

# A Practical Guide to GIS in AutoCAD® Civil 3D® 2014

**Rick Ellis and Russell Martin**



A Cadapult Software Solutions Publication

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## Exercise Data

I would like to thank the City of Springfield, Oregon for providing the data for this book. The dataset provided is for illustration purposes only. While it is based on real world information to add relevance to the exercises, it has been altered and modified to more effectively demonstrate certain features as well as to protect all parties involved. The data should not be used for any project work and may not represent actual places or things. It is prohibited to redistribute this data beyond your personal use as a component of training.

# **A Practical Guide to GIS in AutoCAD Civil 3D 2014**

## **Introduction**

Congratulations on choosing this course to help you learn how to use GIS in AutoCAD Civil 3D 2014. The term “practical” is used in the title because this course focuses on what you need to effectively use AutoCAD Civil 3D 2014, and does not complicate your learning experience with unnecessary details of every feature in the product. Should you want to pursue aspects of features and functionality in greater detail than provided in this course, you are directed and guided to that information.

Each lesson contains the concepts and principles of each feature to provide you with the background and foundation of knowledge that you need to complete the lesson. You then work through real world exercises to reinforce your understanding and provide you with practice on common tasks that other professionals are performing with AutoCAD Civil 3D 2014 in the workplace every day.

You can take the lessons in this course in whatever order is appropriate for your personal needs. If you want to concentrate on specific features, the lesson for those features does not require that you complete prior lessons. With this course organization, you can customize your own individual approach to learning AutoCAD Civil 3D.

When you complete this course, you will be armed with the background and knowledge to apply AutoCAD Civil 3D to your job tasks, and become more effective and productive in your job.

## **Course Objectives**

The objectives of this course are performance based. In other words, once you have completed the course, you will be able to perform each objective listed. If you are already familiar with AutoCAD Civil 3D, you will be able to analyze your existing workflows, and make changes to improve your performance based on the tools and features that you learn and practice in this course.

After completing this course, you will be able to:

- Work with coordinate systems
- Clean drawings with common geometry errors
- Insert rectified raster images
- Work with a variety of attribute data
- Apply object classification to your mapping system
- Import GIS data from a variety of sources
- Create surfaces and pipe networks directly from GIS data
- Export geometry and attribute data to other GIS formats
- Export Civil 3D objects to other GIS formats
- Connect directly to GIS data
- Connect to raster surface data
- Attach and query source drawings
- Save changes to attached source drawings
- Extract data for reports and quantity takeoffs
- Create, manage and analyze topologies
- Produce sophisticated map books

## Prerequisites

Before starting this course, you should have a basic working knowledge of AutoCAD. A deep understanding of AutoCAD is not required, but you should be able to:

- Pan and Zoom in the AutoCAD drawing screen.
- Describe what layers are in AutoCAD, and change the current layer.
- Create basic CAD geometry, such as lines, polylines and circles.
- Use Object Snaps.
- Describe what blocks are, and how to insert them.
- Perform basic CAD editing functions such as Erase, Copy, and Move.

If you are not familiar with these functions, you can refer to the AutoCAD Help system throughout the course to gain the fundamental skills needed to complete the exercises.

## Conventions

The course uses the following icons and formatting to draw your attention to guidelines that increase your effectiveness in AutoCAD Civil 3D, or provide deeper insight into a subject.



The magnifying glass indicates that this text provides deeper insights into the subject.



The compass indicates that this text provides guidance that is based on the experience of other users of AutoCAD Civil 3D. This guidance is often in the form of how to perform a task more efficiently.



The warning indicates that a specific exercise might not function properly on 64 bit operating systems.

## Exercises

The exercises in this course have been carefully chosen and designed to represent common tasks that are performed by mapping and GIS professionals. The data included in the exercises are typical drawings and maps used by local governments and municipalities. You work with road networks, parcel maps, sewer collection systems, water distribution systems, aerial photos, raster surfaces, and much more.

Exercises provide higher level process information throughout the exercise tasks. You are given information about not only what to do, but why you are doing it. In most cases, an image is included to help guide you.

## Installing the Datasets

The CD included with this book contains all of the datasets required for the exercises.

