbit). Orbit the drawing as shown in Figure 2–57. Press <Esc>.

Figure 2–57

5. Save the drawing.

Chapter Review Questions

1. In which workspace is the Coordinate System panel located?
   a. Civil 3D
   b. 2D Drafting and Annotation
   c. 3D Modeling
   d. Planning and Analysis
2. What type of data cannot be connected using the Data Connection palette?
   a. ArcSDE
   b. Oracle
   c. Microstation DGN file
   d. ESRI Shape File
3. You have to be in the Planning and Analysis workspace to access the Data Connect palette.
   a. True
   b. False
4. In which workspace is the **Create Surface from GIS Data** command located?
   a. Civil 3D
   b. 2D Drafting and Annotation
   c. 3D Modeling
   d. Planning and Analysis
5. What toolspace do you need to be in to drape an image on a surface?
   a. Civil 3D
   b. 3D Modeling
   c. Planning and Analysis
   d. It does not matter because the *Surface* contextual tab displays when you select a surface no matter which workspace you are using.

Command Summary

Button	Command	Location
	**Assign**	■ **Workspace:** Planning and Analysis ■ **Ribbon:** *Map Setup* tab>Coordinate System panel ■ **Command Prompt:** MAPCSASSIGN
	**Create Surface from GIS Data**	■ **Workspace:** Civil 3D ■ **Ribbon:** *Home* tab>Create Ground Data panel ■ **Command Prompt:** CreateSurfaceFromGISData
	**Data Connect**	■ **Workspace:** Planning and Analysis ■ **Ribbon:** *Home* tab>Data panel ■ **Command Prompt:** MAPCONNECT
	**Drape Image**	■ **Ribbon:** Contextual *Surface* tab> Surface Tools panel
	**Map Task Pane**	■ **Workspace:** Civil 3D ■ **Ribbon:** *Home* tab>Expanded Palettes panel ■ **Command Prompt:** MapWSpace