There are two ways to install the dataset:

- Use the Setup.exe.
- Unzip the files.

## Use Setup.exe

Double click setup.exe and follow the instructions for installation.

## Unzip the Files

Unzip *GIS in Civil 3D Training.zip* directly to the C drive. The zip file will create the following folder structure:

C:\A Practical Guide\GIS in Civil 3D 2014\Chapter Number\Files for Exercises

## 64 Bit Database Drivers

On 64 bit systems, exercises that require a connection to an ODBC database need to have the proper drivers from Microsoft installed. If your system does not have these installed, you can download them from Microsoft. Go to [ <http://www.microsoft.com> ] and search for Microsoft Access Database Engine.

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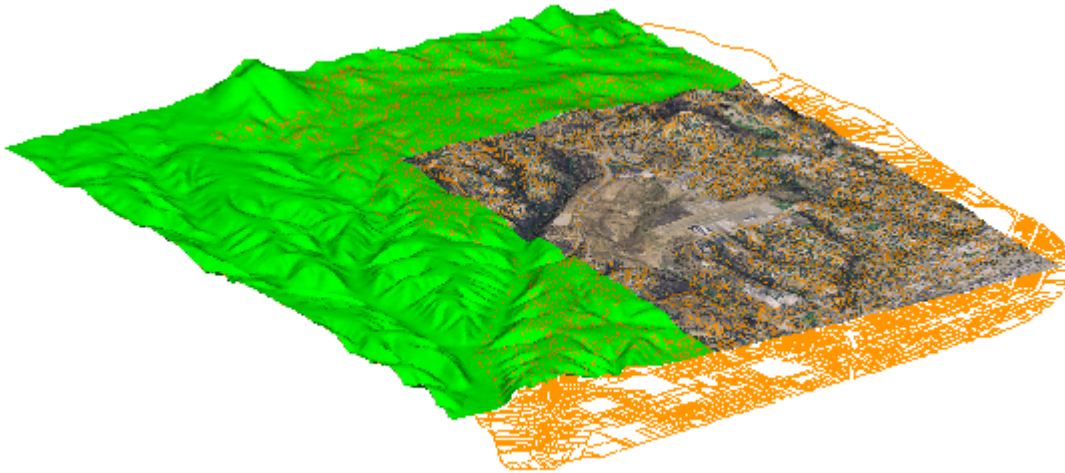


## 7.3 Lesson: Connecting to Raster and Raster Surfaces

### Introduction

Connecting to raster data as a feature source is similar to inserting images using *Image Insert*. In each case, the file is only referenced and not part of the drawing itself. In this lesson, you also learn the differences between these two methods and the advantages of using the feature source connection. You also learn about the tools that are used to connect to a raster image, and then connect to a raster image.

Connecting to raster surfaces is similar to connecting to raster images. The main difference is that raster surfaces contain elevation data associated with each pixel. Civil 3D uses this method for simple surface analysis and visualization as part of the feature source. In this lesson, you learn the basic concepts of raster surfaces, the types of files that you can access, and how raster surfaces can be used as part of your mapping system. You then connect to a digital elevation model, and add it to your map.



### Key Concepts

Concepts and key terms covered in this lesson are:

- Raster feature sources
- Raster surfaces
- Viewing raster surfaces in 3D
- Draping raster and vectors over surfaces

### Objectives

After completing this lesson, you will be able to:

- Describe what a raster feature source is.
- List the types of raster formats that can be accessed.
- Explain how raster surfaces can be used.
- Connect to an ortho photo.
- Connect to a raster surface.
- Drape vectors and raster over a raster surface.

## Raster Feature Source Concepts

You can use raster data in Civil 3D through the Map Image Insert command and by connecting to raster as a feature source. There are some very powerful reasons to use a feature source connection rather than inserting raster:

- Performance
- File formats
- Coordinate conversion

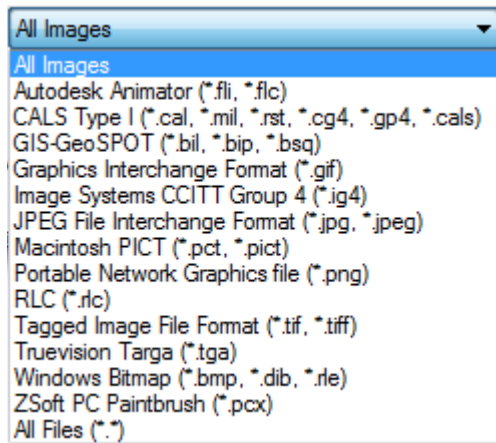
### Performance

The performance of raster as a feature source is much better than that of raster inserted in a drawing. In some cases this performance enables access to raster that otherwise cannot be used because of file size.

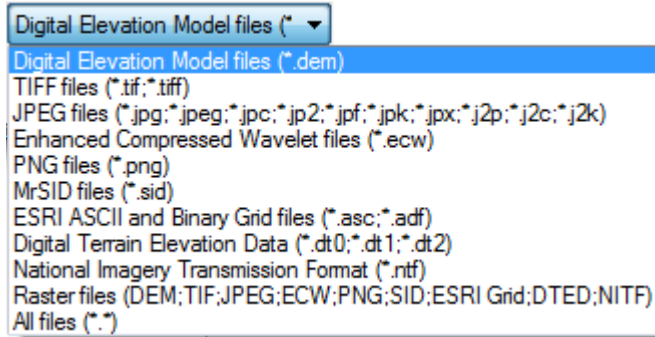
### File Formats

Connecting to raster as a feature source opens a larger selection of geospatial-based file formats to work with. In addition to the formats that are offered directly in standard Civil 3D, the fact that the feature data objects (FDO) technology is open source enables developers to write additional FDO providers to access even more file formats.

The following illustration shows the file formats available in the Map Image Insert command. While it offers a wide variety of file formats to select from, when considering the geospatial specific formats, it is fairly limited.



The following illustration shows the file formats available when connecting to raster as a feature source. The formats available through this method are especially useful for geospatial applications.



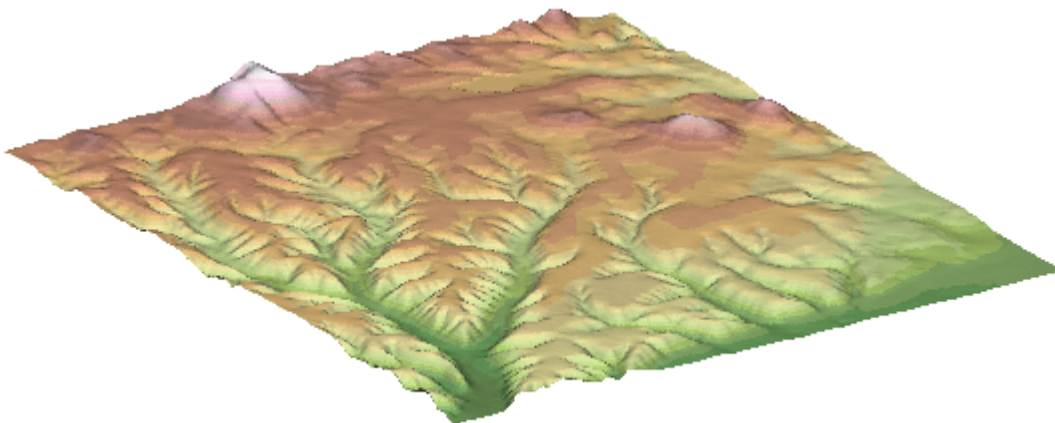
### Coordinate Conversion

Connecting to raster as a feature source enables the coordinates of the raster to be converted to the coordinates of the current drawing. This is a very important distinction between connecting and inserting raster. When using Map raster insert, whatever the coordinates of the raster are determines the coordinates of your map. This is very limiting when compared to the coordinate conversion available using a raster feature source connection.

### Raster Surface Concepts

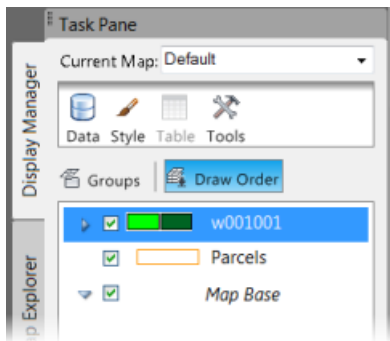
When working with raster as feature sources, the process and procedures to connect and add both standard raster and raster surfaces are the same.

Both types of raster are composed of pixels. In the case of raster surfaces, each pixel has a Z value rather than a value such as grey scale or color that produces a "picture". Civil 3D can interpret the Z values in a raster surface, and produce three dimensional views and analysis.



## Raster Feature Layers

When a raster is connected to, and added to a map, the management of the feature layer is the same as that of vector based feature layers.



## Working with Raster Surfaces

There are several tools available to take advantage of the elevation data that is inherent in a raster surface. These tools include creating contours, slope, aspect, and elevation analysis, draping, and assigning exaggeration values to the elevations. In this lesson, you work with draping and exaggeration.

### Draping

Draping refers to vector and raster objects which adopt the three dimensional characteristics of the underlying surface. By default, when a raster surface feature layer is present in a drawing, all other feature layers, both vector and raster drape over the raster surface depending on the draw order of the feature layers.

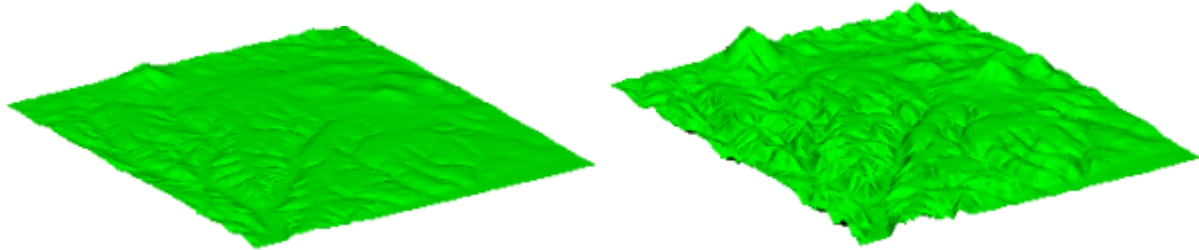


AutoCAD objects do not drape over raster surfaces.

## Exaggeration

Exaggeration can be applied to raster surfaces to create a more impactful representation of the terrain when needed.

In the following illustrations, the image on the left is a raster viewed in 3D with no exaggeration. The image on the right is the same raster surface with an exaggeration value of 3x.



Exaggeration should be used sparingly. It often dramatically misrepresents the map.


## Exercises: Connecting to Raster and Raster Surfaces

In these exercises, you start in a drawing that has a parcel feature layer connected. You connect to a raster image of an ortho photo of the area of interest. You then connect to a raster surface, change the draw order, and view the map in 3D.

You do the following:

- Connect to a raster image and add it to the map.
- Change the draw order to view the parcels on top of the raster.
- Connect to and add a raster surface to the map.
- Set the draw order to drape the parcels and ortho photo over the surface.

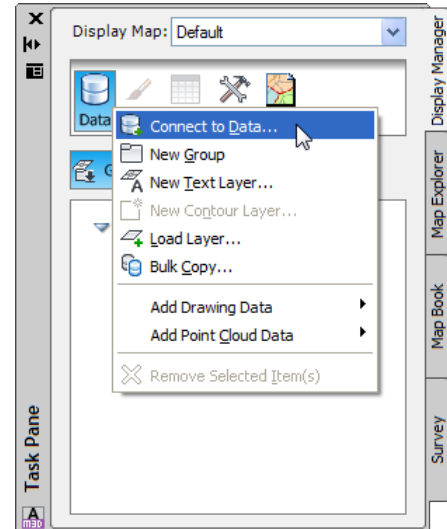
### 7.3.1 Connecting to an Aerial Photo

 For this exercise you should be in the *Planning & Analysis* workspace.

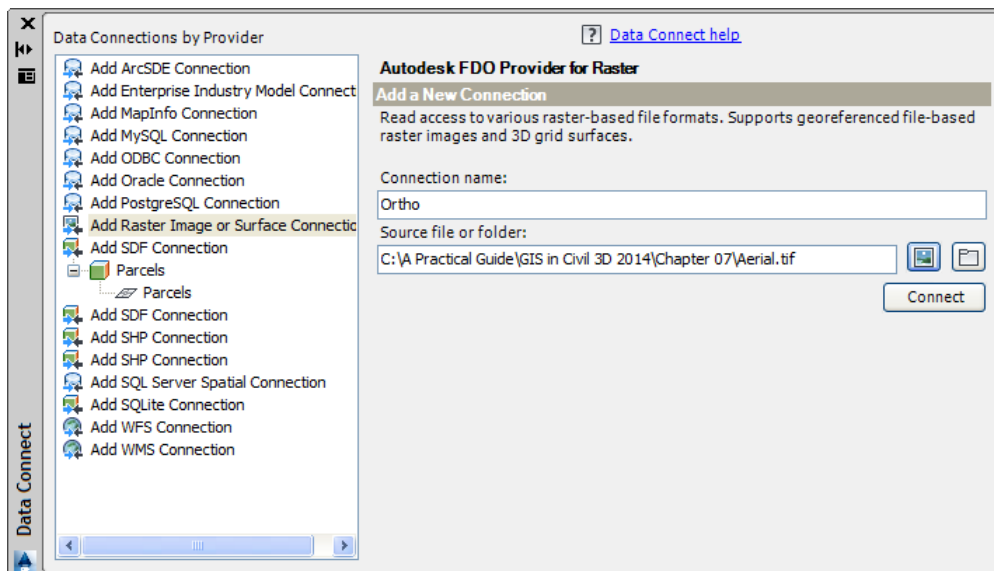
1. Open the drawing **Connect to Raster.dwg** from the **Chapter 07** folder.


In the first series of steps, you connect to the raster image and add it to the map.

2. If the **Task Pane** is not visible, at the command line enter:  
Command: MAPSPACE.
3. At the command line, enter **ON** to display the *Task Pane*, which includes the *Display Manager*.
4. In the **Display Manager**, confirm that the **Groups** button is selected.
5. In the **Display Manager**, click the **Data** button, and then select  $\Rightarrow$  **Connect to Data...**

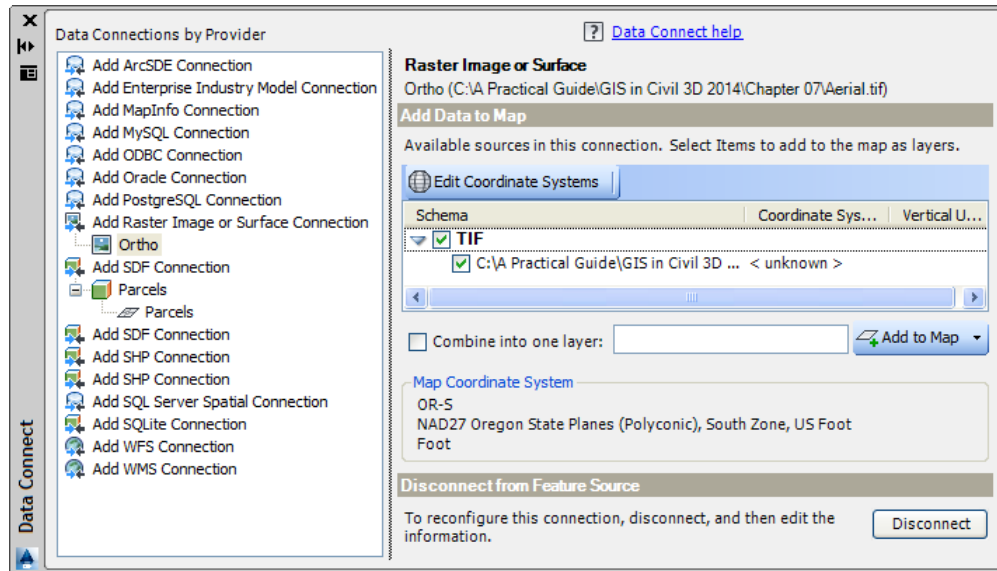


The *Data Connect* palette opens. Here you can select from many different data providers or sources. In this exercise you will be connecting to a raster image file.



6. From the *Data Connections by Provider* list, select **Add Raster Image or Surface Connection**.
7. Change the *Connection name:* to **Ortho**.
8. Click the file button  and browse to: **C:\A Practical Guide\GIS in Civil 3D 2014\Chapter 07**, and select **Aerial.tif**.

9. Click <<**Connect**>>.



10. Click <<**Add to Map**>>.
11. Close the *Data Connect* palette.

Notice the *feature* layer *Aerial* now appears in the *Display Manager*. A layer in the *Display Manager* is different than an *AutoCAD* layer; it is the name of a data source and where you manage its properties.

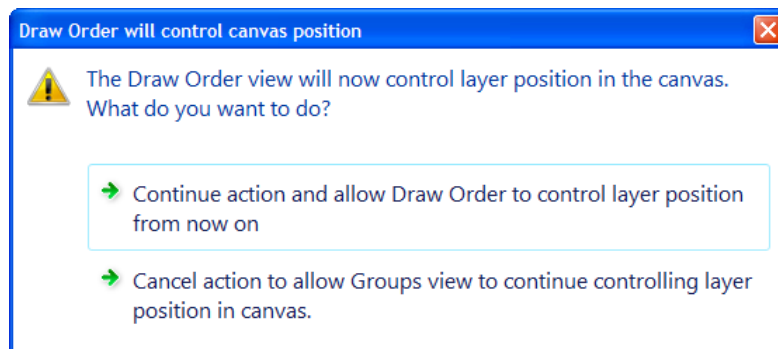
Notice the aerial photo is on top of the parcels.

12. In the **Display Manager**, select the **Draw Order** button.

The list of feature layers is displayed in the current draw order. The order these are listed in matches the feature layers in the drawing.

13. Drag the **Parcels** feature layer above the **Aerial** layer.

The first time you change the sequence of the *Display Map Draw Order* list in a drawing, an alert is displayed, informing you that the *Draw Order* list will now control the visual display of feature layers.



14. Click **Continue action and allow Draw Order to control layer position from now on**.
15. Zoom into the map to view the image with the parcels overlaid.
16. Save the drawing for use in the next exercise.

### 7.3.2 Connecting to a Raster Surface

In this exercise you connect to and add to the map an elevation enabled raster, or raster surface. Once the surface raster is added to the map, you change the draw order, and view the map in 3D. Any feature layer that is on top of the surface will automatically drapes over the surface.

1. Continue working in **Connect to Raster.dwg** from the previous exercise.

If you did not complete the previous exercise you can open the drawing **Connect to Surface.dwg**.

2. Connect to a Raster Surface. Repeat Steps 5-11 from the previous exercise using the following information:

- For the Connection Name enter **Elevation**
- Connect to the file **Existing Ground.dem** in the **Chapter 07** folder

3. In the **Display Manager**, select **Draw Order**.

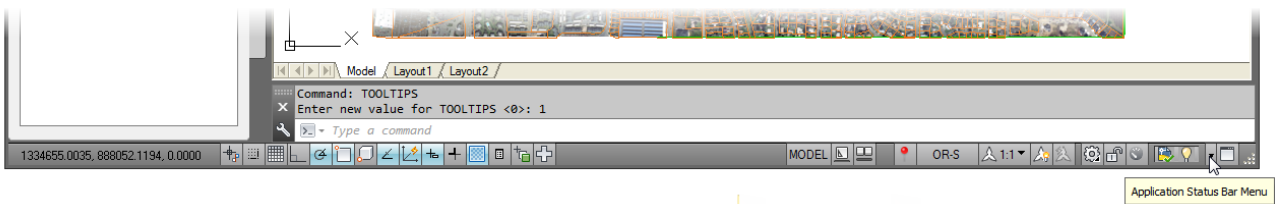
The list of feature layers is displayed in the current draw order. The order these are listed in matches the feature layers in the drawing.

4. Drag the feature layers to match the following order:

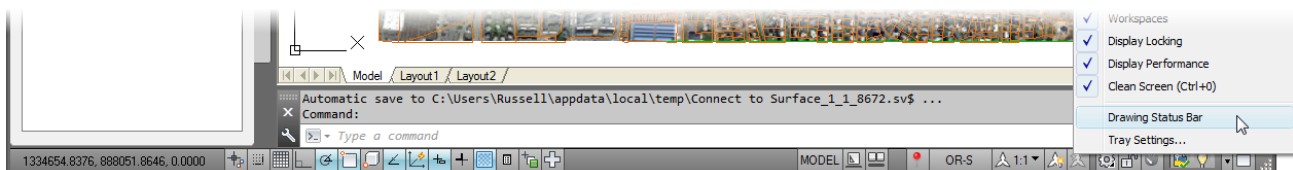
- Parcels
- Aerial
- Existing Ground

To view the Parcels and Aerial features draped over the Existing Ground DEM feature, you need to switch the drawing editor from 2D to 3D views. The tools to switch views reside on the Map Status Bar, which can be added to the Drawing Status Bar. In the standard, out-of-the-box installation of Civil 3D, neither of these Status Bars are displayed, only the Application Status Bar, at the very bottom of the Civil 3D window is displayed, by default. Turning on the Drawing Status Bar, and then adding the Map Status Bar is a two-step process.

5. Click the Application Status Bar Menu tool, near the far right-hand end of the Application Status Bar.



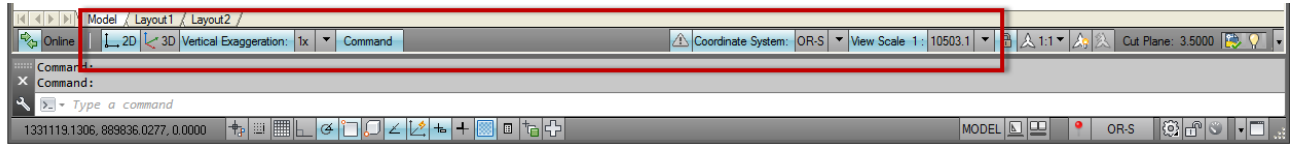
6. Right-click, and from the fly-out menu select ⇒ **Drawing Status Bar**.



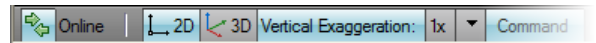
The *Drawing Status Bar* appears under the *Drawing Editor* window.

7. Enter **MAPSTATUSBAR** on the *Command Line*, and select **<Show>**.

The *Drawing Status Bar* now shows additional tools for some *AutoCAD Map 3D* functions, such as 2D / 3D Viewing and Vertical Exaggeration on the left, plus Coordinate Systems and View Scale on the right.



8. In the *Drawing Status Bar*, click **3D**.



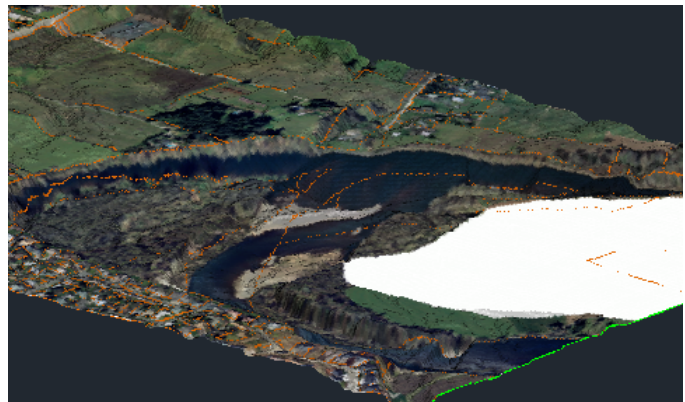
The drawing is displayed in 3D.

9. In the Status bar, for Vertical Exaggeration, select 2x.



Note: It might take a few moments to optimize the layer.

10. Zoom into the drawing to view how the raster and parcels are draped over the surface raster.
11. Experiment with various Vertical Exaggeration values and 3D viewing angles.



NOTE: Be careful when applying Vertical Exaggeration, and use it sparingly. While it can help visualize terrain in relatively flat areas, it can dramatically misrepresent actual conditions.

### Lesson Review

In these exercises you integrated three different sources of data. Vector based parcels, an ortho photo, and a surface. Together, these sources of data were combined to view how the parcels and the image drape over the existing ground terrain.